2nd

WORLD CONGRESS ON DISASTER MANAGEMENT

TOGETHER

FOR A SAFER WORLD

GOVERNMENT OF ANDHRA PRADESH

DMICS

Disaster Management, Initiatives and Convergence Society

Envisioning a Disaster Resilient Society

OUR PARTNERS & SUPPORTERS

2nd

WORLD CONGRESS ON DISASTER MANAGEMENT

WCDM-2015

TOGETHER FOR A SAFER WORLD

सत्यमेव जयते

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Together for a Safer World

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DMICS is registered under Societies Registration Act, Government of Andhra Pradesh. Its mission to reduce vulnerability to all types of hazards, natural or human-induced by putting in place institutional and policy framework. Its vision is to build a safer and resilient world through sustainable collective efforts, synergy by building capacities and enabling participation.

राजनाथ सिंह
RAJNATH SINGH

सत्यमेव जयते

गृह मंत्री
भारत
नई दिल्ली-110001
HOME MINISTER
INDIA
NEW DELHI-110001

MESSAGE

I am happy to note that the Disaster Management, Initiatives and Convergence Society (DMICS), organized the 2nd World Congress on Disaster Management in Visakhapatnam in November, 2015, which was well attended by nearly 1,000 participants from numerous countries. I am pleased to observe that the level of participation of national and state governments as well as academic and civil society organisations, were of a very high order.

The Visakhapatnam Declaration has provided new directions to many in improving local, regional, national and global approaches to disaster management.

The publication, 'Towards a Safer World', a compilation of the key papers and presentations contributed by numerous experts, policy makers, planners and practitioners is, indeed, praiseworthy.

I am sure the publication will be very productive for those who are interested in learning about disasters and managing them better as a useful reference.

I wish DMICS success in all its endeavours.

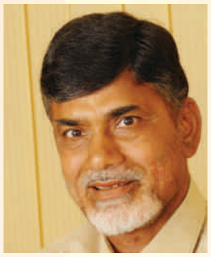
26.4.16

(Rajnath Singh)

Inaugural Address

N. CHANDRABABU NAIDU

Hon'ble Chief Minister, Government of Andhra Pradesh



I welcome you all, from India and abroad, to the state of Andhra Pradesh and also to the beautiful city of Visakhapatnam. When the experts of DMICS met me with the request to host 2nd World Congress on Disaster Management, I had welcomed the idea instantly. It makes perfect sense to host this important conference in the city Visakhapatnam. The State of Andhra Pradesh as a whole has been vulnerable to natural hazards and cyclones. Exactly a year ago, Hudhud cyclone devastated this city and the neighbouring areas in Andhra Pradesh. Though Andhra Pradesh is a newly formed state, we mounted a rapid response, as we have always responded. We mobilized all the resources required. Personally, I had stayed here for the first nine days in order to ensure normalcy is restored rapidly.

As you may have seen the city of Visakhapatnam since you arrived, it is all together different. People of Visakhapatnam have rapidly recovered; and now, everyone has gained confidence to face any type of disasters in the future. During this conference, through the main plenary sessions as well as technical sessions; we urge you to highlight the best practices and lessons learned, which can illumine our future path within the state of Andhra Pradesh and also all across the global disaster management community. We have realized that we cannot prevent disasters totally; but at the same time if one takes preventive measures then we can control and minimize the loss of lives and damages. When Hudhud cyclone started, Government of India and Government of Andhra Pradesh worked very closely to put in place all possible preventive precautions. But the velocity of cyclone was more than 200 to 235 km speed which we were unable to control with terrestrial systems which collapsed due to high velocity; but then Indian navy was able to give us the required information. But if you see the human loss, because of our continuous motivation and education, people were prepared. This has enabled us to reduce human life losses to the very minimum. And we also learnt lessons about buildings that survive such a fury of nature.

I have experienced as a matter of fact, as the Chief Minister of the united Andhra Pradesh, a killer hurricane hit the konaseema region in 1996. We were able to respond and help the early recovery of the affected population in a week. This experience helped me when super cyclone hit the state of Odisha in 1999. I had deployed all my machinery to Odisha immediately; I didn't argue whether it happened in my state or not. Immediately I sent all my force to Odisha state and did everything possible. We have given first satellite phone to then chief minister as the communication systems were totally destroyed. Once he received the satellite phone, he was able to communicate outside. This is why I believe, you are doing extremely good work which is for a noble cause. If you concentrate on how to take preventive measures and also how to strengthen preparedness as well as how to network all agencies even before disasters strike; our response will be immediate.

As you may have heard, for the last one week in Tamil Nadu and also in Andhra Pradesh, we are having depression resulting into a heavy downpour (nearly 30 cm of rain in one or two places) impacting 3 to 4 districts.

In fact, I want to be the First Beneficiary of this conference. We are jointly hosting this unique conference. I am looking forward to receiving the best practices you are going to share with evidence. I would like to utilize them to strengthen our administrative capacity. I plan to add your best practices in our disaster management manual.

I am very happy to see so many people here in Visakhapatnam. This is a beautiful city. This is best suited to share your best thoughts for the society for the universal benefit. I wish you all fruitful deliberations during this World Congress.

- N. Chandrababu Naidu

सत्यमेव जयते

Chief Guest

M. VENKAIAH NAIDU

Hon'ble Union Minister for Urban Development, Parliamentary Affairs
Government of India

Friends I am really happy to be here, though the subject which we are going to discuss is not a happy one. However, it is our endeavour to understand and discover how to make our disaster management effective. This is the task before us. I would like to compliment the organisers of the 2^{nd} World Congress for bringing together experts, academicians, scientists, practitioners and vulnerable community representatives and children towards sharing knowledge about the disaster management between number of national and international agencies. This is going to enable evolution of better management techniques for disaster prevention, disaster mitigation, disaster preparedness and disaster relief, rehabilitation and reconstruction. This 2^{nd} World Congress is a platform, a congregation of the people, who assembled for the same purpose. Our focus is disaster risk reduction which includes mitigation too.

As you well know, events of natural hazards are on the rise in India. We have witnessed widespread natural calamities in the past ranging from floods to earthquakes, landslides, cyclones like super cyclone 1999, Gujarat earthquake 2001, South Indian Tsunami in 2004, Mumbai floods in 2005, Kashmir earthquake in 2005, Kosi floods in 2008, Sikkim earthquake in 2011, Cyclone Phailin in 2013 and Hudhud in 2014, just to name a few. Ever since I have been a student from 1970s I have personally experienced and witnessed frequent, cyclones and floods. Today, as I speak to you, we have a flood situation in the districts of Nellore, Chittoor and Kadapa as well as a severe flood situation in Chennai city of Tamil Nadu. Last year, we encountered Cyclone Hudhud in Visakhapatnam. Nearly 59% of India's land area is prone to earthquake of moderate to very high intensity which accounts for over 40 million hectares; 12% of India's land is prone to floods, about 5,007 kms coastline is cyclone prone; and also exposed to floods and storm surges; 2% of the land is landslide prone and 68% of India's arable land is affected by drought. Flooding in cities and towns is a recent phenomenon caused by indiscriminate encroachment of waterways, inadequate drainage systems and lack of maintenance of the drainage infrastructure.

Andhra Pradesh with a coastline of 974 kms is prone to cyclones. Since 1891, 77 cyclones hit Andhra Pradesh, the 77^{th} being Cyclone Hudhud (12 October 2014). We are now in this very same city, which has been devastated by Hudhud cyclone exactly a year ago. Thanks to the able guidance and supervision of the Honourable Chief Minister Sri. Chandrababu Naidu and also the timely assistance given by the Hon'ble Prime Minister Sri Narendra Modi, as well as promptness and the commitment shown by the district administration, state officials and central government officials, and mostly significantly by the people of Visakhapatnam, it has returned back to its original state.

From the last 6 decades of experience we have gained, it is now becoming very clear that disaster risk reduction is a must for sustainable development; and that sharing experiences, knowledge of disaster risk reduction case studies and networking of various experts is indispensable in effective disaster management. In view of this it is clear that in the last decade the international community had witnessed a steady increase in the number and magnitude of emergencies and disasters. 90% of the disaster effected population are in Asia, which is another important imperative towards enhancing the confidence and skills of local and national authorities and strengthen coordination among diverse stakeholders.

Government of India established robust institutional mechanisms from national to provincial level with legislature and backup policy framework in enacting a Disaster Management Act in 2005 and setting up of Disaster Management Authority at national, state and district levels as well as creation of a dedicated fund for disaster response and establish National Disaster Response Force (NDRF) as well as State Disaster Response Force (SDRF) and the National Institute of Disaster Management (NIDM) for training and capacity building.

India acts as a regional specialised metrological centre for monitoring prediction and early warning of cyclone over Indian ocean as designated by the world metrological organisation (WMO) and provides advisories to the WMO ESAP panel member countries.

Further, Water Commission for flood data and information relating to various dams, INCOIS for tsunami warning, Ministry of agriculture for drought-related information, Ministry of Defence ORDO for avalanche information, National spatial data infrastructure, Indian National Centre for oceanic information services, Indian institute of Remote Sensing agency (IIRS), National Remote Sensing Agency (NRSA) and the Indian Space Research Organisation (ISRO) are the other such organisations which provide spatial information on various hazards and disasters.

India is also drawing the best practices around the globe to improve its system and process for disaster management.

Hyogo Framework for Action (2005-2015) which coincides with the national enactment of National Disaster Management Act 2005 provided blueprint for Disaster Risk Reduction (DRR) including promotion of culture of prevention, mitigation, preparedness and resilience at all levels. India is a party to the Sendai Framework for Disaster Risk Reduction (2015-2030) which has now provided a more practical and useful document with the people centred preventive approaches.

Urban Ministry of Government of India has finalized the list of 100 cities which are to be transformed as Smart Cities. I would like this world Congress to give us clear analysis, perspective and guidance on how to incorporate resilience agenda in the smart city approach in terms of government's mission in venerability reduction across all types of hazards be it natural or human-induced.

Moving forward, Government of India would be embarking on strengthening this further.

- It is necessary to have infrastructure and communication systems which will withstand the wind speed of more than one than 200 kilometres per hour. This is one lesson all the planners, builders, government departments should learn from the recent cyclone Hudhud that ravaged Visakhapatnam in 2014.
- Underground cabling is needed in important cities through a duct system, namely, wiring all the electric cables, telecom cables, IT cables, even drainage, a separate pipeline for drinking water separate, etc.
- Similarly the telecommunications towers have to be built-up strong to withstand such high speed wind.
- The municipal law needs to be changed in order to developed plans and have them approved ahead of a disaster and pre-stock JCBs, tippers, trucks, etc

I wish to compliment DMICS, Andhra Pradesh government, their partners - Jawaharlal Nehru of University, UNICEF, Save the Children, Geo-Climate Society and many others who have worked tirelessly to bring the best to this conference.

We would be wise when we learn from other's experience; and also stop playing with the nature, one of the reasons for its fury, especially when we cut forests.

I wish this August gathering an enriching three days in order to emerge with good outcomes. I am looking forward to Vishakhapatnam Declaration which I wish to use for the betterment of the future of the country particularly with reference to my department in strengthening Urban Resilience through SMART CITY initiatives.

Jai Hind!

- M. Venkaiah Naidu

Presidential Address

N. CHINA RAJAPPA

Hon'ble Deputy Chief Minister and Minister for Home
and Disaster Management,
Govt. of Andhra Pradesh & Chairman, Steering Committee

The Government and people of Andhra Pradesh are indeed privileged to welcome you to this 2nd World Congress on Disaster Management. Visakhapatnam is indeed the fittest city to host this Congress, as it has just recovered from Cyclone Hudhud, which ravaged the city in October 2014. We are happy to inform you that the city has returned to its normalcy within one year. The District Collector and his team will certainly share this case study with you.

As we are starting this historic World Congress today, I would like to put forward my deliberations and expectations before you from a very local perspective.

As the state of Andhra Pradesh has a very long coast line which encounters cyclones and flooding annually, the communities who are located in the coastline are invariably the marginalized fisher communities and other vulnerable groups. Hence, Local level preparedness is one of our strong priorities. In this regard, specifically, Cyclone preparedness is an important agenda for us. We are developing dos and donts in this regard. I would request you to kindly provide your guidance and inputs in this.

Today, our world has progressed technologically. There is a strong expectation to utilize the new technologies in managing disasters better. Hence, in the 2nd World Congress, there are many presentations on Application of Science and Technology to manage disasters more efficiently. The local governance institutions would like to learn to take technology to the last mile. I do hope that this Congress would give us inspiration and inputs to do so.

In addition, there are every day risks that vulnerable communities specially children and women face. Their safety and security needs to be strengthened. We are going to develop guidelines in this regard. Further, our special attention goes towards mitigating risks to the children and communities.

Along with the Government of India and the global community, we would like to prioritize Comprehensive School Safety. In this regard, we would like to give assurance of proper roads, water facilities for children in schools.

As the Chair of the Steering Committee for 2nd World Congress on Disaster Management, I would like to congratulate DMICS for all the strenuous efforts made in bringing the international disaster management experts, scientists, planners, policy makers and all the stakeholders including vulnerable children and community representatives together today. I wish you an enjoyable stay in Visakhapatnam and enriching deliberations and outcomes.

- N. China Rajappa

DMICS
Disaster Management, Initiatives and Convergence Society
Envisioning a Disaster Resilient Society

Dr S. ANANDA BABU

President

Today, is indeed a Red Letter day in the annals of DMICS. The historic 2nd World Congress on Disaster Management is inaugurated by our Hon'ble Chief Minister of Andhra Pradesh, Sri Nara Chandrababu Naidu. Government of Andhra Pradesh and DMICS had dreamt of this unique occasion to bring all the stakeholders of disaster management, namely, the authorities, practitioners, governance representatives, scientists, researchers and others on a single platform. Today, this has come true. 2nd WCDM has another special feature. The Children and Youth are given a special space as per the Sendai Framework for DRR.

In this endeavour, our position is very clear. We do not want to beaten or victimized by disasters. Instead, we are determined to bounce back rapidly. Therefore the following 4 priorities outlined in Sendai Framework for Disaster Risk Reduction on March 18, 2015 are our guiding priorities:

1. Understanding Disaster Risks
2. Enhancing Disaster Risk Governance
3. Investing in Disaster Risk Reduction for Resilience
4. Preparedness to Build Back Better.

In order to fulfil this mission, we have planned 5 Plenary Sessions, 25 Technical and Thematic Sessions. Another unique feature of this Congress is making space for Children and Youth to share their experiences and expectations so that they can be brought to the centre stage as future citizens.

At the end of the Congress, we would be also promulgating Visakhapatnam Declaration as our commitment to work “Together for a Safer World”.

DMICS is very honoured that you have arrived in Visakhapatnam from all parts of the world bringing your noble experiences to be shared with all. We hope to draw a new road map to manage local disasters with global knowledge and practice.

I would like place my profound gratitude to the Government of Andhra Pradesh, Governing Body and Office Bearers of DMICS, my immediate team and other collaborators. When I witnessed their hard work with such a dedication and commitment, one message springs up from my heart:

“It is only together, we can do it!”

Dr S. Ananda Babu

Dedicated to

those innocent, who lost their lives

due to natural hazards, human-induced disasters

and other preventable causes

VISAKHAPATNAM DECLARATION

PREAMBLE

We are in a world that is facing humanitarian crises of unprecedented magnitude and intensity in the recent decades, in the form of natural hazards of disproportionate consequences and impacts, climate change as well as human - induced disasters.

In the midst of growing threat of increasing frequency of disasters especially due to climate change and every day risks to the marginalized, who continue to experience inter-generational poverty and inequality; we wish to express our firm commitment to Sendai Framework for DRR and Sustainable Development Goals. Further, we would remain responsive to the upcoming international commitment on Climate Change and World Humanitarian Summit.

At the 2nd World Congress on Disaster Management (WCDM) held in Visakhapatnam, in November 2015, approximately 1,000 disaster management professionals, practitioners including children and students, researchers, academicians, defense service personnel, government authorities, NGOs, multi-lateral organizations, media, private sector as well as representatives of communities - committed to disaster management came together and dialogued intensely about relevant issues . Building on the experience of recent decades, we have resolved to commit ourselves, communities and institutions to innovate and create an accountable action plan. In doing so, it is important to identify the risk drivers and address their root causes. Natural Resources and Environmental changes are a critical concern which impact the life-line of communities.

2nd World Congress on Disaster Management believes in sustaining a deep focus on vulnerability reduction and capacity development of women, youth, children, disabled, elderly and strengthening inclusive approaches.

Whereas global processes "towards building resilience of communities and nations" through IDNDR followed by Yokohama strategy, HFA and recently, Sendai Framework for DRR (2015-30), which laid down 4 priorities and 7 targets – the last two decades of action has contributed to bring about a significant change in the perception and mindset, at the national levels in most countries, which has helped create an enabling environment; but, the same has not percolated down to the sub-national, especially local levels.

Therefore, keeping its focus on local realities, 2nd WCDM affirms its commitment and resolves to do the following in order to achieve the objectives of Sendai Framework for Disaster Risk Reduction and integration into Sustainable Development Goals and Climate Change Adaptation:

LOCAL LEVEL

Sub-national / provincial / district / local (like Panchayats in India / Upozilla in Bangladesh, etc as per the local context)

- Set up a full time dedicated, independent body of experts. This would be equivalent of State Disaster Management Authority at sub-national / provincial level, aligned with national legislation / mandate.
- Invest in Strengthening and Operationalizing district level / regional units (for example DDMAs in India / Provincial in Sri Lanka); and institutionalize accountability mechanisms (as obligated under respective national DM Act) – with strong convergence at local level structures.
- Generally, Communities are the First Responders to every disaster. However, we must recognize that they are also the Last / Sustained Responders. 2nd WCDM would like to place on record that devolution of approach to the last level of governance and communities (both in rural and urban areas), is the key to an innovation in disaster management that we wish to deliver on.
- To strengthen and enable the development functions (line-departments) to deliver on their risk reduction functions (roles and responsibility).
- Targeted Vulnerability reduction: Recommend adaptive use of social protection schemes for resilience building.

State/provincial Governments will provide policy directive to the District Magistrates, BDOs and Panchayats to recognize stress amongst the most vulnerable families and provide in-time and needs based support through adaptive use of social protection schemes.

Keeping in view the experience of India with 73rd and 74th amendments to the Constitution of India and other similar national and regional experiences regarding devolution of powers to local governance structures and mechanisms, it is important to recognize their critical role in all phases of disaster management – preparedness planning, response, recovery and mainstreaming DRR into development processes and outcomes.

In the context of the newly formed state of Andhra Pradesh, which is hosting 2nd WCDM, the government is building the new Capital City. We desire to see the new capital becoming a model for the rest of India and the world, as a Smart Resilient City which includes the concerns of all stakeholders. The new capital should become sister to Kyoto, Tokyo, Singapore – which are not only smart cities but also disaster resilient models. The 21st century city must retain its ancient cultural heritage and history; at the same time, becoming disaster / climate resilient.

New culture of prevention and preparedness should be incorporated as an essential component of all development planning and implementation. State Disaster Management Authority should spearhead and lead this, so that, it is risk-informed and risk-sensitive. Promoting culture of safe construction practices and improvement of unsafe buildings (schools, hospitals, other critical infrastructure) through retrofitting is important. Public Awareness campaigns are an important priority of focus in this endeavour.

Local initiatives at preserving the knowledge and history of disasters must be encouraged through supporting concepts such as 'Disaster Museum' – not only as institutions of history and culture; but also as a space for learning, by preserving the remains of disaster impacts, as a living memory for future generations..

NATIONAL

- Effective funding mechanisms need to be generated, such as national disaster mitigation fund to resource implementation of local plans
- Build a platform of knowledge management / good practices / innovations at local level

REGIONAL / CONTINENTAL

- Promote effective regional mechanisms for sharing of data which is gender-sensitive and age-appropriate
- Explore Appropriate Practices / Networks at the level of governments / multi-lateral organizations, which can activate rapid response, when needed (humanitarian access)
- Pro-Active strategies such as Comprehensive School Safety, which includes Children out of School (so that no child is left behind) can be piloted as a regional cooperation among nations

GLOBAL LINKAGES

- Undertake cooperative studies among communities and local governance on evidencing climate change understanding and local commitments. This would be undertaken at intra-, and international levels.
- Promote Private Sector Partnerships to strengthen humanitarian commitments

Use of modern / innovative technologies in all their forms and manifestations (space – telecom – earth sciences – cyber – geo-spatial mapping)-- as drivers for early warning systems applicable for multi-hazard contexts, disaster surveillance; and efficient use for dissemination to vulnerable communities / masses

IMPLEMENTATION MECHANISMS

- WCDM secretariat (DMICS) will help negotiate / advise for substantial outcomes
- Make WCDM as a biennial event (once every two years)
- Promote and nurture partnerships among stakeholders
- We, as participants of 2nd WCDM, pledge to commit ourselves to Visakhapatnam Declaration and resolve to undertake steps needed to realize this action agenda.

Action Agenda of 2nd World Congress on Disaster Management
First Year of Implementation of Visakhapatnam Action Agenda

Local Level:

- Vulnerability Assessments and Capacity Mapping of local conditions and stakeholders to develop risk-informed plans
- Strengthen Panchayati Raj Institutions / Urban Local Bodies along with resource allocation to be the critical responder and to put in place necessary protocols incorporating new technologies
- Regular mock drills at community levels led by Panchayat and Urban Bodies
- Local Contingency Planning including pre-stocking for first response

Sub-National / National / Regional Level

- Where national building codes and standards exist, these need to be enforced for every new structure to be built (homes, schools, health centres, hospitals, - in fact, all infrastructure)
- For the existing critical structures, professional assessment needs to be undertaken and retrofitting to be planned and implemented.
- Comprehensive School Safety to be a pioneering initiative in the region

Resilient Cities:

- Newly emerging cities can be guided by standards for SMART and Resilient Cities with adaptation features

Study / Research Agenda

- Undertake Disaster and Climate Risk studies from a local point of view and develop risk reduction and adaptation

Recommendations for Commitments for strategic and sustained Disaster Management:

- Whereas resources have been made available for relief during disaster response times, it is necessary to allocate specific funds for mitigation, research and innovation in the areas of resilience and adaptation
- Army to be included in planning and support for Disaster Risk Reduction initiatives
- Culture of Preparedness must include all stakeholders and vulnerable groups with a balance of short and long term initiatives
- Media to play responsible role in awareness generation on Disasters and Prevention
- Academic institutions including engineering and medical institutions; and experts to work with Revenue, Police, Fire Service, SDRF, NDRF and other armed forces to strengthen preparedness and prevention initiatives in DRR and CCA. Whenever situation demands, defense / para-military force may be requisitioned especially for response including search and rescue
- Use of technology and specially 'walkie-talkie' to be available at local to handle disasters from a local perspective

22 November 2015

Proceedings at a Glance

Constitution of World Congress

The idea of World Congress in the state of Andhra Pradesh emerged in 2008. It is envisioned that in the absence of a large platform that brings together the entire Disaster Management Community which includes scientists, researchers, policy makers, planners, practitioners including the vulnerable children and communities was a felt-need. The objective of the World Congress is "Bringing together the world disaster risk reduction community on a single platform in order to share their knowledge, technologies, best practices for the benefit of the society as a whole". DMICS has taken upon itself the mandate to conduct this bi-annually.

Steering Committee and its proceedings:

On 5th of May 2015, DMICS met the Hon'ble Chief Minister of Andhra Pradesh and presented the plan to jointly hold the 2nd World Congress on Disaster Management. The Chief Minister readily agreed; and directed that it should be held in Andhra University, Visakhapatnam. Subsequently, Government has also formed a Steering Committee chaired by Deputy Chief Minister and Minister for Home and Disaster Management, Shri Chinna Rajappa. Shri K Dhananjaya Reddy IAS, Director Disaster Management has been nominated as the Nodal Officer and Dr. N. Yuvaraj, IAS, Collector and District Magistrate, Visakhapatnam was appointed as Chairman of the Local Organizing Committee. Dr S. Ananda Babu, President of DMICS has been named as the Member-Convenor of 2nd World Congress on Disaster Management.

Learnings from First World Congress on Disaster Management: 21st to 24th October 2008

Dr A.P.J. Abdul Kalam, former President Republic of India delivered the inaugural address. The Hyderabad Declaration issued at the end of the Congress suggested collaborative partnerships and work towards global harmony focusing on new emerging types of Disasters and work towards people's movement. It has set the trend for a more aggressive approach in the coming years ensuring enlargement of the scope of disasters and involvement of all Nations with the ultimate aim to ensure a World without Disasters.

2nd World Congress on Disaster Management: November 19 – 22, 2015 – Visakhapatnam, Andhra Pradesh, India

A. Inauguration and Curtain Raiser:

The inauguration of the Congress started with the lighting of the Ceremonial Lamp by the Chief Guest Shri M Venkaiah Naidu, Hon'ble Union Minister for Urban Development, Housing and Urban Poverty Alleviation and Parliamentary Affairs, Govt of India. Thereafter, Shri J.C. Sharma, IAS, Principal Secretary, Revenue and Disaster Management welcomed the gathering. Apart from 8 Central Government Ministries, as many as 20 State Government ministers in addition to the representatives of Public Sector undertakings participated in the event. The Inaugural function was also well attended by many Union and State Ministers, Hon'ble Members of Parliament, Members of Legislative Assembly and Council, Commissioners and Senior Officers of Police, HEADS of Government Departments, UN Organizations, Officers of the Defense representing Army, Air Force and Navy, eminent Scientists, Technologists, Media as well as NGOs and community level practitioners including children and youth. About 1000 Disaster Management professionals and stake holders registered and attended.

Chief Guest Shri M. Venkaiah Naidu, presented his key note address to the delegates. The Chief Guest expressed the confidence that the valuable suggestions emerging from the deliberations in the Congress will help in preventing the intensity of Disasters. Delivering the inaugural address, Hon'ble Chief Minister stressed the need for developing capacity building and bringing in scientific system of forecasting of the impending Disasters and taking preventive actions. Hon'ble Chief Minster also said that Government has now designed a blue print to conduct rehearsals in schools and villages to improve awareness through preventive measures. Professor Amita Singh, Secretary General, NAPSIPAG, JNU elaborated the various types of Disasters, research carried out and various preventive methods. Hon'ble Minister for Revenue, State of Himachal Pradesh Shri Kaul Singh Thakur also addressed the gathering

A. 10 minute Video on Hudhud was also shown at the Congress.

After presentation of 2nd WCDM Memento to the Chief Guest Shri M Venkaiah Naidu by Dr S Ananda Babu, Convenor, the inaugural function ended with vote of thanks by Dr. N. Yuvaraj, IAS, Collector & District Magistrate, Visakhapatnam & Chairman Local Organizing Committee.

Further, Hon'ble Minister for Panchayath Raj, RWS and NREGS, Shri Ch Ayyanna Patrudu and Hon'ble Minister for Human Resources Development, Shri Ganta Srinivasa Rao participated in the Inaugural function.

Hon'ble Member of Parliament (Lok Sabha), Shri Muttamsetti Srinivasa Rao, Shri M V V S Murthy, Hon'ble MLC, Shri Ramakrishna Babu Velagapudi, Hon'ble MLA, Visakhapatnam East A/c, Shri Penmetsa Vishnu Kumar Raju, Hon'ble MLA, Visakhapatnam North, Shri Palla S Srinivasa Rao, Hon'ble MLA, Gajuwaka, Shri Bandaru Satyanarayana Murty, Hon'ble MLA Pendurthi, A/c, Shri Panchakarla Ramesh Babu, Hon'ble MLA, Yelamanchili, Smt Anitha Vangalapudi, Hon'ble MLA, Payakaraopeta, graced the Occasion.

The highlight of the first day of the Congress is the inauguration of 50 exhibition stalls by the Hon'ble Chief Minister Shri N Chandrababu Naidu. While all exhibition stalls have been appreciated for their innovation, stalls from Gujarat State Disaster Management Authority, Kamineni Hospitals, Navy, AP Tourism, Save the Children of National Humanitarian and DRR received special applause for their creativity

B. Plenary Sessions: 2nd WCDM had 5 major plenaries discussing vital and relevant aspects of disaster management. They are:

B.1: Disaster Management – Global, National and Local Approaches

B.2: Children and Disaster Risk Reduction

B.3: Mainstreaming Disaster Risk Reduction into Development

B.4: Post Disaster Reconstruction (Ministry of Urban Development)

B.5: Declaration of World Congress and Valedictory

These were chaired by very eminent experts from the Government and Field of disaster management, namely, Shri Kamal Kishore - NDMA, Shri Anil Kumar Sinha – BSDMA et al.

C. Technical / Thematic Sessions: In all there were 25 thematic sessions including two open sessions, wherein overall, about 200 professionals present their papers with research, practice and academic excellence. The topics covered centered around enhancing Disaster preparedness, Children and Disaster Risk Reduction (UNICEF and Save the Children), Industrial Disasters, Disaster Response and Recovery, minimizing damage from cyclones, CBRN, Rail and stampede accidents, Role of NGO's in Disaster management, Multi-Hazard Early Warning and Communication System, Disaster Recovery, Reconstruction and Rehabilitation, Social Resilience to Disasters, Risk Financing and Governance, Empowerment of Communities, Regional Cooperation etc.

D. Visakhapatnam Declaration and Follow-up:
Shri Anil K. Sinha, Vice Chair of Bihar State Disaster Management Authority has been designated as Chair of the Visakhapatnam Declaration Drafting Committee with a core group comprising of Sri Balaji Singh Chowhan, Ms Sunitha Reddy, Dr. S. Ananda Babu and Ray Kancharla.

The Visakhapatnam Declaration summarizing the proceedings and future action plans at National/Regional/Continental levels with emphasis on global linkage and use of modern/innovative technologies, prepared by the Special Committee chaired by Shri Anil K Sinha, IAS (Retd), Hon'ble Vice Chairman, BSDMA. This was released by Hon'ble Chief Minister of Andhra Pradesh, Shri N. Chandra Babu Naidu.

E. Valedictory Function:
Hon'ble Deputy Chief Minister, Minister for Home and Disaster Management, Chairman, Steering Committee, 2nd WCDM, Shri N. China Rajappa, spoke on the initiative being taken by State Government for extending relief measures during natural calamities and also stated that the recommendations of all the eminent Scientists emerging out of the deliberations in the various sessions will be carefully studied and implemented.

The valedictory function was marked with the appreciation conveyed by the Convener Dr. S. Ananda Babu for the excellent support received from sponsors, particularly OXFAM INDIA, Kolkata, COAL INDIA LTD, Kolkata, KERALA TOURISM DEVELOPMENT CORPORATION (KTDC), Kerala, CAIRN INDIA, Gurgaon, KAMINENI HOSPITALS, Hyderabad, HINDUSTAN SHIPYARD LIMITED (HSL), Visakhapatnam, UNICEF INDIA, Delhi, and expressed his confidence that DMICS would receive their support in much greater measure in all future projects. The convener also thanked the substantial support received from Government of Andhra Pradesh and other State Governments and Government of India, public sector and central Government organizations without whose support the 2nd WCDM would not have achieved the tremendous success it did.

After address by the Chief Guest, presentation of awards, participation certificates to the delegates, speakers, sponsors was conducted. After his valedictory address and vote of thanks by Shri Ray Kancharla, National Humanitarian and DRR Manager, the four day conference concluded with the commitment of everyone to work ***"Together for a safer World, and to build a disaster resilient society".***

Disaster Management Initiatives and Convergent Society, has now taken a new identity to become relevant in the changing scenario. DMICS has been registered with the Registrar of Societies in the year 2005 with the Government of Andhra Pradesh, India; and has been relentlessly committed to scientific disaster management. DMICS has been conducting workshops, seminars, World conferences and Congresses.

2nd WORLD CONGRESS ON DISASTER MANAGEMENT

19 – 22, November, 2015 – Visakhapatnam, Andhra Pradesh, India

Road-map and Recommended Actions

2nd WCDM affirms its commitment to work ***Together for a safer World, and to build a disaster resilient society***. In the light of this commitment**,** to the following actions have been recommended to the Global Community, to the Regional Bodies, Governments at National and Local Levels as well as the practitioners and scientific community.

Global:

- Involvement of Media in awareness generation on Disasters and prevention
- Global linkages through cooperative studies among communities and local governance bringing climate change understanding
- Undertake International Research on relevant disaster management subjects

Regional:

- Comprehensive school safety to be a pioneering initiative in the region

National:

- Allocation of specific funds for mitigation, research and innovation in the areas of Resilience and adaptation
- Army to be included in planning and support for Disaster Risk Reduction Initiatives
- Coordination between academic institutions including Engineering and Medical Institutions and departments of Revenue, Police, Fire service, SDRF, NDRF and armed forces
- Newly emerging Cities to be guided by standards of SMART and Resilient Cities

State / Province:

- Setting up full time dedicated independent body of experts on the lines of State Disaster Management Authority
- Newly emerging cities can be guided by standards from SMART and Resilient Cities with adaptation features
- Establish a knowledge centre – DRR Museum in Visakhapatnam / New Capital City as part of SDMA structure

Local:

- Vulnerability Assessments and Capacity Mapping of local conditions and stakeholders to develop risk-informed plans
- Strengthen Panchayati Raj Institutions/Urban Local Bodies along with resource allocation to be the critical responder and to put in place necessary protocols incorporating new technologies
- Regular Mock drills at Community Levels led by Panchayat and Urban Bodies
- Local Constituency Planning including pre-stocking for first response
- Strengthening of local bodies

Follow-up:

- It was also suggested to make 2nd WCDM as a Biennial event and promote partnerships amongst stake holders.

ACKNOWLEDGEMENT

The 2nd World Congress on Disaster Management has been a memorable experience for all involved. The documentation of material presented in this volume comprises the proceedings of 2nd World Congress on Disaster Management (19-22 Nov. 2015), jointly Organized by Government of Andhra Pradesh and DMICS. No event of great importance is ever possible without very strong support of the government and the personal encouragement and support of individual officers and leaders.

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Without everyone's collaboration and unconditional support, a work of this nature would not be thinkable; hence, I would like to express a warm hearted thank you and look forward to working with you for the 3rd World Congress Disaster Management (3rd WCDM) which we hope to host in 2017.

CONTENTS

AWARENESS - EDUCATION & RESEARCH IN DISASTER MANAGEMENT **1-16**

- Awareness Of School Heads' Roles And Responsibilities Relative to Disaster Risk Reduction 2
  - Celeste N. Nasalita, Ph.D.
- Disaster Management And Role of Education - *Dr. Pilkhane Abhijit Anilrao* *15*
- Values And Training To Value The Intangibles - *Nirmala Devi* *16*
- Sensitization For Disaster Management Through Visual Medium - *Navneet Kumar Gupta and Dr. Irfana Begum* *16*

CHEMICAL, BIOLOGICAL, NUCLEAR RISKS **17-30**

- Chemical disaster management: Current status and perspectives - *Narendra Kumar Tiwari* *18*
- Mainstreaming Nuclear Disaster Risk Reduction in India - *Dr. Rajesh Kumar* *29*
- A Serious Game-based Approach for CBRNeFirst Responder Training - *Alexander Ferworn, Christopher Chan* *30*

CHILD CENTRED DISASTER RISK REDUCTION & COMPREHENSIVE SCHOOL SAFETY **31-46**

- Child Centred Disaster Risk Reduction – How is South Asia moving forward in this direction?
  – *Ashish Singh,* Researcher, SDMC & Ray Kancharla, National Manager, Humanitarian & DRR/CCA, Save the Children *33*
- Comprehensive School Safety (CSS) - Ray Kancharla, National Manager – *Humanitarian* *36*
  Response - Disaster Risk Reduction / Climate Change Adaptation, Save the Children
- Children in Climate Change adaptation programming in cities – a need and an imperative
  - Sudeshna Chatterjee, Action for Children's Environments 42
- Children and Youth Participation in Disaster Risk Reduction - Rama Rao Dammala
  Technical Specialist – Disaster Risk Management, ChildFund India 44
- Children and Youth Participation Panel: 45
  Chair: Shri Kamal Kishore, Member – NDMA
  Facilitator: Ray Kancharla, National Manager, Child Centred DRR/CCA, Save the Children
  Children and Youth Panel Members:
  Sarita Mohanty, 14 years (Kendrapada, Odisha, India)
  Ashwini, 14 years (Rajahmundry, Andhra Pradesh, India)
  Sonam, 12 years (Darbhanga, Bihar, India)
  Suchashmita, 22 years (Malkangiri, Odisha, India)

CLIMATE CHANGE ADAPTATION **47-48**

- Impact of Climate Change on Frequency and Intensity of Natural Disasters inSouth Asia:
  Mitigation Measures & Adaptation Strategies Needed - *Prof. M. Bhaskar Rao, M.Tech, Ph.D, FIE* *48*

COMMUNITY BASED DISASTER PREPAREDNESS **49-69**

- Community based preparedness for disaster vulnerability reduction - lessons learned from Tutti Island (Sudan)
  - Azahir Hassan Abd Elrahman *50*
- Disaster Management: Need For Youth Preparedness - *Dr. K.Suneetha & B. Venkata Subbareddy* *56*
- Indigenous Knowledge and Practices in Disaster Management: Experience of the Coast of Bangladesh
  - Dr Mahfuzul Haque *63*

CROWD MANAGEMENT **70-120**

- DisRes for Crowd sourcing of Crisis Information - *Dr. Neelima Satyam D* *71*
- Detection, Analysis, and Management of Atypical Behavior of People in Crowd
  - Suresh Kumar, Sc. 'D' & N. P. Singh, Sc. 'G' *75*
- Risk Management Strategies To Avoid Stampede At Mass Gatherings *-Lakshaya,, Nomesh B. Bolia a* *85*
- Stampedes are Community Avertible Crowd Disasters - *Dr W G Prasanna Kumar , Dr T Sumalini* *94*
- Disaster Preparedness for Mass Religious Gatherings in India - Learning from Case Studies
  - Sindhuja Kasthala, Harshit S. Lakra *108*

CYCLONE 121-171

- Cloud Technology for Automated Aggregation of Survey Data of Housing and Buildings towards Cyclone Vulnerability Assessment - *1. K. Sasikala, 2. P. Harikrishna, 3. S. Thamarai Selvi* 122
- Thane Cyclone Damages Caused To Agriculture In Villupuram District Of North Eastern Zone Of Tamil Nadu - *Dr. R. Vaidyanathan and Dr. M. Jayaramachandran* 136
- A Study on Cyclone Persuaded Human Behaviours and Responses: With Special Reference to Orissa Super Cyclone 1999 and Phailin 2013 - *Niranjan Sahoo* 141
- Disaster Management And Thane Cyclone Rehabilitaion In Cuddalore District Of Tamil Nadu, India - *L.Jeeva Jothi1, K.Sakthivel2, K.Raja2, I.Cannayane2, and M.Jawaharlal4* 154

DISASTER MANAGEMENT 172-279

- Disaster Management the case of Guinea-Bissau - *Mr. Guilherme Da Costa (Guinea)* 174
- Disaster Mitigation and Management - *A Futuristic Approach O. Eswara reddy-1, A. Pavan kumar-2* 175
- Strategies To Reduce Impact Of Disasters Caused By Natural Hazards In India - *J.Bhattacharjee* 181
- National Level Disaster Management working Mechanism - *Naresh Jain* 188
- The Disaster Management Act,2005: A Socio Legal Analysis -*Devender Jindolia* 188
- Disaster Management -Need For Social Work Approach - *Rajendra Baikady1, Venkat Pulla 2, Dr. Channaveer Rm1* 189
- Management and Mitigation of Natural Disasters in Telangana, Andhra Pradesh and Odisha - *Supriya Mohanty1 and Pradeep Kumar Ramancharla* 189
- Disaster Management: “Managing the Risk of Mining Disaster” - *Aftab Ahmad, Dr. A K Sinha, and Dr. R M Bhattacharjee* 190
- Management Of Hydro-Met Disaster -Support From Armed Forces -*Commander Sanjay Kumar, Commander Vivek Kalia and Lt Cdr RK Maharana* 197
- Disaster Management – Indian Railways - *Mr.Muralidhar Gangichetty* 209
- Development Of Multi-Terrain Vehicle Systems For Disaster Management - *S. Selvarajan* 226
- A New Approach to Post-Disaster Relief and Reconstruction A Case Study of Jammu and Kashmir Floods - *Himanshu Shekhar Mishra* 238
- Effective Handling Of Disasters An Indian Army Perspective (With Special Reference To Uttarakhand Tragedy 2013) - *Col R Ravi Shankar, Indian Army* 239
- Sonar Systems with reference to Disaster Management - *Satyanarayana Yegireddi and Suranjan Pal* 251
- Disaster Handling Preparedness Indian Railway's Lessons - *Alok Kumar Tewari.* 257
- Talent Needs Assessment Of Humanitarian Logistician: An Empirical Investigation - *Yamini Meduri3 & Fakruddin Ali Ahmed4* 262
- Relief Work Management Of Post Earthquake Of Nepal - *Bishnu H. Bhatta* 269
- Multi-Attribute Decision Making Approach to Preposition Facility Location in Humanitarian Relief Operations Author by: *Prashant Barsinga,1, Sushil Kumarb and Omkarprasad S Vaidyac* 270
- Critical Road Path Identification Post Disaster for Vijayawada City - *Akhila Manne, Avijit Vajpayee and Neelima Satyam D* 271
- Community Participation in Post Disaster Recovery: Locating the Role of Social Capital - *Md. Anwar Hossain* 272
- Coordination in Disaster Management: Case Studies in the Coastal Areas in Bangladesh - *Author by: Mst. Marzina Begum* 273
- Managing Natural Disaster in Himalayas: DIBER(DRDO) Experience Author by: *Ankur Agarwal, P S Negi, Manoj Pant, H S Meena, S K Dwivedi, M C Arya and M. Nasim* 274

DISASTER RISK REDUCTION 280-282

- Disaster Management And The Hyogo Framework Within the Humanitarian World Summit: Challenges For 2016 - *Paloma Serra Robles* 281
- Post Disaster Reconstruction and Geoinformatics for Disaster Risk Reduction (DRR) for 2013 - Flash Floods in Uttarakhand, INDIA – A case of Rudrapryag District - *Dr. Indrajit Pal a *, AbhinavWaliab* 282

EARTHQUAKES **283-337**

- Simplified Procedure For Seismic Vulnerability Assessment Of Soft Storey Buildings
  -G.V. Rama Rao†#, N. Gopalakrishnan†, K. Sathish Kumar†, J. Prakashvel 284
- Simulation Of Ground Motions For Different Indian Cities Due To 25th April 2015 Main Shock Of Mw 7.8 Nepal Earthquake - *Kamatchi, P. & Balaji Rao K.* 291
- Seismic Risk Assessment for Aqaba city in Jordan. Case study - *Dr. Adnan Khasawneh, Eng. Naela Al Daoud ,Dr. Rasheed Jardata, Dr. Muheeb Awawdeh (Yarmouk University)* 298
- Study of Different Staggered Shear Wall Configurations on Seismic Performance of RCC Framed Buildings
  -Bajarang Gupta 1 and S.K. Madan2 324
- A Study On Sequence Of Plastic Hinge Formation In RC Frame By Nonlinear Static Analysis
  - Ravikumara H S1, Supriya R Kulkarni2,Babu Narayan K S3 337

EARLY WARNING SYSTEM **338-344**

- Early Warning System At The Community Level – Technological Advancements
  - Dr. Sourabh Bhattacharya, Divya Nagilla 339

ENVIRONMENT - ECO SYSTEMS & CLIMATE CHANGE ADAPTATION **345-370**

- The Role Of Coastal Vegetation In Protecting Shorelines: A Case Study In Bhitarkanika Conservation Area, Odhisa, India - *Dhruv Verma & Sonali Ghosh* 346
- Study on Ecosystem based Disaster Risk Reduction in Sunderbans, UNESCO World Heritage Site.
  - Rupa and Sonali Ghosh 346
- Strategic Environmental Assessment as a tool in Disaster Management
  - Md. Shafiqul Baria and Uttam Kumar Majumderb 347
- Mangroves play an important role in natural disaster reduction and resilience - *Akhil Singh.* 348
- Government Strategy In Dealing With Climate Change: A Case Study Of Food Security Crisis In Malaysi
  - Dr. Ahmad Martadha Mohamed and Zahrul Akmal Damin 349
- Impact And Role Of Mangrove Forests And Biodiversity Conservation In Disaster Management In East Godavari Riverine Estuarine Ecosystem (Egree) Region - *Dr. Thulsi Rao Kundhi, M. Ravikumar, Dr. Kalyani Bai Kunte* 350
- Some Anthropogenic Factors Of Landslide In Aizawl, Mizoram - *Lalrokima Chenkual* 359
- Impact Of Drought On Community, Vulnerability And Coping Methods Used In Villages Of Northern Rajasthan, India - *Dr. Rajiv Gupta , Dr. Amrita Agrawal* 364

FIRE **371-385**

- Rocky Forest Fire in California - *Dr. Mukta Girdhar* 372
- An Eye on the Most Prevalent Threat of the Disaster FIRE - *Pankaj Tiwari ,Abhay Gupta & Prince Anurag* 373

FLOODS **386-412**

- The challenges of flood disaster management in Nigeria - *Professor A. M Jinadu* 387
- Rapid Assessment and Training of Resilient Communities to floods in Karari and Eastern Nile localities of Khartoum state, Sudan. -*Magzoub Toar* 397
- September 2014 Floods in Jammu & Kashmir: The way forward to build a sustainable & flood resilient Jammu & Kashmir - *S.K.Bukari, Saqib Gulzar, Ovais Gulzar* 411
- Identification and Prediction of Extreme Rainfall events over India during the monsoon of 2014.
  -G. Ch. Satyanarayana, D. V. Bhaskar Rao, D. Srinivas and C. V. Naidu 412

GENDERING **413-426**

- Gendering Disasters: Rethinking disasters using a feminist lens - *Dr. Shubhda Arora & Dr. Santosh Kumar* 414
- Genderscope: defying societal rules for him and her - *Eilia Jafar* 415
- Gendered vulnerabilities in times of disaster: Case of Bangladesh -*Dr. Shahnaz Huda* 424
- Women and Disaster - *Priyaanka Jha* 425
- Roles of Women and Disaster Planning in Rural Mindanao, Philippines - *Mr. Mervin Gascon* 426

HEALTH **427-443**
- Study Of Compliance Of Crash Carts To Standards In The Emergency Of A Tertiary Care Teaching Hospital - *Makkar N, Madaan N.* *428*

INTER AGENCY GROUP PREPAREDNESS **444-447**
- Evaluating Inter-Organizational Network Preparedness To Respond Tsunami Early Warning System In West Sumatra - *Mizan Bustanul Fuady Bisril* *445*

INFORMATION COMMUNICATION TECHNOLOGIES **448-512**
- ICT Support Services for National Disaster Management - *Dr. M. S. Rao* *449*
- Tool for Disaster Communication: *Experiences of M.KRISHI during Hudhud Cyclone -Siddhesh Nar, Dr. Veerender Veer Singh2, Dineshkumar Singh, Srinivasan Karthik, Divya Piplani, Dr. Srinivasu Paapula* *458*
- Role of Human Biological Monitoring in Disaster Management - *Dr. Vijay Bhatnagar, PhD* *459*
- Communication in Disaster Response and Recovery: A Case Study of Uttarakhand, India - *Shabana Khan* *464*
- Analysis of GPS TEC for Precursor Signatures of Earthquakes using Multi Signal Classification Algorithm (MUSIC) - *R. Revathi , K. S. Ramesh and S. Koteshwararao* *464*
- Digital Flood Estimation Technique using Geospatial Tools - *RK Suryawanshi1, SS Gedam* *465*
- Using Uav Technologies For Fire Fighting - *K.Satish & N. Kishan* *466*
- Applications of RS and GIS Techniques for Disaster studies in East Godavari District, Andhra Pradesh, India *- Dr K Padma Kumari, V G K Kasyap and K Srinivas* *474*
- Role of Informatics in Effective Disaster Management, A case study *- Bidisha Lahiri, Satyanarayana Yegireddi and Suranjan Pal* *485*
- Innovative Use of Technology(GIS) For Disaster Risk Reduction A Case Study - *Dr. Namrata Agrawal* *489*
- Support Services for National Disaster Management - *M. S. Rao* *500*
- Mapping of Disaster Zones In India - *Prof. BupinderZutshi, PriyaBhakat, Homolata Borah* *501*
- Application of ICT tools in Drought Monitoring and Mitigation - *G S Srinivasa Reddy and C N Prabhu* *502*

IMPACT **513-516**
- Socio Economic Impact of Coastal Hazard in Kerala - *Malini Prava Sethi* *514*
- Impacts of Natural Disasters and Its Coping Strategies at Kazircharvillage In Muladi Upazila, Barisal *- Md. Humayain Kabir, Md. Tanvir Hossain* *514*
- Post-Disaster Economic Vulnerability of Female-Headed Households -*Isaias S Sealza* *515*
- Socio Economic Impact of Coastal Hazard in Kerala - *Malini Prava Sethi.* *515*
- Social & Psychological Imprints of Disasters understanding the social and Psychological impact of disasters on the disaster effected people of Uttarakhand - *Dr. Vinay Sharma, Dr. Kapil Joshi,IFS* *516*

LANDSLIDES **517-530**
- Guidelines About Preparing Standards of Hazard and Risk Map forLandslide and Rock Fall at Turkey *- Cigdem Tetik Bicer and Mehmet Akif Danaci* *518*

LESSON LEARNT **531-543**
- Evaluation of Post- Tsunami Resettlements in Kerala- Lessons from Alappad, Kollam. *- Shyni.K1 and Dr. HaimantiBanerji* *532*
- Behavioral Aspects of Emergency Response Teams - Responding to Emergency more effectively through learning after a Disaster - *Shri Jayanta Bordoloi,CE (S&E) Ms. M.B.Sarma,Sr.Manager (S&E)* *543*

LIVELIHOOD **544-557**
- Disaster Management of Thane Cyclone on Sugarcane over the coastal part of Cuddalore District, Tamil Nadu - *Dr. R.S. Purushothaman* *545*
- Agronomic Remodelling, Revitalization of Cyclone prone Agricultural Ecosystem of Coromandel Coast *- M.S.Aneesa Rani , V.Prema , C.Prabakar and V.Ravi* *549*

LIVESTOCK **558-565**
- Livestock Disaster Management in Tamil Nadu- An analysis *-Dr.P.Mathialagan1 and Dr.N.Vimal Rajkumar* *559*

MEDIA AND DISASTERS **566-573**
- Earthquake Reporting and Reporters: Challenges and Problems - *Ms. Meera Amatya* *567*
- Role of Media in Disaster Management - *Sagat Shaunik* *568*

NON - GOVERNMENTAL ORGANIZATIONS **574-590**
- Role of NGOs in Disaster Management: Some experiences of Local NGOs involvement in Disaster Management in Sri Lanka - *K. D. Chithrapala* *575*
- Sustainable NGO Government Partnership at Microlevel for Community Managed Disaster Risk Reduction - *Neena Joseph* *576*
- Role of Indian NGOs In Natural Disaster Management - *Bhagwansing M. Bainade* *577*
- Strengthening The Role of NGOs In Disaster Management - Multi Stake Holder Participation Green India (Nellore - AP) experiments - *Dr. Ch. Murali Krishna* *578*

POST DISASTER NEEDS ASSESSMENT (PDNA) **591-599**
- Post - Disaster Needs Assessment (PDNA) - *Shri AK JHA, CE, CPWD* *592*

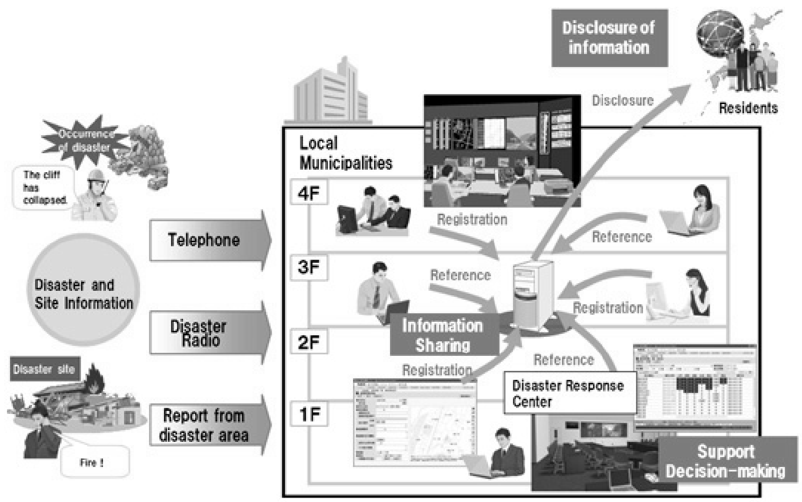
RESILIENCE **600-686**
- Pathways to Resilience Process: Way Forward - *Mr Pradeep Mahapatra* *601*
- Building Communities around Disaster Management- Demystifying Disaster Management *-Pinaki Dasgupta* *606*
- Alternative Technologies as a Toolkit for Management of Rain Water Flooding in Machilipatnam Municipality *- Prof. Dr. P. Padmavathi, Ar.P.Pavan Kumar (Ph.D.),* *607*
- Resilient Infrastructure for the Capital City Amaravathi - *Pothula Shiva Sai Kiran, Harshit Sosan Lakra* *610*
- Effectiveness of Base Isolation Technique and Influence of Isolator System Parameters on Response of a Base Isolated Building - *Sunita Tolani and Dr. Ajay Sharma* *619*
- Repair and Rehabilitation of Buildings: *Shri MKSharma, CE, CPWD.* *620*
- Seismic / Cyclonic Retrofitting of Buildings: *D T K M Soni, CE, CPWD* *664*
- Precautions required in Building Construction in Earthquake & Cyclone Prone Areas *-Shri Shailendra Sharma.* *674*
- Precautions for Improving Wind / Cyclone Resistance of Buildings 679
- Building Community Disaster Resilience through Multi-Sectoral Collaboration at Local Level - *Jayashree Parida, Niharranjan Mishra* *686*

STAKEHOLDERS **687-688**
- Role of National Service Scheme (NSS) in Disaster Management - *Dr. Prashant Amrutkar* *688*

SUSTAINABLE DEVELOPMENT GOALS **689-691**
- Cultural Discourse of Space: An alternative on Sustainable Development - *Dr. Ritu Sharma.* *690*
- Sustainability and Survivability: Exploring the Nexus Between Disaster Management and Sustainable Development - *Manika Kamthan* *691*

VULNERABILITY **692-730**
- Disaster Vulnerability a National Mayhem: An International Grief - *Gajadhar Choudhary* *693*
- Development and Vulnerabilities: A case from Sahyadri Mountain - *Shailendra Rai and Omkar Khare* *702*
- Defining Vulnerability from the flood prone area: A case study at Village Shival, Bairiya Tehsil, Ballia (UP) *- Shishir Kumar Yadav* *715*
- Social Vulnerability to Disaster and Need for Social Policy: A Study of 2015 Flood in West Bengal *- Dr. Rabindranath Bhattacharyya* *716*
- Remembering Durkheim: A Sociological Perspective on Disaster Risk Reduction - *Sanghamitra Nath* *718*
- Disaster and Social Vulnerability- Experiences of Dalits in India - *Binod Kumar* *719*
- Most vulnerable social elements of natural disaster in Bangladesh: Surviving pattern and search for a new paradigm - *Nazmul Huda* *720*

AWARENESS – EDUCATION
&
RESEARCH IN DISASTER MANAGEMENT



- Awareness of School Heads' Roles and Responsibilities Relative to Disaster Risk Reduction **-** *Celeste N. Nasalita, Ph.D.*
- Disaster Management and Role of Education - *Dr. Pilkhane Abhijit Anilrao*
- Values and Training to Value the Intangibles - *Nirmala Devi*
- Sensitization for Disaster Management through Visual Medium- *Navneet Kumar Gupta and Dr. Irfana Begum*

AWARENESS OF SCHOOL HEADS' ROLES AND RESPONSIBILITIES RELATIVE TO DISASTER RISK REDUCTION

Celeste N. Nasalita, Ph. D.
Senior Education Program Specialist, Schools Division Office of Ligao City

Background of the Study

The occurrence of disaster is becoming a global trend nowadays. Disasters, whether natural or man-made, can strike anytime and anywhere resulting in greater degree of devastation, threatening lives and properties and finally resulting in greater economic, social and political unrest. In the Philippines, which is located between the South China Sea and the Pacific Ocean, is highly vulnerable to all types of natural hazards. The vulnerability of our country to disaster requires the government to organize an effective disaster preparedness or avoidance system in the belief that this country is not totally helpless against disaster.

Albay, is one of the provinces in the Philippines, located in the Bicol region, is often battered by typhoons considering its topography with a low elevation of 0-30 meters Mean Sea Level (MSL). Three fourths or 208,256 hectares of the provinces' total land area is prone to extensive flooding.
Each year, roughly 198,000 houses are threatened with destructions from storm surges and at least 350,000 people need to be evacuated. Another 300,000 of the population are threatened by tsunamis. And with the active volcano in its midst, three cities and five municipalities are under threats from mayon eruptions.

Last September 15, 2015 at 10:00 PM, Alert Level 3 status of Mayon Volcano was raised by the Philippine Institute of Volcanology and Seismology (PHILVOCS) which prompted the Provincial Government of Albay to impose the forced evacuation to more or less 15,044 individuals or 2,898 families residing within the 6-8 permanent danger zone (PDZ).

As revealed by DepEd DRRM Office Region V, there were 52,700 learners who were displaced during the height of the forced evacuation procedures and 724 classrooms of the 78 schools in Albay were used as evacuation centers. Ligao City has evacuated 3,893 individuals or 835 families from the barangays of Baligang, Amtic, Tambo and Nabonton respectively. Two schools were used as evacuation centers namely Ligao West Central Elementary School (Binatagan) and Nabonton ES.

Thus, in the cluster approach strategy implemented by the Albay Public safety and Emergency Management Office (APSEMO) and the Provincial Government of Albay to achieve the Zero Casualty Goal, the education sector specifically the school heads were assigned as camp managers.

School heads are educational leaders who have the paramount responsibility of safeguarding and protecting the school properties, personnel and students, facilities, equipment, fixtures, instructional materials and students' records. They are also expected to plan and implement contingency measures for alternative learning system as well as rehabilitation of learning venues to ensure continuity of instruction. This is to carry out the duties and responsibilities of the school to deliver instruction even in times of emergencies and calamities.

To effectively achieve the expected response in times of disasters, school heads must fully understand their roles and responsibilities relative to risk reduction, mitigation and prevention. Results of this study will be used as basis for the preparation of an action plan to provide massive awareness among the school heads on their specific roles and responsibilities during disasters and calamities.

Statement of the Problem

Generally, this study aims to determine the level of awareness of Public Elementary and Secondary School Heads in Ligao City Division on their roles and responsibilities as basis for the formulation of an action plan to provide extensive awareness on risk reduction and mitigation, thereby lessening the detrimental effects of disasters in schools.

Specifically, this aims to answer the following sub-problems:

1. What is the level of awareness of public elementary and secondary school heads' in Ligao City Division on their roles and responsibilities in risk reduction before, during and after the occurrence of a/an:
   - Typhoon
   - Earthquake
   - Flood
   - Volcanic Eruption

2. What action plan may be proposed to enhance the school heads' awareness on disaster risk reduction?

Significance of the Study

The study was envisioned to be useful and significant to the following:

Department of Education Officials: The output of this study can be a basis for crafting memoranda related to the conduct of massive trainings for school heads, teachers and students to increase their level of awareness along disaster risk reduction.

School Administrators: They can use the findings of this study as feedback information to map out plans and strategies in strengthening the risk reduction program of their schools to avoid effectively the adverse effects of all types of hazards.

Teachers: The study will give them an insight on the importance of being prepared in event that any disaster occurs. They may also use the result of this study to propose other capability building activities or instructional materials along disaster reduction.

Local Government Units: This study can give the LGU's insights on how to create, formulate programs and collaborate with the Department of Education to ensure safety among people.

Parents: The output of this endeavor will provide them important information on the appropriate response measures directed towards saving life and property in the event that an unexpected disaster may occur.

Students: The result of this study will benefit them because they will become the ultimate beneficiaries of the information and learnings that the school heads will acquire from the action plan to be proposed by the researcher related to disaster risk reduction.

Researcher: This will provide inspiration in spearheading more capacity enhancement seminars and trainings for school heads, teachers and students to ensure that risk reduction programs will be properly implemented and institutionalized in all the elementary and secondary schools in Ligao City Division.

Scope and Delimitation

This study is confined to the determination of the level of awareness of public elementary and secondary school heads in Ligao City Division on their roles and responsibilities on disaster risk reduction to be able to formulate an action plan suited to their needs which will be very vital in the inclusion to the Division DRRM Plan. It intends to cover the 55 public elementary and 11 secondary schools in Ligao City. All the principals and Teacher-In-Charge (TICs) will be taken as respondents. The test on whether there is a significant difference on the responses of the respondents along the variables cited will be undertaken.

The study was delimited to four natural hazards specifically typhoon, flood, earthquake and volcanic eruption because these are the destructive phenomena that regularly occur in the site of study and poses a great threat to the respondents. Other natural disasters like tsunamis, drought, landslides, hurricanes and bush fires and man-made disasters like major accidents, epidemics, arson and civil unrest were excluded since the vulnerability to these events of the respondents were noted to be very low and insignificant. The time reference is from January 2015 to March 2016. Students were excluded due to the fact that they will be the recipients of the study. Teachers were not included also because their roles and responsibilities are different from that of the school heads.

Research Methodology

This study utilized the descriptive evaluative method of research. The descriptive method has for its purpose to tell "what exist" or "what is" about a certain phenomenon. It is a method of collecting information which provides the researcher the chance to describe the status, in this study, of the school heads as information agents in times of disaster.

Sources of Data: The primary source of data are the responses of the respondents to the items in the questionnaire used in this study. Other sources of information are documents from Albay Public Safety and Emergency Management Office (APSEMO) and other related offices, theses, dissertations, write-ups and sample programs on disaster management.

Instrumentation: A survey questionnaire was prepared by the researcher exclusively for the use of this study. It is composed of four parts and each part has three sub-parts. The researcher will also use a five-point Likert Scale wherein the respondents will be instructed to check the number that corresponds to their perception of their level of awareness of each role and responsibility. Five (5) means "fully aware", four (4) means "much aware", three (3) means "aware", two (2) means "less aware" and one (1) means "not aware".

Validation of the Research Instrument: To determine the clarity and validity of the instrument, a try-out was conducted to selected school heads from the Albay Division using the instrument. Considering that the questionnaire checklist was developed basically from formulated possibilities, it is not a standard instrument whose validity have been established. There was a suggestion to place a short letter of introduction on the front page of the instrument which was incorporated during the finalization of the questionnaire.

Data Gathering Procedure: The validated instrument was utilized to gather the needed data. The steps followed are: (1) Requested approval from the Schools Division Superintendent to conduct the study in the 66 public elementary and secondary schools in Ligao City; (2) Sought permission from the school heads for the administration of the survey questionnaire; (3) gathered the needed data and information; and (4) analyzed the data gathered.

Definition of Terms

The following are conceptually and operationally defined:

Awareness: It is the state of being informed/ knowledgeable. In this study, it refers to the knowledge of the school heads on their roles and responsibilities before, during and after a calamity/ disaster as measured by the survey.

Level of awareness: It pertains to the difference in measures of the state of awareness of a person. In this study, it means the differences in the knowledge of the respondents of the variables as statistically computed.

Disaster: This means the serious disruption of the functioning of a community or society causing widespread human, material or economic losses, which exceed the ability of the affected community to cope with using its own resources.

Disaster Risk Reduction: This refers to the foundation of community based-disaster risk management. In this study, it refers to the activities of the school heads to minimize disaster-related losses of life and property. Such activities may also be described as mitigation measures.

School Heads: Refers to any individual who passed the principal exam or was appointed as Teacher –In-Charge responsible for managing the activities of a certain school.

Ligao City Division: Refers to a small division of the Department of Education created by virtue of the approval of the Republic Act creating Ligao as a component city.

Calamity: This refers to the extreme distress or misfortune produced by some adverse circumstances or events to cause loss or misery due to natural forces such as earthquakes, typhoons, floods, volcanic eruptions and other disasters causing widespread loss and/or extreme damage to human lives and properties.

Flood: A very large amount of water that has overflowed from a source such as river into a previously dry area.

Earthquake: A violent shaking of the earth's crust that may cause destruction to buildings and results from the sudden release of tectonic stress along fault line or from a volcanic activity

Typhoon: A disturbance accompanied by strong winds, rain, lightning and thunder causing destruction and damages to properties and loss of lives.

Volcanic Eruption: Refers to a disturbance created by the massive release of pyroclastic materials, lava and ash fall from the crater of an active volcano.

Statistical Treatment of data

The numerical findings gathered after the conduct of the survey were statistically analyzed and interpreted. Data were organized and presented in tables to facilitate clear understanding.
Simple descriptive statistics like frequency, percentage and weighted mean were utilized in the treatment of the data.The weighted mean was used to find out the extent of awareness of school heads' as perceived by them of their roles and responsibilities in disaster risk reduction before, during and after a typhoon, an earthquake, a flood and a volcanic eruption.

The formula for each computation follows:

Percentage:

$$P = \frac{\sum f}{f}$$

Where: P= Percentage

$F = Frequency\ or\ Number$

$\sum f$= Summation or frequency or number

Weighted Mean

$$WM = \frac{\sum (f \times W)}{\sum f}$$

Where: WM= Weighted Mean
f = Frequency
W= Weight of response
$\sum f$ = Total frequency

Quantification of Data

To find out the level of awareness of the respondents the scale below was used, patterned after Earle Bobbie's Social Research.

Scale	Range	Description
5	4.51-5.00	Fully aware
4	3.51-4.50	Much Aware
3	2.51-3.50	Moderately Aware
2	1.51-2.50	Less Aware
1	1.00-1.50	Not Aware

Analysis and Discussion: The school has for its mission the provision of quality education equitably which is accessible for all; and the laying of foundation for lifelong learning and service for the common good. But sometimes this mission is hindered by factors beyond human control, such as disasters, whether human or man-made. In these cases, however, human knowledge and experiences can act as mitigators against the disaster's adverse effects.

The discussions of the roles and responsibilities of the respondents are in three parts: before, during and after the calamity. The results are presented in corresponding tables.

Table 1: Awareness of School Heads' Roles and Responsibilities before a Typhoon

Roles/Responsibilities	Mean N=66	Description
1. Organize and maintain DRR Team for EOC Activation	4.08	Much Aware
2. Plan the necessary precautionary measures to ensure that textbooks, computers and other important records are moved to a safe place.	4.48	Much aware

3. Attend the Division and Local DRRM Emergency Meeting to know the latest updates on the tracking pattern of the typhoon and the possible scenario that may happen	4.42	Much aware
4. Coordinate with the Division DRR Focal Person and Baranggay Officials to facilitate and identify the needs of the evacuees	4.44 **AWM= 4.355**	Much Aware **Much aware**

Table 1 shows the level of awareness of the respondents on their roles and responsibilities before a typhoon. This level was obtained by computing the weighted mean of the respondents' answer to the four indicators, quantified and interpreted.

It could be deduced from the data presented that the highest weighted mean is4.48 while the lowest is 4.08. The average weighted mean is 4.355 which means "much aware". The lowest response is on "organizing and maintaining a DRRM team for EOC activation with a weighted mean of 4.08. The data show that the respondents are "much aware" that planning the necessary precautionary measures to ensure that text books, computers and other important records are moved to a safe place.

These findings show that contingency planning for the school where the school head is assigned could be easier and lighter because of proper coordination. When individuals join together and coordinate their mental and physical efforts, great and exciting things can happen.

Table 2: Awareness of School Heads' Roles and Responsibilities during a Typhoon

Roles/ Responsibilities	Mean N=66	Description
1. Stay alert and monitor weather updates through television, radio and social media	4.61	Fully aware
2. Keep constant communication with the Division DRR Focal Person to provide updates via text message on the status of the school	4.38	Much aware
3. Maintain relevant and updated emergency hotlines for possible rescue operation if necessary	3.94	Much Aware

4. Ensure that all rooms used as evacuation centers are open to accommodate the evacuees	4.65	Fully Aware
5. Monitor the status of the school personnel and facilities regularly	4.42 **AWM=4.4**	Much aware **Much Aware**

Table 2 presents the results of the level of awareness of the respondents on their roles and responsibilities during the occurrence of a typhoon. Although at the onset of a typhoon the school heads are premised to be in their respective homes already due to the automatic suspension of classes every time warning signals are raised by PAG-ASA.

It could be deduced from the said table that among the five indicators, the average weighted mean is 4.42 which means "much aware". Ensuring that all rooms used as evacuation centers are open to accommodate the evacuees has the highest mean of 4.65 while maintaining relevant and updated hotlines for possible rescue operation if necessary has the lowest mean of 3.94.

The findings suggest that the respondents have the wide knowledge on what to do to ensure that evacuees are properly accommodated during the evacuation period. But there are still perhaps other details not within the awareness that must be enhanced through constant monitoring of the latest bulletin from disaster authorities.

Table 3: Awareness of School Heads' on their Roles and Responsibilities after a Typhoon

Roles/ Responsibilities	Mean N=66	Description
1. Gather and submit data for Rapid Damage Assessment Reports (RADAR) to DepEd DRRMO and Division Focal Person Immediately after the occurrence of a typhoon	4.44	Much aware
2. Identify the need for temporary learning spaces (TLS) and alternative delivery modes of education to ensure immediate resumption of classes	4.32	Much aware
3. Account for the number of teachers and students injured, killed, displaced and missing	4.52 **AWM=4.43**	Much aware **Much Aware**

Table 3 shows the level of awareness of the respondents on their roles and responsibilities after a typhoon. It appears that the respondents believed that "accounting the number of teachers and students injured, killed, displaced and missing" was their first responsibility after a typhoon. It has a weighted mean of 4.52 which means "much aware" and is considered the highest among the indicators cited. "Identifying the need for temporary learning spaces (TLS) and alternative delivery modes of education to ensure immediate resumption of classes" has the lowest weighted mean of 4.32 which means "much aware". The average weighted mean is 4.43 which means "much aware" of their roles and responsibilities.

The findings revealed that there are no major problems met by school heads after the occurrence of a typhoon. They are "much aware" on their roles and responsibilities on what to do, how to do and when to do them. However, in a school system, one of the basic tasks is planning. Every school heads should already have their contingency planning in consonance with the goals of the local government units to promote and pursue a community-based disaster risk management approach.

Table 4: Awareness of School Heads' on their Roles and Responsibilities before an Earthquake

Roles/ Responsibilities	Mean N=66	Description
1. Spearhead capacity building activities for teachers and students	4.17	Much Aware
2. Evaluate the structural soundness of school building and recommend for condemnation or retrofitting if necessary	3.95	Much Aware
3. Conduct quarterly fire and earthquake drill	3.85	Much Aware
4. Make sure that all classrooms have entry or exit doors and gates	3.95	Much Aware
5. Devise a school earthquake evacuation plan and escape route	4.12	Much Aware
	AWM= 4.00	**Much aware**

Although to date, earthquakes cannot be predicted, it is still important and necessary that everyone should be prepared for such eventuality. There are preparatory activities that must be done or must be in placed to lessen the impact of earthquake when it occurs. Table 4 shows the level of awareness of the respondents on what to do before an earthquake. It could be deduced from the data that the highest weighted mean of 4.17 which means "much aware" is on indicator 1 which states that school heads should spearhead capacity building activities for their teachers and students. They are also "much aware" that devising an earthquake evacuation plan and escape route with a weighted mean of 4.12. The rest of the indicators have weighted means ranging from3.85 to 3.95 which means "much aware".

Thus, it could be implied that school heads have complete knowledge of the outcomes of each alternative and its probabilistic estimate of the outcomes of each alternative. This is certainty.

Table 5: Awareness of School Heads' Roles and Responsibilities during an Earthquake

Roles/ Responsibilities	Mean N=66	Description
1. Direct students to move to an open area when earthquake happens	4.70	Fully Aware
2. Supervise students and teachers as they move away from buildings and/or classrooms	4.42	Much Aware
3. Guide teachers in the correct handling of students as they take the fastest and safest way out if inside an old or weak building	4.50	Much Aware
4. Remind students to avoid falling debris by getting under a sturdy table	4.64	Fully Aware
	AWM= 5.57	**Fully Aware**

Table 5 shows the school heads' roles and responsibilities during an earthquake. Based on the data presented, they are "fully aware" that it is necessary to direct students to move to an open area when earthquake happens and they should be reminded to avoid falling debris by getting under a sturdy table. The indicator that received the lowest weighted mean of 4.42 states that students and teachers should be supervised by their school heads as they move away from buildings and/ or classrooms. The average weighted mean is 4.57 which means "fully aware".

The findings revealed that even if an earthquake cannot be predicted, still school heads have a high level of awareness on what to do during its occurrence. However, any knowledge of an alternative if not properly implemented, is an abstraction. It is entirely possible for high level of awareness to be negated by poor implementation.

Table 6: Awareness of School Heads' Roles and Responsibilities after an Earthquake

Roles/ Responsibilities	Mean N=66	Description
1. Check teachers and students for possible cuts/ injuries and ask for immediate first aid	4.38	Much aware
2. Bring casualties to the nearest hospital	4.70	Fully Aware
3. Report to local authorities		

information relative to injuries/death for immediate need assistance	4.41 **AWM=4.50**	Much Aware **Much Aware**

Table 6 shows the level of awareness of school heads on their roles and responsibilities after an earthquake. The data show that 4.70 or "fully aware" is on bringing the casualties to the nearest hospital. "Checking teachers and students for possible cuts/injuries and asking for immediate assistance and reporting to local authorities information relative to injuries/death for immediate need assistance" had a weighted means of 4.38 and 4.41 respectively which means "much aware". The data revealed that they are "much aware" of their responsibilities after an earthquake, but still, there is room for further improvement.

Carter emphasized that if disaster mitigation is to be successful, its requirements must be widely known and understood by all. Public awareness will provide a strong foundation in reducing risk and destruction to life and properties.

Table 7: Awareness of the School Heads' Roles and Responsibilities before an occurrence of Flood

Roles/ Responsibilities	Mean N=66	Description
1. Know the flood warning system in the school, if none, this must be recommended	4.47	Much Aware
2. Plan and implement a comprehensive and pro=active waste program to manage school wastes	4.26	Much Aware
3. Conduct Annual School Based Risk Assessment and Mapping religiously	4.09 **AWM=4.27**	Much Aware **Much Aware**

Table 7 contains the level of awareness of the school heads under study, on their roles and responsibilities before an occurrence of flood. The data revealed that respondents are "much aware" as indicated by the average weighted mean of 4.27. Knowing the flood warning system of the school and planning and implementing a comprehensive and pro-active waste program to manage school wastes got the highest mean of 4.47 and 4.26 respectively.

In the study made by Ondiz, entitled Flood Disaster Preparedness, it was shown that the disaster coordinating councils studied were strong in contingency planning but weak in other aspects such as conduct of enough drills/exercises on flood preparedness and sourcing of enough funds for preparedness programs.

Thus, although the school heads are aware of their responsibilities before a flood, there are other factors that need to be taken into consideration for an effective mitigation program in schools, where the most vulnerable population are to be found. It can be implied that school heads should attend more trainings and seminars on the nature, causes, effects and precautionary measures of floods.

Table 8: Awareness of School Heads' Roles and Responsibilities on their Roles and Responsibilities during an occurrence of a Flood

Roles/ Responsibilities	Mean N=66	Description
1. Follow and disseminate to school personnel orders and instructions given by concerned authorities	4.36	Much Aware
2. Tune in or monitor to radio stations for updates to avoid areas prone to sudden flooding and be cautious of water-covered roads and bridges before sending students to their homes	4.48	Much Aware
3. Remind teachers to advise their students to take precautionary measures during flood occurrences and give safety reminders on what to do and where to go in case of evacuation	4.55	Fully Aware
	AWM=4.46	**Much Aware**

Table 8 shows the level of awareness of school heads on their roles and responsibilities during the occurrence of a flood. The data show that the respondents are "much aware" on following and disseminating to school personnel orders and instructions given by concerned authorities and tuning in or monitoring to radio stations for updates to avoid areas prone to sudden flooding and be cautious of water-covered roads and bridges before sending students to their homes. These indicators got a weighted mean of 4.36 and 4.48 respectively. The average weighted mean is 4.46 or "much aware".

The level of awareness of the school heads on their roles and responsibilities during floods may be attributed to their sad experience during Typhoon Reming in 2006 when the water level of Kabilogan River rose unexpectedly resulting in flooding in some low lying areas of the city.

Table 9: Awareness of School Heads' Roles and Responsibilities after an Earthquake

Roles/ Responsibilities	Mean N=66	Description
1. Report broken or destroyed utility lines (electricity, gas, water, etc.)	4.50	Much aware
2. Ensure that electrical appliances are checked by competent electrician	4.67	Fully Aware

before switching them on		
3. Submit Rapid Damages Assessment Report I and 2 to the Division Office and DepEd Central DRRM Office	4.51 **AWM=4.56**	Fully Aware **Fully Aware**

Table 9 presents the level of awareness of school heads on their roles and responsibilities after the occurrence of floods. It could be gleaned from the data that "ensuring electrical appliances are checked by competent electrician before switching them on and submitting Rapid Damages Assessment Report I and 2 to the Division Office and DepEd Central DRRM Office" got the highest means of 4.67 and 4.51 respectively. The average weighted mean is 4.56 which means "fully aware".

The findings imply that school heads have a good understanding of their responsibilities after a flood. The high level of awareness may be attributed to their repeated experiences of flooding in some low-lying areas of Ligao and in the nearby municipalities of Oas, Polangui and Libon where vast areas of rice fields are often submerged in water; the unexpected deaths of students and young children living nearby riverbanks and destruction of temporary shanties.

Findings:

The following are the salient findings of the study based on the presented data:

The level of awareness of the respondents on their roles and responsibilities in disaster risk reduction in the occurrence of :

- Typhoon- Respondents were found to be "much aware" before, during and after a typhoon with weighted means of 4.35, 4.4 and 4.43 respectively.

- Earthquake- The level of awareness before an earthquake had a weighted mean of 4.00 and after an earthquake 4.50 which showed that the respondents were "much aware"; while during an earthquake, they were "fully aware" as shown by the weighted mean of 4.57.

- Flood- The respondents were found to be "much aware" before and during a flood with a weighted means of 4.27 and 4.46 respectively, while after the occurrence of a flood respondents were "fully aware" as indicated by the weighted mean of 4.56.

- Volcanic Eruption- Respondents were "much aware" of their roles and responsibilities before and after a volcanic eruption as shown by the weighted means of 4.22 and4.43 respectively, they were "fully aware" on their roles and responsibilities during an earthquake as indicated by the weighted mean of 4.54.

Although, the school heads in Ligao City were ""much aware" of their roles and responsibilities in disaster risk reduction, there is still a need for them to enhance their awareness through an action plan prepared by the researcher herself to make them "fully aware". The action plan to be prepared will be included in the Division DRRM Medium Term Plan.

Conclusion

Based on the findings presented the following conclusions were formulated:

- The respondents were "much aware" on their roles and responsibilities in disaster risk reduction before, during and after a typhoon but "fully aware" during an earthquake, after a flood and during a volcanic eruption.

- The action plan as output of this study is a vital need as an intervention to enhance further the school heads' roles and responsibilities in disaster risk reduction before, during and after a calamity or disaster. Activities to be included in the action plan will be included in the Medium Term DRRM Plan.

Recommendation

Based on the findings and conclusions, the following are recommended:

- This study should be replicated at the barangay level involving family heads, households and barangay
- officials because they are the most vulnerable to risk in times of disasters, thus relevant, accurate and timely information on disaster risk reduction must be promoted.

- The action plan as output of this research can be distributed to all public and private elementary and
- secondary school heads as a guide to enhance their awareness on the roles and responsibilities that they
- have to perform before, during and after the occurrence of calamities or disasters.

- School heads should attend more trainings related to disaster risk reduction.

- Varied and latest materials on disaster preparedness and risk reduction, in coordination with other agencies should be made available by the school heads in their libraries or reading corners for the teachers and students.

- Disaster control Groups/ Teams should be organized in every school to actively spearhead activities related to disaster preparedness and risk reduction.

- The School Division Office through the Disaster Risk Reduction Coordinator should conduct a Division Roll out Seminar on Planning to acquaint school heads of their roles and responsibilities relative to disaster preparedness and mitigation.

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DISASTER MANAGEMENT AND ROLE OF EDUCATION

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Abstract

Prevention is better than cure, is an old saying which is very apt in the context of disaster management. Every year colossal amount of resources are used by our Government as well as Aid agencies in relief and rehabilitation measures. It is now becoming increasingly evident and mitigation and investment in disaster preparedness can save thousands of lives, vital economic assets, livelihoods and reduce the cost of overall disaster relief.

When urban cities and rural villages are invaded by flood waters, when earthquakes strike and ruin buildings and infrastructures, when landslides take away homes (and even lives), the role of governments as emergency providers become most relevant. In this, role of education is important factor to educate people about disaster, Education make sense and awareness which help to reduce casualty.

Key words *– Education role, community participation, Good Governance*

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Definition of Disaster

A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Though often caused by nature, disasters can have human origins.

A Disaster is an event that occurs in most cases suddenly and unexpectedly, causing severe disturbances to people, objects and environment, resulting in loss of life, property and health of the population. Such a situation causes disruption in normal pattern of life, generating misfortune, helplessness and suffering affecting the socio-economic structure of a region/country to such an extent that there is a need for assistance or immediate outside intervention

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VALUES AND TRAINING TO VALUE THE INTANGIBLES

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Abstract

In the current scenario, we have a global population crisis. There are increasingly more and more numbers to take care off and a crisis of government capacity to manage these increasing numbers. On one side there is a conflict of classes, caste, gender and age but on the other hand there is this unmanageable crisis of man-animal conflict. Every new institution of government which has been raised in the last 50 years to prevent injustices and misuse in any form leading to corruption and global crisis of human integrity has failed to achieve its objective.

This paper attempts to suggest that a training in integrity which in turn helps to value the wealth which does not speak for itself but is a silent contributor to human well being needs to be calculated and measured in policy implementation. Indian constitution has sufficient base in the form of Art. 51A and Art.48A to suggest that the training methods of disaster management officials is seriously lacking. This paper suggests a training in a high quality human resource rather than institutional structures which could be misused by human beings with low ethics and a lower understanding of human values.

A rich in values human resource is the key to sustainable disaster management.

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SENSITIZATION FOR DISASTER MANAGEMENT THROUGH VISUAL MEDIUM

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Abstract

Visual media is a means of communication using visual effects. The communication is meant to reach a large number of people in a short span of time. Examples of visual media include television, internet, website, youtube, films & demonstrative seminars. Visual medium is a strong medium to sensitize the common public either they are educated, literate or illiterate. To sensitize the common public for the causes of disaster Vigyan Prasar developd movie titled "Catastrophic Events in the Garhwal Himalaya on Kedarnath" misshapen in June 2013 and one episode in Planet earth serial during 2009. Both video programme telecasted on various free to air channel which helps to sensitize the public about the causes of the natural disaster. In response of the programme Vigyan Prasar receive letter from their audience around the country as the feedback of the programme.

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CHEMICAL, BIOLOGICAL, NUCLEAR RISKS

- Chemical Disaster Management: Current status and Perspectives - *Narendra Kumar Tiwari*
- Mainstreaming Nuclear Disaster Risk Reduction in India - *Dr. Rajesh Kumar*
- A Serious Game-Based Approach for CBRNe First Responder Training - *Alexander Ferworn, Christopher Chan*

CHEMICAL DISASTER MANAGEMENT
CURRENT STATUS AND PERSPECTIVES

Narendra Kumar Tiwari, *UPSDMA*

Abstract

Analysis of major chemical accidents has exhibited deficiencies like laxity towards safety measures, non-conformance to techno-legal systems and lesser public consultation. A paradigm shift has occurred in government's focus from rescue, relief, restoration-centric approach to planning, prevention/mitigation and preparedness approach. The designing of safer engineering practices, standard operating procedures, well-rehearsed on/off-site emergency plans, community awareness, resource and risk inventory built up, training, education, capacity built up, are important practices that may eventually help in development of community mindset to bravely face disasters so as to reduce their impact. This review summarizes existing concept of chemical (industrial) disaster management in India, discusses some important key issues, identifies gray areas needing recuperation and presents future trends and challenges.

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The first step in preparing a disaster management plan for any chemical process industry (CPI) is to identify and mitigate the conditions that might cause them. In practice, such a plan should start early in the design phase of the chemical facility, and continue throughout its life. The objective is to prevent emergencies by eliminating hazards wherever possible. In-spite of the advances made in knowledge and technology, failure-free design and devices have remained elusive. Even the well designed and inherently safe chemical facility must prepare to control potentially hazardous events that are caused by human or mechanical failure, or by natural forces such as floods or earthquakes. The need for effective technological disaster management programs by chemical facilities and their neighbouring communities became painfully clear in the 1980s, a decade marred by tragic events linked to the manufacture and distribution of chemical products. Unfortunately, several events during this decade, though not on a scale to match the previous one, have nevertheless cast a heavy burden and responsibility on the management. The chemical industry has vigorously responded to these problems in a wide variety of ways. The CPI took actions to improve the reliability of their operations, drew up emergency plans in consultation with the neighbourhood and the regulating authorities and practise emergency exercises regularly to alleviate public fear.

The Chemical industry is one of the oldest industries in India. The Indian chemical industries comprise small, medium and large-scale units. The chemical sector accounts for about 17.6% of the manufacturing sector output, 13 to 14% in total exports and 8-9% of total imports of the country. Chemical Industry is inherently prone to hazards. Emergencies can occur during the handling, storage and transportation. According to classification of Ministry of Environment and Forest there are 1894 Major Accident Hazard (MAH) units spread across 286 district and 26 States and UTs. India has witnessed the world's worst industrial disaster "Bhopal Gas Tragedy" in the year 1984 andcontinued witnessing a series of chemical accidents after Bhopal has demonstrated the vulnerability of the country. Four major chemical incidents that took place during the last 25 years include an explosion in IPCL Gas Cracker Complex at Nagothane in Maharashtra (1990); vapour cloud explosion at HPCL refinery at Vishakhapatnam (1997); fire in an oil well in Andhra Pradesh and IOCL Fire Tragedy of Jaipur (October 2009) . Also, there were 25 chemical accidents reported during 2002 to 2006, out of which 16 accidents resulted into loss of life. Large amounts of chemicals are also stored and processed in the Industries located in densely populated areas. Inappropriate and haphazard constructions and lack of awareness and preparedness on the part of the community further enhances the vulnerability. During 1995 sarin nerve agent attack on TOKYO subway system, roughly 3800 people were affected with 12 deaths. In 1984, the accidental release of 40 tons of methyl isocyanate from a pesticide factory in Bhopal, India injured hundreds of people and killed about 4000. Thus the respiratory inhalation of volatile chemicals can present a major danger of mass casualties.

One of the worst industrial chemical disasters occurred without warning early on the morning of December 3, 1984, at Union Carbide's pesticide plant in Bhopal, India. While most people slept, a leak, caused by a series of mechanical and human failures, released a cloud of lethal methyl isocyanateover the sleeping city. Some two thousand people died immediately and another eight thousand died later. Health officials, not informed about chemicals at the factory, were completely unprepared for the tragedy.

Congressional hearings that followed the Bhopal accident revealed that U.S. companies routinely discharged hazardous chemicals into the air, while emergency planners knew little about the potential for disaster at local industrial facilities. Less than a year later, a Union Carbide plant that produced methyl isocyanate in Institute, West Virginia, leaked a toxic cloud in the Kanawha Valley. While the West Virginia incident was not another tragedy, it was a shocking reminder that an accident such as the one that occurred at Bhopal could happen in the United States.

To help emergency responders know what they are dealing with, the Department of Transportation (DOT) has established a hazardous materials placard system. Rail cars and trucks carrying toxic or dangerous materials must display a diamond-shaped sign having on it a material identification number, which can be looked up to determine what hazardous materials are on board, and a hazard class number and symbol that tells whether the contents are flammable, explosive, corrosive, etc. Color codes also convey instant information: blue (health), red (flammability), yellow (reactivity), white (special notice). The placard system is as follows:

- Hazard class 1: Explosives
- Hazard class 2: Gases (nonflammable, flammable, toxic gas, oxygen, inhalation hazard)
- Hazard class 3: Flammable liquids
- Hazard class 4: Flammable solids (flammable solid, spontaneously combustible, dangerous when wet)
- Hazard class 5: Oxidizer and organic peroxide
- Hazard class 6: Toxic/poisonous and infectious substances labels (PG III, inhalation hazard, poison, toxic)
- Hazard class 7: Radioactive (I, II, III, and fissile)
- Hazard class 8: Corrosive
- Hazard class 9: Miscellaneous dangerous goods

One of the most common concerns over chemical accidents and hazardous materials spills is acute, or short-term, toxicity. Acutely toxic contaminants, such as cyanide and chlorine released from hazardous materials spills, pose an immediate threat to public health. For example, a chemical accident in which chlorine gas or cyanide gas is released would likely result in widespread deaths as the plume, or toxic cloud, moved through a populated area. Another class of toxicity is chronic, or long term. One of the most common types of chronic toxicity is exposure to carcinogens that may result in cancer twenty to thirty years after the time of the spill. An example of such an exposure occurred on July 10, 1976, in Meda, Italy, a small town about 12 miles north of Milan, where an explosion occurred at the ICMESA chemical plant in a 2,4,5-trichlorophenol reactor. (2,4,5-Trichlorophenol is an industrial chemical used as a building block to make pesticides and antiseptics.) A toxic cloud containing dioxins, which are very potent cancer-causing chemicals, was released into the atmosphere and spread across the nearby densely populated city of Seveso. Exposure to such carcinogens does not result in short-term health problems, but the effects may be expressed decades later. It was found that the women who developed breast cancer had a ten-fold increase of the toxic chemical in their blood.

Another very different effect of chemical spills and accidents is ecotoxicity, a toxic effect on the environment rather than on human health. The most dramatic ecotoxicity resulting from chemical spills results from petroleum spills at sea or in rivers or lakes. When such a catastrophe occurs, the toxicity often depends on the type of petroleum. The most common material spill, crude oil, contains some toxic chemicals that dissolve in the water. Most of the petroleum, however, floats on the water's surface. It causes environmental damage by coating the feathers of birds and the gills of fish, physically disrupting their movements and their ability to breathe. Oil washed ashore also disrupts marine life in fragile areas. One of the worst oil spill disasters in history occurred on March 24, 1989, when the oceangoing oil tanker Exxon Valdez ran aground on Bligh Reef in Alaska's Prince William Sound. Nearly eleven million gallons of crude oil spilled from the ship, and every trophic level of the biologically rich waters of Prince William Sound was severely impacted. Some residual oil remains to this day.

Emergency response personnel are involved in assessing the risk of hazardous material releases and working to avoid any harmful effects. Teams of workers evaluate the concentrations of the chemicals, where and how people might be exposed, and potential toxic effects on the exposed people. In many cases, emergency response teams are on twenty-four-hour call; if a spill occurs, they use source data (such as the hazmat placards on trucks and tanker cars), databases of chemical properties, and chemical movement models to rapidly predict the movement of contaminants and the toxicity of the spilled chemicals. If rapid spill cleanup is necessary, the emergency response team designs and implements cleanup measures to protect exposed populations and ecosystems from toxic responses. A wide range of cleanup systems has been developed for chemical spills. Small spills on land are cleaned up by simply excavating the contaminated soil and moving it to a secure landfill. Oil spills on water are contained using floating booms and adsorbents, or solid materials that capture the soil, so that it can be disposed of in landfills. Newer, more innovative methods for spill cleanup include bioremediation (using bacteria to metabolize the contaminants) and chemical oxidation (using oxidants, such as hydrogen peroxide and ozone to break the chemicals down). Although chemical spills represent potentially very large environmental problems from a wide range of chemicals, emergency response procedures developed by environmental scientists and engineers are providing solutions to the resulting human health and ecological effects.

Chemical accidents and spills can be devastating to humans, wildlife, and the environment. The best way to reduce the harm caused by chemical accidents is to design plants with better safety controls that operate at lower temperatures and pressures, and to use and manufacture less toxic compounds, a field that is being pursued by "green" chemists and engineers. But until toxic chemicals are routinely replaced by less harmful substitutes, the emergency response procedures developed by environmental scientists and engineers help lessen the human health and ecological effects of chemical spills and accidents.

Kanpur is a major leather-processing centre in Uttar Pradesh in North India, with an estimated 20,000 tannery workers. Leather production includes many operations with different exposures, which can be harmful for the health of the workers, and particularly be carcinogenic. Some compounds in the tanning process are considered as probably being carcinogenic to humans (some benzene-based dyes and formaldehyde. Besides these, scores of other chemicals and organic solvents such as chromate and bichromate salts, aniline, butyl acetate, ethanol, benzene, toluene, sulfuric acid and ammonium hydrogen sulphide are used in the tannery industry. An important health risk factor for the tannery workers is occupational exposure to chromium, mainly in the organic Cr (Ш) form or in the protein bound-form (leather dust). Chromium may enter the body by inhalation, ingestion and by direct cutaneous contact. Professional exposure to Cr (Ш) increases the risk of dermatitis, ulcers and perforation of the nasal septum and respiratory illnesses as well as increased lung and nasal cancers. Cr-specific health hazards like carcinoma of the larynx and lung parenchyma and Para nasal sinuses have also been reported. The purpose of the study was, therefore, to investigate the adverse health effects of exposure to basic tanning pigments (both trivalent and hexavalent chromium salts), organic solvents and other chemicals used in the leather tanning industries at Kanpur.

An important health risk factor for the tannery workers is occupational exposure to chromium, which is used as a basic tanning pigment. The workers on exposure to leather dust, which contains chromium in the protein-bound form, exhibited a higher mean concentration of urinary and blood chromium than the reference values. The personal sampling conducted at different work sites exhibited higher levels of total chromium. The high morbidity (40.1%) observed in the tanners in comparison to the reference values (19.6%) could be due to high levels of chromium in the biological samples of the exposed workers and air samples collected at the worksite. The increased morbidity in the exposed workers could be attributed to high respiratory illness

(16.7%) compared with 4.27 % in the control group. The higher biological values of chromium among the tanners could be explained by atmospheric pollution caused by the liberated leather dust at the work place. The increased pulmonary morbidity is also associated with certain characteristic symptoms such as dry cough (5.6%), throat irritation (3.6%) and lung congestion in 3.0% of the workers. Among the respiratory morbidity in the exposed group, the cases of occupational asthma (5.0%) were more prominent than other respiratory illnesses. It has been reported in the literature that it is the metabolism distribution and transport of the chromium in the blood that is a causal factor for increased respiratory morbidity.The hexavalent chromium is rapidly absorbed by the lungs into the blood and easily penetrates the cellular membranes and binds to the hemoglobin in the red blood cells thereby affecting the oxygen carrying capacity and impairing the lung function status.The high morbidity among the tannery workers may be due to elevated levels of urinary and blood chromium levels resulting from increased air levels of chromium at the work place. The study recommends that the biomonitoring of the chromium levels in the biological fluids,.

What are Chemicals?

Most people automatically associate chemicals with scientists in laboratories, but chemicals are also found in many of the products we use at work and at home. While they have a variety of beneficial uses, chemicals can also be extremely harmful if they are misused.

Here are some examples of commonly used household products that can damage your health or cause a fire or explosion if used incorrectly:

- cleaning products such as toilet cleaners, disinfectants, mildew remover and chlorine bleach
- art supplies, such as paint thinner and pottery glazes
- garage supplies, such as parts degreasers and cleaning solvents
- office materials, such as photocopier toner

Three Main Chemical States

All chemicals exist in one of three states: solid, liquid or gas.

- A solid has shape and form, whether it's a dust particle or a steel pipe.
- A liquid is a formless fluid. It takes the shape of its container, but doesn't necessarily fill it. Solvents and oils are examples of chemicals in liquid form.
- A gas is a formless substance that expands to occupy all the space of its container. Oxygen and carbon monoxide are examples of chemicals in gaseous form. Gases are usually invisible, but they may be detected in some cases by their taste or smell.

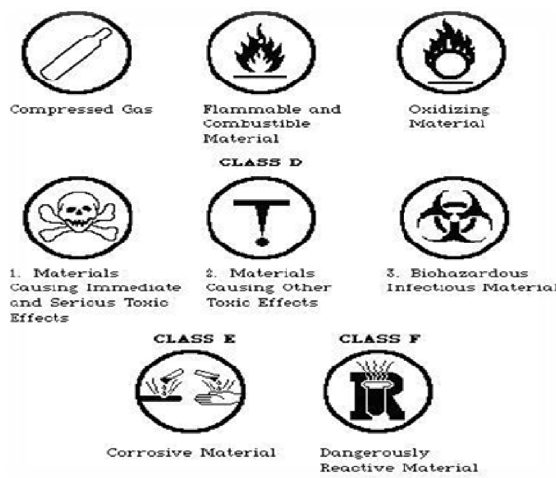
Some chemicals move from one state to another with a change in temperature or pressure. Water is a chemical which is normally a liquid but becomes a solid at temperatures below 0 degrees Celsius.

Knowing the physical states of hazardous chemicals is important factor in understanding their health effects. The physical state of a chemical determines which route it may use to enter the body. For example, a gas may easily enter the body by inhalation, while liquids are more likely to be absorbed through the skin. The fact that chemicals may change their state during work processes that involve changes in temperature and pressure makes it all the more important to take all the possible states of a chemical into account.

Common chemical hazards Specific types of chemicals have been associated with harmful health effects. Common chemical hazards include:

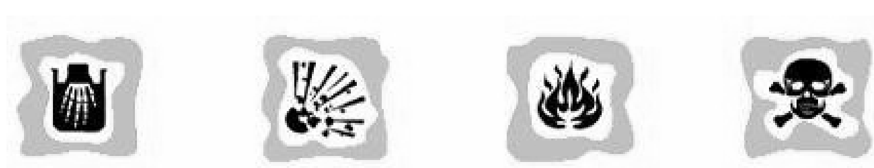
- skin irritation, disfiguring burns, eye injury or blindness caused by corrosive chemical products
- toxic by-products, such as vapours and fumes, caused by mixing incompatible chemicals
- serious burns from flammable solvents that catch on fire
- injury from exploding containers, such as spray cans
- poisoning from accidental swallowing, especially with young children

Hazardous substances in the workplace will be labelled with these WHIMIS symbols:



The Consumer Products Act and regulations outlines the requirements for chemical products that you buy for your personal use. Consumer products can be dangerous, so make sure that you read the label on the product and follow the manufacturer's directions for use, clean-up and disposal.

Hazardous consumer products will have these symbols:



General Tips for Chemical Safety

- Always read the label on the chemical bottle.
- Always follow the directions and precautions listed on the label.
- Never use a chemical if you are unsure what it is or how to protect yourself.
- Always take the time to protect yourself and those working around you.

- Always dispose of a chemical properly. Every municipality has a household hazardous waste drop-off location. For safe disposal of chemical products at work, contact your health and safety representative.

Controlling Chemical Hazards in the Workplace

- Reduce or eliminate the use of hazardous chemicals whenever possible.
- Maintain adequate ventilation systems to reduce concentrations of airborne chemicals.
- Practicing good personal hygiene (e.g. **washing hands**) and maintaining regular workplace cleaning routines can reduce the amount of a chemical substance that is absorbed by a worker's body. Learn how to **avoid carrying hazardous substances home**.
- Introduce administrative controls to minimize exposure to chemicals (e.g. rotate workers through different jobs or locations, perform maintenance work in off-hours so that accidental release of toxic substances will affect fewer workers).
- Use personal protective equipment and devices.
- Maintain equipment in good order to prevent leaks and breakdowns that may release toxic substances.

Take the first step to a safer workplace Safety. It's a subject you've heard about since you were a child. You know there's a risky way of doing things and a right way.

But how much of the safety message have you really taken to heart? How often do you think about safety when you're at work…at home…at play? If you're like most people, probably not enough. We all tend to think that accidents only happen to other people - not to us.

Be Safe, not Sorry

Unfortunately, accidents do happen. All it takes is a moment's inattention - one bad decision - and your life may be changed forever. When it comes to safety, little things make a big difference.
Ideally, safety is something that you should think about all the time, not just now and then. It's in your own best interest to make good safety habits an integral part of your daily routine. When you really put your mind to it, safety is as easy as A-B-C!

A is for Attitude

When it comes to safety, attitude isn't everything, but it comes pretty close. Attitude represents your frame of mind – the way you approach any situation.

A safe attitude means:

- thinking of yourself as part of a team – **safety is everyone's responsibility**
- staying alert and focused on the job at hand. Concentration is the key – if you're tired, bored or distracted, you're much more accident-prone.
- taking safety guidelines and practices seriously
- never fooling around or taking chances with safety
- knowing the risks. It's impossible to avoid all risks but you can be smart about your decisions. Don't take chances with your safety.
- never letting emotions, like anger or frustration, get in the way of job performance

B is for Behaviour

Your reaction to a situation is a very important part of the safety equation.
Safe behaviour means:

- following established safety guidelines and procedures
- refusing to take "short-cuts." Take those extra few minutes to do the job the safe way.
- asking questions and gathering information about the task or activity you're expected to perform
- asking for assistance to carry out any tasks that are too complex or too physically demanding to be carried out by one person
- using protective equipment, where appropriate
- helping colleagues, friends and family understand the importance of safe practices
- being prepared for emergencies

C is for Control

If you care about your safety and the safety of others, take responsibility for making your workplace, home or recreational facility a safe place to be – even when it isn't "your job."

Control means:

- keeping your surroundings clean, orderly and free from hazards
- cleaning up spills and debris or reporting them to the appropriate person
- making sure that all walking areas or pathways are free from obstacles
- keeping all machines and tools in good repair
- storing chemicals properly
- reporting faulty equipment, ventilation problems or potential hazards to the appropriate person

Safety rights and responsibilities

Your work environment has a tremendous influence on your physical, social and mental well-being. Just think – in a typical week, you may spend up to 10 or more hours a day working and commuting. You probably spend more time at work than you do at home or with your family!

A Safe Workplace – it's all about you!

Because so much of your day revolves around work, it's important that your workplace is safe. The Peel board cares about the well-being of its staff and students and is committed to building an organizational culture that supports workplace safety.

In Ontario, workplace safety is governed by the **Occupational Health and Safety Act (OHSA)**. OHSA protects workers against health and safety hazards on the job and outlines the rights and responsibilities of every person in the workplace.

Recognizing that a safe workplace requires a strong partnership between employer and worker, the act encourages organizations to adopt a concept of shared responsibility, known as the ***Internal Responsibility System (IRS)***.

What is the IRS?

The IRS gives everyone within an organization direct responsibility for health and safety – it becomes an essential part of every job. Each individual is responsible for achieving health and safety in a way that suits the kind of work that he or she does.

The goal of an effective IRS is to get people involved in identifying and controlling hazards before they can cause harm. Everyone is expected to take the initiative on health and safety issues and to work towards solving problems and making improvements on an ongoing basis. People may do this on their own or by working co-operatively with others.

While the IRS concept supports shared responsibility for a safe and healthy workplace, it also recognizes that this responsibility may be limited by each person's level of authority and ability. For example, an employer would have more responsibility for workplace health and safety than an employee – and an employee would have more responsibility than a supplier.

When the IRS is implemented successfully, it usually results in a reduction of work-related accidents and illnesses. Find out more about the **keys to a successful IRS**.

Your basic rights

The act also establishes ***four basic rights*** for everyone in the workplace:

The right to know – You have a right to information on issues that affect your health and safety. This includes the right to be trained and to have information on machinery, equipment, working conditions, processes and hazardous substances.

The right to participate – You have a right to be involved in the process of identifying and resolving workplace health and safety concerns. This right is expressed by worker representation on health and safety committees or through health and safety representatives. You also have the right to report conditions that you believe are unsafe.

The right to refuse work – You have a right to refuse work that you believe is dangerous, either to your own health and safety or to the health and safety of another worker.

The right to stop work – Under certain circumstances, certified Joint Health and Safety Committee members can stop work that is dangerous.

In addition to these basic rights, the act also specifies the rights and responsibilities of **employers**, **supervisors**, **workers**, and **contractors**.

A safe work environment:

- meets or exceeds current health and safety legislation and directives
- manages general conditions and ensures cleanliness and safety
- manages the various aspects of occupational hygiene, including lighting, indoor air quality and noise control
- ensures that employees understand the emergency systems provided in each worksite
- establishes strategies to address the potential risk of violence at the workplace

Be safe, not sorry

The responsibility for your personal safety begins and ends with you. These guidelines will help you identify common safety problems and develop good safety habits to reduce your risk of accidents.

Safety essentials

1. Look at the Big Picture

- Recognize that accidents hurt everyone. An accidental injury can have far-reaching effects, not only on you, but also on your family, co-workers and employer.
- Take responsibility for keeping your home, workplace and recreational areas as safe and risk-free as possible.

2. Follow the Golden Rule

- When you're at work, at home or out having fun, act as safely around others as you would want them to act around you.
- Recognize and report or repair safety hazards.
- Before you take unsafe "short cuts," remember that this could be the time that you cause an accident.

3. Know the Common Hazards

- Be aware of the four main causes of accidents:
    - physical overload – lifting too much, straining, twisting or making the body move in unnatural ways
    - unexpected impact – being hit by or hitting an object
    - slips and falls – falling from a height or falling during a slip
    - machine accidents – getting caught in moving machine parts

4. Put your Mind to Safety

- Accidents don't just happen. They are always caused by a combination of:
    - unsafe attitudes – coming to work angry, not taking safety rules seriously, not paying attention to the task at hand
    - unsafe behaviour – failing to follow safety procedures, fooling around, refusing to wear protective clothing
    - unsafe conditions – a work area cluttered with debris, spills, broken equipment

5. Protect your Back

- Stretch and strengthen your back. Exercise your back and stomach muscles to protect yourself from injury.
- Use safe lifting techniques to avoid strains and injuries.

6. Avoid Chemical Hazards

- Know how to protect yourself from the health hazards of the chemicals you use.
- Read the warning labels on any chemical before you use it.
- Remember that an unlabelled chemical is a dangerous one.
- Never sniff or smell an unlabelled chemical.

- The board provides Material Safety Data Sheets (MSDS) for all hazardous chemicals used in the workplace. MSDSs describe the contents, hazards and applications of these chemical products. They also provide guidelines for using the chemicals safely and for treating dangerous exposures. Before handling hazardous chemicals, learn how to read and understand MSDS and find out where you can access them in your workplace.

7. Use Protective Clothing and Equipment

- Protective clothing and equipment can keep you safe from many hazards – but they only work if you wear them and use them correctly.
- Know the right type of protective clothing for the task.
- Inspect all personal protection clothing and equipment regularly and replace damaged or worn pieces when necessary.

8. Respect Machinery

- Modern machinery can be very dangerous if you don't operate or repair it properly.
- Always leave machine guards in place and follow instructions for operating machinery.
- Avoid wearing loose sleeves, gloves, rings or other jewelry that could get caught in a machine.

9. Prevent Slips, Trips and Falls

- Everywhere you look, there are hazards that could cause you to slip and fall. Be aware of your surroundings and avoid situations that put you at risk.

10. Be Prepared for Emergencies

- Knowing how to react in an emergency can often mean the difference between life and death. Develop emergency plans for common situations in your home or work life and make sure that you know:
    - the location of fire extinguishers, first aid kits and exits
    - what type of fire extinguisher to use on a fire
    - medical first-aid procedures, such as cardiopulmonary resuscitation (CPR)
    - what to do if you inhale a hazardous chemical or get a dangerous substance on your skin or eyes

What is ergonomics?

Ergonomics comes from two Greek words ERGOS (work) and NOMOS (natural law). Loosely translated, it means the rules of work. Essentially, ergonomics is the science of designing the job to fit the worker, rather than physically forcing the worker's body to fit the job. Many people think that ergonomics is only associated with computers. However, ergonomic principles can be applied to any task that puts your body to work, from doing your household chores to the daily routines of your job.

Ergonomics is used to eliminate or reduce the wear and tear on the body that may cause a task to become difficult or painful. Ergonomically designed work processes, tools, equipment and workstations are adapted to the capabilities and limitations of the human body. When ergonomic principles are applied in a workplace, they improve efficiency and productivity, increase job satisfaction and reduce the risk of fatigue, short-term pain and chronic illnesses, such aswork-related musculoskeletal disorders.

Ergonomic Job Design

Work that is ergonomically designed includes these important elements:

- **Task Variety** – alternating tasks within a job minimizes repetitive activities and reduces wear and tear on the body
- **Appropriate Work Pace** – when the pace of work is too fast, the body has very little recovery time between repetitive or forceful movements
- **Work Breaks** – resting, stretching or changing position between tasks helps prevent muscle fatigue and injury
- **Rest Breaks** – stopping work for a period time during the day provides an important physical and mental break
- **Training and Education** – acquiring the appropriate skills to do a job safely and efficiently prevents accidents and injury

Ergonomic Basics

Many ergonomic solutions are low-tech and common sense – simple changes can make a big difference. Here are some tips to help you improve the ergonomics of your work area:

- keep tools, materials, equipment in easy reach
- work at proper heights in relation to your body – use adjustable workstations (chairs, tables, platforms)
- work in a good, comfortable posture
- reduce excessive repetition in tasks and activities
- avoid excessively forceful movements – e.g. striking computer keys with too much force, twisting or jerking to lift heavy loads
- minimize general fatigue by taking appropriate work and rest breaks
- avoid direct pressure on legs, feet and hands
- maintain a comfortable environment (heat, light, humidity)

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MAINSTREAMING NUCLEAR DISASTER RISK REDUCTION IN INDIA

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Abstract

India has 22 nuclear power reactors operational and several new are coming up in different parts of the country. The issue of setting up and operating of new nuclear power and reprocessing plants stands intertwined between development, environmental concerns, and areas under mega projects being struck with natural calamities' like floods, earthquakes, tsunamis, manmade accidents or breach of security all leading to nuclear disaster. Dependence on nuclear power, storage and disposal of nuclear waste, areas surrounding reprocessing plants, transportations of nuclear warheads and their safety is a highly risky proposition in the country. Before, during, and after major nuclear disaster, a coordinated emergency response to restoration and mitigation of further complications in nuclear power sector is an enormous problem due to: the large number of factors involved in the response, emerging issues with the interoperability of generation, distribution and other modules of the nuclear power sector. In aftermath of Fukushima accident, a lot of concern is being expressed in the country regarding the capabilities and responsibilities of Central and State Governments in India that it cannot match the state preparedness and disaster planning in Japan and other developed countries of the world. Apprehensions are being cast about the NDMA Guidelines for dealing with nuclear disasters which remain by and large on papers only.

The objective of the paper is to analyze India's preparedness, in the light of her national and international responsibilities and capabilities in case of nuclear disaster in the country. It is to know about the awareness level and training among people in general and youth in particular, about the nuclear disaster risks and necessary preparedness living in Amritsar, a city situated very close to international boundary. The paper is divided in three sections. First section, deals with the backgrounds in which India has resorted to the path of generating nuclear energy and greater risks involved with nuclear disaster at places of civilian or military nuclear programmes. Second Section, deals with post-disaster scenario in the light of; necessary legislations, international obligations, preparations, creation of structures, fixing of responsibilities for managing nuclear disasters in the country. The last section, deals with the outcomes of survey conducted on the campuses and necessary policy interventions needed for mainstreaming of nuclear disaster risk reduction in India.

The methodology used for completing paper is content analysis of existing literature and a large sample survey being conducted on the University campus and nearby colleges using a structured questionnaire which includes questions related to factors leading nuclear disaster and needed response and preparedness of the state and the society. Reports of various international agencies/think tanks, state as well as non-state agencies, like IAEA, NDMA, UN, CRS of USA and companies who sell reactors all over the world would be used. It also uses press coverage reviews and web sources. The paper is based on assumptions like; greater the dependence of India on nuclear energy for civilian or military purposes, greater would be the risk of nuclear disaster. Given vast population residing close to nuclear power plants and poor records of handling non nuclear disasters by the administration in past, managing of nuclear disaster in the country would be very difficult.

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A SERIOUS GAME-BASED APPROACH FOR CBRNE FIRST RESPONDER TRAINING

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Abstract

Specialized response teams of first responders deal with CBRNe-related incidents that can run the gamut from conventional improvised explosive devices (IEDs) to new threats like enhanced blast weapons such as "dirty bombs". In the event of a CBRNe incident, one of the guiding principles when dealing with an unknown threat is to avoid contact with the threat until such time as the nature of it can be determined. Our research demonstrates that we can safely create, inspect and manipulate a 3D model of a suspected CBRNe threat within a physics-based game engine usingsoftware models created from extremely accurate data gathered from multiple and diverse sensors. Our system allows for the creation of accurate models and simulations providing custom functionality, such as virtual inspection of explosive containers and provides first responders with the ability to predict physical behaviors in simulation. We introduce the notion of game scoring as a means of measuring first responder success in the device neutralization task. The primary goal of our research is to demonstrate that the functionality we developed can be used to provide accurate information to its users and potentially assist CBR Netraining and planning efforts.

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Child Centred Disaster Risk Reduction
&
Comprehensive School Safety

- **Child Centred Disaster Risk Reduction** – How is South Asia moving forward in this direction? *– Ashish Singh, Researcher, SDMC & Ray Kancharla, National Manager, Humanitarian & DRR/CCA, Save the Children*

- **Comprehensive School Safety (CSS) -** *Ray Kancharla*, *National Manager – Humanitarian Response -Disaster Risk Reduction / Climate Change Adaptation, Save the Children*

- **Children in Climate Change adaptation programming in cities** – *a need and an imperative - Sudeshna Chatterjee*, *Action for Children's Environments*

- **Children and Youth Participation in Disaster Risk Reduction -** Rama Rao Dammala *Technical Specialist – Disaster Risk Management, ChildFund India*

- **Children and Youth Participation Panel:**

  Chair: **Shri Kamal Kishore**, Member – NDMA

  Facilitator: **Ray Kancharla**, National Manager, Child Centred DRR/CCA, Save the Children

  Children and Youth Panel Members:
  - **Sarita Mohanty**, 14 years (Kendrapada, Odisha, India)
  - **Ashwini**, 14 years (Rajahmundry, Andhra Pradesh, India)
  - **Sonam**, 12 years (Darbhanga, Bihar, India)
  - **Suchashmita**, 22 years (Malkangiri, Odisha, India)

CHILD CENTRED DISASTER RISK REDUCTION

How is South Asia moving forward in this direction?

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Researcher, SAARC Disaster Management Centre, New Delhi, India

Ray Kancharla
National Humanitarian-DRR/CCA Manager, Save the Children

Introduction

The eight countries of South Asia, namely, Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka have been in the forefront in terms of children agenda. In 2011, when "**SAARC Framework for Care, Protection and Participation of Children in Disasters"**[1] was promulgated in UNISDR Global Platform, this was somehow the one and only regional framework developed with 10 priorities for action along with a clear road-map.

In September 2015, South Asia Policy for Child Centred Disaster Risk Reduction has been affirmed by the High Level Policy Dialogue of SAARC member states.

Regional Situation of Children in Disasters[2] (*ref.: SAARC Framework for Child Centred DRR, 2011 and 2016 – SDMC, Unicef, Save the Children*)

A vast majority of the 689 million children in South Asia are at risk of disasters from natural hazards and stresses. In 2015 alone, 1.1 million children were severely affected by the April 25 earthquake in Nepal; 840,000 children were affected by the Cyclone Komen in Bangladesh; approximately 560,000 children were displaced due to avalanches, floods and conflict in Afghanistan; 4.25 million children were affected by floods in Jammu and Kashmir, India; and more than 1 million children are suffering from acute malnutrition

since the drought in the Sindh Province of Pakistan. Children are disproportionately affected by the breakdown of critical systems and services like health, nutrition, education and protection, and this impact is worsened in the region with persisting vulnerabilities like poverty, malnutrition, inequality, and exclusion.

Disasters further exacerbate the poverty in the region, where 24.6% iv population live below poverty line, translating to poor purchasing power and very limited access to basic social services. Under these circumstances, an estimated 38% of children under five are stunted due to chronic nutrition deprivation in the region, over 12% of children in South Asia aged 5-14 are engaged in child labour and one-third of students enrolled in the first grade are predicted to leave school before reaching the last grade. All of these factors contribute to the vulnerability of children to the impact of disasters.

Children – girls and boys – are directly affected by disasters through death, injuries and displacement. The loss of lives for children has been higher than that of adults in the majority of disasters in the region. Disasters also separate children from their families and increase vulnerability to trafficking, exploitation and abuse. Damage to critical infrastructure such as schools, day care centres, hospitals, play areas - which are vital to children's survival and fulfilment of their other rights

[1] SAARC Framework for Care, Protection and Participation of Children in Disasters, May 2011
[2] South Asia Framework for Child Centred DRR, September 2015

– has a long-lasting impact on their growth and development. Children's inability to continue schooling due to damage to school infrastructure not only impinges on children's rightful entitlement to education, but also has a direct impact on a generation's ability to earn adequate income in their adult years. Disruptions to children's education are also common in conditions h shelters are not adequately prepared for disasters and schools are used by families and communities as an alternative safe place to their homes. In Bangladesh, an estimated 1.5 million children missed out on education due to cyclones Sidr in 2007 and Aila in 2009, with damage to school infrastructure reckoned to reach US$140 million. The Nepal earthquake caused damage to 32,000 classrooms, which resulted in more than 1 million children being unable to attend regular classes for the rest of 2015. Despite increased recognition of the disproportionate impact of disasters on children, most disaster risk reduction policies and programmes still tend to overlook the needs and capacities of children. For example, in building safer schools, doors or windows to exit from should be made in a way that children could help themselves to open it or climb out of it. In the context of floods, while boats or alternative transportation are made available by the government and search and rescue teams are trained, children would benefit from swimming lessons for their own survival. Disaster response should also be shaped by consulting children on what would be the most on appropriate life-saving interventions for them.

SAARC Member States are signatories to the UN Convention on the Rights of the Child (CRC), 1989. Disasters disrupt the fulfilment of the rights enshrined in the CRC, including the right to survival and development as stated in Article 6. Article 27 states that 'Children have the right to a standard of living that is good enough to meet their physical and mental needs', a condition that cannot be achieved where there is high exposure to disaster risk. Article 12 and 13 of the CRC protect the rights of children to participate in decision making processes that affect their lives as well as to get and share information.

All SAARC Member States have recently adopted the Sendai Framework for Disaster Risk Reduction (SFDRR) at the Third World Conference on Disaster Risk Reduction, March 2015. SFDRR has envisaged as its key outcome "the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries" The expected goal is to "prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience".

Laying down a comprehensive and action oriented framework for 15 years, SFDRR

- Recognizes the disproportionate impact of disasters on children,
- Embodies the substantial reduction of disruption to education as one of its seven targets, and
- Reiterates the urgent need for pre-disaster risk assessments by adopting 'understanding disaster risk' as the first of its four priorities for action.

The proposed Sustainable Development Goals that will replace the Millennium Development Goals in late 2015 to guide development action also recognise the need for building resilience to disasters as integral to achieving several of the proposed goals, including ending 'poverty in all forms everywhere.'

Child-Centered Disaster Risk Reduction - Vision and Targets

Vision: Disaster risks to children in South Asia are reduced substantially by 2020 and children's survival, safety, protection, development and participation are ensured though risk informed decision making.

Target 1: By 2020, all SAAR C Member States use Child-Centred Risk Assessments (CCRA) as the basis for designing and implementing all sectoral and cross-sectoral programmes.

Target 2: By 2020, all SAAR C Member States develop, adopt and activate Comprehensive School Safety (CSS) through policy revisions, implementation arrangements and capacity enhancement.

Target 3: By 2020, all SAAR C Member States establish, adopt and implement policies, guidelines and mechanisms to ensure the participation of children in decision making processes for identifying and addressing disaster risks.

Target 4: By 2020, all SAAR C Member States strengthen and operationalise their child protection systems and mechanisms with mandates, resources and capacities to ensure the protection of children at risk of disasters in the region.

Existing National Provisions for Child Centred Disaster Risk Reduction in South Asia Region:

Afghanistan:

- National Strategy for Children at risk, 2004

Bhutan:

- Comprehensive Disaster Management Project for the Education Sector.
- The constitution of Bhutan's Children Parliament, 2015
- National Action Plan for School Earthquake Safety

India:

- National School Safety Programme (NSSP)

Maldives:

- The Children's Fund under the Department of Gender and Family Protection Services provides emergency child protection services as well as medical treatment for life-threatening and debilitating conditions

Nepal:

- Child Friendly Local Governance Framework
- Schools as Zones of Peace (SZOP) Directive, 2011
- National Strategic Plan on Child Protection in Emergencies

Pakistan:

- National Policy Guidelines on Vulnerable Groups in Disasters, 2014.
- National Assembly Resolution on Safe Schools, 2008
- SoPs on Separated, Unaccompanied and Mission Children in Disasters

Sri Lanka:

- National Guidelines for Disaster-Safe Schools, 2005
- Tsunami (Special Provisions) Act No. 15, 2005

India & Sri Lanka:

- Disaster Risk Reduction in School Curriculum

COMPREHENSIVE SCHOOL SAFETY (CSS)

Ray Kancharla

National Manager – Humanitarian Response -Disaster Risk Reduction / Climate Change Adaptation, Save the Children

Abstract

Every Child spends about 7 – 8 hours (best hours of day) in school. This is at least upto minimum 12 years of schooling, on a day to day basis. 36% of South Asia's population are children under 18 years of age. In all disasters, it has been established time and again that about 70% of all impacted are children. However, they are hardly reflected or made visible in policy, planning and implementation.

Further, there is a need to influence a change in the mindset of the policy makers, planners as well as implementers at the level of government, NGOs and civil society at large including the institutional environment such as schools, colleges and academia at large.

South Asia has given a visible leadership in incorporating children and mainstreaming them with specific framework with defined pillars of action.

- SAARC framework for Care, Protection and Participation of Children in Disasters – promulgated in UNISDR Global Platform, Geneva – May 2011
- South Asia Policy Framework for Child Centred Disaster Risk Reduction – affirmed by SAARC member states in September 2015

In addition, there is Asia Pacific Coalition for School Safety (APCSS) as well as Worldwide Initiate for School Safety (WISS).

Sendai Framework for Disaster Risk Reduction (2015-30) has affirmed the role of Children and Youth as agents of change and the need to provide adequate space in legislature and also incorporate risk and resilience education in national curricula.

In 2015, in the context of UN World Congress of DRR in Sendai, Comprehensive School Safety framework was also formally launched. This is a great boon and blessing for promoting the BEST INTEREST OF CHILDREN and YOUTH in our world.

Context:

Locally, Nationally and Globally, schools have often been a 'first victim' in almost every major natural and/or human-induced crises. There are strong evidences of schools being closed for 6months or even more; and sometimes they have been taken over for other purposes.

A few facts to evidence this reality in our world, where children's education gets compromised:

- Kumbakonam (Tamilnadu, India) Fire tragedy in which 90 children died, 16th July 2004
- Over 400 Children died in the Town of Anjar in Gujarat'2001 due to earthquake
- 19,000 children died in schools during the Kashmir Earthquake in 2005 in Pakistan.
- In Sichuan earthquake'2008, China, over 7,000 schoolrooms collapsed leading to the death of nearly 5,000 students
- Nepal Earthquake 2015: 30,000 classrooms lost in Gorkha Earthquake while all 200 schools retrofitted by ADB in Nepal survived.
- 400 people (majority children) died in a fire, on 23rd Dec. 1995 at Mandi Dabwali, during

annual function of a school in Sirsa district, Haryana

- In 2014 flooding in Jammu Kashmir, schools have been closed for nearly six months in some areas and the assessment by the government declared majority of them unfit for use.
- In 2013, 24 children died of food poisoning after the mid-day meal in a Bihar school
- In 2014, a 6-year old child was raped by two gym instructors.
- September 2009, 5 school girl died in Stempede in Government School in Delhi
- 28.5 million children, half of all children out of school globally, live in countries affected by conflict (source: *EFA Global Monitoring Report* 2013/14).
- The proportion of out-of-school children living in conflict-affected countries increased from 30% in 1999 to 36% in 2012, and increased substantially in the Arab States and in South and West Asia (source: *EFA Global Monitoring Report 2015*).
- During armed conflict, schools provide an important link to life-saving services, such as mine-awareness, HIV prevention, feeding programs and psychosocial services. They can also act as a safe space to protect from dangers such as forced or under-age recruitment or use by armed actors; trafficking, sexual violence and exploitation.
- In conflict environments, education spaces can be an important avenue for psycho-social recovery and restoring social cohesion.[3]

All these facts and scenario argues for a strong policy, planning and implementation of Comprehensive School Safety at the local level.

Comprehensive School Safety (CSS)

CSS is a global framework in support of The Global Alliance for Disaster Risk Reduction and Resilience in the Education Sector and The Worldwide Initiative for Safe Schools, March, 2016

Purpose

This framework provides a comprehensive approach to reducing risks from all hazards to the education sector. The past decade has brought children's advocates together:

- To improve all children's equitable and safe access to a quality, inclusive and integrated basic education
- To monitor and evaluate progress of initiatives for reducing disaster and conflict risks
- To increase availability of and access to hazard-related evidence, such as multi-hazard early warning systems' data and disaster risk information
- To promote risk reduction and resilience in the education sector, including clear focus in major international agreements (eg. Sustainable Development Goals and Sendai Framework for Action 2015-2030)
- To strengthen coordination and networks for resilience from all levels- local to international
- To strengthen education governance and local participation
- To strengthen capacity development in disaster and conflict risk reduction in order to implement integrated, inclusive measures to prevent and reduce hazard exposure and

[3] The Safe Schools Declaration and the *Guidelines for Protecting Schools and Universities from Military Use during Armed Conflict (July 2016)* – GCPEA (Global Coalition to Protection Education from Attack) has public communication material on the Guidelines and the Safe Schools Declaration readily available for dissemination – see the « Resources » section p. 10.

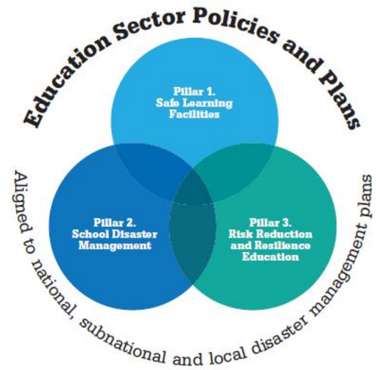
vulnerability to disaster, increase preparedness for response and recovery, and strengthen resilience

At the core of these child-centered, child-participatory, and evidence-based efforts is the recognition of children's rights to survival and protection as well as to educational continuity and participation. All children should be facilitated to participate in all aspects of comprehensive school safety, to be better protected, and so that their energy, knowledge and ideas shape long-term sustainability.

School Safety, DRR and Education:

Children, teachers, school management committees in Odisha, West Bengal, Andaman Nicobar Islands, Bihar and Assam have been convinced in undertaking pioneering initiatives in this area. Save the Children in India had been facilitating school safety planning with the overarching approach of 'five pillar action' outlined earlier in this. The evidence of such a dynamic process and outcomes were demonstrated to National Disaster Management Authority when a flagship project titled National School Safety Project was initiated.

- September 1 – 2, 2011 – *National Disaster Management Authority launched its flagship programme titled National School Safety Project* (NSSP). Children from Odisha, Bihar and West Bengal projects of Save the Children participated and shared their knowledge and practice of School Safety. This has been highly appreciated by central and state disaster management authorities. As a result of the children's genius of experience sharing which outlined the processes of risk mapping, preparedness planning as well as active participation in task forces, enabled a most profound statement placed before all – "***ANY SCHOOL SAFETY INITIATIVE MUST BEGIN WITH CHILDREN FIRST AND MUST BE SUSTAINED BY CHILDREN AND SCHOOL COMMUNITIES***"
- Further, Safe School Constructions in Leh and Kargil after cloud burst of August 2010 were also models of how a safe school with disaster resilient features needs to be undertaken. The technology was very much the people's own – Passive Solar Technology with new dimensions of Disaster Resilience and Child Friendly Features. School Safety Planning is an integral part of it all.
- Mock Drills have been a regular phenomenon
- On October 29th, National DRR day Rallies by School Children have been a regular phenomenon.



Comprehensive School Safety (CSS) [4]

The Goal of CSS is to:

- Protect learners and education workers from death, Injury and harm in schools
- To plan for educational continuity in the face of all expected hazards and threats – including every day risks

[4] Comprehensive School Safety - A global framework in support of The Global Alliance for Disaster Risk Reduction and Resilience in the Education **Sector** and **The Worldwide Initiative for Safe Schools,** in preparation for the 3rd U.N. World Conference on Disaster Risk Reduction, 2015

- To safeguard education sector investments
- To strengthen risk reduction and resilience through education

There are three key pillars to CSS:

Pillar 1: Safe Learning Facilities:

- Building maintenance
- Non-structural mitigation
- Fire safety

Pillar 2: School Disaster Management

- Multi-hazard risk assessment
- Education sector analysis
- Child-centred assessment & planning

Pillar 3: Risk Reduction and Resilience Education

- Structural safety education
- Construction as educational opportunity
- Household disaster plan
- Family reunification plan

Recommendation: The following recommendations need to be considered seriously in order to make our world safer for children and their schools resilient

- Every Child under 18 must be Safe, Prepared, Adaptive and Resilient
- '**0**' death of children, teachers, parents and '**0**' days lost in school
- Every child must have an opportunity to study and understand risk, safety, disasters, climate change as part of the school curriculum.
- By 2020, every school has met three benchmarks – a. Safe Learning Facilities; b. School Disaster Management Planning; c. Incorporation of Risk and Resilience in school curriculum.

Sendai Framework for Disaster Risk Reduction (2015-30) has made an emphatic statement saying – "**children and youth are agents of change and should be given the space and modalities to contribute to disaster risk reduction, in accordance with legislation, national practice and educational curricula'**[5]

Numerous governments have already committed to the Worldwide Initiative of School Safety (WISS). More governments need to commit to the Comprehensive School Safety agenda and dedicate resources in ensuring that Children are protected and Schools are Resilient.

[5] Sendai Framework for Disaster Risk Reduction (2015 – 2030), UNISDR – Role of Stakeholders – page 23

Case Study:

How does Child Centred Resilience work in humanitarian crisis operations?

Invariably, when Save the Children (SC) begins to work, SC always begins by taking a close look through a study titled: 'Children Risk and Rights Situation Analysis', Currently, this has been completed in West Bengal, Bihar Odisha, Assam and Uttar Pradesh.

Child Friendly Spaces / Temporary Learning Centres were created by Save the Children to provide a space where children can learn, laugh and be protected while their parents attempt to restart their lives in the aftermath of the disaster

- Children related assessments have always exposed and reiterated the fact in the post-disaster situations, Children's vulnerabilities are heightened. As their protective layer is shattered, often with government's departments becoming disabled, children's exposure to neglect, abuse, trafficking, etc. heighten.
- With schools damaged or destroyed, schools are not functional for long periods of time; hence, children become school drop-outs. Often, parents resort to sending children into labour, as supplementary earners.
- CFS/TLC are niche approaches to ensure children are protected and their education is restored immediately.

CHILDREN CHARTER

The Children's Charter on Disaster Risk Reduction[6]

The Children's Charter for DRR (the 'Charter'), which identifies children's priorities for risk reduction, was launched at the Global Platform in 2011 by partners of the Children in a Changing Climate Coalition (Plan International, Save the Children, UNICEF and World Vision). The Charter was developed through consultations with over 600 girls and boys in 21 high-risk countries in Africa, Asia and Latin America and identifies five key priorities for DRR which is inclusive of children:

- **Schools must be safe and education must not be interrupted;**
- **Child protection must be a priority before, during and after a disaster;**
- **Children have the right to participate and to access the information they need;**
- **Community infrastructure must be safe, and relief and reconstruction must help reduce future risk;**
- **DRR must reach the most vulnerable.**

Following its launch, the Charter attracted high profile support. Currently over 200 representatives from government to staff from NGOs and the UN have pledged their support to the realization of the Charter's priorities.

The Charter provides a clear mandate from children on priorities for DRR. In 2012/2013, follow up research consulted more than 1200 children in 17 countries, across Africa, Asia and Latin America. These consultations focused on how the Charter priorities can be achieved - exploring enabling factors and challenges in implementation.

This constitutes important evidence that can better inform post-2015 decision making.

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[6] The Resilient Future We Want – Children and Disaster Risk Reduction – post 2015 – CCC, 2013

CHILDREN IN CLIMATE CHANGE ADAPTATION PROGRAMMING IN CITIES

– a need and an imperative

Sudeshna Chatterjee

Action for Children's Environments

Abstract

Climate change presents particularly strong challenges to children in the Global South, who are already at a disadvantage due to poverty, migration, rapid urbanization, inequitable and poor access to infrastructure, education, health and other protective services. More than 700 million children below the age of 15 (often comprising as much as 40% of the population or more) live in the 20 countries deemed at "extreme risk" from climate change (mainly in the belt around and immediately north of the equator). These represent some of the fastest urbanizing countries in the world. Included in this group are many Asian countries with some of the largest and most populated cities in the world, located on the floodplains of major rivers and cyclone prone coastal areas which make them susceptible to significant impacts of climate change both now and into the future. A large proportion of the population in Asian countries and indeed in Asian cities are infants, children and adolescents who arguably represent one of the most vulnerable categories subjected to a spectrum of risks from climate change in cities. Yet few urban adaptation and resilience building programs in Asia focus on children.

The advantages that cities notionally offer, such as improved access to clean water, sanitation, education, health services and livelihood opportunities, rarely trickle down to the urban poor, or worse, tend to bypass them all together. Impoverished urban children simply cannot thrive without resilient urban infrastructure, social protection mechanisms, inclusive urban planning and good governance that will lift them out of extreme poverty or declining conditions. Despite growing evidence that children in poverty can be catalysts for reducing risks to their lives and livelihoods in the disaster context, in the absence of resources, an enabling environment and support for their capacity building, they may be exposed to increased personal risks.

As urbanisation continues more people including children will be exposed to direct and indirect hazards of climate change. No doubt children's still evolving development makes them physiologically and metabolically less able than adults to cope with high exposure to hazards. The impacts will continue to devastate lives and homes – and have the potential to undo many development gains of the last few decades. Understanding climate change risks and impacts on urban children's lives begins to equip communities, governments and stakeholders to prevent long-term development losses and enables urban programs to systematically build children's resilience to the specific challenges that climate change will bring to their lives.

Climate change risks and resilience in urban children in Asia

This paper investigates the risks climate change poses to the development of urban children in Asian cities as many such children are already at a disadvantage. The implications of climate change for urban areas is a growing field of study, however the risks that climate change impacts pose to urban children's lives, survival and development are relatively under researched. The paper will report on a multi-city study in secondary cities in three Asian countries: Bangladesh, the Philippines, and Vietnam, commissioned by Save the Children in partnership with the International Institute for Environment and Development (IIED) and supported by the Rockefeller Foundation's Asian Cities Climate Change Resilience Network (ACCCRN). It will share the findings of this research which found some categories of urban *children to be more vulnerable to the impacts of climate change– most particularly: migrant children, children living in informal housing, children living and working in the streets, disabled children, and children undertaking labour. The paper considers the opportunities and gaps in current urban and climate change planning regarding the needs of children and puts forward recommendations for more child-centred adaptation that addresses all aspects of risk reduction planning, including: protection from longer-term risks, preparedness for extreme sudden and slow-onset climatic events, response to immediate losses and threats, and effective rebuilding to reduce future risks in urban children's lives.*

Recommendations for Child-Centred Climate Change Adaptation

- Reduce disaster (climatic and non-climatic) risks in children's lives and invest in increasing protective factors.
- Consider the co-benefits (direct and indirect) of all long-term risk reduction programming
- Strengthening critical infrastructure and building climate smart adequate housing for the poor to reduce the fragility in the living environments of children in the face of climate impacts and to reduce the risk of cascading failures.
- Building the capacities of social agents to anticipate and develop adaptive responses
- Building the capacity of institutions and different sectors to effectively plan climate smart and disaster resilient urban and rural areas by adopting a child-centred approach.

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CHILDREN AND YOUTH PARTICIPATION IN DISASTER RISK REDUCTION

Rama Rao Dammala
Technical Specialist – Disaster Risk Management, ChildFund India

Context:

Providing opportunities for children and adolescents to take part in management and decision-making on matters affecting their own interests and those of their communities. The following Global Frameworks have emphasized the need for children's participation and leadership at all levels, primarily, not as a tokenistic favour, but as their right. (Ref: UNCRC, SAARC Framework, The National Policy for Children 2007, Sendai Framework)

Risk Assessment and Management at *Community Level*

Child Rights Governance and Leadership

Local Governance Planning and Policy

Risk Assessment and Management at *Institutional level*

Challenges

- Quality of participation facilitated and owned by the respective duty bearers and care givers
- Attitude towards children participation,
- Youth and Children are seen as passive receivers of adult directives / dictates
- Opinions, views and articulations by children and youth are seen as immature and/or at times irrelevant.
- Children participation in humanitarian crises response operations at the level of assessments and peer-to-peer support have not been understood and practised.

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CHILDREN PARTICIPATION – PANEL:

Chair; **Kamal Kishore**
Member – NDMA

Facilitator: **Ray Kancharla**
National Manager, Child Centred DRR/CCA, Save the Children

Sarita Mohanty, 14 years, 9th standard, Kendrapada, Odisha, India

"*I want to thank the organizers of the World Congress on Disaster Management for making space for Children and Youth to be here. It is really great that you are recognizing Children's Right to Participation on the 27th anniversary of United National Convention on the Rights of the Child. In our village and block, Children have been organized as Children Group and we have participated in risk assessments and also facilitated adoption of Child Centred DRR plan in our Gram Sabha and at Panchayat level. We are also included in task forces and have received training. We are actively contributing to our local governance at all levels*".

Ashwini, 14 years, 9th standard, Rajahmundry, East Godavari, Andhra Pradesh, India

"*I have received training on school risk assessments through Action, an NGO who initiated Child Centred DRR and School Safety in our village. We are also trained as Task Forces. Today, we are confident about facing cyclone risks in our area*"

Sonam, 12 years, 8th standard, Darbhanga, Bihar, India

" *I am a member of School Disaster Management Plan related task force. Bihar is a very disaster prone area like many other places. Floods, Drought, Fire and so many other risks affect us. Our schools are affected badly. Through School Safety programme we have understood Do's and Don't's in every disaster. Unicef and Bihar Seva Samaj have trained us. Through all this, we are now prepared. Also, in Darbhanga there are so many schools, but all are not included in this. So, our school invited all other schools in our block and sensitized them to understand the need for School Safety. They are now convinced. Let us not be afraid of disasters. We can be prepared and be safe*"

Suchishmita, 22 years, Member of Youth Club, Malkangiri, Odisha

"*Before cyclone Hudhud came and destroyed a lot of our houses and properties, generally people were not sensitive about disasters and risks. Our youth club took immediate efforts in providing relief and also first aid. Now, the community accepts that preparedness is critical and we should have task forces for Search and Rescue, Early Warning, First Aid, etc. Child Fund has helped us in enabling our youth group to do this*"

Chair's Summary: - Kamal Kishore, *Member - NDMA*

Sendai Framework has highlighted very clearly about delivering resilience at the local level and especially at the community level. In the vulnerability, risk and disasters mapping, it has been clearly established how Children and Women are highly vulnerable to every day risks and disaster shocks. They are more impacted than others.

On the other hand, today we are encountering a shift in the way the vulnerability is being transformed into resilience. In this regard, Children are not just subjects of Disaster Risk Reduction. Indeed, they are the drivers of DRR in the communities.

It is now emerging clearly that even those who have been promoters and advocates of Disaster Risk Reduction are being requested and encouraged to take an additional step, namely, to enable and include Children and Youth in the Disaster Risk Reduction / Resilience Action at the local, state and national levels; and gradually lead them to the centre stage.

Urban risks are also abounding greatly due to unplanned urbanisation and inadequate planning and resources allocation to improve the condition of slum population. This has to be prioritized in strengthening the protective environment for children in terms of their health, nutrition, education and other life survival and developmental needs.

Children have testified to us in so many ways such as:

- “If I can do it; we can all do it”
- “Youth created demand for their leadership in DRR at the local level; we all can do the same”

Therefore, let Children and Youth do it themselves. When they are empowered to do it, the FUTURE is BRIGHT!!!

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CLIMATE CHANGE ADAPTATION

- Impact of Climate Change on Frequency and Intensity of Natural Disasters in South Asia: Mitigation Measures and Adaptation Strategies Needed - *Prof. M. Bhaskar Rao, M.Tech, Ph.D, FIE*

IMPACT OF CLIMATE CHANGE ON FREQUENCY AND INTENSITY OF NATURAL DISASTERS IN SOUTH ASIA: MITIGATION MEASURES AND ADAPTATION STRATEGIES NEEDED

Prof. M. Bhaskar Rao, M. Tech, Ph. D, FIE

Superintending Engineer & Member-Secretary, DWSC, Rural Water Supply and Sanitation Engineering Department, Government of Andhra Pradesh.

Abstract

In the South Asia region, the frequency, intensity and magnitude of natural disasters has increased significantly in the recent past. This can be clearly attributed to Climate Change. Though the SAARC region is contributing very little towards Climate Change through emission of Green House Gases, pollution and environmental degradation, it is suffering the most due to the adverse impacts of Climate Change.

Because of climate change, water resources, agriculture, biodiversity and other ecosystems would be affected adversely due to anticipated changes in precipitation, temperature and monsoon patterns in the SAARC region. Climate Change may severely affect the ecological balance and lead to soil erosion and environment degradation, resulting in more increased frequency and magnitude of natural disasters like floods, cyclones, tsunamis, drought etc. Agriculture, rural development, irrigation, water supply and sanitation sectors are going to be worst affected due to the impacts of climate change. Since the SAARC region is predominantly dependent on these sectors it will have serious implications on the overall development of the SAARC region. This paper briefly discusses the impact of Climate Change on natural disasters in South Asia and appropriate adaptation strategies required, down scaling techniques and necessary mitigation measures needed in the SAARC region.

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COMMUNITY BASED DISASTER PREPAREDNESS

- Community Based Preparedness for Disaster Vulnerability Reduction - Lessons Learned from Tutti Island (Sudan) - *Azahir Hassan Abd Elrahman*
- Disaster Management: Need For Youth Preparedness - *Dr. K.Suneetha & B. Venkata Subbareddy*
- Indigenous Knowledge and Practices in Disaster Management: Experience of the Coast of Bangladesh - *Dr Mahfuzul Haque*

COMMUNITY BASED PREPAREDNESS FOR DISASTER VULNERABILITY REDUCTION - LESSONS LEARNED FROM TUTTI ISLAND – SUDAN

Azahir Hassan and Elrahman

Assistant Prof., Disaster management and Refugee Studies Institute, International University of Africa.

The Disaster Management and Refugee Studies Institute (DIMARSI) of the International University of Africa –Sudan is recognizing Sudanese basic communities' best practices in disaster risk reduction, worth admiration and dissemination.

Tutti Island lies in the central part of Khartoum, the capital of Sudan, and is located at the junction of the Blue Nile, the White Nile and the river Nile. Tutti Island Community has been selected as the model due to their distinguished role in fighting the repetitive devastating seasonal floods of the Nile. Theirs is a very unique experience where the community of the Island has taken upon itself to prevent flood hazard which is menacing the Island and its means of livelihoods.

The paper examines this experience as a community initiative in reducing levels of vulnerability and building resilience. The paper focuses on the Island's experience in combating floods in the light of five priority areas of Hyogo framework for action to draw lessons learned as a bench mark for communities in similar conditions.The researcher conducted interviews with community leaders in a gender sensitive manner so as to explore the spirit and devotion that drive the community members.

The results of the research are expected to validate the main assumption of the paper that Tutti Island example represents a success story of how a community can manage flood disasters and reduce vulnerability.

Introduction

This paper is aiming at monitoring the experience of local community in Tutti Island as it confirms the hazard of flooding which poses an imminent threat to the islands community, also aims at documenting this experience as it is considered one of the most important practices by local communities in reducing risks associated with flood on national, regional and global levels. More over this experience embodies the best model in using traditional based on cultural legacy and local means for facing flood hazard in Sudan.

Some Definitions and Concepts

Local Communities: Local communities are defined as those organizations targeting by their direct services the units which are collectively forming the local community such as 'unions, youth and students organizations, sport and cultural clubs, Co-operations and other similar civil society organizations'.[1] They are also defined as' any civil organization or association or union initiated by local community in order to execute development programmes and achieve its own interests 'Given these characteristics; they are considered to be voluntary social capital starting from the bottom and evolving through interaction and networking for the betterment of the society.

[1] Omer Yosouf, the role of local organizations in Tutti Island in disaster risk reduction, international conference on community based disaster risk reduction, International University of Africa, Disaster Management and Refugee Studies Institute, 2014.

Disasters: Disasters are tragedies that overwhelm communities, destroy property, and harm our populations. The United Nations General Assembly, recognizing the magnitude of the problem, has declared the 1990s the International Decade of Natural Disaster Reduction and has called for a worldwide effort to reduce the loss of life and property.

Flood: Flood is defined as an overflow of water that submerges land which is usually dry

.

Location of the Island and elements of hazard

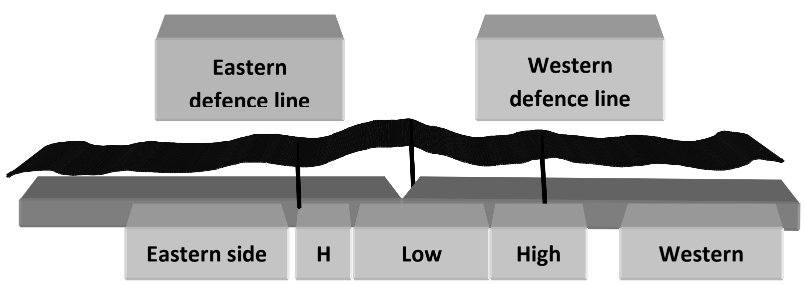
Tutti Island is located in heart of Khartoum (central Sudan) engulfed between three major rivers: White Nile, Blue Nile and River Nile. Geographically the Island is located between latitude 32.49- 32.31, and longitude 36-38 with a total area of 4200m2 equivalent to 950 Feddans, the Island is surrounded by water from all directions where huge quantity of water is carried into the Island during flooding, this poses a threat not only to the inhabitants of the Island, but also to their means of livelihoods. The Island is also confronted by imminent negative impact of erosion which erodes lands by strong current of the Blue Nile that surrounds the Island from three sides. The erosion is minimizing the fertile land considerably every year.

Tutti Island is unequally characterized by (high level of danger differently from all other human habitats which are located in River Nile Banks and it's a tributaries) which deserves a great deal of vigilance and consciousness from the population to confront this great danger.

From geographical perspective and as the Island is sprawling in a muddy soil coming from where the Blue Nile is originated from Ethiopia that comes fully saturated with volcanic soil easily eroded by strong waves during flood season in August and September[2].

The Island is located between Two Rivers with different hydrological and strength of erosion, the Island receives waters from both rivers during flood through two low planes from Eastern and Western sides of the Island, this on the one hand minimizes the pressure of the flood, and gives an opportunity as a source of irrigation to the Island on the other hand. These waters flooding the Island do not cause threat to the houses of the people in the Island as these building are located in the higher planes of the Island as Yousof stated in his preview of how waters invade the Island, he mentioned that: (zigzag shape of the Island is fortifying the it from being flooded easily, though waters can come from the two planes first without much resistance from the defenders where it stands in front of the high two planes which are considered natural first and last defense line, if these two high planes were flooded that will result in a disaster and all resistance operation lines would collapse.)[3].

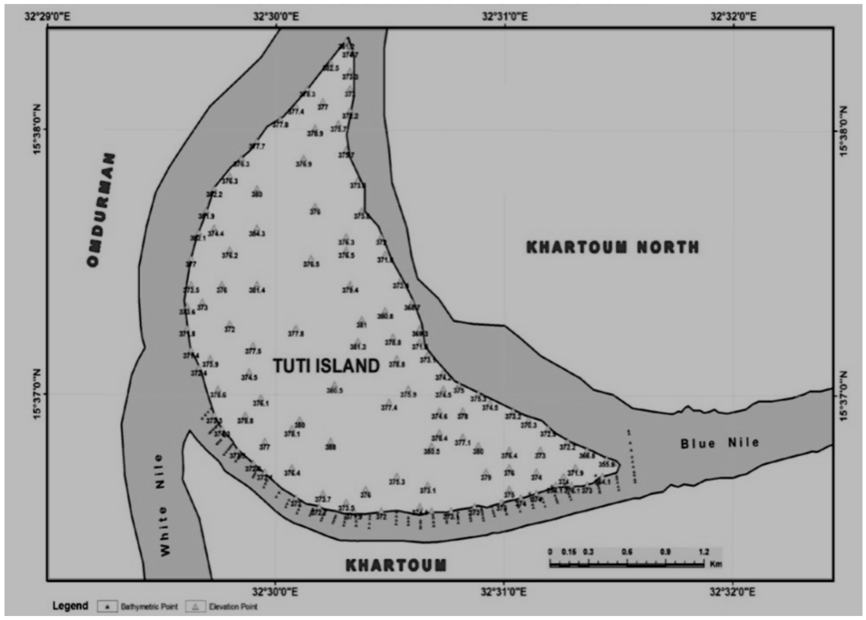
Zigzag Shape in the Island



Source : Omer Yousof, 2014 Location Map of Tutti Island

[2]Mustafa M. Khogli, introduction in disaster studies, International University of Africa, 2014.

[3]Omer Yosouf, 2014.



Source: Nadia Ibrahim, 2014

Demographic Structure of the Island

The demographical structure of Tutti Island is dominated by Mahass tribe which inhabited the Island since early 16th century, this tribe migrated to the area from up North Sudan, and they are all of the same origin. There are also big families from whom all inhabitants descend. In addition to these groupings there are also the (Konoze a tribe which has come from Egyptian rural areas, and other tribes like Awamra and Sawajeer.)[4] these groups have melted through the bond of marriage with the indigenous people.

This humongous structure in Tutti Island has enabled in a accumulating noble social values and heritage such as conservatism and piousness and collective social interdependency and love for public social work, this had paved the way for the inhabitants of the Island to become champions in flood resistance.
It is generally observed that, the bulk of the population of the Island is from youth group which represents (15-35) 62% of the total population, specially those who worked during flood of 1946 the most vehement flood the Island has ever witnessed in the last century, most of the guarding operations to the vulnerable points were done by this group.

This demographical feature has its clear positive impact in increasing resistance effectiveness of the flood which is considered a much distinguished Sudanese experience using local and endogenous knowledge in disaster management. This has resulted in a concrete social fabric which made the Island incubate an active community based institution in confronting disasters especially during 1946 flood. This experience is reflected in cooperative culture whereas all inhabitants stand as one unified line (elderly, youth, women, men and even children) in a magnificent division of labor that mad this experience stand as a model for community based disaster risk reduction.

Tools of Defending the Island

It could be clearly observed as mentioned earlier the zigzag shape of the Island has created a natural defense line specially on the high plane, yet in low areas where level of water rises higher the inhabitants of the

[4]Omer Yosouf, 2014.

Island become very alert and their proven sense of bravery was quite obvious from the heroic epic when some of them had to put their own bodies as solid objects to prevent penetration of the water instead of dumping sand during 1946 flood. Moreover the inhabitants have innovated means of early warning such as hitting on drums in order to mobilize much more manpower, this measure has practically reduced human losses and property, all these defensive measures were not taken in isolation from the community organization and local leadership, the area chief and spiritual leadership have played a mobilizing role that unleashed the capacities and encouraged sacrifices in confronting the flood.

In this context the researcher Omer Yousof has emphasized the same facts by saying (all administrative arrangements and preparations for different combating operations were done in the chief house which is located within vicinity of the old Mosque of the Island , these two neighboring (chief house and the Mosque) had it is own symbolic connotations in the success of co operations, all monitoring and evaluation processes were done in daily basis inside the Mosque after final day prayer (Esha Prayer) this meeting was considered to be a daily general assembly where supervisors of weak points summit the reports of their performance and their expectations of flood situation and needs for combating operations, then they get the directives from the chief with well wishing of the religious leader to get their efforts successful, in the mean time reciting QURAAN goes on nonstop. The charismatic appeal for both the religious leader and chief played a vital role in getting work done in a greater degree of efficiency and accuracy).

It could be concluded that flood hazard was confronted in a high level of mobilization of the whole community of the Island who has a deep insight and high level of understanding of the danger through mobilizing all resources in the society; materially and spiritually from inside and the outside the Island by making available all means to combat the hazard where the Mosque and drumming and funding are all mobilized for the same purpose.

Astonishingly enough in such a conservative society, the most salient feature of this good practices is that, the gender dimension has been cared for in a clear cut division of labour where all are involved and working round the clock in shape of shifts: where youth are working during the night to monitor flood situation, men are working on awareness raising, whereas women are preparing food and beverages voluntarily and children are delivering them to weak points where youth groups are camping.

Tutti Island Experience from Hyogo Framework for Action Priorities

Reading the experience in the light of priorities of Hyogo frame for action:

This experience could be read from the second priority of Hyogo framework for action (Identify, assess and monitor disaster risks and enhance early warning.) through remaining vigilant all night long on the side of the Island during flood and transmitting information firsthand about vulnerable positions by hitting drums in the past and through SMS in present times as a part of early warning operations.

From the third priority of Hyogo framework for action (Use knowledge, innovation and education to build a culture of safety and resilience at all levels) within this priority the greatest indicator of this good practice appears for the Islands of the community to combat flood hazard, they invented means of orientation and upbringing to children not only for making them skillful in swimming, but also in delivering food to youth groups who are camping around vulnerable positions on the river bank round the clock which threatens them seasonally, they have developed an accumulated knowledge specially on what would be termed (psychology of the river), this knowledge has become part of their indigenous culture, moreover, they have created poems and enthusiastic songs to encourage individuals towards combating flood hazard.

The experience also has considered gender dimension, both men and women are playing their respective roles in equal footings during flood, from this perspective this experience is considered the first experience to mainstream gender dimension to combat one of the most imminent hazards in Sudan.

In the forth priority (Reduce the underlying risk factors) the local community fully contributes without receiving aid from the government in fortifying weaker positions by dumping them in bagged sand, the historical memory preserves some men have put their own bodies to curb the river from penetrating inside their Island, this was during the flood 1946.

In the fifth priority (Strengthen disaster preparedness for effective response at all levels) the experience could be read as a good practice with utmost sense preparedness throughout the year, each and every house in the Island is equipped with tools of preparedness such as spades, jute bags, swimming skills for rescue purposes, this made them well prepared materially and psychologically to protect their Island by their own efforts without any outside intervention from civil protection forces.

Indicators of the Experience Success:

- Tutti Island has been selected as a champion for disaster risk reduction based on local communities by UNISDR in October 2015.
- The Island did not submerged by floods though it has witnessed severe flooding in 1946, 1988, 2003 in comparison with other Islands which have submerged due to negligence.
- Peerless community based combating flood hazard has created a culture based on local voluntary community initiatives.
- The Island has become a source of administration from tourists and investors alike due to its distinguished geographical location in the heart of Sudanese capital with it is attractive nature and moderate atmosphere.

Measuring Success of the Experience:

Elements of success to this unique experience could be listed in the following:

- Preservation of the survival of the Island and it is social entity where it is inhabitants have become a unique social fabric of their own; the Island continued to supply the rest of Khartoum city with fresh vegetables and fruits as a share of healthy food to Khartoum State.
- Homogeneity among different social groupings.
- Deep awareness of the inhabitants with flood hazard and means to combating it.
- Knowledge to deal with risks of flood hazard with the sense of initiation and self denial among the inhabitants without distinction.
- Inherited social values from generation to generation in dealing with flood hazard has created a culture of safety among the community.

Lessons Learned:

Lessons learned from this experience that it gives indicator to the vividness to the local community which is practically embodied in the following statement *(communities are the first affected by disasters and f*irst *respond*) the community has also become more organized and institutionalized through its permanent committee in the Island which cares for:

- Planning for responding to flood hazard.
- Documenting the experience through photographing and other arts which are exhibited in the cultural club of the Island.
- It has become a source of admiration of other similar communities as it has been documented in epical songs
- A feeling of self steam among the community of the Island is created without receiving aid from outside.

Recommendations

- This experience should be replicated in Sudan and elsewhere outside Sudan in Islands of similar conditions.
- Community based disaster risk reduction should be introduced in educational curriculum at all levels.
- There should be an institutional base for implementing and supporting such experiences based on Hyogo framework for action and Sendai priorities.

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DISASTER MANAGEMENT: NEED FOR YOUTH PREPAREDNESS

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Abstract

Almost every day disasters are striking several parts of the world. In India, 59 per cent of the land mass is susceptible to seismic hazard; 5 per cent of the total geographical area is prone to floods; 8 per cent of the total landmass is prone to cyclones; 70 per cent of the total cultivable area is vulnerable to drought. Apart from this the hilly regions are vulnerable to avalanches/ landslides/hailstorms/cloudbursts. In addition to this manmade hazards, which are frequent and cause huge damage to life and property. It is therefore important to have preparation to cope with the effects disasters such as damage, disruption of assets, networks, and social capital and casualties. Preparedness therefore encompasses those measures taken before a disaster event which are aimed at minimizing loss of life, disruption of critical services, and damage when the disaster occurs. Preparedness includes the formulation of viable emergency plans, the development of warning systems, the maintenance of inventories and the training of personnel.

In this scenario we can involve the India's potential force that is youth in disaster preparedness. But there is dearth of youth volunteers in disaster mitigation because of knowledge, attitude and behavior deficit. Hence efforts are needed by educational institutions to develop knowledge on disaster management and climate change among the youth .And also built attitude towards the importance of preparedness. Further the youth has to be equipped with the skills essential to participate in disaster management activities .In this connection the Universities through extension programmes, NCC, NSS, Nehru Yuva kendras, Red Cross societies, Boys and Scouts and NGOs etc has to train the youth volunteers to bring hazardous situation under control faster by systemic approach.

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Introduction

The regular occurrence of disasters both Natural and Man-made in Coastal Andhra Pradesh of India has had a series of repercussions on economy of the state and its development policies, political equilibrium and daily life of millions of people. Andhra Pradesh is battered by every kind of natural disaster: cyclones, floods, earthquakes and drought. The coastal region suffers repeated cyclone and floods. The 1977 cyclone and tidal wave, which resulted in great loss of life, attracted the attention of the central and state Governments of India and the international donor communities, as did those of 1979, 1990 and 1996. The floods in the Godavari and Krishna Rivers caused havoc in the East and West Godavari and Krishna districts. Earthquakes in the recent past have occurred along and off the Andhra Pradesh coast and in regions in the Godavari river valley. More than sixty cyclones have affected AP this century. The incidence of cyclones seems to have increased in the past decades, to the extent that severe cyclones have become a common event occurring every two to three years, repeatedly and severely affecting the state's economy while challenging its financial and institutional resources. Almost 29 million people are vulnerable to cyclones and their effects in Coastal AP, 3.3 million of whom belong to communities located within 5 km from the seashore. Social and economic life of AP's population is characterized by recurring natural disasters.

About 44 percent of the state is vulnerable to tropical storms and related hazards. In India, the cyclones develop in the pre-monsoon (April to May) and post-monsoon seasons (October to December), but most of them tend to form in the month of November. Cyclones on the east coast originate in the Bay of Bengal, the Andaman Sea or the South China Sea, and usually reach the coastline of Tamil Nadu, Andhra Pradesh, Odisha and West Bengal, which are the most vulnerable to these types of hazards. Along the Andhra coast, the section between Nizampatnam and Machilipatnam is the most prone to storm surges. Vulnerability to storm surges is not uniform along Indian coasts. According to the available disaster inventories, AP is the state that has suffered the most from the adverse effects of severe cyclones. It has been estimated that about 44 percent of AP's total territory is vulnerable to tropical storms and related hazards, while its coastal belt is likely to be the most vulnerable region in India to these natural phenomena. Five districts in Coastal AP, four districts in Rayalaseema are affected by monsoon floods and drought.

Andhra Pradesh with coastline of 1,030 K.Ms, is the second largest in the country next only to Gujarat State and the longest on the East Coast of India. The total coastal area spreads over 92,906 Sq. KMs. in nine coastal districts which have population of 2.87 Crores. There are 2,482 villages along the 0-20 KMs. wide coast line with a population of 54.33 lakhs. Of these 11.63 lakh live in 500 villages within a coastal belt of 5 KMs. These people are the most vulnerable to the ravages of nature, particularly of cyclonic storms and tidal waves. On the morning of 26.12.2004 Tsunami tidal waves ranging from 2 to 6 metres high lashed the Andhra Pradesh coast. The major brunt of the tidal waves was along the coast of Nellore, Prakasam, Guntur, Krishna, East Godavari, and West Godavari Districts. Many people on the beaches as well as close to the coast were washed away and otherwise affected. The tidal waters entered the villages along the coast inundating large number of villages.

Overview of Literature

Emphasize the need for effective coordination and communication mechanisms such as National Platforms on disaster risk reduction to bring together governments and different stakeholders at all levels towards resilience efforts and support the post- 2015 Hyogo framework implementation in particular by improving the coordination of work and knowledge on prevention and mitigation of hazards and disasters, increasing understanding of other stakeholders operating in the field ,better coordinated development and dissemination of knowledge, data, methods and experience and more effective use of resources within society, civilians, private business and government and Support local level implementation and collaboration to prevent and mitigate disaster consequences.(EFDRR,2014)

In United States at the end of the 20th century, an estimated 66.5 million children each year were affected by a disaster (Penrose and Takaki, 2006), and this number will most likely increase, owing to shifts within society and large climate changes. Despite this vulnerability, however, scant attention has been given to this particular population regarding emergency preparedness and planning. Both researchers and practitioners have traditionally overlooked children's needs and experiences in a disaster, along with their role in disaster preparedness education and training. If proper training is imparted to these children they will take care of disaster risk reduction activities for another 40-50 year during their life course. But scholars and professionals have failed to explore the importance of youth disaster education programs and their particular impact and effectiveness on shaping children's perceptions of what to do in a disaster event. Therefore, it is important that programs that target the youth population are developed and that these programs cater to their specific needs while delineating what role they will play in disaster preparedness (National Commission on Children and Disasters, 2009). Since children spend so much time in school, the schools may be seen as the ideal setting for the dissemination of risk-based educational programs (Ronan and Johnston, 2003).

Now -a-days schools, colleges have included environment educational components in their curriculum with special focus on climate change, environmental protection and less emphasis is on disaster management to impart knowledge. But knowledge is not enough in disaster preparedness developing appropriate knowledge, attitude, skills and effective implementation is needed. School-integrated injury prevention and disaster preparedness curricula and programs should be considered a principal strategy for long-term instruction and behavior change. Materials should be well written and age appropriate and should be disseminated through various means of print and electronic media. Hands-on, experiential learning is also another effective way to reach and engage children better (Peek, 2008).In France, disaster education has four main goals: (1) teaching students preventive and protective measures against major risks in a daily life context; (2) informing students of different types of rescue services; (3) teaching students basic survival steps while waiting for organized rescue; and (4) encouraging students to develop civic-minded behavior and sense of individual and collective responsibility (United Nations, 2007).

Local communities play a major role in terms of providing support, encouraging participation in training and education programs, and raising overall awareness of proper preparedness protocol and procedures. Participation of communities in developing a disaster preparedness and mitigation system can be helpful in determining a community's resources, capabilities, coping mechanisms, and facilities (Newport and Jawahar, 2003). Use a graduated sequence of learning across school years by starting with basic messages and incorporate all phases of emergency management: preparedness, mitigation, response, and recovery. Practice preparedness responses using in- and out-of-class simulations and through experiential exercises. Research shows that mock scenarios should test children's skill levels and reinforce those skills. When joined with appropriate feedback, repeated practice of the desired skills will help develop the self-confidence necessary to ultimately change a child's behavior. Promote youth education programs throughout the community, via partnerships, to increase community-based preparedness discussions and activities. Promote outreach through media, parent–teacher groups, emergency management agencies, community and neighborhood groups, boys and girls programs, and local businesses and engage with other readiness-based efforts.

Increasingly, disasters are affecting large geographical areas that contain diverse populations who experience their aftermath in different ways. Social work case managers can play a critical role in assisting communities to plan and organize around issues of diversity in disaster relief and recovery. Using mixed methods, this study examines disaster recovery case management, reported shortcomings in agency preparation, a lack of understanding of ethnic intra group differences, and challenges when working with elderly and disabled clients, to find out the scope for social work disaster case managers in developing methods for gaining awareness of diverse populations within their service areas. Implications for future training and preparation of youth and social workers as volunteers with appropriate training.

The National Disaster Management Framework drawn up by the Ministry of Home Affairs envisages association of youth organizations in disaster management activities and its inclusion in their training programmes as well as in their regular activities.(News letter, Ministry of Home affairs) Youth face particular risks in disaster situations. However, substantial benefits can be reaped from empowering and educating youth with regards to disaster preparedness and response. This National Strategy seeks to couple national attention on emergency and disaster preparedness with community action that focuses specifically on youth readiness for disasters and related events. Organizations that focus on youth are encouraged to read this National Strategy, determine what role they can play in furthering a community of prepared youth, and affirm the National Strategy.(The National Strategy for Youth Preparedness Education Empowering, Educating And Building Resilience , FEMA &American Red Cross)

Taking into account the experience gained through the implementation of the **Hyogo Framework for Action,** and in pursuance of the expected outcome and goal, there is a need for focused action within and across sectors by States at local, national, regional and global levels in the following four priority areas:

Priority 1: Understanding disaster risk.
Priority 2: Strengthening disaster risk governance to manage disaster risk.
Priority 3: Investing in disaster risk reduction for resilience.
Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

The steady growth of disaster risk, including the increase of people and assets exposure, combined with the lessons learned from past disasters, indicates the need to further strengthen disaster preparedness for response, take action in anticipation of events, integrate disaster risk reduction in response preparedness and ensure that capacities are in place for effective response and recovery at all levels. The guidelines suggest regarding priority 4 of Sendai report

- To establish community centres for the promotion of public awareness and the stockpiling of necessary materials to implement rescue and relief activities;
- To adopt public policies and actions that support the role of public service workers to establish or strengthen coordination and funding mechanisms and procedures for relief assistance and plan and prepare for post-disaster recovery and reconstruction;
- To train the existing workforce and voluntary workers in disaster response and strengthen technical and logistical capacities to ensure better response in emergencies;
- Children and youth are agents of change and should be given the space and modalities to contribute to disaster risk reduction, in accordance with legislation, national practice and educational curricula (Sendai Framework for Disaster Risk Reduction 2015-2030)

Methodology

Recognizing the need for research to evaluate the current state of disaster preparedness education and research regarding involvement of youth and children in disaster emergency management activities by the government and NGOs and review of the literature related to emergency preparedness education for youth is the focal theme of the paper.

Objectives: the Objectives of the Study are as Follows

- To understand the socio-economic and demographic characteristics of the respondents i.e. youth.
- To assess the respondents knowledge on disaster mitigation and management,
- to find out respondents opinion on Information dissemination by different agencies regarding disaster mitigation and management,
- to elicit youth opinion on the need for youth volunteers preparedness training on disaster mitigation and management to disaster risk reduction.

Hypothesis

- There is significant age difference with regard to awareness on disaster mitigation and management
- There is significant difference with regard to awareness on disaster mitigation and management among different educational groups.

Study Area: The study is intended to be undertaken in a select district of Andhra Pradesh state i.e. Nellore. The Nellore district consists of Five revenue divisions namely Kavali, Nellore ,Gudur , Nayudupeta and Atmakur with 46 mandals. Off this 71 villages of 12 coastal mandals are affected by, tsunami ,cyclones , floods etc. These mandal are Kavali -4 villages , Bogolu -5 , Allur-4, Vidavaluru- 11, Indukur peta -4, TP Gudur - 6, Muthukur- 5 ,Kota- 5, Vakadu -14 , Sulluru peta-4, and in Tada-9 villages are prone to cyclones ,floods etc. All the reaming mandals of the district are prone to climate change due to power plants like NCCPPL, TPCIL, Meenakshi energy Ltd, KPCIL, Coastal Andhra Power Corporation etc, located at Krishnapatam port etc. Drought in some mandals are very common, fire accidents etc also occur some times as more industries are coming up in Nellore district. First the researcher has identified disaster prone risk areas as mentioned above (71 villages) , by using simple random sampling method 5 villages were identified and the youth residing in that particular communities and collected information of their understanding on disaster management and then find out the scope for youth volunteers preparedness .

Sampling: The total population of the district as per 2011 population census is 29.64 lakhs. Among them 10,38,557 are in the age group of 15 -34 years constituting 36.56 percent of total population.(Hand book of 2013-2015,SPS Nellore). First the researcher has identified 5 villages i.e. namely Vakadu, Vidavaluru ,TP Gudur, Muthukur, Kavali are disaster prone as mentioned above (71 villages) by using simple random sampling method. Then from each place 80 youth were identified from degree colleges and explained the study objectives and sought their cooperation. The study sample comprises of 400 youth selected through stratified random sampling method who are residing in 5 select areas namely Vakadu, Vidavaluru ,TP Gudur , Muthukur and Kavali .

Data Collection: Interview schedule and focus group discussions were used to gather information regarding the objectives with prior information. The schedule included questions to assess youth knowledge and skills with regard to disaster management. The researcher explained the study objectives and sought cooperation of the selected sample. Focus group discussions were conducted to elicit information of their understanding on disaster management and found the scope for youth volunteers preparedness.

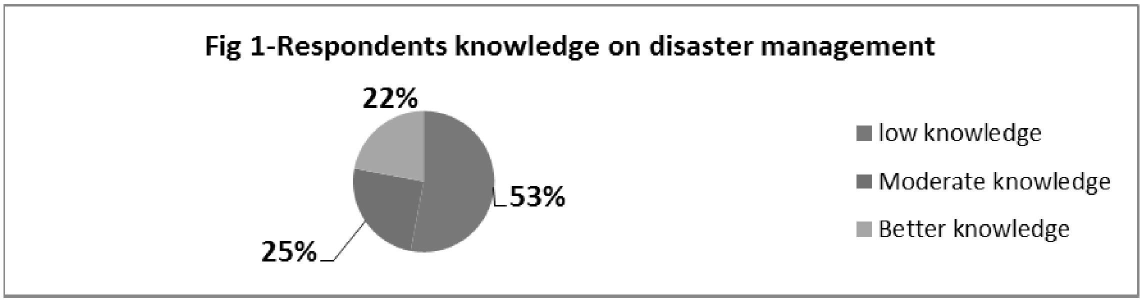
Data Analysis: The collected data was analysed by SPSS 16.00 package .The collected data has been analyzed by using certain well established statistical techniques such as the following: Percentages, mean, median, standard deviation have been calculated . Comparison of mean scores with respect to respondents knowledge and socio-economic variables by using 't' test and ANOVA.

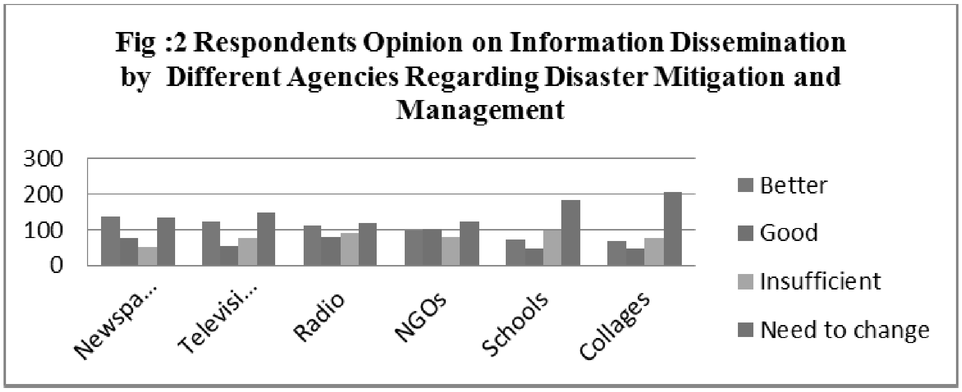
Results: Table 1: Socio-Economic and Demographic Characteristics of the Respondents

S. No	Characteristics	Majority Percentages
1	Sex	56 % male 44% female
2	Age	84 % in 15-20 years age group
3	Religion	72% Hindu
4	Caste	74% belongs to Scheduled community
5	Type of Family	69% were from nuclear family.
6	Education	84% perusing degree
7	Income	86% are not having any income at present
8	Family Income	80 % with Rs3000-Rs4000 monthly income
9	Staying	88% are staying with family
10	Type of house	79% are staying in semi structured houses

Demographic and socio-economic characteristics of them are very important to understand the knowledge of the respondents. Table no 1, reveals that a majority i.e. 64 percent of the respondents was in the age group of 15-20 years , 56 percent of the respondents are male the remaining 44 percent of the respondent are female . Results show that nearly three fourths of the respondents 72percent belong to SC community and the same percentage were Hindus .The table also reveals a majority 71 percent were currently unmarried and pursuing degree education. 84percent not having any income of their own. Regarding family income majority of respondents 80 percent are with Rs 3,000-Rs 4,000 monthly income.

Respondents Knowledge about Disaster Mitigation and Management: Regarding respondents knowledge the results revealed that a little above half are having low knowledge followed by 25 percent moderate knowledge and 22 percent are having better knowledge regarding disasters and its mitigation and management (Fig-1)





Regarding respondents opinion on information dissemination on disaster mitigation and management, the study revealed that most of the youth are with opinion that the media agencies has to change their approach of information dissemination with regard to disaster mitigation and management. Further the study revealed that the present status of information dissemination better with regard to newspaper.(Fig-2)

Table No: 2 Age Wise Distribution of Respondents with Regarding to their Awareness on Disaster Management.

Variable	Age	N	Mean	SD	t	DF	P-value	Result
Awareness on Disaster management	15-20	338	22.9024	2.3199	1.5816	398	0.1145	Not significant
	21-35	62	22.4032	2.0761				

Further the results from table no 2 revealed that the mean scores of youth awareness on disaster management with regard to age groups does not differ significantly. So, we reject the hypothesis and it is found that 'the respondents awareness on disaster management does not get affected by their age'.

Table No: 3 Education Group wise Distribution of Respondents with Regarding to their Awareness on Disaster Management.

Variable	Education	N	Mean	SD	Score	DA	Mean Square	F-value	P-value	Result
Awareness on Disaster management	**Arts**	23	20.5217	1.3774	Between groups	3	147.6691	35.5107	0.000	Significant at 1% level
	Commerce	90	21.3778	1.8758						
	BSc (Maths)	160	23.2563	2.2854						
	BSc (Sciences)	127	23.7244	1.9135	Within groups	396	4.1584			

It is clear from Table No.3 that, a high mean score for awareness on disaster management (23.7244) is found in the case of B Sc (Science) graduation students . The mean scores of disaster management differ significantly at 1 percent level for different educational group of students. So, the results prove the hypothesis that the awareness on disaster management of the respondents varies with their educational group wise. It is observed that education provides more awareness disaster management.

Conclusion: There is dearth of youth volunteers in disaster mitigation because of knowledge, attitude and behaviour deficit. Hence efforts are needed by educational institutions to develop knowledge on disaster management and climate change among the youth and also build attitude towards the importance of preparedness. Further the youth has to be equipped with the skills essential to participate in disaster management activities .In this connection the Universities through extension programmes, NCC, NSS, Nehru Yuva kendras, Red Cross societies, Boys and Scouts and NGOs etc has to train the youth volunteers to bring hazardous situation under control faster by systematic approach. Further there is a need to establish a **Disaster Mitigation and Management Cell** to monitor and coordinate line departments. Further this centres must be equipped with all infrastructure to provide simulative training to youth volunteers in disaster management.

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INDIGENOUS KNOWLEDGE AND PRACTICES IN DISASTER MANAGEMENT:

Experience of the Coast of Bangladesh

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Introduction

Indigenous knowledge (IK) means the functional knowledge of local people inhibiting in a particular ethno-cultural and agro-ecological condition. Indigenous knowledge develops through experience sharing and normally passes through generations by oral expressions and it operates in all aspects of community life and persists therein as unwritten forms (Haque 2013a). Although, it is often said that unwritten knowledge is vulnerable to being lost, local wisdom has a habit of persisting in the villages, old towns, markets and other places, where people continue to put it into practice. IK usually connotes a holistic system of knowledge, comprising of values, concepts, beliefs and perceptions, which is naturally located amongst people living in a local (often rural) environment (Warner 1991; Sillitoe *et al.*, 1998). IK is "knowledge of rural people themselves" and therefore is grown and developed in relative independence of external influence. IK is not generally codified or written down in formal language or forum. It refers to the whole body of knowledge including values, concepts, perceptions and beliefs of a particular local community. It is inherently diverse and multi-faceted knowledge system with varied expressions. It is socially and culturally specific, constructed and bound. It is typically developed in the process of local people's experiment with varied livelihood, survival and coping strategies. IK is mostly found in rural areas in unwritten form and in informal conversations. It is difficult to trace and track these soft traditional sources and translate them into formal, written and "scientific" language, codes and methods.

Indigenous knowledge is the knowledge held collectively by a defined community. The term "indigenous" is synonymous with "traditional" and "local", differentiating this knowledge from that developed by formal science in institutions such as universities and government research centres (Walker *et al*. 1991; Sillitoe 2000). IK refers to local and traditional knowledge used by rural people for agriculture, natural resource management, fisheries, livestock, healthcare practices and other activities. Sillotoe *et al* (1998) maintain that indigenous knowledge relates to any knowledge held collectively by a population, which informs understanding of the world. It may encompass knowledge of any kind/domain including that pertaining to socio-cultural and natural processes. It is culturally relative, being informed by people's socio-cultural tradition and history of which it is an integral part.

Coast of Bangladesh

Bangladesh is vulnerable to periodic natural disasters due to its conical shape and location on the tip of the Bay of Bengal. Bangladesh faces 710 km long coast with the Bay of Bengal containing several ecosystems of high conservation value starting from the Saint Martin's Island to the district of Satkhira (Rasheed 2008). The coastal zone is characterized by a vast network of rivers and tidal channels; erosion and accretion processes continue, siltation takes place on water courses and river beds; and the area is prone to cyclone, storm surges and salinity intrusion. The largest mangrove forests of the world, the Sundarbans covers a big chunk of the coast along with India. It's a land of natural disaster. Series of tropical cyclones, tornadoes, tidal bore and floods attack the coast every year. Threat of sea level rise due to climate change is also looming large.

A coast is an area where a) tidal water movements determine agricultural practices, movement of river transport, estuarine commercial activities and everyday life; b) water is under salinity intrusion; and c) the area runs tremendous risk of cyclones and storm surges. Based on the above 3 criteria: tidal water movements; salinity intrusion; and risk of cyclones, an area of 47,201 sq km (32% of the country) of Bangladesh within 19 districts in 147 coastal *Upazilas* could be termed as coastal area (Rasheed 2008). The area is populated by 35 million people (2005) representing 29% of total population. The people of the coast are generally known for their resilience, as they fiercely face periodic natural disaster and climate change. In fact, inaccessibility and remoteness of the coast made the people fierce and self-dependent.

The people of the coast in particular and the country in general have developed through a process of innovation and adaptation, a variety of coping strategies and techniques that are fine-tuned to the local environment, economy and socio-cultural system. The people inhabiting a disaster-prone country have their localized knowledge and practices, developed through cumulative experience, that constitute a survival strategy in the face of natural disasters. Bangladesh possesses a rich heritage of indigenous knowledge and practices, much of which has been lost due to their non-documentation. Nevertheless, people in disaster-prone areas still nurture such knowledge in their myths, beliefs and traditions.

Varied Faces of Disaster

The major natural disasters that periodically visit Bangladesh include cyclones, tidal surges, tornadoes, floods, drought, desertification, earthquakes, river erosion etc. We also face man-made disaster like climate change leading to sea level rise. There are many mitigation measures, which are mainly scientific in nature. However, these natural disasters are nothing new. They are age-old problems and people of this deltaic region, especially in the coastal areas have developed their indigenous knowledge and practices over the years in combating the disaster. We are to remember that perhaps, we cannot prevent all natural disasters, but we can reduce the number of casualties. Some of the disasters can be managed, thus the question is to be resolved is how can we better manage them? As we have no choice but to live with some of the disasters, we need to find ways and means to tackle them. The coping strategies of people in disaster-hit areas should be documented for their potential utilization in other parts of the country. The policy makers and technocrats are to be made aware that there many non-structural solutions to these disasters, practiced by people of the locality for generations.

Cyclone and Tidal Surges

Cyclones originate when mixture of heat and moisture air forms a low pressure over the oceans. In the Northern Hemisphere it is anti-clock wise and in the Southern Hemisphere, it rotates clock-wise. Bay of Bengal is most important cyclone-prone area because of its funnel shape and most cyclones visit in the month of October and November period. In last 150 years, 35 devastating cyclones hit Bangladesh Coast. Cyclone and tidal bore of 12 April 1970 killed 500,000 people. Cyclone and associated water surges of 29 April 1991 killed 140,000 people in the coast. We also recently faced two bad cyclonic storms and associated tidal bore named *Sidr* in 2007 and *Aila* in 2009 causing loss of lives and damages to standing crops and property.

It is evident that disasters like cyclones, tornadoes and tidal bores will continue to visit us and they cannot be controlled. May be through better management practices, damages could be reduced to a large extent. People of the southern coastal belt use the word *tufan*, to describe a cyclone, which apparently seems close to "hurricane" in Atlantic Ocean; "typhoon" in Pacific Ocean; "baggio" in Philippines Sea; and "willie willie" in the Pacific. Regarding low or high intensity of cyclones, they put a prefix like *choto* (small) *tufan* and *boro* (big) *tufan* respectively. In a separate study, it was revealed that the coastal people identified five major symptoms in anticipating and predicting cyclones. They are: a) wind direction; b) temperature and salinity of sea water; c) colour and shape of cloud; d) appearance of rainbow; and e) behavior of certain bird species. Regarding the direction of wind, the coastal people believed that a wind blowing from *Agni-con* (south-east) is more likely to create a storm, while the wind direction from *Ishan-con* (north-east) has the potential to generate a cyclones but not to that extent in case of severity. The wind direction is also associated with other attributes, i.e., a rise in sea water temperature, red coloured cloud, and the appearance of a rainbow (if it is day time) implying the formation of deep depression in the sea. In most cases such depressions are formed near the Andaman Islands of India. Abnormal behavior of the tree living birds is regarded as a signal of rapid storm approach. Also, cloud in the shape of an elephant's trunk is considered to be a symptom of tidal surge (Hassan 2000).

Cyclone warning system helps people to take refuse in cyclone shelters. Previously, we had 11 warning signals for sea ports and 4 warning signals for inland ports, which were a bit misleading and created confusion among the people as they thought danger signal 8 is less severe than that of danger signal 10. In fact, the message was that the storm was passing either by the eastern or western side of the sea-port. Based on consultation held with the coastal people, the meteorological departmentis in the process of revising the signals to make the warnings easily understood. There is a storm warning centre at the met office and it is responsible for issuing warnings for the tropical cyclones. There are Standing Orders on Disaster (SOD), 2010 issued by the Disaster Management Bureau, Ministry of Food and Disaster Management spelling out the responsibilities and duties of various agencies at different levels. It was prepared based on intensive consultation involving all Ministries, Divisions, Agencies and other stakeholders, including the coastal people. Pre-disaster and post-disaster measures/activities are laid down in the Standing Orders.

How do they survive during and after a cyclonic disaster? What are the indigenous survival strategies? In a study conducted on the people of the coastal islands, it was revealed that the islanders have developed certain short term survival strategies of their own (Hassan 2000). Simple tactics like holding onto and binding themselves to trees; looking for comparatively more dependable places like embankments and polders; using floating items such as timber, thatched roof, straw piles and bunches of coconuts represent spontaneous survival strategies. People of the locality have also devised appropriate methods for food preservation during cyclones and tidal surges. Emergency dry foods like *Chira* (thatched rice) and molasses are wrapped up in polythene and kept in earthen pots buried under the earth. They become handy when the water is gone. Self protection instinct dominated the indigenous survival strategy. The women prefer putting on *Salwar* and *Kamiz* dress instead of *Saris*(traditional female dress in South Asia), as the later makes it difficult to swim. During aftermath of a disaster, coping strategies work well with the help of the community members to their mutual benefit. Generally, outside help and relief goods appear 2/3 days after the disaster. What do they do during this intervening period? People eat stems and roots of edible plants. For drinking purposes, they drink rain water, as cyclones are always followed by rain for several hours. In absence of rainwater, they share coconut water. Due to non-availability of medicines, generally, the victims depend on herbs and other local substances for treating minor injuries, fever and diarrheal diseases.

Among structural measures, the people in the coast are seen using roofing materials and design (sloping the wind direction). They plant local varieties of plants surrounding their homesteads. In Sandwip island, people plant *Hurma* trees, which are strong and can withstand tidal waves. Lives of many people were saved during the April 1991 cyclone, as they hold on the trees of mangrove species, like *Keora* and *Sundari*. Another interesting phenomenon was that during tidal surges, people tied rafts to coconut trees so that they rose and fell with the level of the water (Haque 2000a).

Bangladesh has been lauded for its good managerial capabilities of natural disasters. Considering the two bad cyclones of 12 April 1970 (500,000 died) and 29 April 1991 (140,000 died), the recent cyclones *Sidr* and *Aila*, although were very deadly, casualties were at minimum. It was possible due to application of indigenous knowledge and practices of the local coastal community. The deadly super storm "Sandy" that hit New York City, Long Island, New Jersey and six other states of USA on 29 October 2012 killing 32 people with the streets and subways flooded, airports remained inoperative for days is fresh in our memory. Most catastrophic cyclones were Hurricane *Jeanne* in Florida (2004), *Ivan* also in Florida (2004), *Catrina* in New Orleans (August 2005) and *Emily* in the Caribbean (2005). During *Catrina* in 2005, dead bodies were found floating on the water for days due poor management experience of such calamities. In Bangladesh, SOD 2010 played an important role in streamlining post-cyclone activities in various tiers of the government.

Floods

It is a flood-prone country and floods visit us every year, often twice and thrice. People of Bangladesh never consider all floods as bad floods. We have been living with floods for generations. There are many songs and dances on the monsoon flood. Floods are blessing as well, as they bring alluvial soil. In the north-eastern *Haor* areas, all social and cultural festivities, like marriage, visiting father's house and religious meetings etc are generally held during the floods. We had bad floods considering their severity and damages of human lives and properties. They are the floods of 1987, 1988, 1998, 2004, and 2007. The 1998 flood was unprecedented in the living memory, as it inundated two-thirds of Bangladesh for two long months causing damages to lives and properties. There are four main types of floods frequently visiting Bangladesh. They are: a) Short duration (2/3 days) flash floods characterized by a sharp rise and drop in water level with high velocity damaging crops and property (north-eastern wetlands of *Haors* and the south-eastern hills); b) Rain floods due to heavy rainfall; c) Monsoon floods resulting from heavy monsoon rainfall over the Himalayas; and d) Coastal floods arising from storm surges in the coastal areas. Flood severity is generally measured by the area of inundation. When the flood inundates 25%. of the locality, it is considered as high flood (*Chotto Bannya* in local term); when 35% of the area is engulfed by flood water, it is known as severe flood; and in the case of above 35% of area inundation, it is termed as catastrophic flood. In local terms, the later two floods are known as *Bara Bannya*. The floods of 1987 and 1988 are known as *Jora Bannya*; and the floods of 1998, 2004 and 2007 are termed as *Baro Bannya*. When referring to a period, like the date of birth or marriage etc. the villagers use such terminology.

The islanders undertake human safety measures during the floods. These include making rafts from banana trunks, keeping vigil at night when the water is high or rising. They remain awake at night to keep away snakes and prevent children from drowning. The most common type of human safety measure is the construction of a high platform above floodwater level on bamboo poles. Often beds are raised by placing something under the legs.

Flood Forecasting and Warning Centre of Bangladesh Water Development Board has been playing an important role in flood forecasting through print and electronic media. They also have a vibrant website on flood forecasting. Bangladesh has proven expertise in managing the floods unlike many other developed countries. The Standing Orders on Disaster (SOD), 2010 published by the Disaster management Bureau has spelt out responsibilities of various tiers of the government starting from the local government to district, divisional and central levels. It has elaborated the emergency response during warning period, during the disaster and post-disaster period. For long-term risk reduction, responsibilities of the Disaster Management Committees at various tiers are also discussed. The stakeholders are involved in these committees. For example, in the *Upazila* Disaster Management Committee (UzDMC), representatives of local women's groups, NGOs, Red Crescent and socially reputed persons have been inducted. Bangladesh's Standing Order on Disasters, 2010 have been well acknowledged locally and globally.

In a study conducted on the assessment of 1998 flood on Dhaka city, the respondents instead of a structural solution, suggested age-old indigenous knowledge and practices to tackle such floods (Haque 2000b). Use of sand bags, frozen cements and bricks as walls against the onrush of floods was a common sight. Extending the silencer pipes of motorvehicles up above the flood water level with an L-shaped pipe was an innovative coping strategy. Daily activities of marooned people did not stop with the floods. They continued developing new strategies to cope with the situation. In case of transportation in the capital, they introduced country boats, rickshaw vans and rafts made of empty barrels. New and alternative routes were discovered everyday as flood water continued to rise. Railway communication between Dhaka and Narayanganj gave relief to the weary commuters. People also discovered riverine communication and new routes. Small steamers started to ferry passengers to nearby locality, not accessed by boats before.

Rich "social capital" of the people of Bangladesh was found to be very handy during a disaster. The community came forward with the needed help in cash and kind (dry food, drinking water, essential medicines etc). During 1998 flood, the community took collective efforts in tackling water leakages of Dhaka-Narayanganj-Demra embankments. Local youths worked day and night to protect the embankment or else there could have been a major disaster. In a disaster like flood, the low income and middle income people, mostly being fatalists, try to cope with the disaster themselves and don't complain much. The low income people help each other on community basis. The middle income people extend help to the lower income neighbours and take help from friends and relatives (Islam 2000).

River Erosion and *Charland* People

In the coastal areas of Bangladesh, many rivers are changing their courses frequently giving rise to erosion and bringing miseries to riverbank people. *Nodi Sikosti* (river erosion) is a silent disaster. There is no relief and often no compensation for the victims is offered. After *Nodi Poisti* (Char formation, when a strip of land rises out of a river bed), the victims of river erosion are rarely rehabilitated (Haque 2013b). People living in the *charlands*(raised shoals in the river) are vulnerable to the vagaries of nature. They are the most desperate and vulnerable people living on these newly formed land in the coast. Fragile riverbanks and *charlands* have never been abandoned because of flooding. On the contrary, these erosion-prone areas are accommodating a rapidly expanding population. Their survival strategy in the hazard-prone areas largely depends on how they put to use their experience and they are likely to differ according to the perception and economic ability of the persons in question. The people of the *charlands* understand their climate very well as they risk living in such a vulnerable situation. They have keen power of observation and can predict the nature of floods likely to hit them. If the monsoon rain is abundant and the water flow is relatively clean and has a current, they become alert of the onslaught of flood (Hasan 2000). However, not all of their observations are found correct. Different coping strategies are adopted by the *charland* people depending on the severity of the flood.

Indigenous knowledge in structural measures include those activities or practices intended to reduce damage to dwelling structures and household goods. Normal flooding does not call for repair of houses (re-thatching the straw) every year. What they do every year for their homestead is strengthening the bamboo poles. With the level of flood water, they raise their six-legged wooden cots over bamboo platforms and store their seeds and dry food in large earthen pots. During the monsoon, the basic foundation of the house (plinth) is usually plastered with a paste of mud, jute fibre and husks to protect the plinth from direct impact of flood water. On a similar such situation, people living in erosion-hit *haor*(saucer-shaped water bodies) areas in the north-east, plant *Chailla* grass in and around their homesteads in order to halt wave action that continuously erode their houses. They plant rows of *Hijal, Karoch* and *Barun*- typical *Haor* plants in front of their homesteads to halt *Afaals* (wave actions) of *haor* waters.

People living in the *charlands* are subject to the whims of the river and portray a typical man-environment interaction. Indigenous knowledge in agricultural cropping is the adjustment with respect to crops after and before flooding. Selection of crops is very vital for the *charland* people. Usually, groundnuts and sweet potatoes are sown at the highest level of the land where the soil is little sandy. At the waterfront, the people plant *Aman* paddy, which is adaptable to high flooding. The deep-water *Aman* can grow at the rate of six inches per day and reaches a height of 15 feet to keep pace with the rising waters. There are also practices like inter-cropping to accommodate the risk of crop failure. The short term flood sensitive *Aus* is sown together with the long stemmed flood-tolerant *Aman* in the same field. Normal flooding would two crops, while a dry year will give a good *Aus* but no *Aman* crop; abnormal floods will favour *Aman* but will affect *Aus* production. Often flood sensitive crops like *Aus* and jute are harvested before peak floods hit the *Charlands*. During post-flooding period, the farmers go for seedlings. Sometimes, they prepare floating seedbeds by horizontally placing banana trunks on the water with water-hyacinth and mud on them, locally known as "Baira" cultivation or floating gardens. As the hyacinth starts rotting, seedlings are raised on these floating gardens. Boats are a common mode of transport in the *charlands*. The poor man's boat is the raft made of banana trunks.

Population displacement due to riverbank erosion is widespread in the coastal areas of the country. A family at times need to shift their homes 8 to 10 times during it's lifetime as riverbank erodes.Indigenous knowledge of the people in the *charlands* and riverbanks is an important survival means for them during erosion and floods. They shift their homes only when forced to. They consider river erosion is a natural process and it should be remedied by natural measures (Hasan *et al* 2000). Building embankments and repairing and maintaining them every year is a burdensome and expensive task. They remain neglected because of the inaccessibility and instability of the area far away from the growth centres.

Drought

With just one per cent tree cover in the *Barind* area of Rajshahi division (in western side of Bangladesh)there are reports of creeping desertification. Despite years of irrigation using ground water by *Barind* Multipurpose Development Authority, the soil remains dry, dark, dusty and without any moisture. Ground water level is falling down due to excessive extraction of water. In order to address such a situation, people of the area have adopted many coping strategies. They dig a pond at the corner of their land and fill it with water round the year. This water reservoir changes humidity of the area and is used for irrigation and fisheries. Banks of the little pond are also afforested. There are many *Kharis* (canal) in the vicinity. Farmers fill them up with rain water and create a reservoir by erecting cross dams. This reservoir helps irrigation during dry season. Because of dryness and aridity of the area, people plant less water dependent trees like, *Babla, Shishu, Pipul, Tentul* etc (Haque 2013b).

Earthquake

Earthquakes result from seismic waves generated by sudden release of energy from within the earth due to tectonic movement or volcanic activity. Bangladesh is mainly an alluvial plain with some strips of hills on the north-east and south-eastern region. The country is surrounded by high seismic regions. It is not really an earthquake prone country but there are some large earthquakes occurred in the past in and around the country. Major earthquakes took place in 1869 (Kachhar), 1885 (Bengal), 1897 (Gr Indian), 1918 (Sri Mongal) and 1930 (Dhubri). Intensity of an earthquake is measured in "Richter Scale". There are 10 units. We also recently experienced "Tsunami" the earthquake in the oceans. Although, there is no scientific method of fore-warning people of an earthquake, it is known that the insects become restless and move haphazardly before an earthquake. People of an earthquake zone can read their movements and take preparation of an impending disaster.

Conclusion

Indigenous knowledge is now recognized as an under-utilized resource in the rural Bangladesh. All measures are to be taken to document them. Policy makers and disaster management experts are stressing on the need to create a storehouse of knowledge available at various places on management of disaster. Local community through generations have developed many indigenous knowledge and practices as they have been facing onslaught of natural disasters. Moreover, there are ethnic communities in many parts of the world, who have developed unique system to address natural disaster. There are many NGOs engaged in field research and studies on disaster and adaptation of the local community. Community-based adaptation strategy developed by these people over many generations, remain scattered and uncared for. Such knowledge runs the risk of disappearance in the event of a major disaster causing wiping out of the whole community.

Time and again, the people of the disaster-prone country like Bangladesh have proved that instead of structural methods, local indigenous knowledge and practices have solved many problems related to natural disaster, natural resource management, water logging and river bank erosion. The people of the waterlogged area in the south didn't accept structural solution for Beel Dakatia water logging problem, rather they suggested continuation of natural tidal flow in the form of tidal river management and in fact it did work. Unfortunately, due to arrogance of the technical experts and their reluctance to consult the local community, many development projects in Bangladesh are turning into "development disaster". Functional knowledge of the local people gained over the generations has proved to be very effective when technical solutions failed. Such knowledge is transmitted via oral traditions and need to be documented as it is fast disappearing with the decline of elderly people. For effective management of natural disaster in a deltaic land like Bangladesh, we are to bank on this traditional knowledge and practices and document them for our posterity.

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CROWD MANAGEMENT

- DisRes for Crowd sourcing of Crisis Information - *Dr. Neelima Satyam D*
- Detection, Analysis, and Management of Atypical Behavior of People in Crowd - *Suresh Kumar, Sc. 'D' & N. P. Singh, Sc. 'G'*
- Risk Management Strategies To Avoid Stampede At Mass Gatherings -*Lakshaya, Nomesh B. Bolia a*
- Stampedes are Community Avertible Crowd Disasters - *Dr W G Prasanna Kumar , Dr T Sumalini*
- Disaster Preparedness for Mass Religious Gatherings in India - Learning from Case Studies - *Sindhuja Kasthala, Harshit S. Lakra*,

DISRES FOR CROWD SOURCING OF CRISIS INFORMATION

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Introduction

The principle of crowd sourcing is that more heads are better than one. By canvassing a large crowd of people for Information will result in superior, faster inflow of disaster data to our database. The aim of this project is to model crisis communication scheme from the perspective of community, individuals and crisis management groups. The project aims at developing an efficient model and implementation of the model for efficient functioning of various rescue and recovery subsystems by providing them to and fro communication channels, so that they function efficiently on an individual basis and also interact properly with one another to ensure rapid measures during any crisis. The course of action taken and plans to chalk down a recovery model becomes easier for people as the project implementation provides them a wealth of information to mine from. The disasters that are so far considered for prototype are Earthquake, Fire, Could bursts, Flash Floods and Cyclone. Also, we built a mobile app on Android Platform and web app prototypes. The main channel to report a disaster is the mobile application, but its validation is verified based on the number of sos, Social media posts (twitter, Facebook) thus this verification system from crowdsourced information helps to handle false alarms. There is an offline search feature for the mobile users to get the location and contact information of the rescue organisations in their locality. We get the relief organisations to register with us and form an aggregate database of all such groups. Such a database is very useful for coordination of rescue activities. We store data related to all notifications and messages from different sources namely rescuers, organisations and disaster affected people so that such data can be used to better understand and cope up with the situation. To enable rescue organizations better utilize resources for their operation.

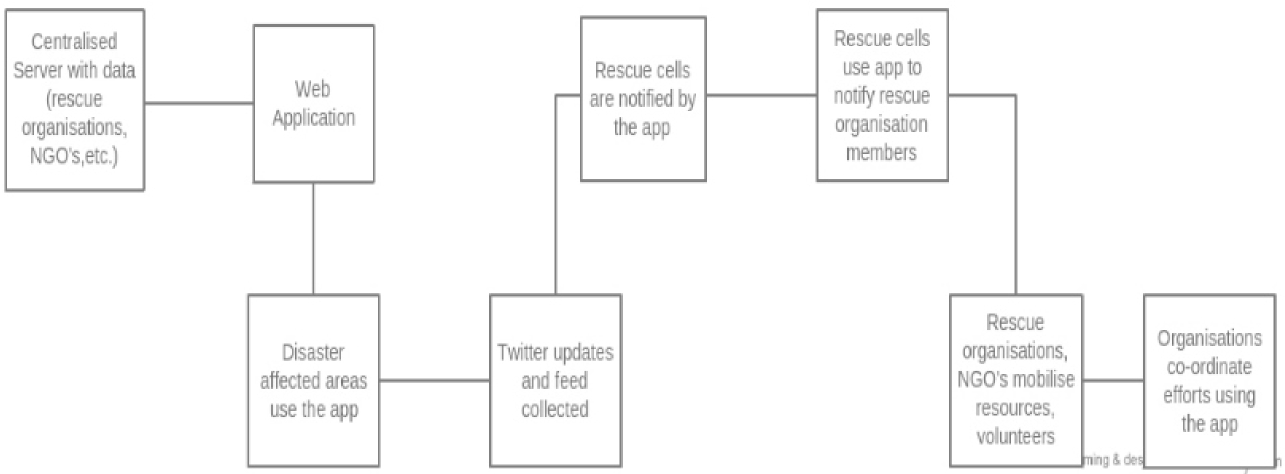
The Federal Emergency Management Agency has a wireless crowd sourcing disaster-recovery information services with an application that lets users pinpoint damage using their smart phone's GPS, and also provide a detailed report of disaster to help the government plan the recovery. We include the same features and also plan on including a bluetooth/wifi beacon system to ease up the rescue of people stuck under debris.

Literature Review

There are often insufficient emergency workforces to gather situational information during a disaster, the crowd sourced data can offer a additional means for data collection or dissemination immediately after the event. In addition, this can help to empower citizens with their involvement. During the 2010 Haiti earthquake, crowd sourced data was first used to generate a web map application to help the humanitarian effort. Citizen participation in emergency response has been active through social media in recent years. The *National Journal* reported that more people turn to social media like Twitter or Facebook as a communication tool during an emergency (Hatch, 2011). Twitter, in particular, has already proven its communication speed in past emergency events like the Southern California wildfire in 2007 and the Mumbai terrorist attack in 2008 (Hughes & Palen, 2009). The USGS experimented with earthquake detection on Twitter and found that it was faster relaying the event than a scientific alert (Earle, Bowden, & Guy, 2012). Social media's speed advantage allows humanitarian efforts. Using social media, some citizens in disaster affected areas started to communicate with people in the outside world almost immediately by sending out help requests for supplies or immediate rescue. Zook, Graham, Shelton, and Gorman (2010) analyzed information technologies (ITs) used for relief effort in Haiti including Crisis Camp Haiti, OpenStreetMap, Ushahidi, and GeoCommons. Their findings revealed that it was effective way through a noticeable difference in the work of relief and aid agencies without actually being physically present in Haiti (Zook et al., 2010). The World Bank (2012) reported that Open source portals, such as the Ushahidi-based sinsai.info, are important tools that allow requests for help from local people to be logged and acted upon.

Operations

- The initial phase of the system deals with the determination of parameters which need to be collected from various rescue/rescue related organizations such as Police, Hospitals, Blood Banks, NGO's and Volunteer Groups.
- The Data Collection is done by getting various organizations to register with us, on registration they have to provide their working capacity. Such data can be used as a central contact hub.
- The Web Application and Android Application are developed with the centralised server holding all the database data and communicating with both the application so that intercommunication is maintained between both platform users.
- After a disaster when the network is back, The volunteers, rescue cells (and the police) use the mobile app to notify (SOS) the administrator.
- The administrator (a domain expert) is notified of the number of sos originationg from an area, and the number of social media posts that stand as evidence for the reported SOS.
- The Administrator thus Approves/Rejects based on the legitimacy of the report, After which all the registered relief organizations in that area are notified automatically
- The Volunteers/rescue personnel involved also send detailed report with images and description, this data is available to all the relief organizations to understand the situation better.
- Certain features of the Mobile application can be utilized even when there is no network, Provided the user has network in that area at least 3 hours before disaster (offline storage).
- When offline the user can get his nearby relief organizations contact details, location on map, and also the working capacity.



Workflow

Figure 1: Workflow of the application explained above

Organisation Data

In order to keep track of capacity of various relief organizations each organization registered with us need to update their operational data every 3 months,

For this the device Data model is

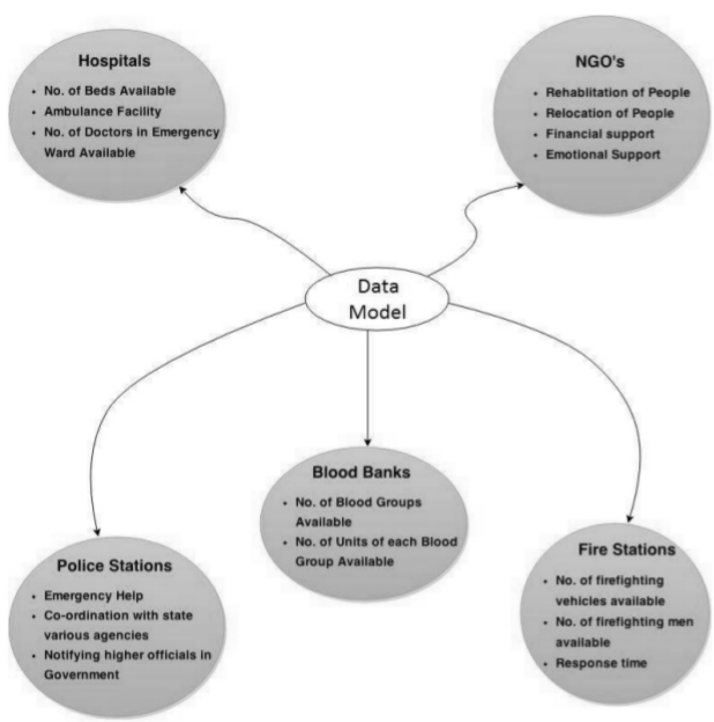


Figure 2: Simple Data Model of different types of registered Organizations

Planned Features

- Allow organizations to seek help and resources from other organizations. At times of disaster supplies like medicine, food run out quickly, so we provide a portal for the organizations to post for medicines, assistance in other matters so that all organizations can co-ordinate with each other and work more effectively.

- Live updates of resources and rescue personnel in an organization. This is to let the notify the NGO's and volunteers stay updated on which hospital to divert the injured people to so as to avoid overcrowding at one hospital.

- Assign Volunteers to work with various organizations. People in the area who are unaffected can choose to volunteer, such people put their agreement to volunteer through the app are recruited by various organizations to improve the workforce.

- Wi-Fi/Bluetooth Beacon system to help rescue people under debris. When people stuck under debris, it is difficult for the rescue personnel to identify their location with dogs or wait for some advanced tech to detect life forms under the debris. So after a disaster if anyone stuck under debris can reach out to their phone in their pocket and activate this, the rescue personnel can roughly locate them under the debris based on the signal strength.

- Provide an offline Safety information database based on possible disasters at the user's location.

Conclusion

As opposed to current way of managing the disaster individually by each relief organizations this provides a unified database of all relief organizations, occurred disasters to study and improve the response activities. And keep track of the supplies that were required during previous disasters. The app also helps the organizations to dispatch their personnel to affected areas with a better understanding rather than to march in with some hard assumptions. Thus achieving better resource utilization. The users/people with the mobile application have access to organization information in their locality and hence can help the injured to get to the relief organizations.

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DETECTION, ANALYSIS, AND MANAGEMENT OF ATYPICAL BEHAVIOR OF PEOPLE IN CROWD

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Abstract

Detection, analysis and management of atypical behavior of crowds & individual (s) in public gathering is a crucial component for managing mob's reactions. Public gathering may range from simple, nonviolent protests to mob or violent crowd and a peaceful gathering can turn in violent crowd by triggering a single cause or a combination of causes. These gatherings also provide antinational elements the prospect of high impact attacks, with large numbers of casualties. *Thus security agencies needs to identify such individuals or groups within crowd who may have intention to cause disruption, violence, killings, destruction of properties, and violence at large scale. In light of this the present study attempts to identify behavioral markers of such vulnerable individual who can violence in gathering. The study also attempts to develop crowd behavior analysis software for automatic detection of these behavioral markers. These results of the study will help Security Forces to understand the behavioral pattern and vulnerability of the crowd, which further will help them to evolve suitable crowd management strategies. Based on the data of 779 security officials, a set of 108 markers was identified. The factor analysis clustered these markers in four domains consist of 14 factors. The four domains are Characteristics of Gathering, understanding the aim of gathering, Triggers for violence, and suspicious behavior. Using regression analysis the factor provocateur was found to be the most important predictor of mob behavior with 41% variance in mob behavior.*

The decision support system i.e., crowd behavior analysis software for automatic detections takes into account an online images of the crowd and provides an analysis of following markers: Detect the density of crowd; Speed of crowd; Merging and separation of people from the crowd; Person with violent materials like sticks and rods; Leader of the group; Person being followed; Direction of crowd and Noise level raised by crowd as a vulnerable marker. The results indicate 70 to 98 percent of accuracy in prediction of behavior of people in crowd according to set parameters. Further researches in this area can be augmented to use other behavioral markers for expanding the scope of the system.

Key Words: *Crowd, Mob, atypical Behavior,*

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Introduction

Gathering of people is a common practice and can frequently be seen at *religious places, shopping malls, cinema halls, hospitals, railway stations, or any other public and private places.* Although, each and every persons have the right to march, demonstrate, protest, rally, or assemble peacefully to perform other activities but with the condition of without arms. This fundamental right is protected under The Right to Assemble - Article 19(1) (b), Constitution of India. It is true that most of the participants are law-abiding citizens, who intend that their protests be nonviolent. But when it involved individuals particularly youths with malicious intent or hooligans, than the chance of violence in these gathering becomes too high. *In the present scenario day to day protesting in Delhi, Jammu and Kashmir and North-East area, in India have offered antinational elements the prospect of high impact attacks with large numbers of casualties.* However, it *is not necessary that all crowds disperse peacefully; neither do all crowds necessarily become mobs or violent crowd (Grieger, 2003). In their survey,* Kenny et al. (2001) found that in the United States between the 1960s and 1990s, less than ten percent of protests were only become violent.

Crowd can be define as a large group of people which are bounded by some common interest that can occur for many different reasons and can vary in size and composition. Everyone in the crowd has awareness of the law and willingness to respect the principles of law and order. On the other hand a mob can be define as an assembly which was not unlawful when it assembled, may subsequently become an unlawful assembly. It is characterized by leadership, organization, a common motive for action, emotion, and irrationality (Schweringruber, 2000). In mob, members have lost their concern for law and authority and follow their leaders and other into unlawful and disruptive acts. However, the depth of violence is determined by the willingness of demonstrators to display and voice their opinions in support of their cause.

Researches in the area of crowd have trying to uncovered many potential factors that can cause or triggers violence in crowd. For example, Russell and Huang (1998) found that young, single men tended to be crowd participants most prone to violent behavior. Webb et al. (1995) observed that male dominated crowds have been shown to display more aggressive behaviours in comparison to female dominated crowds. Stott and Reicher (1998) suggest that many times violence happened where the maximum people in the crowd belongs to low socioeconomic status. Similarly Miller (1993) found that racial tension as a frequent trigger for violent crowd behavior. Some studies (e.g., Derlega et al., 2002; Singells, 2000; etc.,) examining collectivist cultures and found that people in these cultures may be more prone to collective violence and confrontation towards their opponents.

De-individuation theory (Festinger, Pepitone & Newcombe, 1952) of crowd behavior explained that, when individuals lose their sense of self-awareness, self-observation, self-responsibility and individualised identity and this leads to unsocialised and antisocial behaviours (e.g., Duval & Wicklund, 1972; Diener, 1979; Diener et al., 1980; Festinger et al., 1952; Mann, Newton & Innes, 1982; Prentice-Dunn & Rogers, 1982, 1989; Singer, Brush & Lublin, 1965; Zimbardo, 1970; Zimbardo et al., 1982). Likewise when individuals believe they have lost their anonymity within a crowd they tend to become more prone to violence (Rehm, Steinleiter & Lilli, 1987; Watson, 1973).

A number of researchers (see McPhail, 1991) agreed that each crowd member is cognitively capable of setting the terms of his or her cooperation with the group's goals. Therefore, crowd behavior is determined by the extent to which a consensus is reached between the rational calculation of the individual members and those of the group. Johnson and Feinberg (1977) and Feinberg and Johnson (1988) found that violence may occur when individual agitators successfully influence other members and direct the goals of the crowd toward violence. They also note that an ambiguity or chaos often causes crowds to be more accepting of violent behavior. Emergent Norm Theory (e.g., Turner & Killian, 1957, 1987), suggests that crowd behaviours are governed by norms which emerge from the distinctive actions i.e., rare actions, such as antisocial behaviours of prominent crowd members. As more members adhere to these norms, they become more influential and pressure to behave in an antisocial manner increases.

Schweingruber (2000) suggest that during the development of gathering, spread of rumors, and can easily convert a peaceful crowd into violent crowd. Some experts (e.g., Diener et al., 1980; Mann, 1981; Mullen, 1986) explain that violence is more likely occur in the dark and in larger crowds. In some situation Intoxication, considered to be a situational moderator of a crowd's and it is also highly influential over the levels of antisocial behaviour within a crowd (e.g., Tomsen, 1997; Moore et. al., 2008). Moore et al. (2008) suggests that increased intoxication is also associated with decreased physical stability of the crowd as a whole, since more intoxicated individuals are more likely to stumble or collide with other crowd members.

Thus the critical nature of such gatherings leads us to address the question of why violent reactions occur in some gathering and not in other, even when all the security guidelines were taken into consideration. Efforts by security forces trying to diagnoses and detect the vulnerability of such crowd often becomes more difficult when these individuals or groups with malicious intent can easily conceal themselves within the crowd. They do not give warnings, have not shown a readiness to use violent tactics, and the majority of their attacks have as a primary intent for deaths of large numbers of people.

Generally to mange or control these crowd, method that have been physical in nature, where force is required e.g., lathi charge, shoot and site, and other lethal & non lethal weapon etc. are used to restrict the movement of crowd or disperse the crowd. For example in India, crowd violence or riots have been declared a crime under Section 146 in the Indian Penal Code, where assembly of five or more people is designated as unlawful assembly. Section 144 of the Code of Criminal Procedure empowers the police to break up such an unlawful assembly, using force if necessary. In India, this is popularly known as curfew and is a fairly common police tactic in the country. However these methods help in crisis situations but don't find a solution. These methods applied based on previous crowd incidents experiences and sometimes present crowd characteristics and other suitable methods are not taken into consideration.

In addition, unpredictably of various form of violent behavior and other leading factors that initiate violence in crowd also leads mismatch between the extent of erupting violence and its management methods for the security forces. In a survey ibid (2006) found that there were 140 occasions in which police had to use deadly fire to control violent mobs and almost 128 civilians and 372 police personnel were injured during these incidents. Here it is pertinent to mention that the aim of security forces not only to restrict or control the movement of people in crowd rather their aim is to protect the right of people being democratic country and to influence the behavior of leader/protesting group/crowd in such a way that negative group process and moved in a less destructive direction and people go home safely. Thus management of crowd has been become a challenging task for the security forces and it needs to be considered as serious offenses and all efforts are made to handle them expeditiously and properly.

These issues have challenged law forcing agencies to develop new strategies for maintaining peace as well as new training programs to facilitate these strategies. Thus therefore analyses of crowd behavior, its markers to the extent of various behaviors including any malicious intent shall guide the security forces to have a risk analysis. Such an analysis shall help the security forces to preempt the suitable strategies, methods and technique to manage the crowd and its action. This shall save lots of life as well as efforts of the security forces.

The project also attempts to develop crowd behavior analysis software for automatic detections of behavioral markers in crowd. These study of markers will help the Security Forces to study the behavioral pattern of crowd and these will help to understand the evolve Strategies for management of crowd and mob.

Method

A total of 779 security officers (age between 37 to 56 years) from various state police, military/paramilitary forces and other organization, who had minimum 3 to 4 years of experiences in crowd management participated in the study. Open-ended questionnaire and the battery of audio-video footages of crowd and mob are used as tools for data collection.

Procedure

The present study was carried out broadly in two stages. In stage-1 a list of 180 markers of crowd behavior was prepared on the basis of literature reviewed and expert's opinion. All the markers in the list were classified in four domains i.e., characteristics of gathering (Domain-1), understanding the goal of gathering (Domain-2), variables that triggers violence (Domain-3), and behavior or activity of suspicious individual (Domain-4). In stage-II security officers were asked to encircle their choice for enlisted 180 markers in Crowd Behavioral Markers List (CBML) based on their experiences of handling different types of crowd on a 5 point rating scale form strongly disagree (1) to strongly agree (5). The collected data was subjected to factor and stepwise regression analysis.

Results & Discussion

Factors that Make a Crowd Violent

Factor Analysis: Factor analysis was carried out by using Principal components method of factor extraction and the obtained factors loadings were rotated in accordance with Kaiser's (1958) criterion of varimax rotation. The acceptance of number of factor was decided by the researches on the basis of Screen Test criterion (Cattell, 1966).

Domain-1: Characteristics of Gathering: In the first domain three factors were extracted and all the three factors accounted for 37.74 percent of the variance. These three factors are:

Mob: (Factor-I, Variance-22.20%): This factor structure define that in this type of gathering, people shows aggressive behavior, hold violent material, make noise, and often dominated by young. The participants frequently seem try to disrupt the normal situations around them, try to damage and destruction the civil and govt. properties, act against law and order and seem out of control. Most of the individuals had no self motive and they just follow others without any reasoning. This type of gathering needs little triggers for violence. A number of earlier studies, (e.g., Brown, 1954; Momboisse, 1967d; Schweringruber, 2000; Shuttleworth & Flower, 2000; Jane's Facility Security Handbook, 2000; Young, 2010) also suggests that members of mob have lost their concern for law and authority and follow their leaders and other into unlawful and disruptive acts.

Casual Crowd: (Factor-II, Variance-8.03%): 2nd factor, characterized such a crowd who always transitory in nature, influenced by the presence or absence of leadership, avoid direct confutation, work on their agenda and always try to attempt not to be seen by others. This type of crowd requires substantial provocation to stimulate violence. According to Jane's Facility Security Handbook (2000) in casual crowd people has no common interest or purpose, having extremely low emotional level and they see themselves as individuals or personal groups. Yang (2009) also suggest that casual crowd has no unity of purpose and no leadership, i.e. shoppers, on-lookers, or watchers who come and go, and will usually respond to direction by police.

Cohesive Crowd: (Factor-III, Variance-7.51%): This factor structure demonstrate that a gathering of 10 people can be a crowd whose members are standing in close proximity at a specific location who feel united, work collectively and acted in unison with each other to achieve the group goal. According to Jane's Facility Security Handbook (2000) cohesive crowd refers to the crowd with a defined purpose and possesses intense internal discipline and often displays high levels of emotional energy. This type of crowd requires little provocation to stimulate violence. Berlonghi (1995) suggest that a crowd which shares a sense of social identity and cohesion is more likely to act as a united group and, therefore, may react against opposing groups.

Domain-II: Understanding the Aim of Gathering: In the present domain, 2 factors were and both factors accounted for 42.46 percent of the variance.

Composition (Factor- I, Variance- 24.43%): This factor demonstrates that the profile of participants, cause, size of crowd, history of venue, and nearby available facilities play an important role to determine the futuristic action of crowd. If any gathering consisting maximum youth, having criminals, availability of violent materials, assembled for emotional cause, having sufficient in number, venue who had history of violence than the probability of violence crowd is become very high. Stott & Adang (2005) stated that characteristics of venue and size of crowd are found associated with higher levels of violence. For instance some places experience more violence than others, some bars experience more fights.

Exhibit (Factor-II, Variance- 18.03%): This factor demonstrated that the probability of violence in any gathering becomes high, when participants exhibit their demands with prompt material (e.g., instigative or abusive language, written slogan on hoardings, banner and other material, etc.). This type of behavioral manifestation has direct influence on gathering and as result gathering can take shape of violent crowd. For example when people gather in front of authority and starts slogging and obscene language with black flags or ribbon against authority than they will make more impact on crowd as well as on authority.

Domain 3 Variables that Triggers Violence in Crowd*:* Following the criterion, 5 factors were accepted for the 3rd domain. All factors accounted for 48.44 percent of the variance.

Provocateur (Factor-I, Variance-14.46): Provocateur refers to when any individual intentionally *by* verbal-non verbal behavior provokes others to commit a wrong or rash action or to commit a specified or desired action. For example often leader provoke or raise a reaction or emotion gathering, by playing with their sentiments. For this he can use religion, cast, language, shows of weapon, hooting against particular religion and cast, *etc. to* provoke other for violence. Noise itself becomes a trigger for violent behaviour. Researchers found that noise and unpleasant scenes appear to act as intensifiers in an already tense situation and play important flashpoint for crowd towards violence (e.g., Krahe, 2001; Geen & O'Neal, 1969; Rotten et. al., 1979). Russell (2004) suggests that extreme noise levels increase the likelihood of interpersonal aggression.

Physical Condition (Factor-I, Variance-9.85): This factor demonstrates that apart from density, temperature (weather), alcohol, scent and several other physical contribute in the triggering of violence in crowd. For example crowd density influences the behavior of people and critical crowd density can lead at worst to crushing, injury and even death of people in gathering. Anderson and Anderson (1998) suggest that hot temperature is related to an increased amount of riots and of crime rate. They stated that most of the riot happened in summer than in winter. Some experts (e.g., Diener et al., 1980; Mann, 1981; Mullen, 1986, Webb, Neale & Phillips, 1995; Knight, Fabes & Higgins, 1996; Wann et al., 2003; Young, 2002) stated that the violence in crowd is more likely to occur in night and A majority male particularly young and single men dominated the crowd. It was also found that groups who include teenagers/young people are relatively more actively involved in violent activity than rest of the crowd.

Socio-Economic *(Factor-I, Variance-*9.14*):* This factor represent *that crowd* violence occurred in every century and every region of the world and these have been attributed to poverty, hunger, unemployment, strikes, and industrial disputes, religious and ethnic differences. They suggest that when the frustration of people becomes high, it takes a small (seemingly minor) incident, rumour, or act of injustice to ignite groups within a crowd to riot and act violently.

Situational (Factor-I, Variance-7.54*): Situation refers to a* set of circumstances like when authority or police use forces against woman and child or a state of affairs increase the chances of crowd to become unruly. *Sometimes* women and children have often been used as a barrier in civil disturbance operations by the crowd or other leader. With the innocent and the weak directly facing authorities, aggressive and violence-prone individuals or groups behind them attempt to provoke authorities to react.

Retort (Factor-I, Variance-7.46): This factor structure define that when any govt. or security agencies try to disperse crowd by force and show negative attitude towards public then the probability of crowd to become violent is high. Finding of several studies also suggests that if the police perceive the whole crowd to be troublesome whereas the crowd perceive themselves to be peaceful protesters conflict is more likely to result in violence (e.g., Drury & Reicher, 2000, 2005; Drury et al., 2003a; Drury, Stott & Farsides, 2003b; Drury & Winter, 2004; Waddington, 2007).

Domain-4 Behavior or Activity of Suspicious Individual: In this domain a total of 4 factors were accepted. All the 4 factors accounted for 39.01 percent of the variance.

Snooping (Factor-I, Variance-13.07): According to this factor the person may be suspicious if he/she is not actually using the transient system put in place or avoiding the entry gate or ignoring the elevator system and follows the wrong path like jump on wall. On who probes the boundary, taking pictures or video of facilities, buildings or infrastructure, security related equipment (perimeter fencing, security cameras), or one who makes drastic and sudden change in their appearance *to conceal their identity is also come under suspicion*.

Panicky Factor (Factor-I, Variance-9.27): This factor explains that during the execution phase of violence or criminal activity the executor show several leakages in their nonverbal behavior (NVB). However the person will perform certain action in order to minimize the visibility of these signs of NVB which will create another set of suspicious behavior. For example the person who come from outside to conduct a criminal act will try to look like or try to mix-up with the target population. But out of his conscious by naturally if they were brought up in a crowded city, they might feel comfortable in close contact with others; whereas a person who came from less populated country, might need a little more personal space to feel comfortable.

Extended Behavior (Factor-I, Variance-9.24): This factor demonstrated that the person may be suspicious one who stands at transport terminals *while buses and trains come and go* or sitting in a telephone booth and carries long conversations *for an extended period of time* is an indication about the malicious behavior of person. The person also come under suspicion if he/she stands at undesirable place, scratches or writes something and disturbed the equipment.

Escaping Behavior (Factor-I, Variance-7.43): This factor structure define that the person comes under surveillance if he/she if *he*/she tries to hide in darkness or behind objects or try to duck in a crowd by shrinking his body or attempt to keep from being clearly seen avoid uniformed personal, avoid security equipments and he/she does not argue with other and stand at a distant from crowd.

Multiple Regressions

Step wise regression equation for mob (Dependent Variables) was worked out to predict its vulnerability towards violence on the basis of Compositional (Co), Exhibit (Ex), Provocateur (Pr), Physical Condition (PC), Socio-Economic (SE), Situational(Si), Retort (GA), Snooping (Sn), Panicky (Pa) , Extended (Ext) , and Escaping (Es). The results of step-wise regression analysis are summarized in Table-10. A perusal of results in Table-10 indicates that stepwise analysis permitted entry to five i.e., Pr, Ex, Pc, SE, and Si out of the eleven predictor variables, which contribute significantly to the prediction of vulnerability in mob behavior.

Provocateur is a measure of triggers for violence in Crowd, entered the equation at step-1. The multiple R for this variable's entry at step-1 is .64 (F-to-enter =18.23, $p < .0001$, df=1/256). It suggests that 41.3 percent of variance in Mob is attributable to Pr. This finding clearly suggests that Pr in the Mob behavior is the most potent predictor of converting it into unlawful, destructive and violent condition. With the entry Ex at step-2, the multiple R increased to .67 (F-to-enter = 13.54, $p < .0001$). The multiple R square at this step being .44, means about 44% of the variance in mob behavior is accounted for by Pr and Ex jointly. It may be noted that Ex contributed 3 percent of variance in Mob behavior in addition to that already contributed by Pr.

Table-1: Summary of Stepwise Regression Analysis

Variable	Step	Multiple R	Multiple R-square	R-square Change	F - to enter/rem	p
Pr	1	.64	.41	.41	18.23	.01
Ex	2	.67	.44	.03	13.54	.01
Pc	3	.68	.46	.01	6.20	.01
SE	4	.69	.47	.02	7.69	.01
Si	5	.70	.48	.01	4.02	.05

Final Statistics

R	R^2	Adjusted R^2	F	Std. Err.	p
.71	.50	.48	6.77	22.20	.001

Analysis of Variance

	Sum of Squares	df	Mean squares	F	p
Regression	11185.614	11	1016.874	22.198	.001
Residual	11268.917	246	45.809		
Total	22454.531	257			

Variables in the Analysis

[

Variable	Std. BETA	B	Std. Err. of B	t	P
Intercept		16.47	3.25	5.06	.001
Pr	.54	.56	.07	7.42	.001
Ex	.21	.42	.12	3.62	.001
Pc	.20	.28	.10	2.84	.001
SE	.18	.30	.12	2.59	.01
Si	.15	.31	.13	2.41	.02

With entry of PC (F-to-enter= 6.20, p < .01), the multiple are increased to .68 at step 3, indicating there by that .46 percent of variance in Mob is accounted by variables i.e., Pr, Ex, and PC. At step-4, SE entered in the equation with F-to-enter 7.70 (p <.01) as result multiple R increased to .69, indicated thereby that 47 percent of variance in Mob is accounted for by four predictor variables i.e. Pr, Ex, PC, and SE. The F-to-enter for Si variable at step-5 is equals to 4.02, which is significant at .05 probability level. With the entry of Si the multiple R increased to .70, indicated thereby that 48 percent of variance in Mob is accounted for by five predictor variables i.e. Pr, Ext, PC, SE and Si.

The equation terminated at step-5, because after that none of the other measures contributed significantly in addition to that already predicted by Pr, Ex, PC, SE, and Si. It is pertinent to mention that R square contributed by the five predictors (.48) is in well match of adjusted R square (.48). This findings point to the fact that obtained estimate is as to the parameter (population R square).

The regression equation for these five predictors may be written as under:

General linear equation:

$$Y' = a + b_1 X_1 + b_2 X_2 \ldots\ldots. b_k X_k$$

Where Y is the predicted value of Y´, the dependent variable; 'a' is the constant i.e., value of Y when all Xs are zero; b_1 to b_k represent regression coefficients; and X_1 to X_k represent the scores on independent variables.

$$a = \bar{Y} - [(b_1 \bar{X}_1) + (b_2 \bar{X}_2) + \ldots\ldots\ldots (b_k \bar{X}_k)]$$

Predicted equation:

$$a = \bar{Y} - [(b_{Pr} \bar{X}_{Pr}) + (b_{Ex} \bar{X}_{Ex}) + (b_{PC} \bar{X}_{PC)} + (b_{SE} \bar{X}_{SE}) + (b_{Si} \bar{X}_{Si)}]$$

$$Y' = a + [(b_{Pr}X_{Pr}) + (b_{Ex}X_{Ex}) + (b_{PC}X_{PC)} + (b_{SE}X_{SE}) + (b_{Si}X_{Si)}]$$

$$a = 57.38 - [(.54\times 6.88) + (.21\times 23.26) + (.2\times 33.39) + (.18\times 24.7) + (.15\times 21.76)]$$

$$Y' = 61.24 + (.54\, X_{Pr}) + (.21\, X_{Ex}) + (.21X_{PC)} + (.18X_{SE}) + (.15X_{-Si)}$$

Using above equation once score on mob can be predicted by entering its score on the measure of Pr, Ex, PC, SE and Si into the equation. The predicted score is likely to deviate with limit of ±43.51 (SE=22.20), from the obtained score with 95% confidence. It may be noted that with one unit change in the predictor i.e. Pr, Ex, PC, SE and Si the dependent measure of triggers to turning a crowd, records a corresponding change of .54, .21, .20, .18 and .15 units respectively.

Crowd Behavior Analysis Software (CBAS)

In order to understand and analyze the identified crowd behavioral markers, a Crowd Behavior Analysis Software (CBAS) has been developed. The CBAS was designed to help the security forces in making their decision of vulnerability of crowd. With the help of experts, initially feasible markers were selected for simulation for initial prototype trial. The decision support system takes into consideration online images of the crowd and provides an analysis of markers. These markers are: Crowd density head count based; Crowd density regional based, Crowd flow (speed), Crowd flow (Direction), Groups in crowd, crowd groups merging and separation; suspicious group with sticks; suspicious and malicious individual in zone intrusion, suspicious and malicious individual hiding behind the object, suspicious and malicious individual evasive behavior, Leader detection and Noise level raised by crowd as a vulnerable marker.

Validation of the CBAS: For the validation of simulated marker and to check the performance of developed software, Video generated by the researchers, live recorded data available from different sources and standard international videos available within public domain are used. Out of all the available data sets only those videos consider which are similar to our criterion of markers and then on those videos validation process has been observed. **Conclusion:** It has been found that the performance of the each marker is more or less same for the all available videos. There is no drastic variation has been observed for each markers for both the types of videos. The results indicate 70 to 98 percent of accuracy in prediction of behavior of people in crowd according to set parameter.

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RISK MANAGEMENT STRATEGIES
TO AVOID STAMPEDE AT MASS GATHERINGS

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Abstract

In the past few years, there are recurring stampedes at places of mass gatherings (religious places, railway stations, sports/political/social events). Infrastructural capacity poses a challenge in such places. At these places, extreme high density may result in crowd disaster (stampede, trampling and suffocation). It has been observed from the past crowd disasters that these places have inadequate risk management strategies, especially in India. Therefore, developing strategies for risk aversion is essential. The suggested strategies not only provide the way for better crowd management, but also for determining suitability of the venue for an event, better route guidance to avoid congestion and finding the pinch points (high risk points). Finally, an overview of pedestrian simulation is presented that can help in developing more strategies for safer events.

Keywords: *stampede, risk management, pedestrian simulation, safety*

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Introduction

Crowding is a phenomena when large number of people gather in a given area. In case of mass gathering (events, festivals, and religious places) people often gather in greater density, which poses a great challenge on infrastructural capacity. This extreme high density may result in crowd disaster (stampede, trampling and suffocation). Stampede is particular instance of crowd disaster. 'Stampede' is derived from a Mexican-Spanish word 'estampida' which means 'uproar'. Stampede is defined as "an act of mass impulse, which occurs in times of massive flight or massive craze response" (Chukwuma and Kingsley 2014). Stampede may result in injury, loss of life, structural damage and also material loss. Table 1 shows the past incidents of stampede which happened at various places.

Stampede has become one of the mass killing disaster, particularly in Asia and Africa (due to population increase). There are mainly three reasons for stampede to occur at a particular place: competitive advantage, safety, and system failure (includes factor related to poor crowd management, poor event management, and improper utilization of space). Table 2 shows the particulars about the human stampedes. Helbing states that (Helbing 2015) "There is the common misconception that crowd disasters result from a psychological state of panic that causes a stampede of people… This absurdity shows that we still have totally misleading ideas of the causes of crowd disasters, and that is also why they happen time and again." As per him, when crowd density reaches a particular threshold value, body contact cannot be avoided anymore. This results in transmission of force from one body to other and this force adds up causing disaster.

Table 1. Past incidents of stampede

Year	Place	Reason	Casualties
1883	Victoria Hall (Britain)	Free toys distribution causes stampede	180
1989	Hillsborough Stadium (Britain)	Local police decided to open the stadium gates in already full	249
1990	Hajj (Mina, Mecca)	Overcrowding	1426
2008	Chamunda devi temple, Jodhpur, Rajasthan (India)	Stampede due to false rumors of bomb	249
2010	Phnom Penh (Cambodia)	Suspension bridge went way over capacity	450
2013	Ratangarh temple (India)	Stampede at bridge	89
2015	Hajj (Mina, Mecca)	Overcrowding	1859

Therefore, management is required for ensuring that overcrowding condition does not prevails. Managing crowd requires: Effective planning, risk assessment, and emergency procedures (Executive 2000). The objective of this study is to develop risk management strategies which will help in minimization of risk related to stampede. Krausz and Bauckhage (2011) presented a modelling based approach to help prevent crowd disaster. They analyzed a video footage from a stampede at the music festival and designed a model for crowd behavior which uses optical field to detect the congestion automatically. Using this model, an alarm is raised whenever there is a high congestion.

Thus enabling the quick identification of critical areas where there is an acute need of channelizing the pedestrian flow. Many image processing (Wu et al. 2006; Guo et al. 2010; A. N. Marana et al. 1999) method have been observed in literature which analyzes the crowd density. A study by Helbing, Johansson, and Al-Abideen (2007) pointed that, extremely high density flows can be turned to turbulent and may cause people to fall. They analyzed the video of Mina/Makkha during the Hajj in Jan 2006 and found out that at 11:53 a.m. the flow turned from laminar to stop and go, and then to turbulent flow. During this time, random and unintended displacements occurred in all directions. This occurred due to strong and rapidly changing force of crowd. A 30 min. stop and go wave was formed which is avoidable, but caused 369 deaths and 265 injuries.

Table 2. Particulars about human stampede

Meaning	Act of mass impulse
Place of happening	Mass gatherings places like religious place, stations etc.
Consequences	Injury, loss of life, structural damage
Reason	Competitive advantage, safety, and system failure Exit
Ways to avoid if stuck	strategy as soon as you arrive: mental note all exit Do not try to resist the crowd Stay on your feet Keep hand on chest and take boxer stance

A great share of literature focuses on monitoring technique for the crowd management. Limited research on developing strategies for risk aversion is there. Hence, it is needed to develop these strategies to deal with the problem in a systematic and analytical way. The rest of the paper is organized as follows. In Section 2, the possible risk management strategies have been suggested and it is shown that how these strategies can help in minimizing the risk of disaster. Section 3 deals with analysis of crowd density and capacity. In section 4, an overview of pedestrian simulation is presented that can help in developing strategies for safer events.

Risk Management Strategies

Crowded condition always possess risk with it. Risk is defined as "the possibility of a person or entity suffering harm or loss" (Chukwuma and Kingsley 2014). At the place of mass gathering various risk which can harm an individual are: overcrowding, fire, gas dispersion, power cuts, accidents, structural collapse, mass illness, and chemical attack. Assessing risk prior to an event is necessary. Risk assessment is defined as "process which involves the identification and assessment of risks to crowd safely within a venue and development of steps to minimize them." (Chukwuma and Kingsley 2014).

Purpose of risk analysis is to find out how, where, and when similar kind of accident happens due to a particular kind of hazard. As per Executive (2000) risk analysis consist of following steps:

- Look for hazard.
- Decide who might be harmed and how.
- Evaluate the risk and precautions.
- Record and review.

Risk analysis helps in finding out activities which can pose risk. It also tells about the field in which precautionary action needs to be taken. Figure 1 shows the framework of managing crowd in case of large gathering for safer events. The strategies to be followed to avoid chances of stampede is presented next. Risk management strategies which can help in reducing the chances of disaster are presented next.

Planning

↓

Assessing risks

↓

Putting precautions in place

↓

Emergency planning and procedures

↓

Communication

↓

Monitoring crowds and review

↓

Figure 1. Managing Crowd to safety (Executive 2000).

Venue Suitability

The foremost task in organizing an event is determining the suitable venue for an event. It is the responsibility of an organizer to find the appropriate venue for a particular event. The selection of venue depends on the projected number of visitors expected for an event. This number can be calculated by online registration, past events analysis etc. On the basis of projected number, a venue which can accommodate them comfortably should be chosen. If actual number of visitors exceeds the capacity of venue (details in section 3), it may lead to overcrowding which in turn may result in crowd disaster.

Thus it is essential to check the capacity of a venue for an event. Kaitsuji and Hokugo (2012) analyzes recent crowd disasters and pointed out three factors for venue suitability: projected number of visitors, venue space use plan, and flow of crowd in access routes. Figure 2 illustrate the way of selecting a venue.

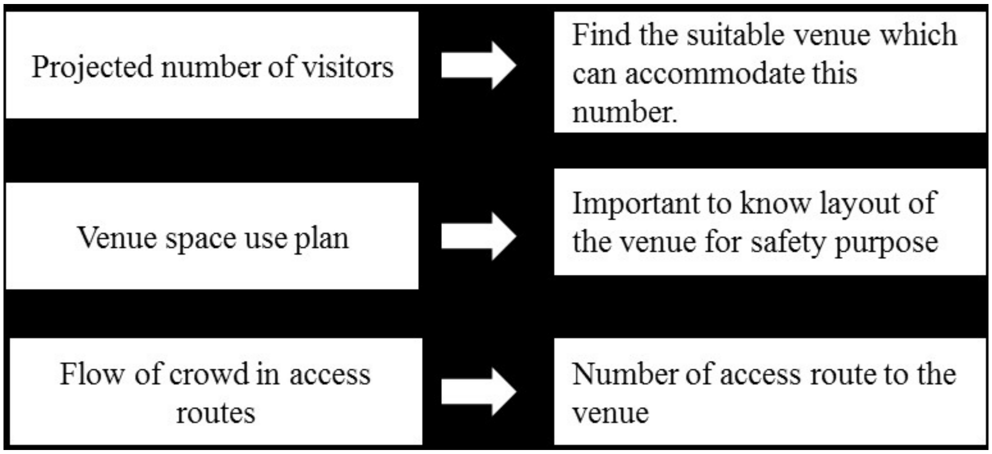

Figure 2. Venue suitability factors (Kaitsuji and Hokugo 2012)

Crowd Management and Control

As life standard increases number of gatherings also increases, due to which management is no longer an option but becomes a necessity. Safety must be paramount issue in such events not the profitability. The safety can be ensured by managing crowd properly. Nowadays, researchers have shifted their focus on developing effective crowd management procedures to avoid risk.

Crowd management includes: planning an event, training of employee for better crowd management and collecting data (Anna, Abbott, and Geddie 2001). It also includes good communication, effective signage, and finding appropriate number of security personnel. Figure 3 shows the factor to be considered for effective crowd management.

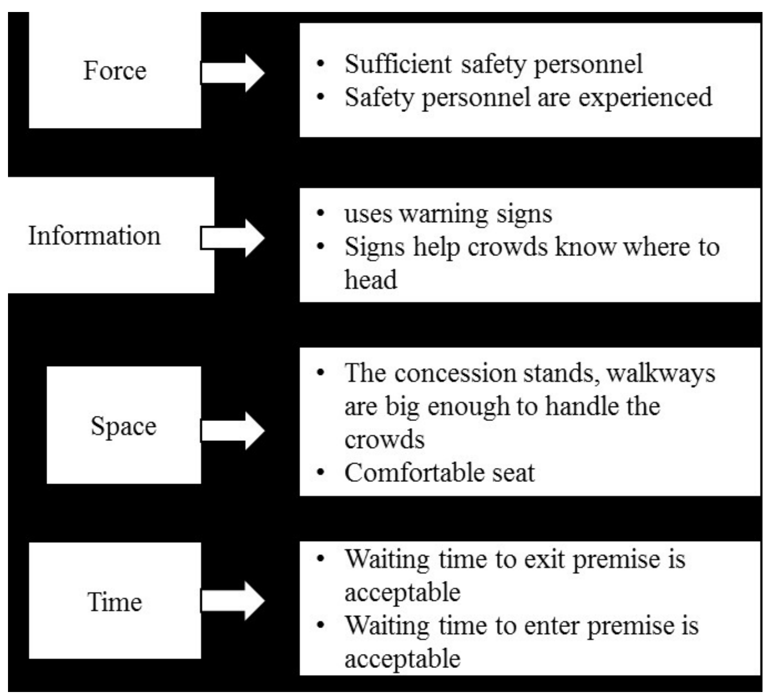

Figure 3. Factor for crowd management (Rahmat et al. 2011)

On the other hand, crowd control includes the procedure needed if crowd loses its control. It is a process of "creating situation models and decision-making processes needed for the successful direction of equipment and manpower" (Anna, Abbott, and Geddie 2001). If there is effective crowd management then crowd control will not be needed.

Emergency Planning and Procedure

Most of the stampede happens due to loss over crowd density (overcrowding). There are also some stampedes, which happened due to emergency situations like fire, bombing rumors, gas dispersion, power cuts etc. Evacuation is a common strategy for handling these situations. People look for exits desperately. In case of evacuation, two important decisions have to be made when to evacuate and where to evacuate. If people are free to choose their route then they will only choose familiar routes and destinations. Due to this, pre-congestion may occur which can result in network gridlock and hence crowd disaster (Afshar and Haghani 2008). An efficient routing plan is essential because of unusual surge in travel demand and scarce network supply.

Routes available in the emergency area are generally limited in number and insufficient in capacity, thus, causing delay. This delay may range from problematic to disastrous. Therefore, evacuation planning is required in order to be prepared to combat disaster. As per Stepanov and Smith (2008) the evacuation process consists of the seven phases illustrated in Figure 4.

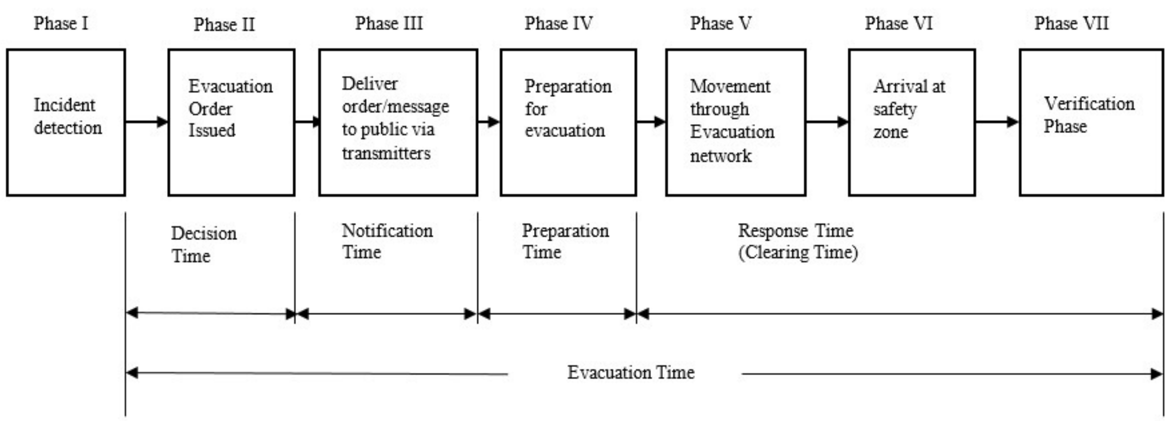

Figure 4. Evacuation process phases (Stepanov and Smith 2008)

A preconceived plan can be immediately put into action which will help in saving many lives. To make an evacuation plan, one needs to study the movements of pedestrian and their interaction behavior with others as well. Preventing crowd disaster includes simulations of movements (pedestrian flow direction) and human behavior in crowds. Details about simulation are given in section 4. Apart from evacuation plan, there should be adequate number of emergency exits, so that all the occupants' must exit in a desired time. A methodology is shown in G. Keith Still (2000) that how to find out the number of exits required for achieving a given evacuation time.

Role of Technology

Risk of stampede can be avoided if appropriate actions are taken by analyzing the behaviors and movements of crowd. There are warning sign for stampede. If appropriate actions are taken beforehand, many lives can be saved and disaster can be avoided. One such action is tracking and monitoring the movements of crowd. This can be done through close circuit televisions, smart phones, Wi-Fi etc. Particularly for religious places, devotees are generally not familiar with the layout of the religious place thus tracking can help in guiding them (if they are lost in crowded condition). Monitoring can also help in congestion management and health condition of devotees (Kulkarni and Shah 2015). Apart from monitoring and tracking, technological instrument (like sensor) can also help in detecting the explosive material, if present in a given area (Yamin et al. 2008). CCTV can also help in calculating crowd density in real time (A N Marana et al. 1998; Wu et al. 2006). These technical instruments (CCTV, sensor, RFID etc.) are useful in managing the crowd safely and avoiding risk of overcrowding. This section presents strategies which help in avoiding the possibility of disaster. These strategies tackle the qualitative risk factor, but there is also a need to consider quantitative risk (CabinetOffice 2004). The problem should also be considered in an analytical way. In the next section, it is shown, why calculating capacity of a venue is important and procedure for its calculation. It is also shown, what are the warning signs for a crowd disaster.

Crowd Capacity and Crowd Density

There are two parameters which can be found analytically for managing the crowd to safety: crowd capacity and crowd density. Crowd capacity is related to maximum number of people allowed in a venue without any risk while crowd density is related to number of pedestrian per meter square of an area.

Crowd Capacity

Capacity is related to maximum number of people which can be allowed in an event without any risk. In other terms it can be stated as maximum attendance limit to an event. Finding capacity for a venue is of uttermost importance. If actual number of visitors exceed this capacity then it may lead to crowd disaster. It is the basis for selecting a venue. The factor to be considered for calculating capacity are: event related (type of event; duration of event), dynamics of crowd, space for movement, egress and evacuation process, crowd behavior, physical area. Green guide (Dcms 2008) is a guide for managing events in stadium, it gives way to calculate capacity of a stadium. It says that four factors need to be considered for calculating the capacity of a venue: time it takes to enter the venue, time it takes to get out from the venue, accommodation capacity, and emergency evacuation time. Overall capacity is minimum of these four.

The correct way to find the total capacity of a venue is adding capacity of all the sections in that venue (refer green guide). The benefits of calculating capacity are: Safety of visitors, profitability and effective evacuation. On the basis of evacuation capacity we can find out the number and width of emergency exit required. Assume capacity of a venue as C pedestrian per meter square, exit flow rate as F pedestrian per meter per minute from exit during evacuation.

It is required to evacuate the area in 3 minutes then:

$$\text{Total exit width required is} = C/F*3$$

If width of each emergency exit is w then we can find out the number of emergency exits required. In this way, capacity of venue is beneficial in avoiding risk of disaster. If number of visitors arrived is more than capacity, then in no case they all should be allowed to enter the venue.

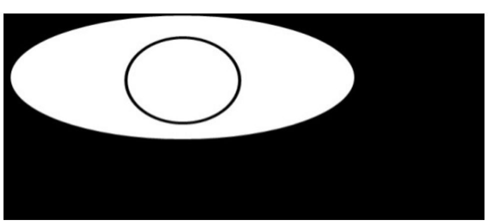

Figure 5. Average size of a pedestrian (Oberhagemann 2012)

Crowd Density

Crowd density tells about the status of crowd, how crowd is distributed (local density), and when are the chances of abrupt behavior with in the crowd. Crowd density is defined as the number of people per meter square of an area. It is significant parameter which is used for security, safety and site management. Main reason for stampede is loss of control over crowd density and lack of attention of over crowd movement. Hence it is essential to develop algorithm to estimate crowd density at different parts of a place in real time. Different methods have been recorded in literature as stated in section 1. Body depth and shoulder breadth are used to calculate the space taken by a pedestrian. Figure 5 shows the average size of a pedestrian used for calculations purpose. Different countries use different values of pedestrian size; for example Indian males have average breadth 45.5cm while 23.50 cm depth.

As density increases there are more number of pedestrians in given area. After a particular threshold density, the body contact cannot be avoided. The voluntary movement of pedestrian is now converted to force movement. This force movement will give rise to formation of pressure wave. This external pressure prevent muscle contraction (of diaphragm) from occurring due to which person can no longer breathe. This may give rise to suffocation conditions (Oberhagemann 2012). Some persons may also fall due to instability, which may result in trampling.

Pedestrian Simulation

Planning of mass events is very difficult as organizer does not know beforehand how many people will come. In that event too many people might collect in enclosed space. Hence flow patterns and movement analysis is required to find out whether overcrowding condition prevails. This insight to crowd dynamics can be achieved by use of simulation models. It helps investigating crowd movements in comprehensive, dynamic and detailed view. Computer simulation is developed to determine evacuation dynamics. A simulation model should be able to simulate the motion and collective phenomena during the crowd movement situations in different evacuation scenarios. Simulation model works on "what if" methodology. Simulation may help in:

- Evaluating the capacity of holding area.
- Evaluating various crowd evacuation strategies.
- Estimating evacuation time.
- Providing trajectory of pedestrians which may help in identifying the congestion and bottlenecks.

These models differ on space and population characterization. Space may be considered as discrete or continuous and population may be assumed to behave in microscopic or macroscopic way. Simulation is capable of modelling an evacuation process in disaggregated, detailed manner. Benefits of applying simulation models is capacity management, commerce and safety. This simulation model can be applied to: events, commercial venues, stadiums, and public transports (INCONTROL 2015). Hence simulation can help in better evacuation strategies through analyzing different scenarios. Simulation may also help in better route guidance to avoid congestion and finding the pinch points (high risk points).

Conclusion and Way Forward

In the present study, various strategies for risk aversion are presented. It has been shown how these strategies provide the way for better crowd management, better route guidance in place of mass gatherings. It has been shown that both the qualitative and quantitative risk assessment is required. It has also been observed that most of the stampede occur due to overcrowding which must be avoided. The way for preventing overcrowding may be cheap tickets in off peak hours, entertainment before and after an event. Establishing venue capacity may help in avoiding the risk of disaster at first place. An overview of pedestrian simulation is presented which can help in developing evacuation strategies for safer events.

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STAMPEDES ARE COMMUNITY AVERTIBLE CROWD DISASTERS

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Abstract

In crowd management, community participation in building resilience is essential apart from structural reinforcement. Capacity building, participation in works and drills aimed at preparedness, continuous two way information sharing and communication with stakeholders could make the crowd events resilient to stampedes.

Crowd disasters can be averted to a large extent provided there is large-scale community education, involvement and preparation. In most of the crowd events the organizers are overwhelmed with managing the event and not managing the crowd. An analysis of stampedes indicates the basic precautions that crowd event managers and administrators can adopt to handle teaming millions of milling crowds. Crowd is managed by not just policing but scientific study and understanding of the routes and rituals associated with the crowd management. In the climate change context the sudden changes in temperature and rain fall can cause huge impact on the way crowds move or behave.

Scientific principles of crowd management are based on those of flooding water management, catchment area management, watershed management, traffic management and water supply management. Crowd control is like bicycle speed control and stopping movement regulation is like applying brakes to cycle. Crowd measurement, crowd monitoring are the first critical steps of crowd management.

The community dimension behind people gets lost, the moment there is crowding, with policing setting in. Learnings from crowd management at Hajj, World Telugu Conference, Sabarimala, Nasik Kubhasth, Godavari Pushkaram, Tirumala Lord Balaji Darshan, Bhadrachalam Lord Rama Kalyanam, UN CoP11 to CBD, International Children's Film Festival of India, Sammakka SarakkaJatara and Bathukamma floral festival in Hyderabad are presented in this paper. The present study is a presentation on 14 crowd situations and strategy to avert crowd disasters with community participation. It would present how preparedness and drills avert crowd disasters and lack of the same could transform the crowding hazards into stampedes which are crowd disasters.

Key Words: *Crowd Management, Stampedes, Incident Response System*

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Introduction

Blaming the crowds for the stampedes is like blaming the Rain for the Flood, the Sea for the Cyclone, the Sun for the Heat wave and Earth for Earthquake. It does not help. Crowd managers, event organisers and governments need to build resilience: think, prepare and act for the crowds. This is just as we build resilience for the floods, cyclones, heat waves and earthquakes. In crowd management, community participation in building resilience is essential apart from the structural reinforcement. Capacity building, participation in works and drills aimed at preparedness, continuous two way information sharing and communication with stakeholders could make the crowd events resilient to stampedes. Capacity building for crowd management is not capacity building of and by the crowds, but it is for the crowd management. The locus is on the crowd, but the focus of building resilience needs to be outside the crowds, which may arrive later. Going by the Murphy's Principle, 'anything that can go wrong, will go wrong', especially in the case of the crowds, as there are innumerable variables many times the numbers in the crowds which need to be managed. Capacity building and training become the core elements of crowd management. Just as in the case of other disasters, constant drills by the crowd managers are a prerequisite for effective crowd management of any crowding area. We cannot do rehearsals and drills just in time or just after the crowds arrive, as in the case of other disasters.

Modern crowds are mobilised crowds. They are a sequel to the need for display of democratic approval of governance and governmental actions. Even the oldest colosseum (stadium) in Italy which could accommodate around 70,000 people had 76 numbered general entrance gates and 4 unnumbered special entrance gates for the royals. Modern democratic governments and democratic movements test their strength or popularity and contest the opposition with mobilisation activities. While we are studying the crowd behaviour, we need to study the behaviour of crowd mobilisers and crowd managers also. Their motives and their methods need to be studied to capacitate the system which is meant to capacitate them in effectively managing the crowds. The increasing assertion of various identities across the world is also responsible for increased mobilisation of people for festivals and events.

Crowd has time and space dimension as important aspects of aggregation of people. Since 2007 every year we have more than 70 people dying from stampedes in India. Maharashtra and Andhra Pradesh top the list with more than 300 deaths in the 15years (2001-15). World Health Organization defines mass gatherings as 'more than a specified number of persons at a specific location for a specific purpose for a defined period of time'. Many events require well organised temporary facilities or open space for accommodating large number of participants. These are organised holding areas. In the absence of such organised holding areas, emergency response of the community, state or nation may be delayed due to limited access to the location of any incident. In disaster situations, Forsythsays that, social relationship between group members binds them, even if individuals are disparate, provided they share living space in that situation for some time. But those local residents who are not part of the agenda of large gathered crowds may be terribly annoyed and disturbed due to severe traffic delays, litter, increased crime, pollution, epidemics, alteration in landscape and haphazard development of the area in case of mass gatherings.This may become the source of medical emergencies and disasters for the local residents and gathered crowds. In the past, deaths and injuries occurred in all kinds of events and countries. People die in stampedes mostly due to suffocation under the high pressure of up to4500N/m on their chests generated by the push of the crowd which is also called as crowd crush resulting into stampede.

Developing countries are more vulnerable to stampedes during mass gathering events, with manifold higher fatality rate than in the rest of the world as their systems and standards of construction are ineffective in practice. Their stage of economic development does not allow them to invest in temporary religious crowd destinations which attract annually millions of pilgrims. The deadliest three human stampedes in the world over in this century include the stampede in Hajj in 2015(1800 fatalities from 28 countries), Baghdad during a religious procession in 2005(965fatalities) and Mina Valley during the annual Hajj in 2006(380 fatalities). Theoretically "shared identity in an emergency crowd enhances expressions of solidarity and reduces 'panic' behaviourand such a shared identity can arise from the shared experience of the emergency itself".But shared identity is not instantaneous. It takes some moments before they experience their shared identity.

Methodology

Apart from analysis of past crowd disasters, 14Case studies of various religious and non-religious crowd management incidents in which the author was personally involved are presented in this paper. It presents both abilities and inabilities of crowd management leading to avoidance or occurrence of stampedes.

Crowd Disturbance in a Stampede

The crowds in religious mass gatherings are heterogeneous by age and physical conditions, they are present as families and small groups, assembled for a common purpose. On exposed to risk, the crowd may respond as a pack. The mass frenzy may force crowds to be irrational. The seed of crowd disturbance thus germinates amongst a few individuals who may adopt irrational escape strategies, ultimately disrupting crowd movement and spreading the perceived danger in the absence of mass exit. Whenever there are limited options of exit, the physical pressures build up for space. Dr.Schreckenberg analysing the Duisburg Love Parade stampede in Germany in 2010, says that the stampede was an inevitable outcome when the participants had limited options for movement in a closed tunnel. It is an involuntary response to physical pressures rather than decision-making. When individuals get packed together with no physical space between them, they move and swing as a pack in seconds. Rush and surge of people to enter into a special place for better view/participation in the functions results in jostling, suffocation, failure of confining walls, barriers and gates. Accidents occur when there is a collapse of temporary or permanent structures, accidents on bridges or vehicle accidents. Natural or human induced hazards occur in case of slope failure, heavy rain and slippery surfaces, fire orintentional acts. Rumors spread about an accident, terror attack, stampede or a calamity near to the venue and about distribution of free goods. There is a competition for procurement of a valued scarce material, position and seat, especially when they are given away for free. There could be a sudden notice of change in venue, platforms, counter and loss of access to entry or exit points. There could be end-of-event exit or beginning-of-event crowd surge with sudden propensity of crowds to exit as fast as possible when an event is over.

Stampede Risk Reduction in Mass Gatherings

Coordinating a mass gathering event without creating much stress on the organizers and without adversely affecting the wellbeing of the community requires effective risk management strategies developed during the planning process. Planning for mass gatherings is an inter-agency, multi-disciplinary approach which relies on the identification of potential hazards to the design and execution of appropriate mitigation measures.

The safety aspects are to be discussed, decided and implemented during the course of planning and organizing an event considering the type of event, venue, duration and history of accidents. A draft plan of the event is made with required structural and non-structural safety components after verifying the suitability of the venue, duration of the event, capability of the local administration to hold the event, safety measures planned and anticipated crowd size.

Consultation and cooperation with the stakeholders such as event organizers, local government, district administration, police department, emergency medical services, fire and rescue services, private security services, essential service departments, media and volunteers need to be initiated from the risk assessment phase to develop a coordinated effort in minimizing the risk factors.

Mass gatherings managed by government should have joint expert committee with the representatives from organizers, emergency services and line departments to perform risk assessment and subsequent planning by considering the potential risks and consequences. Risk assessment which is an integral part of mass gathering safety will consider the (a) crowd characteristics of participants and spectators, (b) accidents and (c) extreme events of natural or human origin. Extreme heat, cold, rain or power failure and road accidents can trigger human stampedes. While considering the demographic characteristics, the risk assessment team must account for the composition of the crowd expected. The scale of risk at the venue will vary depending on the age, gender, educational level and social status of the crowd. The demographics of the participants and spectators are to be understood well before proceeding to the planning phase.

Participative planning and meticulous risk assessment should cover scenarios of hazards, response mechanism, resources, evacuation plans, crowd management strategies and allied structural and non- structural risk reduction measures. Crowd expectations and safety considerations should go hand in hand at every stage of the event. Every event venue should have an emergency response plan which is communicated and understood by all participants.

We need to take into consideration past experience of any incidents, casualties and areas where there were casualties while preparing response and risk reduction plans. Continuous communication is essential for mobilising teams and volunteers from the central control room as per the requirement.

Live CCTV surveillance of the crowd will enable the organizers to monitor the pressure build up areas, increase in crowd density, blockage of movement walking pilgrims and bottlenecks to identify the source of crowd disturbance. Any action taken to improve the mobility of crowd by reducing congestion through timely action via inter-agency communication and public communication will be effective. Effective warning system will have to go in tandem with the communication system management. The safety officer and information officer will have to work together to arrive at warning timings and methods of communicating warning messages.

First we need to construct all structures required for the event. Then we plan and prepare security systems for operationalising the structures. We need to prepare maps and table top plans. Field level mock drills are essential for increasing functional effectiveness in normal times and in emergency situations. Regular briefing meetings with important stakeholders are essential right from the planning stage to the completion of the event. These meetings could be prefixed for ensuring effective participation. They will bring to fore critical concerns and response procedures. Documentation, written instructions and reporting the follow up action taken will build confidence among the stakeholders. Their partnership will be ensured in case of any emergencies.

Safety in Religious Gatherings

Safety and comfort of religious mass gatherings is primarily influenced by the vulnerability of the location and their accompanying characteristics. Religious festivals, especially when located at remote rural areas and on hilly terrains, and on the foothills or at river banks lacking proper pathways always pose a geographical risk to the pilgrims. Lack of adequate lighting and narrow exits exacerbate the crush, ultimately resulting in stampedes. Steep slopes, uneven topography of the venue, dead ends, slippery and muddy floors, narrow passages, convergence of pedestrian flow to a single point are among the common risks prevailing in religious gathering sites, compromising safety and triggering stampedes. Devotees visiting the locations even during the late night to early morning lead to huge and prolonged mass gatherings at vulnerable locations. The venue becomes the host to innumerable street vendors and local food stalls with scant safety and security concerns. Fire outbreaks from the stalls or rumors as such have triggered stampedes at various festivals. Medical and emergency aid services are hampered due to the absence of nearby health facilities and inadequate road and other infrastructure.

Whatever limited infrastructure and medical care systems exist are usually overwhelmed by the stampede event. Immediate transportation of victims to better medical facilities without losing the golden hours of treatment and response is imperative but rarely feasible in rural India. Therefore, venue safety and supporting health care facilities are serious concerns in the management of human stampede during a mass gathering event. Effective management is essential to reduce the casualty in the event of an acute accident. Crowd disasters during religious pilgrimage in the recent past led to important insights and also to significant improvements of crowd management and control. Many of the lessons learned can also be transferred to other mass events in order to improve their safety.

Analysis of the Crowd Disasters Suggests the Following

When we have huge crowds, it is the `queuing effect' which causes a denser and denser queue of people over time, and a lot of pushing in the crowd happens unintentionally. This is, because physical forces start to add up when the density becomes so high that people start to have body contact. Aggravating factors, which may lead to intentional pushing are (1) long waiting times without food, water, facilities, and entertainment, (2) the absence of understandable, communicated reasons for the delays, and (3) threatening high-density conditions. These aggravating factors are present in most of the religious events in India which attract lakhs of pilgrims and are linked to certain time based predetermined auspicious moments.Most appropriate width of queue of long religious crowds is that which accommodates three people at a time, as families consisting of members of different ages come to these events.

The main crowd dangers are posed as per the laws of physics, not psychology. People don't normally die because they panic, they panic when perceive that their life is in danger. They get impatient after long waiting time. Some of them also disrespect rules in order to get towards their goal especially when they consider that the rules not justified to them. However, even under extremely critical conditions, people helped each other and behaved quite rationally as can be seen from the video footages of stampede in Rajahmundry in 2015. They overcame barriers, used slopes, staircases, poles and evacuated themselves to escape from the density in the crowd. Unreasonable crowd forcing its way into the festival area is better interpreted as a crowd trying to find a way out of the dangerous trap it was in. However, despite a rather rational behaviour altogether, some individuals suffered from `tunnel vision', which is a phenomenon that can occur under conditions of stress. This is clear from the fact that those standing around the poles, staircase and container, hoping to get out, were not considering alternative emergency routes anymore, even when prompted to them by the police.

We must distinguish between a `crush' and a `crowd quake', and between active trampling and being trampled. In a classical crush, people are moving towards a physical bottleneck and die in front of its narrowest point. In a `crowd quake', there is typically no systematic flow direction, but people are pushed around by fluctuating forces in the crowd.

People's lives are endangered not by a stampede that crushed other people, but by high crowd pressures defined as density times variability of body movements. An extreme and fluctuating pressure builds up, when the densities become so high that they cause contact forces between bodies to add up. This ultimately implies the onset of `crowd turbulence'. Under such conditions, the sizes and directions of forces acting on the bodies of visitors move them around in an uncontrolled way, and people have difficulties keeping their balance; when people stumble and fall, this can be the nucleus of a crowd disaster.

When trying to avoid the deadly `domino effect', people may be forced to step on others. Only a few people will be relentlessly `crawling' or walking over the heads or shoulders of others. This happened around 7:30am in Rajahmundry on 14th July 2015, when the ultimate inferno of the crowd disaster happened and it was likely that 27 people died.

Many people probably step on others who were lying on the ground. They do such a thing because in a dense and shaky crowd, fallen people have difficulties to get up on their feet again. This may cause a `hole' in the crowd, so that the surrounding people are not anymore counter-balanced: they are pushed from behind, but not anymore from the front. As a consequence, the surrounding people may fall one after another like dominos, causing a pile of people. If they cannot get back on their feet quickly, they are likely to pass out or suffocate, since they cannot breathe anymore under the weight of others piling up on top of them. Therefore, to avoid falling when pushed around by the crowd, people might be forced to step on others. However, under these conditions, they are rather `walked' than `walking'. This is like entry into a local train in Mumbai. It is not trampling but it is being trampled. There is no intention, there is a happening.

History of Crowd Disasters in India in Recent Past

Religious festivals in India are special occasions of prayers, worship and community celebrations which last for days to weeks or even months. Some of the world's largest gatherings of religious crowds take place in India and the single largest gathering of pilgrims is Kumbh Mela at Allahabad and single largest gathering of women religious event annual Pongal festival day in Trivandrumin India. Irrespective of time and space, festivals are hotspots of mass gatherings with children, youth, middle-aged and aged people. They have fireworks, processions and Rathyathras where deity paraded on hand-drawn carts,free food distribution and cultural events. In February 2012 a human stampede occurred at Bhavnath temple on the foothills of Mount Girnar in Gujarat during the festive Mahashivrathri day, when approximately 900,000 people gathered on the day for offering prayers, where a breakdown of two transport buses on a bridge created the crowd disturbances which finally lead to seven deaths, with 12injured. Uncontrolled crowd rush to attend the religious processes have also resulted in stampedes as in Nasik Kumbh Mela festival of 2003 and Puri Jagannath temple stampede of 2006. Stampedes due to crowd surge have also been reported from a police recruitment drive in Kalinga 2010 Mumbai. Crowd disasters in India have also been spawned by accidents as in Mandhar Devi temple stampede 2005 and Sabarimala temple stampede 2011 and natural calamities as in Sabarimala temple stampede 1999 and rumors of accidents as in Ram Janki Temple stampede 2010 and Khajuri Khas School Stampede Delhi 2009. Stampede due to competition to procure freely distributed items has resulted in deaths in a flood relief camp in Tamil Nadu in 2005 and at Dera Sacha Sauda Sect headquarters, Haryana in 2010. Sudden announcement of platform change or entry gate have also lead to stampedes in New Delhi Railway Station in 2004 and 2010 as well as in Lucknow railway station in 2007.

The community dimension behind people gets lost, the moment there is crowding, with policing setting in. Learnings from crowd management at Hajj, Sabarimala, Nasik Kubhasth, Godavari Pushkaram, Tirumala Lord BalajiDarshan, Bhadrachalam Lord Rama Kalyanam, UN CoP11 to CBD, International Children's Film Festival of India, Sammakka SarakkaJatara and Bathukamma floral festival in Hyderabad are presented in this paper. The present study is a presentation on 14 crowd situations and strategy to avert crowd disasters with community participation. It would present how preparedness and drills avert crowd disasters and lack of the same could transform the crowding hazards into stampedes which are crowd disasters.

Execution of Crowd Management Plan

Short Comings in Crowd Management	Crowd Management Capacity Building
Inefficient deployment of staff and resources	Systematic and complete planning process
Unclear chain of command and supervision	Clear cut chain of command
Missing inter-agency coordination	Accountable incident response team members
Adhoc planning, no accountability and no training	Well thought out pre-designated roles for each member of the response team
Improper communication plan	Effective staff and resource management
Lack of orderly risk assessment, infringing into autonomy of systematic planning process, proper communication plan and inefficient use of available resources	System for effectively integrating independent agencies into the planning and command structure retaining concerned agency independence with coordinated communications
No integration of community resources, NGOs and professionals in response effort	Integration of local community resources and people in the response effort

Analysis of the Crowd Event Management

14 Crowd Events under Analysis				
S No	**Event**	**Promoters**	**Crowd Management Issues**	**Method Adopted**
1.	Hajj Stampede 2015	Government of Saudi Arabia	Crisscrossing of pilgrim routes of coming in and going out, stopping of the crowd movement and high temperatures	Construction of multi-storeyed queue complex, extension of ritual space, introduction of parallel routes, accommodation and water facilities on the way
2.	Sabarimala Stampede 2009	Government of Kerala, India	Sudden movement of vehicle which went out of control in a suddenly dispersing crowded pedestrian area	Introduction of queue complex and strengthening of the pilgrim movement infrastructure
3.	Nasik Kumbhasth 2003	Government of Maharashtra, India	Crisscrossing of the religious heads and pilgrims. Everybody wanting to take the chosen route in the chosen time only	Identifying the structural and non-structural risks and hazards addressing them before the event. Strategic training of festival staff and police officers while implementing the Incident Response System
4.	Godavari Pushkaram 2003 and 2015	Government of Andhra Pradesh, India	Crisscrossing of the incoming and outgoing pilgrims, allowing unmanageable crowds in a limited area and exasperation of pilgrims due to humidity	Escalating the command of administration to the Chief Minister with the support of senior state level officer and introduction of daily evening coordination briefings
5.	Godavari Pushkaram 2015	Government of Telangana, India	Crisscrossing of the incoming and outgoing pilgrims avoided, not allowing unmanageable crowds in a limited area and water facilities on the way for pilgrims due to humidity	Incident Response System in operation with rehearsals in the filed much before the event with incident commanders in position much before the event
6.	Tirumala Darshan2010	Tirumala TirupatiDevasthanamAP, India	Regular flow of thousands of pilgrims continuously all over the year into the small temple town on the hill in excess of the temple infrastructure	Staggered release of pilgrims, diversion, differential access and segregating vulnerable sections like old and disabled with special entrance for them
7.	Bhadrachalam mKalyanam 2015	Endowments Department, Government of	Arrangements for inflow made but outflow is slow with no arrangements, congested	Slow release of the pilgrims irrespective of their movement speed or

		Telangana India	access routes and unrestricted VIP vehicle movements	requirements. Differential access to seating compartments
8.	UN CoP 11to CBD 2012	United Nations Convention on Biological Diversity	Fear of unrestricted entry of crowds in the major international event with participation of high security risk persons from 175 countries	Inlet crowd control by regulating passes and vehicle passes, deployment of well trained volunteers and area completely taken under the UN Police well in advance
9.	World Telugu Conference Tirupathi 2012	Government of Andhra Pradesh	Invitation announcement in newspapers requesting everybody to come and that there is food arrangement at the location	Crowd inflow control in food distribution areas by regulating with passes and vehicle passes, deployment of well trained volunteers in the area after the first day
10.	ICFFI Hyderabad 2013	Government of Telangana, India	Fear of excess unmanageable school children crowds reaching the theatres during the children's film festival	Children movement to the theatres and inside the theatres regulated by specially trained volunteers/PETs from Schools
11.	SammakkaSarakkaJatara 2013	Government of Telangana, India	Traffic jams, small physical infrastructure and space for the pilgrim and traffic inflows expected during biennial tribal festival	Vehicular movement and people movement regulated at source and destination Long one-way movement for vehicles and people introduced.
12.	Bathukamma Floral Festival 2014 and 2015	Government of Telangana, India	Small restricted movement space for the movement of women in the all women participated floral festival held on the water front	Only women allowed on the route, only one-way pedestrian traffic allowed with special ghats constructed for easy rituals on the waterfront.

We need to distinguish between behaviour of formed crowds and behaviour of yet to form crowds. Individual behaviour of some individuals in yet to form crowds may be adopted and followed by group minds. But when physical density reduces to more than 5 people it is physical reaction that takes place. Response of the crowds is always characterised by the composition of the crowds. Religious crowds are multi age and multi sex groups. They are mostly families and neighbourhoods which reach a place together. They are not a pack of individuals but they are a pack of packs of families, kinship and neighbourhood primary groups. Primary groups concerns of safety, security, health and wellbeing in public space become important here.

Crowd Management Guidelines of Government of India: IRS

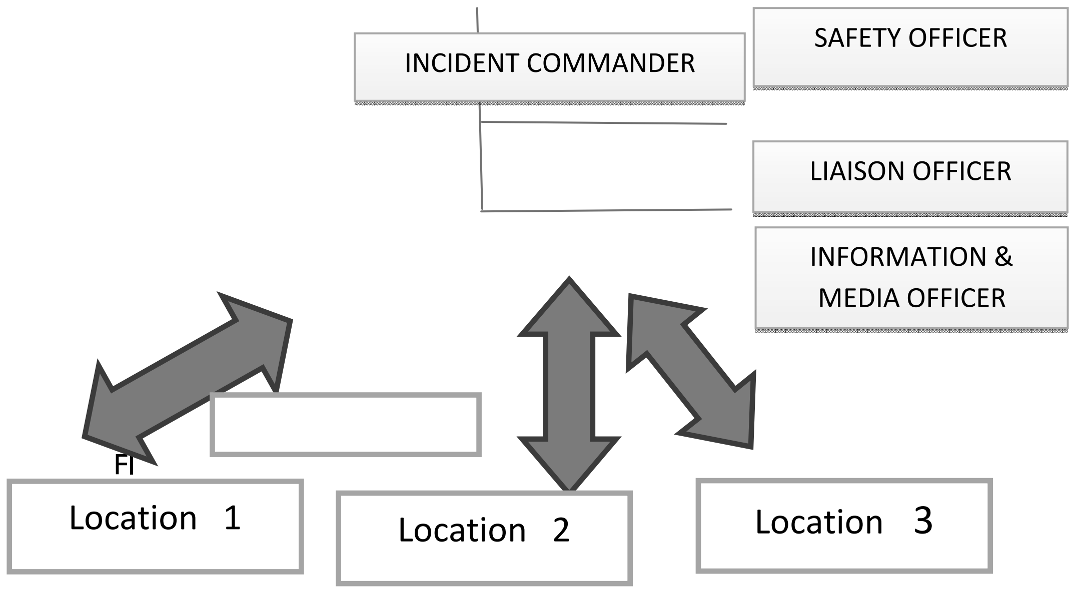
Realising certain shortcomings in our response system and with a desire to address such critical gaps the Government of India reviewed world's best practices for response. It found that the firefighting system in California as comprehensive and decided to adapt this mechanism which is called the Incident Command System. In view of the provisions of the DM Act, 2005, the National Disaster Management Authority issued a set of Guidelines called Incident Response System to suit the Indian administrative set up.The Incident Response System (IRS) is an effective mechanism for reducing the scope for ad-hoc measures in response to events / disasters. Team work is an important aspect of IRS. The IRS team constitution is flexible and all team positions need not be activated. The personnel involved in the IRS team come from various the Government offices and are redesignated in different positions in the team. Each individual in the IRS team will have a pre-fixed duty allotted to him as per the designation in the team not as per his position outside the team, in the office he is coming into the team from. Also, the IRS dictates that the individual is oriented to his duty. IRS ensures a good span of control for effective management where one supervisor does not supervise more than 8 individuals. It ensures good resource management. Unity of command is maintained as one individual receives orders only from his immediate boss, overcoming multi-tasking and decreased effectiveness. Personnel accountability is maintained by checking the attendance of the staff for their duty. Line of communication is maintained. At the end of the day, action plan for the next day is reviewed. The Liaison Officer will support in removal of confusion during the response phase. Everyone will know what needs to be done, who will do it and who is in command. IRS is a flexible system and all the Sections, Branches and Units need not be activated at the same time. Various Sections, Branches and Units need to be activated only as and when they are required.

The main purpose of these Incident Response System Guidelines is to lay down the roles and responsibilities of different functionaries and stakeholders, at State and District levels in order to promote coordination with the multi-tiered institutional mechanisms at the National, State and District levels. It emphasises the need for effective documentation of various activities for better planning, accountability and analysis. It also helps new responders to immediately get a comprehensive picture of the situation and go in for immediate action. A similar response plan can be prepared by venue/event managers for every hazard and risk level. A clear documentation of chain of command as to who will do what and when is put in place in IRS. Efficient functioning of command and control is the single most important component of Crowd Management. As per the best laid out practices, command and control should have unity and chain of command with built-in organizational flexibility, manageable span of control, an integrated information management and communication system, media management and personal accountability.

Incident Response System was proposed to be adopted for Godavari Pushkaram Crowd Management. It was consciously and systematically adopted in its entirety in Nizamabad district in Telangana state. While in Adilabad and Karimnagar it was partially adopted. Some steps in the system were adopted in Khammam and Warangal districts of Telangana and East and West Godavari Districts of Andhra Pradesh.

IRS and Crowd Management Guidelines Adopted for Nizamabad District

At the Nizamabad District, the Incident Response System was adopted for Godavari Pushkaram in Telangana State in 2015 as follows:



The Collector and District Magistrate who was the Area Commander issued directions constituting the Incident Command teams and directing them to operate as teams in the respective ghats. This was very effective as more than 15 days in advance these instructions were issued and every started following these instructions.

Area Incident Commander (IC) is in overall control of the event, here Collector of the district was the Area Commander (AC).

Each Ghat had an Incident Commander(IC). It is basically a joint command of Superintendent of the Police and Collector of the District. Every day the total team took sock of the situation and took decisions on what to on the subsequent day to address each issue that arose that day.

Liaison Officer (LO) looked after 1. Liaising of VIP visits, 2. Coordinating NGOs that want to be part of the event for reducing proper deployment and reduction of duplication of contributions and distribution of food and3. Any visitors/foreigner who were visiting the District during the Pushkaram had to register with the LO which is useful in case of mishaps.

Information and Media Officer: Single source of release of information to media after consulting the IC. All other members of the team were instructed to refrain from interacting with the media. Media also may be informed of this arrangement. This will prevent misguided release of information to media.

Safety Officer: For the safety of the staff working in the Pushkaram locations and Districts the safety officers were identified. They decided and guided on safety issues to both staff and public in consultation with the Ghat level Incident Commanders. The local DSPs who were positioned in each Ghat were the safety officers.

Incident Response System for Godavari Pushkaram

Godavari Pushkaram: the team at Each Location

OPERATIONS
Headed by an officer

PLANNING FOR SITUATIONS. Headed by an officer. Draws up situation for the next day such as weather, no. of pilgrims & vehicles expected, to enable action planning

LOGISTICS, Headed by an officer. Consists of units

Unit headed by an officer

Unit can have assistants

DIVISION- A
BUS STAND,
Headed by an officer

Sanitation Group.(staff for cleaning toilets and ground along with Phenyl, bleaching powder, brooms, drums, JCB)
Para medical Group (small medical camp)
Law & Order Group (Police)
Help Desk & Check-in (Information centre for pilgrims & Attendance Register for staff)
Utility Group (water packets / any other utility)

FOOD UNIT Food for the staff working in the mandal. Knows how many packets to procure

RESOURCE PROVISIONING UNIT –Provides all the resources to staff in divisions, both men and

DIVISION - B Inner Bus Stand.
Headed by an officer

1. Sanitation Group.
2. Para medical Group
3. Law & Order Group
4. Utility Group
5. Help Desk & Check-in
6. Parking

FLOW OF INFORMATION

COMMUNICATIONS UNIT
Prepares communication plan with all mobile numbers and provides wireless sets

FACILITIES UNIT
Helps in setting up facilities like help desk, parking, temporary structures, and information centre in all divisions

DIVISION - C Route to Ghats.
Headed by an Officer

1. Information Centre
2. Mobile Maintenance unit (for vehicles)

GROUND SUPPORT UNIT
Provides vehicles needed in all divisions

DIVISION - DRoute to Ghats .
Headed by an Officer

1. Archaka (Single Resource)
2. Search & Rescue Group(Swimmers, Life jackets, boats)

Major Learnings from Analysis of Implementation of IRS for Crowd Events

Location: Large mass events should preferably take place in locations where experience with the management of large crowds already exists for a long time. It should at least involve some experts who have participated in the organization of previous mass events and know how to handle critical situations. Revenue, Police, NSS and NCC Officers along with Non-Governmental Organisations who are well trained can be alerted in advance for their role in the event coming up.

Support: Local organizing teams of Revenue, Police, NSS and NCC Officers along with Non-Governmental Organisations should be trained and supported by experienced regional or national or international professionals.

Security: The security concept should be finished, distributed, discussed, and exercised at a pre-specified date well in advance of the event by the police. The event must be planned on the basis of the number of expected people, not on the basis of capacity of the system. An organizational concept that requires keeping many people out or delaying them for hours should be avoided. Quick dispersal, evacuation and exit of crowds will have to be planned and thoroughly monitored.

Facilities: Facilities like toilets, supply of food and water, as well as entertainment should be ensured all along the route very near to the barricades for providing succour to people on the way to the festival area and for those waiting to enter. This would reduce anxiety among the pilgrims who stand in the queues for long hours.

Decision Making: One should implement ways of preventing pressure on decisions that may have impact on the safety and security of people. It should not be possible to ignore qualified minority opinions especially those of teachers, local politicians, NGOs and media. Contradictory voices should be documented and seriously addressed. Consultants should be encouraged to comment on any critical issues even beyond the scope of the commissioned analysis. At every ghat there were local public representatives and local media men who raised issues of security of the pilgrims and clearing of construction debris and clay on the waterfront.

An analysis of the expected inflows and outflows and, hence, number of participants needs to be performed, considering the possibility of large flow variations on different days from different locations. A bottleneck analysis of the total route is crucial. It must also take into account moving bottlenecks such as floats, animals, but also the operation of police, ambulances or emergency vehicles. Confluence, turning and intersection points should be determined and specially addressed. This needs thorough analysis to prevent knee jerk reactions later.

Computer Simulation: In this context, computer simulations with state-of-the art software on monitoring pedestrian movement can be useful. But for this model parameters must be carefully chosen. Computer simulations can often help to identify crowded areas, but they are not sufficient to reveal all kinds of organizational challenges.

Critical Points and Safety: Critical points should be identified, addressed and it must be checked, whether the remaining challenges can be safely handled by crowd management and control measures also under adverse conditions. Safety margins such as capacity reserves should be foreseen, and detailed contingency plans should be worked out for likely and unlikely events, and scenario based drills must be conducted.

Contingency plans serve to reduce the need of improvisation and to ensure a quick and effective response to any occurring and reoccurring challenges. Interaction, cascading and side effects of complicating factors should be analysed as well. Remaining areas and factors of concern must be continuously monitored through CCTV video surveillance and special software for real-time analysis. Sufficient security and emergency forces should always be present to remove or at least mitigate challenges in the initial stages. Delays in response must be avoided, as they tend to reinforce challenges. Quick action is often very critical to implement effective counter-measures. To stop possible interaction and cascading effects, suitable decoupling strategies should be implemented.

Pressure relief and evacuation strategies must be prepared for any potentially critical areas. Evacuation measures must be started before an area becomes over-crowded. Intersecting flows should be avoided and different flow directions should be separated as dense counter flows are unstable and dangerous. It is such intersecting flows which caused the Hajj stampede in 2015 and Rajahmundry stampede July 2015.

A `circular' flow one way movement, preferably with alternative routes, should be considered. Moreover, space for emergency vehicles and operations should be reserved. Fences are not good everywhere. They may turn into obstacles and create dangerous situations. Therefore, the use of fences or barricades to stop large numbers of people needs to be carefully considered, as they may be ineffective or deteriorate the situation. In Rajahmundry where more than 27 people lost lives on 14th July 2015, the stampede occurred as the first set of worshippers were coming out of the gate after taking a dip in the river while others waiting outside for a long time tried to force their way into the water at an auspicious time. Similar intersection of people at Hajj caused the stampede there.

In many cases, it is safer to keep people moving by re-routing people rather than stopping them. Situational awareness and well-functioning communication are crucial. Quick feedback information about the situation in any relevant place and about any relevant factor must be ensured. It is important to have an efficient information flow between the different people and institutions involved including the organizers, police, emergency forces and crowd.

In case of challenges, the corresponding contingency plan should be applied, and the situation should be continuously assessed and reassessed to check for the plausibility of any mishaps, considering all possible alternatives. Police and emergency forces are to be given more autonomy for decision-making along with responsibility. This is particularly required when communication is interrupted or quick action is needed.

Communication must work both, from a technical and an organizational perspective. It is important to detect, avoid, and respond to critical situations. Communication is also crucial for the capacity to reduce undesirable interaction effects and to stop dangerous cascading effects. That is why local joint commands are required between police and other officials including the revenue officials.

Finally, a safety culture must be actively promoted, reminding everyone that challenges can always come up. The motto should be: Don't take it easy. Always expect the unexpected!" Preparations should be made for all sorts of unexpected situations including sudden changes of weather, unexpected rains or absence of expected rains.

Conclusion and Natural Laws of Crowd Behavior

For avoiding situations of crowding a choice of a suitable location and an adequate preparation of the mass event, an appropriate organization and crowd management, and a quick response to early warning signs, for which information and communication play a key role are required. It is also important to understand that crowd behavior follows certain laws of nature, which result from physical, physiological, psychological and social needs of humans such as sufficient space, food, water, and air, toilet facilities, feeling of safety, perceived progress towards the goal, information, communication and entertainment. An insufficient consideration of such factors can promote disasters, particularly if shortcomings accumulate. To improve the situational awareness of crowd managers, police and emergency forces a number of successive warning signs of increasingly critical crowd conditions are to be observed. Also, scientific institutions would not have had enough resources to do all the documentation work that is performed by volunteers. However, the collected materials are so voluminous that one can hardly see the wood for the trees. The Incident Response System would definitely prove to be a great asset for efficient crowd management.

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DISASTER PREPAREDNESS FOR MASS RELIGIOUS GATHERINGS IN INDIA - *LEARNING FROM CASE STUDIES*

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Abstract

India, land of spirituality and philosophy, is home to large number of religious gatherings and pilgrimages such as Kumbh melas, Rath Yatra, Ramzan and Durga Puja. Many of these gatherings attract millions of people from most parts of the country and also across the world. The influx of millions of pilgrims during such gatherings creates tremendous amount of pressure on their host cities. And the result of any kind of disaster in those gatherings will result in widespread human and infrastructure impact. With the current trend of increase in both man-made and natural disasters there is a huge need of disaster preparedness. This paper will discuss specific case studies of mass gatherings to ascertain the gaps in infrastructure and strategies adopted for the disaster preparedness. This research is done to derive strategies to improve disaster preparedness for similar mass gatherings in India. The study discusses a few incidents during the Saudi Arabia's Hajj pilgrimage in 2006, incidents during the Cambodia's water festival in 2010 and incidents during the India's Kumbh mela in 2013. This paper is a part of research going on in IIT Roorkee on "Developing Disaster Resilient strategies for the city of Haridwar in the context of Ardh Kumbh mela 2016"

Keywords: *Disaster Preparedness, Hajj, Bon Om Touk, Kumbh Mela, religious mass gatherings*

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Introduction

India, 5th largest and second most populated country in the world, hosts a large number of religious, political and entertainment gatherings. Where people crowd together there are always high chances of stampedes and other hazards such as fire and terrorism. Nearly seventy nine percent of stampedes in India are from religious gatherings and pilgrimages only (Faisel T. Illiyas, 2013). The causes that can trigger disasters during any gathering may vary widely. The causes can be structural failure, defective infrastructure system, difficult access, underestimation of crowd, uncontrolled movement of crowd and vehicles, mass evacuation because of a natural disaster, rumours of a disaster to happen, lack of adequate security and coordination (NDMA, 2014). Poor facilities, lack of basic infrastructure and absence of suitable strategies have increased the vulnerability of mass gatherings. Incident of disasters in such gatherings may lead to huge number of causalities along with anguish and economic loss. Increase in population and influx of a large number of people for the gatherings is increasing the probability of such events.

Learning from past incidents by identifying the breaches in overall planning will help India and other countries in effectively managing the forthcoming mass gatherings. Outlining the good practices will aid to embrace them easily in any forthcoming event. The scope of the paper is:

- Review the case studies, the measures taken and their potential for disaster preparedness
- Evolve strategies in crowd management, traffic management, safety and security, capacity building, information management and use of modern technology

This paper will go through selected case studies of mass gatherings in the global as well as India context. The gatherings that will be deliberated in the paper are: the annual Muslim religious pilgrimage of hajj in Saudi Arabia with the main focus on the tragedy of 2006, the water festival held in Cambodia with emphasis on the 2010 tragedy in Phnom Penh, the Hindu religious gathering of Kumbh mela in India with focus on Allahabad Kumbh mela of 2013. The experience from the past indicates that a minute flaw in the system can trigger disasters. The paper will discuss the measures taken during these selected gatherings and the gaps in measures taken for disaster preparedness.

Research Methodology and Approach

This study is conducted to understand the disaster preparedness in various mass gatherings. The mass gatherings were identified from reviewed literature, newspapers and online reports and the information was used to draft the occurrence of tragedies, measures taken by respective authorities to improve the safety and security, triggering factors and the gaps in the measures taken which led to such incidents. The study peeks into the improvements made in the infrastructure to manage the crowd, ability to monitor the crowd and advanced techniques adopted. The retrospective analysis of the case studies and outlining the gaps will lead to the strategies for better disaster preparedness.

The Haj Pilgrimage in Saudi Arabia

Saudi Arabia annually hosts a religious pilgrimage called 'hajj' to Mecca and related holy sites where millions of pilgrims visit from all over the world. During Hajj a pilgrim arrives at Mecca and leaves for Arafat. En route to Arafat a pilgrim makes overnight stay at Mina and in Muzdaliffah on return as shown in Figure 1 (Abdul Rashid Gatrad, 2005). The Hajj pilgrimage in Saudi Arabia is a mass migration unparalleled in scale. The influx of more than 2 million pilgrims (approximately 2.8 million in 2010) from all over the world during Hajj almost triples the population of Mecca (saudiembassy, 2010). Muslim men and women in millions from more than 183 counties gather for Hajj in Mecca for five specific days each year and often halt for over a month (Blatt, 2015). More than two million people dressed in similar garments, affirming a common identity, perform identical rituals. With this spirit of unity many Hajjis undergo the most significant religious event of their lives. Even though the ritual last for only five days many Hajjis tend to stay for nearly 40 days in the cities of Mecca and Medina (Qanta A Ahmed, 2006). The extended stays and crowded accommodation create extreme congestion of people and vehicles. The extreme traffic, disordered traffic flow led to extended traffic jams. The extreme heat (between 44°C and 50°C during Hajj season) and inadequate stored or prepared food along with jam-packed lodging encourage transmission of diseases (Rassool, 2014). To prevent the occurrence of tragedies such as riots, massacres, fires and stampedes the crowd is monitored centrally by the authorities. The Hajj pilgrimage has seen many tragedies despite the attempts to increase the safety (Davids, 2006).

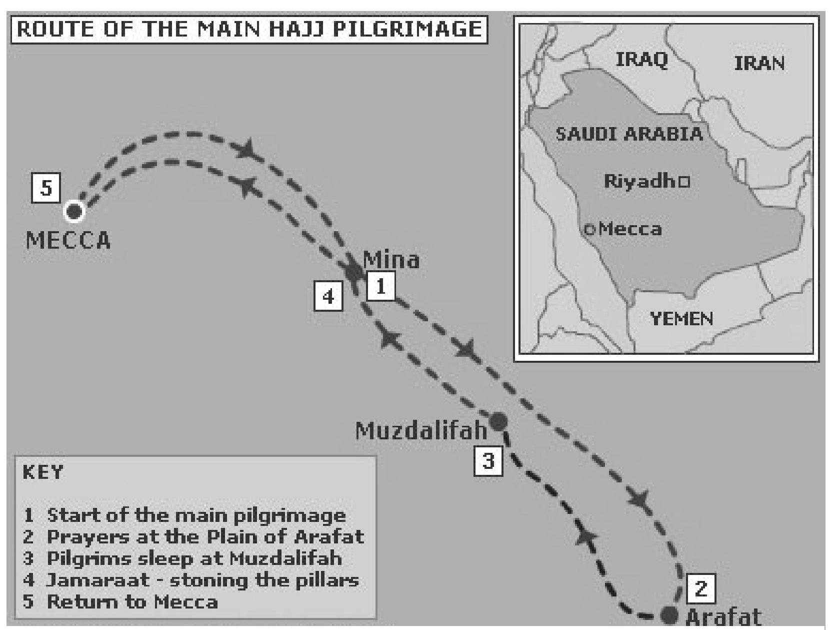

Figure 1 Route of the Hajj Pilgrimage (www.bbc.co.uk)

Incidents during the Haj:

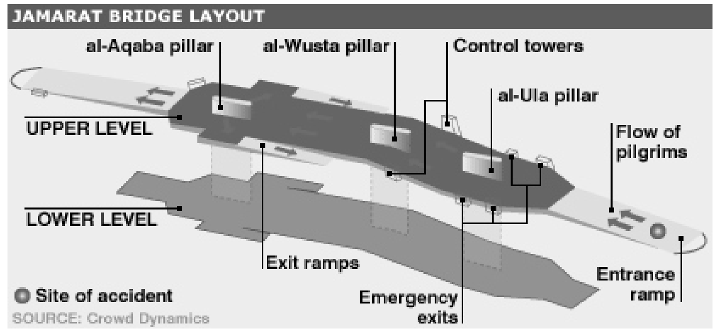

Figure 2 Jamarat Bridge Layout in 2006

In the last 20 years at Hajj people have died in various tragedies like stampedes, fires in camping areas, bomb explosion near Mosque etc. City officials are required to manage huge crowds; provide food, amenities and emergency services. Unfortunately, they couldn't prevent all the disasters from happening. A stampede in a pedestrian tunnel led to death of 1,426 pilgrims in 1990 (Ross, 2015). Because of the tent fires in camping areas which claimed many lives (1975, 1997), the tents are now fireproof (theguardian, 2006) . The pilgrimage was also disrupted by the attack of militants on grand Mosque in 1979 and two bombs explosions in 1989 (Gad-el-Hak, 2008). The worst of the tragedies have occurred during the stoning ritual which is the most dangerous part of the pilgrimage where huge crowds cross the massive Jamarat Bridge to reach the pillars (Googelberg). Stoning ceremony has claimed lives of at least thousand pilgrims in the stampedes of 1994, 2001, 2003, 2004 and 2006 (Ross, 2015). Similar Jamarat incident claimed the lives of at least 1621 in 2015 making it the worst incident in the (Jon Gambrell and Aya Batrawy, 2015). Besides all these the Saudi Government also deals with disease breakouts during Hajj (Gad-el-Hak, 2008).

The Haj Tragedy, 2006: The Hajj tragedy of 2006 happened despite many attempts to manage the crowd and after improving access to Al-Jamart site. Nearly 2.3 million pilgrims performed Hajj in 2006 (saudiembassy, 2006). The causes for the occurrence of tragedies in Hajj 2006 are:

- Unforeseen ingress of pilgrims who were trying to access the ramps to Jamarat Bridge.
- Many people tripping over the luggage that fell from the moving buses resulted in the stampede (Qanta A Ahmed, 2006).
- The sudden flow and pressure of people at various points on the already disaster prone two- layered flyover styled Jamarat bridge in Mina resulted in a stampede; as many as 363 pilgrims have lost their lives and more than 389 got injured (Still, Introduction to Crowd Science, 2013). This was believed to be the worst incident for 16 years in the holy site. Figure 2 shows the Jamarat bridge layout in 2006 with the site of accident.
- A structural failure led to the collapse of a hotel in a narrow street which lodged pilgrims; claimed the lives of 76 (Gad-el-Hak, 2008).
- The aid couldn't reach the victims quickly in large crowds. (Qanta A Ahmed, 2006)
- Exhaustion in the people caused by the heat and tiring physical work
- Tiring physical work in the ritual and the exposed spaces with limited or no shade led to the exhaustion in people and death of 243 pilgrims (Sapa-afp, 206).

Measures Taken: Measures taken for the Hajj pilgrimage in 2006 are:

- To control the pilgrim flow Saudi government has taken up construction of many foot bridges, access ways and emergency exits.
- Multi-lane roads have been built
- Walk ways were widened to almost 80 meters to reduce congestion (Oliver, 2006).
- New air ports came up
- Following many incidents the Jamarat Bridge and pillars were abolished and reconstructed. The round pillars/ tall obelisks were replaced by 26 meter long wall to improve access and reduce crowd densities (Oliver, 2006).
- A wider bridge was built and now the bridge allows an easy and safer access to the pillars.

- Ramps and walkways to the Jamarat site had been widened. It was hoped that by widening the site and giving people a wider area to do the stoning ritual will make the site safer.
- 60,000 personnel were put on the site to avoid accidents and attacks by extremists (Gad-el-Hak, 2008).
- Helicopters flied overhead watching the crowds and authorities monitored the crowd with the help of CCTVs from a control room.
- Special elevators are provided for the handicapped people.
- To ensure high resistance to fire the tents were constructed of fiberglass coated with Teflon in every sector of land.

Gaps in the Measures and Subsequent Developments: During Hajj 2006 it was hoped that by widening the Jamarat site and by giving access to more pilgrims to do the stoning ritual the tragedies in the disaster prone Jamarat site can be prevented. But the signs giving directions on the site were scant. There are two ramps leading to the pillars and two ramps are for exit, but the pilgrims ignored the rules and often went up and down as they wish creating a chance for stampede. A proper system of public transport can move masses more quickly. Sudden ingress of people was the reason for stampede. Inflow and outflow movements of people should be regulated more efficiently. Many pilgrims camped on the sidewalks hindering the free passage of crowds, which was further disrupted by the vendors. Encroached vendors and hawkers selling souvenirs and food to pilgrims narrowed the access routes, disturbed the crowd flow jammed up traffic. The authorities should have limited the vendors and hawkers in the area by giving identity to few. The guidelines for structural safety were not considered. Cautious use of bridges and flyovers was not properly communicated with the pilgrims. Emergency response services were not efficient, thus delaying the rescue operations.

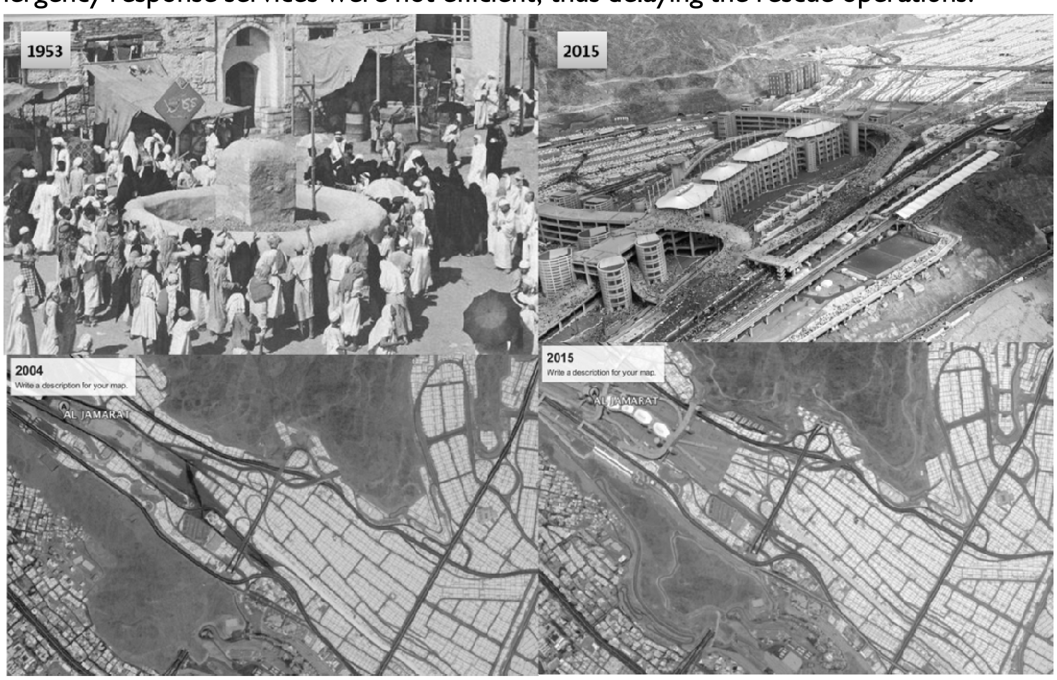

Figure 3 Jamarat Bridge Development (Still, gkstill, 2015)

Following the 2006 stampede the single tiered Jamarat bridge was demolished and new Jamarat project was undertaken to build a 5-level Jamarat bridge as shown in Figure 3 with a capacity of about 5 million pilgrims over 6 hours. This project was aimed to be completed by 2007 Hajj with 12 entrances and 12 exits with all measures of safety and security (kapl-hajj, 2015). Subsequently, no other incident has occurred at Jamarat until the recent 2015 stampede. Saudi Government has started managing the crowd since then. It uses live crowd analytics software which can spot patterns of crowd behaviour and indicate pressures, high densities, stop-and-go waves, turbulence and other anomalies (kapl-hajj, 2015). Figure 6 shows the crowd dynamics model of the Jamarat ridge. The data feeds are monitored by police and military personnel in the control rooms. For transporting the masses quickly authorities employ several buses and track them wireless. Several long-term public transport initiatives are taken up to take the pressure off the roads. A new rail project was finished connecting the holy sites (Christopher S. Bowron, 2015). In the recent years Hajj saw many new interventions like the sensors, tracking the footsteps etc. (Qanta A Ahmed, 2006)

Bon Om Touk in Cambodia

The second case study is the centuries old Khmer Water Festival celebrations, Bon Om Touk, in Cambodia. This celebration which marks the reversal of course of the Mekong River is celebrated in November for three days. Phnom Penh, the capital of Cambodia, marks biggest celebrations with boat racing and concerts which attracts several million people every year (carnifest, 2015). These celebrations swell the city of Phnom Penh by more than two or three million people, both national and international. 20-25% of the country population are crammed in a stretch of 3 kilometres along the Sisowath Quay for boat racing in Phnom Penh (CCHR, 2011).
This festival also called as "Festival of the Reversing Current" and "The Festival of Boat Races" dates back to Angkor Kings in the 12th century. In the evening, the festivities go on with the traditional music performances, carnival rides and concerts at many places in the city (insightguides).

Figure 4 Location map (MYDANS,

Water Festival Crowd Tragedy, 2010: In the water festival many incidents have claimed lives of both nationals and internationals. The incidents mostly involve boat racers and problems with boats. The stampede that occurred by the end of the three days festival in 2010 Khmer water festival in Phnom Penh took at least 345 lives and is the worst tragedy in the festival's history (BBC News, 2010). With the gradual raise in the numbers it was anticipated before the festival that it would attract between 2 to 5 million people in 2010 (CCHR, 2011). For the 2010 festival that took place in between 20 and 22 November, Koh Pich was one of entertainment spots hosting a number of concerts, performances and stalls. Koh Pich is a long split of land as shown in Figure 4. Koh Pich suspension Bridge was built in between 2009 and 2010, linking the island to Phnom Penh, and had opened just in time for the festival (khmerization, 2010). Figure 5 captures the Koh Pich bridge before the tragedy in 2010.The causes for the occurrence of Phnom Penh water festival crowd tragedy in 2010 are:

- During the Water Festival the Koh Poch Bridge reportedly should have only one-way flow of

Figure 5 Koh Pich Bridge before the tragedy (Chanbo)

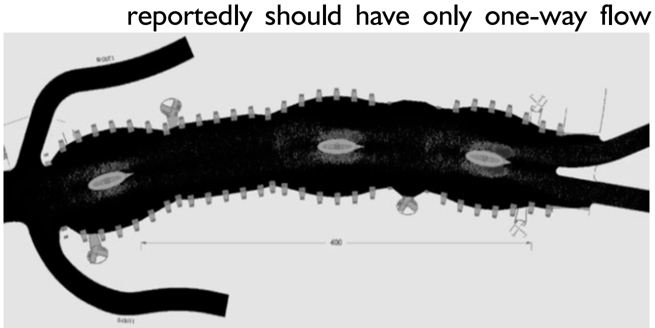

Figure 6 crowd dynamics model of Jamarat Bridge (Still, gkstill, 2015)

people in place. But in fact the people were moving in both the directions

- The Koh Poch Bridge was reported to move crowds from island to city while a second bridge, 200mts to the south was for the people heading into the island. Either the second bridge was closed on that day or the organizers did not enforce traffic directions (CCHR, 2011).
- On 22 November, the final night of festival, thousands of people were crossing the Koh Pich, narrow suspended bridge to attend a free concert and a panic on the overcrowded bridge triggered a stampede crushing at least 375 to death (Still, 2013).
- News reports said that there were 7000 to 8000 people on the bridge at the time which is 10 to 12 people per square metre (A crush may occur when there are more than 6 people per square meter). (CCHR, 2011)
- People began to panic on the over-crowded bridge and started to push in all directions to get out. Because of this they were struck and not able to move. People tripped, fell over and were trampled. It was reported that at some worst point, people were piled up to 8 people deep on floor. People tripped on those who have already fell/died.
  (kohpichmemorial, 2010)
- Some eye witnesses report to have seen a motorbike and few (illegal) vendors on the bridge before the incident.
- Interviews revealed that a cause of stampede was the spread of rumour that the bridge was about to collapse.
- The police used water cannons to stop the crowd which created further panic and also possibly caused electrocution (Wallace, 2010).
- Barricades created pressure in movement of people at various points. People who were exiting the bridge were unable to move away quickly because of barricades.

Measures taken: Measures taken for the Cambodia's Water festival in 2010 as per the report "The Koh Pich Tragedy: One Year on, Questions Remain" (CCHR, 2011, pp. 11-14) are:

- The Phnom Penh capital hall in association with private companies publicised the nine entertainment sites all over the city for concerts, performances, playgrounds etc.
- Live broadcasting was made from all television channels and radio channels
- Map showing the locations of all entertainment sites in the city was published in the official website
- Meeting was held for the discussions on preparedness, safety and security
- Governor laid down the strategies to improve safety and security. Details of the strategies were not given.
- Plan was laid to research and prevent any mobs, terrorist and criminal activity
- To strictly control the targets the expert measures were used
- control of explosives and weapons in the ceremony area
- Protecting the area of ceremony, maintaining public order
- vehicle parking lots
- Police were deployed all over the area for crowd control, safety and security.

Gaps in the Measures and Subsequent Developments: During the 2010 Cambodian Water festival the number of security guards and police who were there was well below the number reportedly set on duty. They might have assisted properly when the incident broke out. The city hospitals and emergency response teams were not able to deal with the large number of causalities quickly. Preparedness for such tragedies was inefficient. Cautions use of Bridges was not articulated. The capacity of the bridge and its capability to handle the anticipated crowd was not defined. A course of action in case of a tragedy was not prepared/ shared with the officials. Access routes were narrowed by the vendors. Official must have restricted the entry of hawkers and vendors on to the bridge. The path for vehicles was not separated from pedestrian ways. Movement of people was not regulated and multiple routes should have been encouraged. Information management was poor and using an announcement system must have controlled the rumours in crowd. Capacity building was not to the mark; responsiveness was poor; the police were not trained for extreme incidents.Following the incident the Phnom Penh municipality linked the Koh Pich to mainland by inaugurating two new bridges parallel to Koh Pich Bridge. A draft law on disaster management was brought including the man-made disasters (Kongkea, 2010). Instead of using roadblocks police are asked to be stationed at many locations to prevent traffic jams and manage crowd congestion. Medical, emergency response and law personnel will be trained and prepared for such incidents.

Kumbh mela in India

The third case study is a famous Hindu religious mass gathering of Kumbh mela where pilgrims gather to bathe in sacred river. Kumbh mela is held in every third year at one of four locations of India by rotation: Allahabad, Haridwar, Ujjain and Nasik. The locations of the Kumbh mela along with the sacred rivers are shown in Figure 7. The venue depends on the position of planets and stars. Ardh Kumbh mela is held only at Allahabad and Haridwar while the Maha Kumbh mela is held once in 12 years only at Allahabad (Annu Baranwal, 2015). The event is held for about one and a half month with attendees from all over the world. The number of pilgrims bathing on the auspicious day may vary and there is no precise method to determine the number. Kumbh Mela is acknowledged to be organised in traditional mode. This gathering gives the challenge of creating a temporary city to accommodate millions of pilgrims for a definite period of time, almost 10 million in less than 60 square kilometres of area (Mass gathering event management, 2013). In mass gatherings mainly in religious gatherings the management of crowds and the movement of masses are very critical. The event should be planned and monitored with innovatively by the authorities to prevent mishap and make it a disaster free event.

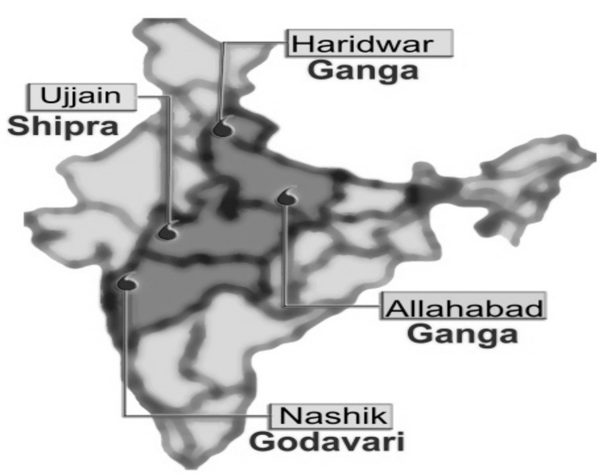

Figure 7 Locations of Kumbh Mela (gangapedia, 2011)

Allahabad Kumbh mela, 2013: In these gatherings many people go missing, get injured and die in incidents like fires, stampedes, accidents etc. The most tragic incident is the Kumbh Mela stampede of 1954 in Allahabad where as many as 1000 people lost their lives (Saksena, 1987). A stampede in Nasik Kumbh mela of 2003 has claimed lives of 39 (Vijapurkar, 2003). Allahabad Kumbh mela of 2013 have also seen a series of tragedies despite the measures taken by the authorities. The 2013 Kumbh mela was held for 55 days from 14 January 2013 to 10 March 2013. It was visited by as many as 120 million people making it the "Biggest gathering on Earth". 10 Feb 2013 was marked as the biggest bathing day of Maha Kumbh mela and also might be the "Largest human gathering on a single day". Various amenities are provided by the government for the mela: roads, water supply, hospitals, transport, land area, new temporary roads etc. (kumbhmelaallahabad.gov.in). The temporary mega city as shown in

Figure 8 was built just in two months after monsoon water has receded and before the first inhabitants arrived in January.

Figure 8 Left: October 2012- before the mela, Right: February 2013- during the mela (South Asia Institute)

The causes for the occurrence of tragedies in Allahabad Kumbh mela of 2013 are:

- In the Maha Kumbh Mela at least 42 people died in different incidents and as many as 3 lakh people were reported missing (www.oneindia.com, 2013).
- As the number of trains arranged has failed to clear the rush a stampede broke out in Allahabad railway station after a railing on a foot-over bridge collapsed and took 30 lives and injured several (Encyclopaedia Britannica, 2014). This is due to the lack of proper care and facilities.
- The Mela witnessed 18 major incidents of fire that injured many. The incidents of fire were frequent because of the use of plastic sheets for cottages and usage of LPG cylinders. (Annu Baranwal, 2015). Unplanned lines of electricity near dwelling areas also backed the problem.
- The fire that breakout in the camping area was brought down quickly but few tents went down by then. (www.ibtimes.co.in, 2013). Fire tents should be fire proofed to avoid such tragedies.

Measures taken for these Gatherings: Measures taken as per the report "Mass gathering event management: A Case Study of Maha Kumbh, 2013, Allahabad" done by Bihar State Disaster Management Authority (2013, pp. 20-34) are:

- Individual administrative blocks were set up for security and public amenities
- The allotment of land for tents and amenities was done at the beginning of mela itself.
- All the basic facilities were associated with the settlements inside the mela.
- Infrastructure and services were provided effectively on time
- Nearly 156.2 kilometers of roads were laid for the crowd management
- 80,000 KLs of drinking water was supplied; huge allotment of food and civil supplies
- Traffic management was done by assigning 3608 special buses for transport.
- CCTVs were used to monitor the crowd.
- GPS mapping of all sectors was made available on field
- Each sector in the mela got its own *sector market* with all the essential commodities for the people.
- The whole information related to mela was made available in the website.
- 36 Fire stations were set up in the mela area and firemen were deployed all over the area.
- To provide emergency services motorcycle mounted firemen were made available to provide services in the area inaccessible by fire tenders.
- The information of the missing persons were instantly uploaded on the website
- Electronic techniques were used in lost and found camps. Electronic signboards were also used by traffic police to give important messages.

Gaps in the Measures and Subsequent Developments: There were some shortfalls in the well planned and well-coordinated Kumbh Mela of 2013. Fires broke out at many places and the fire stations were not strategically located. The settlement patterns were violated and the fire could have been controlled if the settlement patterns were strictly organized. Mere arrangement of fire stations near police stations did not completely help. Fire stations can be arranged in hexagonal patterns to reduce the response time. Fire proof tents should have been adopted like in the case of Hajj. The coordination between railway and roadway administrations was not proper. The transport provisions should be in synchronisation with the growing number of pilgrims. The number of trains arranged during mela failed to clear the rush. The stampede was the result of unforeseen large crowd exiting the city. Proper arrangements should be made for clearing the rush in bus and train stations. Maps of mela were not displayed and clear information on exits and routes were not known. Access to the disabled people was not considered. The communication system was substandard as the voice quality was poor and it was difficult to hear the announcements. The solid waste management was not satisfactory and pollution level got increased in the Ganga Ghat because of the offerings made by devotees. Kumbh melas are managed traditionally and technological interventions can assist in managing the events more effectively.

Strategies

The strategies than can be recommended for the forthcoming gatherings after reviewing the case studies are:

Crowd management

By strictly monitoring the crowd flow in to areas like tunnels, bridges and flyovers Incidents like the stampede of Hajj 2006 can be avoided. The bottlenecks and compression points in infrastructure should be avoided to prevent the crush of people as in case of Hajj 2006 stampede. Control on the flow of people can be better achieved by managing multiple routes, several entrances and exits which can be seen from the remodelling of Jamarat Bridge.

Understanding the behaviour of crowd will help to efficiently manage the crowd than managing by force. But in today's mass gatherings like the Hajj and Kumbh mela it is not just enough to guess the human nature we should be able to model and predict the crowd movement with all risks, pressures, delays and reactions. The Hajj pilgrimage has some experience on crowd dynamics which can also be incorporated in other mass gatherings for better crowd management plans and to prevent stampedes.

Traffic management

The traffic directions and guidelines should be imposed by the authorities. Multiple access roads with varying speed gradients like expressways, emergency, normal should be encouraged to manage huge traffic. Such measures will avoid tragedies like Koh Pich stampede, where vehicular traffic was not completely separated from pedestrian traffic. The stampede in Allahabad Railway station during Kumbh mela was caused as the transport system has failed to clear the rush of the pilgrims. Such situations can be avoided with a suitable transportation system. Systems like metro and light rail can transport large number of people in less time and also reduce the dependence on buses which can cause traffic congestion.

Safety and security

In pilgrimages like Kumbh mela, the fire can be controlled if the tents are made fire proof. In Hajj the tents were constructed of fiberglass coated with Teflon in order to ensure high resistance to fire. The damage during 2013 Kumbh mela could have been minimised if settlement patterns were not violated and if the fire services were arranged in certain patterns to reduce the response time. The electrical lines should follow the patterns of dwellings units to avoid breaches.

Cautious use of bridges, flyovers, ropeways should be communicated to staff and public. By calculating the load bearing capacity of such structures and managing crowd accordingly will prevent incidents like Koh Pich stampede. Barriers can be used to stop motor vehicles and effectively regulate the crowd but the barrier location shouldn't funnel the crowd to an already packed area. In Koh pich tragedy the people exiting the bridge were unable to move quickly because of barricades. In case of an emergency a course of action should be given for the officials and staff to follow. The course of action should include instructions such as what should be done, who is responsible, where does it take place and what is needed

Capacity building

The infrastructure can be improvised based on the research that helps in determining the acceptable crowd velocities and densities at various locations. Extensive simulations and modelling work, extensive analysis of the existing Jamarat Bridge resulted in the massive expansion of the Bridge. For mass gatherings the suitable infrastructure can stop crowd-related accidents.

The damage in Koh Pich tragedy could have been minimised if the security personnel were trained to operate in such situations. Training the security personnel for any disaster should be undertaken. Mock drills and exercises can train them to execute things such as evacuating people and controlling the masses.

Information Management

In pilgrimages like Hajj and Kumbh mela, with people coming from different ethnic backgrounds and different languages there is a need for sign language or other means of communication. With more than 3 lakh persons missing during the 2013 Kumbh mela the authorities managed the situation by constantly updating on website and by announcements. To ease such situations the layout of the area/venue, location of facilities, circulation routes, locations of entrances and exits should be specified to public. Leaflets can be given with Do's & Don'ts', route maps, locations and emergency contacts.

Use of Modern Technology

Tracking and identifying individuals in mass congregations is a very complex task. It becomes more complex if the people are from different languages and backgrounds. But modern technology can give remedies to such situations. Technology based solutions can be given for problems like pilgrim identification such as providing pilgrims with RFID (Radio-frequency identification) tags. Measures like Sensors, Processors and Display Screens once in place, will provide solutions to many problems associated with the identification of pilgrims. In the recent years Hajj pilgrimage witnessed many new interventions such as the sensors and tracking systems. Kumbh mela can learn from the strategies of Hajj. The effective management of crowd can be achieved by updating to new technological interventions.

Conclusion

Several mass gatherings mainly the religious gatherings in India have not yet realised the importance and crucial role of disaster preparedness in event management. A review of past gatherings says that any small trigger can cause huge impacts in mass gatherings. Although few governments and organisations have recognised the importance of disaster preparedness a study of the past gatherings will help in identifying the existing problems and will help in formulating strategies to overcome the problems. Even after the infrastructure developments and technological interventions by the governments the gatherings (such as Hajj) continuous to face major challenges. The projected results in this study indicate a major gap in the strategies adopted for disaster preparedness. The aim of this effort is to bring radical changes in authorities to include disaster preparedness in the organisation of mass gatherings. Proper documentation of the managerial and planning aspects of the gatherings will help in the future. The strategies mentioned in this paper can be considered in forthcoming gatherings to improve disaster preparedness.

Success in this endeavour will not be easy as it requires persistent and continuous efforts and depends on many factors. However, the degree of government willingness to engage in disaster preparedness, their level of commitment and their collaboration with other sectors to build disaster preparedness will ensure the safe gathering.

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♣

CYCLONE

- Cloud Technology for Automated Aggregation of Survey Data of Housing and Buildings towards Cyclone Vulnerability Assessment - *1. K. Sasikala, 2. P. Harikrishna, 3. S. Thamarai Selvi*
- Thane Cyclone Damages Caused To Agriculture In Villupuram District Of North Eastern Zone Of Tamil Nadu - *Dr. R. Vaidyanathan and Dr. M. Jayaramachandran*
- A Study on Cyclone Persuaded Human Behaviours and Responses: With Special Reference to Orissa Super Cyclone 1999 and Phailin 2013 -*Niranjan Sahoo*
- Disaster Management And Thane Cyclone Rehabilitaion In Cuddalore District Of Tamil Nadu, India -L.Jeeva Jothi1, *K.Sakthivel, K.Raja, I.Cannayane, and M.Jawaharlal*

CLOUD TECHNOLOGY FOR AUTOMATED AGGREGATION OF SURVEY DATA OF HOUSING AND BUILDINGS TOWARDS CYCLONE VULNERABILITY ASSESSMENT

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Abstract

Even though the loss of life could be mitigated during the recent cyclones "Phailin" and "Hudhud" with the help of advanced warning systems, the damage to housing is observed to be sustained. CSIR-Structural Engineering Research Centre, Chennai has been involved in carrying out studies for mitigation of damage to housing and buildings due to cyclones for the past few decades. Earlier, with the aid of UNDP, CSIR-SERC has formulated a questionnaire to survey rural housing for cyclone damage mitigation. Using the formulated questionnaire, survey of rural housing was carried out in limited villages along the east coast of India to identify commonly adopted materials and construction practices. Based on which cost-effective retrofit measures for improved resistance to cyclonic winds have been derived by conducting tests at CSIR-SERC. Subsequently, the indigenously formulated questionnaire were standardized by BIS in 2004 (IS: 15499). At present, a research work towards development of a module for automated aggregation of housing survey data as per the standardized Proforma in using the latest 'CLOUD TECHNOLOGY', is being carried out for the purpose of collecting the huge database from the coastal villages, which are geographically located in different Taluks/districts/states of Indian Coastal Region. This paper highlights salient features of the Web Application developed for this purpose.

♣

Introduction

India is prone to various natural hazards, viz. floods, landslides, earthquakes, cyclones, etc. With a coastline of about 7500 km, India is highly vulnerable to cyclones every year. After the super cyclone in Orissa in October 1999 and the Bhuj earthquake in Gujarat in January 2001, the Government of India has shifted its focus from post disaster response and relief to disaster management including prevention, mitigation, preparedness, response and relief[(1)]. By implementing early warning system for monitoring and tracking of the cyclones and construction of cyclone shelters, as part of national cyclone disaster preparedness measures, the loss of life was reduced significantly during the recent very severe cyclone storms, viz. 'Phailin' in 2013 and 'Hudhud' in 2014, as highlighted in Table 1[(2-5)]. However, the damage to housing is observed to be continuing depending upon the intensity of the cyclone and the vulnerability of the landfall region as indicated in Table 1[(2-5)]. Further, the Government of India has realized disaster mitigation as an essential component of the sustainable development strategy and has been implementing various capacity building measures against different hazards[(6)]. Even at global level, there has been a paradigm shift from Disaster Reduction (during International Decade for Natural Disaster Reduction (IDNDR) 1989-1999) to Disaster Risk Reduction (Hyogo Framework for Action 2005-2015)[(7)]. It was observed that ten years after the adoption of the Hyogo Framework for Action, disasters continue to undermine efforts to achieve sustainable development[(8)]. Hence, in the Sendai Framework for Disaster Risk Reduction (2015-2030) [(8)], the priorities have been set to understand disaster risk, strengthen disaster risk governance to manage disaster risk, invest in disaster risk reduction for resilience and enhance disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction[(8)].

It was also emphasized to shift the thinking and action from disaster management to disaster risk management through prevention of vulnerability to disaster and strengthen resilience by promoting collection of relevant data and usage of information and communication technologies[8].

CSIR-Structural Engineering Research Centre, Chennai has been involved in carrying out studies for mitigation of damage to housing and buildings due to cyclones for the past few decades. Earlier, CSIR-SERC has formulated a questinaire[9] (Fig. 1) to survey rural housing as part of the cyclone damage mitigation activities conducted with the aid of UNDP during IDNDR. Using the formulated questionnaire, survey of rural housing was carried out in a pilot mode with the help of various nodal centres in selected villages along the east coast of India to identify commonly adopted materials and construction practices[10]. Based on which cost-effective retrofit measures for improved resistance to cyclonic winds have been derived by conducting tests at CSIR-SERC[11&12]. The indigenously formulated questionnaire were later standardized with improvements by BIS in 2004 (IS: 15499)[13]. At present, a research towards automated aggregation of housing survey data as per the standardized Proformae using the latest 'CLOUD TECHNOLOGY', is being carried out at CSIR-SERC for the purpose of assessing the cyclone vulnerability of housing in coastal villages, which are geographically located in different taluks/districts/states of Indian Coastal Region. This paper highlights salient features of the Web Application developed for aggregation of housing survey data as per the standardized Proformae.

Indian Standard for Rural Housing Survey Proformae[13]

The questionnaire mentioned above have later been updated and standardized. IS:15499 (2004)[13] provides the following proformae for survey of housing and buildings in cyclone prone areas:

Proforma I: To identify the preparedness of the unit for handling a cyclone disaster and the accessibility of the area for the purpose of relief. It has to be filled for each unit.

Proforma IIA: To obtain statistical information for the purpose of characterization of building typology.

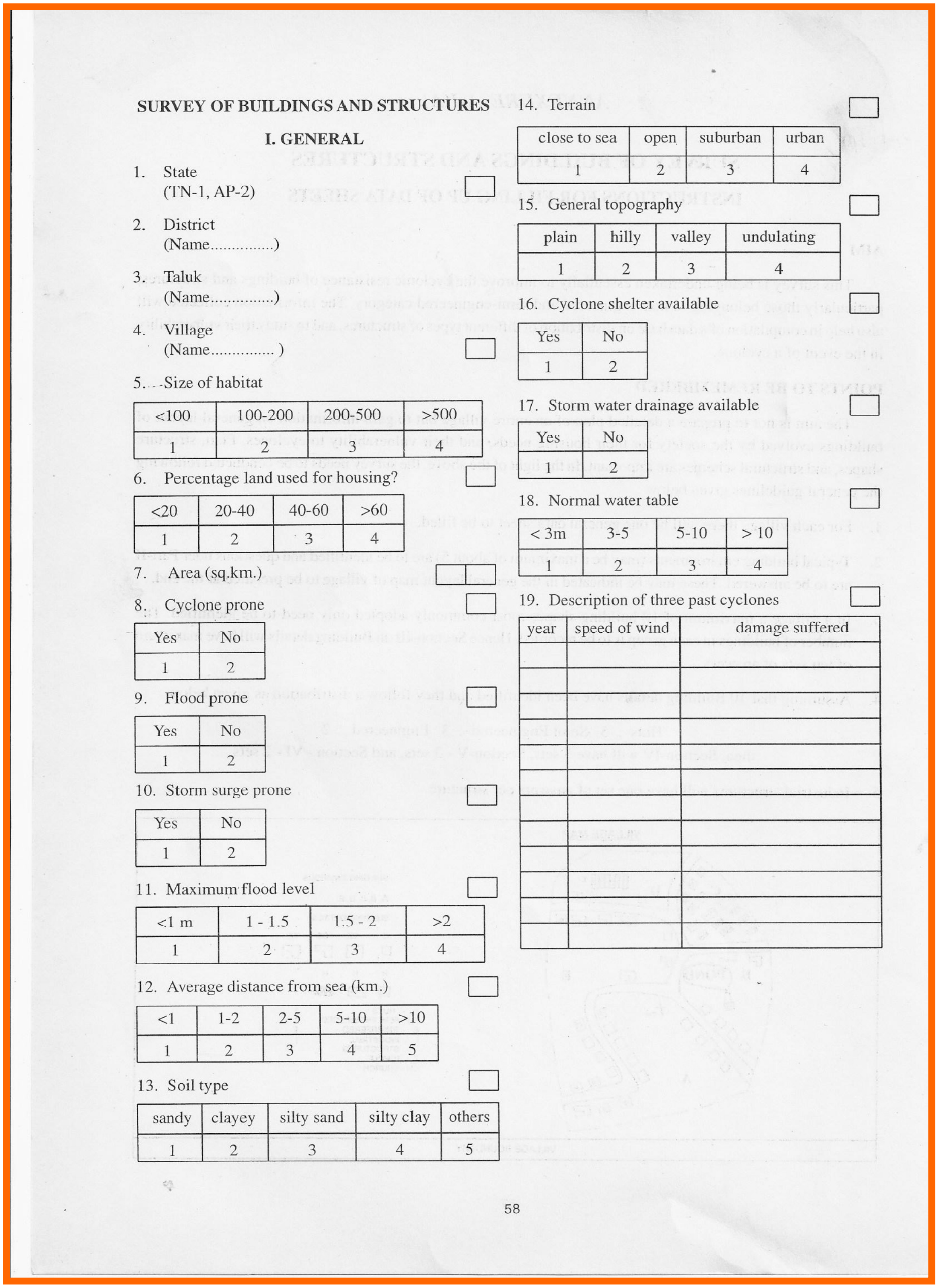
Proforma IIB: To obtain information about structural system employed and various typical member size so that inadequacies of the building can be determined and suitable retrofitting measures designed.

Proforma IIC: To record the extent and nature of damage suffered to buildings only for post cyclone damage survey in a region.

In the present research, these proformae have been considered for developing a cloud based web service module to aggregate the rural housing survey data collected from various villages located along the coastal regions of India. Figs. 2-5 show typical views of the proformae.

Table 1 Statistics of Various Severe Cyclones in the recent decades

Year	Landfall	Intensity	Number of people reported killed	Number of houses reported damaged
1999	Near Paradip, Orissa, India	Super Cyclone (250 kmph)	9893[2]	2,75,000[2]
2011	Near Kadalur, Tamilnadu, India	Severe Cyclone (150 kmph)	57[3]	99,904[3]
2013	Near Gopalpur, Orissa, India	Very Severe Cyclone (220 kmph)	59[4]	5,41,200[4]
2014	Near Visakhapatnam, Andhra Pradesh, India	Very Severe Cyclone (195 kmph)	37[5]	1,23,519[5]



SURVEY OF BUILDINGS AND STRUCTURES

I. GENERAL

1. State (TN-1, AP-2)

2. District (Name..............)

3. Taluk (Name..............)

4. Village (Name..............)

5. Size of habitat

<100	100-200	200-500	>500
1	2	3	4

6. Percentage land used for housing?

<20	20-40	40-60	>60
1	2	3	4

7. Area (sq.km.)

8. Cyclone prone

Yes	No
1	2

9. Flood prone

Yes	No
1	2

10. Storm surge prone

Yes	No
1	2

11. Maximum flood level

<1 m	1 - 1.5	1.5 - 2	>2
1	2	3	4

12. Average distance from sea (km.)

<1	1-2	2-5	5-10	>10
1	2	3	4	5

13. Soil type

sandy	clayey	silty sand	silty clay	others
1	2	3	4	5

14. Terrain

close to sea	open	suburban	urban
1	2	3	4

15. General topography

plain	hilly	valley	undulating
1	2	3	4

16. Cyclone shelter available

Yes	No
1	2

17. Storm water drainage available

Yes	No
1	2

18. Normal water table

< 3m	3-5	5-10	> 10
1	2	3	4

19. Description of three past cyclones

year	speed of wind	damage suffered

58

Fig. 1 Typical view of the questionnaire formulated(9) by CSIR-SERC to survey rural housing for cyclone damage mitigation

ANNEX A

(*Clause* 2.2)

PROFORMAE

PROFORMA I GENERAL

1. State

Tamil Nadu	Andhra Pradesh	Orrisa	West Bengal	Gujarat	Others
1	2	3	4	5	6

2. Name of district:

3. Name of taluk:

4. Name of village/unit:

5. Distance from district headquarters, in km

< 20	≥ 20 but < 40	≥ 40 but < 60	≥ 60
1	2	3	4

6. Area, in km^2

< 10	≥ 10 but < 20	≥ 20 but < 30	≥ 30
1	2	3	4

7. Percentage land use for housing

< 20	≥ 20 but < 40	≥ 40 but < 60	≥ 60
1	2	3	4

8. Number of inhabitants

< 100	≥ 100 but < 200	≥ 200 but < 500	≥ 500
1	2	3	4

9. Cyclone prone

Yes	No
1	2

10. Flood prone

Yes	No
1	2

11. Storm surge prone

Yes	No
1	2

12. Average distance from sea, in km

< 1	≥ 1 but < 5	≥ 5 but < 10	≥ 10 but < 20	≥ 20
1	2	3	4	5

4

Fig. 2 Typical view of Proforma I - General for each village/town/city along the coast

PROFORMA II BUILDING TYPOLOGY AND STRUCTURAL ASSESSMENT
A — TYPOLOGY

1. Name of owner/occupant:

Address:

Taluk: District: State:

2. Location of building amongst the cluster

Corner	Edge	Interior
1	2	3

3. a) Height of surge/standing water, in m

< 1	≥ 1 but < 1.5	≥ 1.5 but < 2	≥ 2 but < 4	≥ 4
1	2	3	4	5

b) Duration for which water stays, in h

< 4	≥ 4 but < 6	≥ 6 but < 8	≥ 8
1	2	4	5

4. Number of occupants

1	2	3 – 4	5 – 6	7 – 8	> 8
1	2	3	4	5	6

5. Area of plot, in m^2

< 10	≥ 10 but < 20	≥ 20 but < 40	≥ 40 but < 60	≥ 60
1	2	3	4	5

6. Area of building, in m^2

< 10	≥ 10 but < 20	≥ 20 but < 30	≥ 30
1	3	4	5

Fig. 3 Typical view of PROFORMA II A for each specific/selective building in a village/town/city along the coast

PROFORMA II BUILDING TYPOLOGY AND STRUCTURAL ASSESSMENT
B — STRUCTURAL AND CONNECTION DETAILS

1. Name of owner:

Address:

Village

Taluk: District: State:

2. Structure details:

   a) Overall length, in m
   b) Overall breadth, in m
   c) Height of external walls, in m
   d) Thickness of external walls, in m
   e) Height of internal walls, in m
   f) Thickness of internal walls, in m
   g) Number of storey

3. Typical plan

4. Typical section

5. Typical member sizes — Materials used:

   a) Ridge beam (m × m)
   b) Rafter (m × m)
   c) Purlin/Battens (m × m)
   d) Beam (m × m)

6. Foundation type

Shallow	Deep
1	2

7. Depth of foundation, in m

< 0.5	≥ 0.5 but < 1	≥ 1 but < 1.5	≥ 1.5 but < 2	≥ 2
1	2	3	4	5

8. Plinth protection/apron provided or not

Yes	No
1	2

Fig. 4 Typical view of PROFORMA II B for each specific/selective building in a village/town/city along the coast

PROFORMA II BUILDING TYPOLOGY AND STRUCTURAL ASSESSMENT
C — DAMAGE DETAILS

1. Name of owner/occupant:

Address:

Village

Taluk: District: State:

2. Damage to roof

None	Marginal	Medium	Heavy	Total
1	2	3	4	5

3. Damage to front walls

None	Marginal	Medium	Heavy	Total
1	2	3	4	5

4. Damage to side wall-1

None	Marginal	Medium	Heavy	Total
1	2	3	4	5

5. Damage to side wall-2

None	Marginal	Medium	Heavy	Total
1	2	3	4	5

6. Damage to rear wall

None	Marginal	Medium	Heavy	Total
1	2	3	4	5

7. Damage to compound wall

None	Marginal	Medium	Heavy	Total
1	2	3	4	5

8. Damage to foundation

None	Marginal	Medium	Heavy	Total
1	2	3	4	5

9. Damage to columns:
   a) Total number of columns
   b) Number of columns of different damage levels

None	Marginal	Medium	Heavy	Total

   c) Overall assessment of damage to columns

None	Marginal	Medium	Heavy	Total
1	2	3	4	5

10. Damage to internal walls

Collapsed Most	Collapsed Few	Cracked Most	Cracked Few	None
1	2	3	4	5

11. Crack locations (please √) [*see* Note 1]

Corner	Middle of Long Wall	Middle of Short Wall	Near Top	On Top of Door/Window Opening	At Staircase	At Junction of Walls

12. Crack orientation (please √) [*see* Note 1]

Fig. 5 Typical view of PROFORMA II C for post-cyclone damage details in a village/town/city along the coast

Automated Aggregation of Housing Survey Data

The schematic representation of the quantum of survey data to be aggregated as per the proformae given in IS: 15499 (2004) through nodal centres, which are considered as collaborating institute / orgnaisation / agency, from various villages along the Indian coast is shown in Fig. 6.

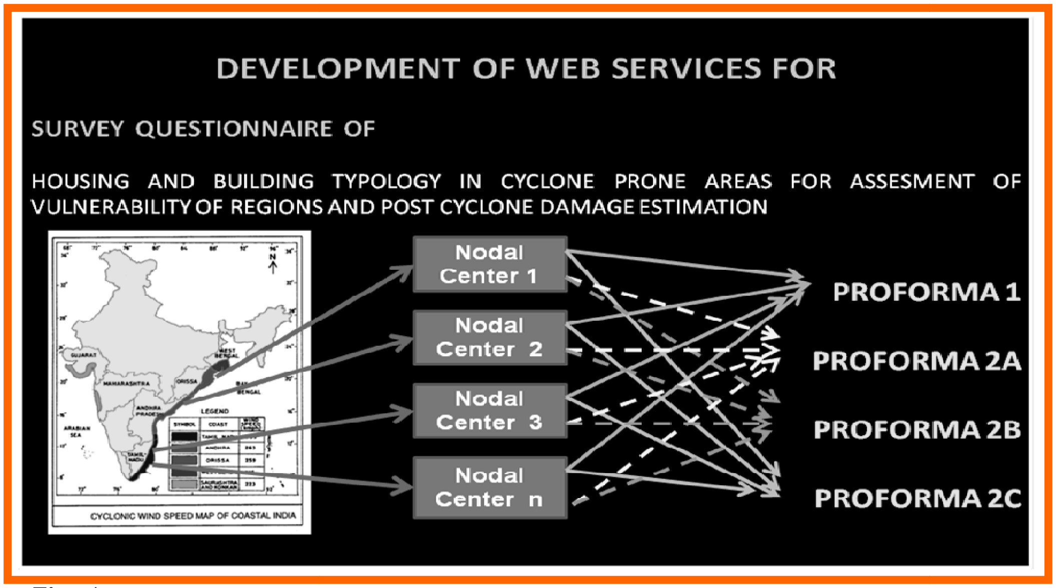


Fig. 6 Schematic view of data aggregation of housing survey data using different proformae.

It can be seen from Fig. 6 that for each of the village one Proforma I consisting of 29 parameters needs to be

MODULE – 1.1	PROFORMA I – 29 Q – (Q(1)=1 to np , ...Q(29)=1 to np)
MODULE – 1.2	PROFORMA II A – 28 Q – (Q(1)=1 to np , ...Q(28)=1 to np)
MODULE – 1.3	PROFORMA II B – 30 Q – (Q(1)=1 to np , ...Q(30)=1 to np)
MODULE – 1.4	PROFORMA II C – 26 Q – (Q(1)=1 to np , ...Q(26)=1 to np)

collected. Further, for each of the housing type in a village: (i) one Proforma IIA consisting of 28 parameters,

(ii) one Proforma IIB consisting of 30 parameters and (iii) one Prforma IIC consisting of 26 parameters (in case of post-cyclone damage survey) needs to be collected. IS 15499 (2004) suggests that a minimum of 10 percent total housing/buildings may be surveyed with maximum numbers of 50, 25 and 15 for non-engineered, semi-engineered and engineered types of housing/buildings, respectively. It is to be noted that the proformae mainly consists of three types of queries: (i) queries with multiple options, (ii) queries about definite quantitative terms in alphanumeric form and (iii) information to be provided in the form drawings/images.

Considering the geographical distribution of the nodal centres/villages along the coast, it is preferable to aggregate the collected surveyed data through internet. In this line, Cloud computing is an Information Technology development, deployment and delivery model. It enables real-time delivery of products, services and solutions over the internet. The Data storage is the primary use of the cloud computing and the data can be accessed from anywhere at any time. The cloud technology removes the need for having the physical hardware to store the data at the user end. The cloud services are the web-based applications/services offered via cloud computing. With a cloud service, the application itself is hosted in the cloud and it removes the need for having the software tools at the user end[(14)]. The requirement to access the cloud geographically at any location at any time, is to have a Desktop PC/ Laptop/ Tablet/ Mobile with wireless or wired Internet connection. According to the requirement and the security measures, the cloud services can be (i) Public Cloud, which can be accessed by any subscriber, (ii) Private Cloud, which can be accessed by a limited users, (iii) Community Cloud, which can be accessed by a group of users, (iv) Hybrid Cloud, which can be accessed between two or more organizations.

Hence, a web service based application has been developed with the following requirements:

- The standard survey questionnaire has to be published in the web for the usage of the Nodal center data entry operators, team members of the cyclone damage analysers and decision makers, who are geographically located at different places.
- The response data of the questionnaire from different locations has to be collected.
- The collected response data has to be stored in a proper format for further usage.

Since the "CLOUD ENVIRONMENT" is a large group of interconnected computers /servers /data centers that are publicly accessible via the internet, the cloud computing techniques have been used for the above said scope of work to attain cloud status through which the manual management of data can be replaced by the automated process.

In the present work, a web service module has been developed (Fig. 7) by using (i) XML based SOAP – Simple Object Access Protocol for accessing a web service, (ii) an open source Application server - GlassFish Server, (iii) an open source web server - Apache Tomcat in the open source, JAVA based - Integrated Development Environment - NetBeans IDE 7.0.1. Typical views of the client and server modules in NetBeans IDE 7.0.1 are shown in Figs. 8 and 9 for collecting the housing survey data as per the proformae of IS: 15499 (2004) (Fig. 9). The web service module to collect the housing survey database as per the proformae has been developed and deployed using the NetBeans IDE 7.0.1 in the "LOCAL HOST" and the data was stored in the local host itself by using 'JavaDataBase'.

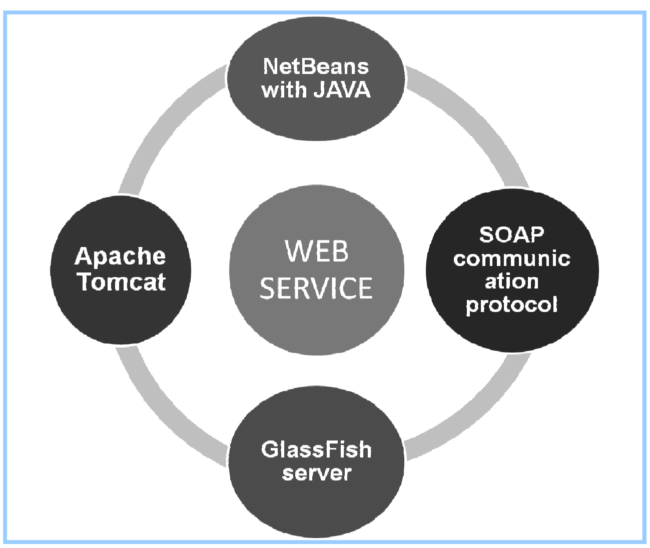


Fig. 7 Schematic representation of the Cloud Technology Tools

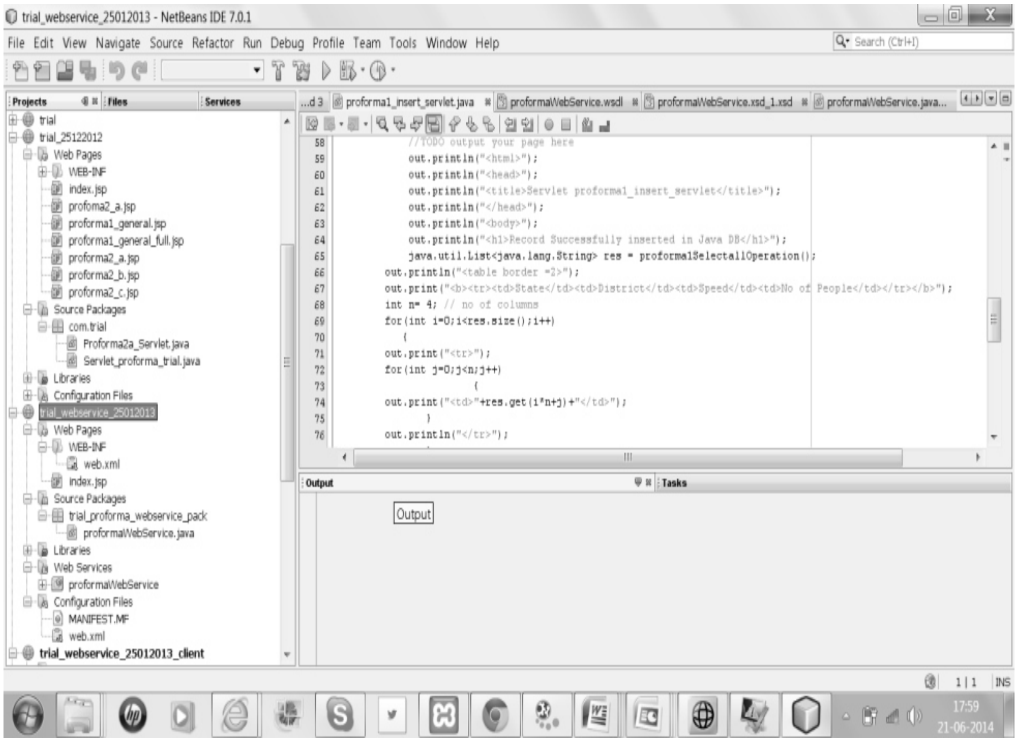


Fig. 8 Client Program in Java-NetBeans

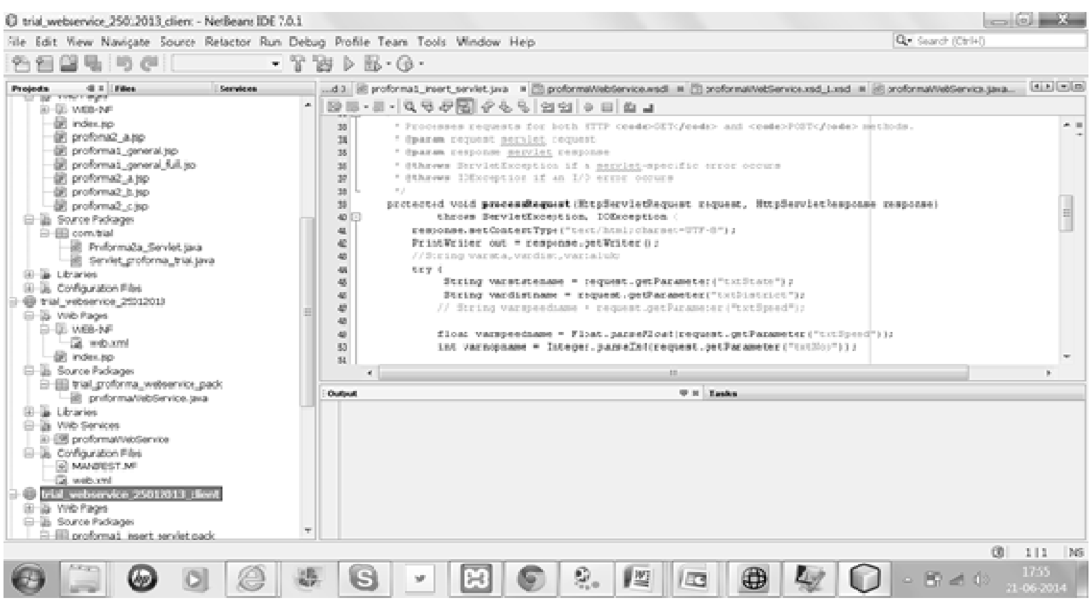
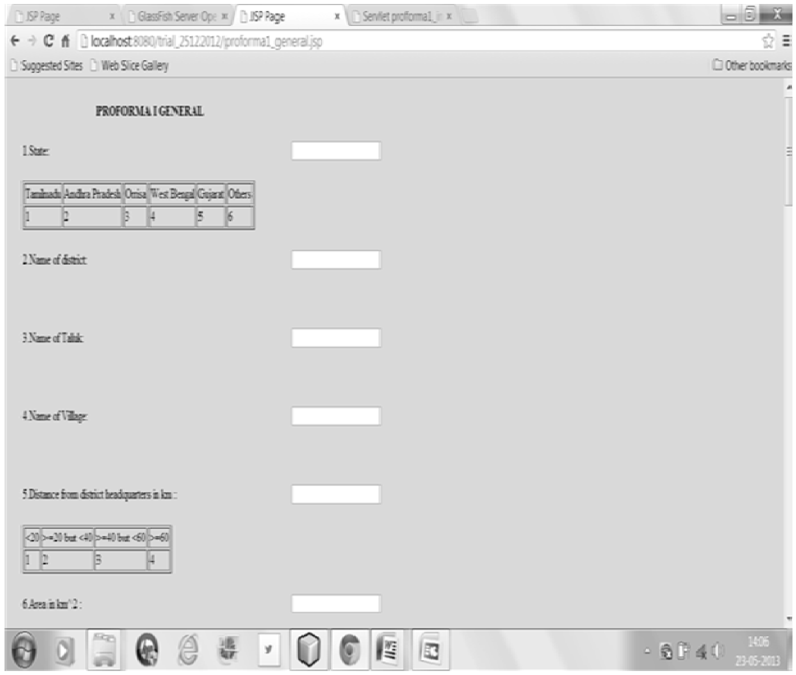


Fig. 9 Server program in Java - NetBeans
(a) Proforma I



(b) Proforma II A

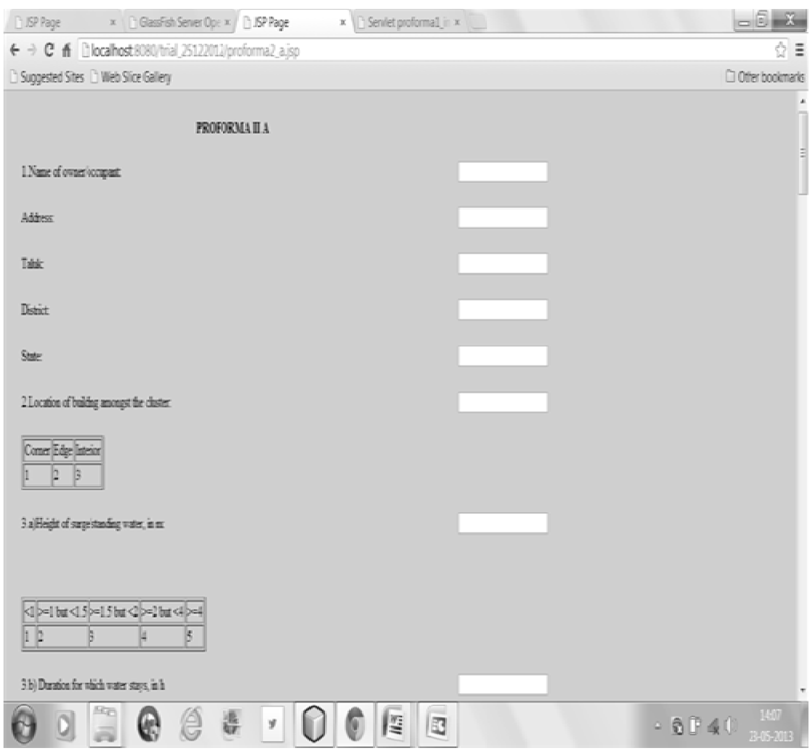


Fig. 10 Frontend of Proformae

Conclusion

India with very wide coastline is highly vulnerable to cyclones every year. There is a continuous evolvement at global and national levels in dealing with disasters from disaster management to disaster mitigation through disaster risk reduction by understanding the risk and managing the risk by various measures, viz. disaster preparedness, disaster resilience, etc. Even though there is significant reduction in loss life reported during cyclones in the recent past with the help of advanced early warning systems, the damage to housing is observed to be continued depending upon the intensity of the cyclone and the vulnerability of cyclone landfall region. This needs to be tackled in a systematic manner by collecting the data of houses and buildings in coastal regions for the assessment of their vulnerability to cyclones and to identify suitable retrofit measures. In this regard, standardized proformae are available in IS: 15499 (2004) for the collection of housing database, specific to assessment of their vulnerability to cyclones. In the present study, these standardized proformae have been considered for the collection of housing data using latest technologies available. With the wide reach of information technology, the latest trend of using Cloud Technology with the requirement of only internet facility/ any browser at the user/client end is becoming most popular in collecting and managing data. As part of the development of a Decision Support System by CSIR-SERC for the purpose of vulnerability assessment of rural housing in coastal regions to cyclones, the usefulness of adopting Cloud Technology for aggregating the housing survey database collected as per IS Codal proformae (IS: 15499 (2004)) is presented in this paper. Further research towards the simulation of aggregating the housing survey data from different 'nodal centers' from different states of Indian Coastal Region needs to be carried out in a infrastructure - "CLOUD LAB". It can also be considered as a proof of concept for adopting this approach in developing various other "Decision Support Database" towards any "Decision Support System" required for the rural development purposes.

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THANE CYCLONE DAMAGES CAUSED TO AGRICULTURE IN VILLUPURAM DISTRICT OF NORTH EASTERN ZONE OF TAMIL NADU

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Introduction

Tamil Nadu is the Southern state of India and geographically the location is vulnerable to cyclonic storms during the onset of North East Monsoon every year. Floods are most common natural disaster in National level and in Tamil Nadu too. During the hot summer, displacement of air masses over the Bay of Bengal causes cyclones during the South West and North East Monsoons. The heavy south west monsoon rain causes the Brahmaputra and other rivers to distend their banks often flooding in surrounding areas. Excess, erratic or untimely monsoon rainfall may also wash away or otherwise ruin crops. Global warming and its direct effects on rising temperature lead to flash floods, torrential rains in North India. The mean annual precipitation have remained steady due to the frequently declining weather systems that generate insufficient amount of rains.

In INDIA, 1737 Calcutta cyclone, 1970 Bhola cyclone, 1991 Bangladesh cyclone caused widespread devastation along the Eastern part of our country. Widespread death and property destruction are reported every year in exposed coastal states of India *viz.*, Orissa, Andhra, Telangana and Tamil Nadu. In terms of sevearity of damage the super cyclone of Orissa which struck the state on 29th October 1999 was the worst in more than a quarter century. About 20 million peoples life was disrupted, 9803 people died and two million people were left homeless.

In Tamil Nadu, the earlier cyclone Nisha, Jall which covered the coastal district without much damage but the very severe cyclonic storm named 'Thane' caused extensive damage to Cuddalore, Villupuram districts and Pondicherry State. The land fall was predicted between Pondicherry and Cuddalore and the system moved in the predicted direction and cause excessive damage. It had the wind speed at 140 kph during its period and crossed the land between 6.30 am and 7.30 am on 30th December 2011. The IMD designated this cyclone as '<u>BoB 05'</u> and it was the 'strongest tropical cyclone' of 2011 within north of Indian Ocean. In the morning of December 31, cyclone 'Thane' had left at least <u>46 dead</u> in Tamil Nadu and Pondicherry. The worst effected district was Cuddalore district compared to Villupuram which the cyclone damaged all the networks (road, cellphone, power). Eventhough the preparedness for meet out the cyclone has been made very extensively, losses of Agricultural crops, horticultural crops, human life and wealth and normal life are inevitable. This paper concentrates on the origin of the cyclone, land fall, after effects, preparedness made by the government agencies and scope for improving the preparedness to meet out the challenges in future.

Geographical Description of Tamil Nadu State

Tamil Nadu is situated in the South Eastern part of the Indian peninsular between North latitudes 08°00' and 13°30' , East longitudes 76°15' and 18°18'. the area of Tamil Nadu is 1,30,058 sq.km and bounded in east by 'Bay of Bengal', in south by '<u>Indian Ocean'</u> in the West by <u>Kerala</u> state and <u>Arabian sea</u> while in the north by Karnataka and Andhra Pradesh. The three major units of our state are western part comprises of Western Ghats, Eastern Ghats and central part comprises of vast track of dissected pediments and pediplains.

The climate of the state is tropical monsoon type. In the plains, the temperature during inter seldom goes below 18°C and in peak summer it rises up to 43°C. Tamil Nadu and Pondicherry receive rains from both the North east and south west monsoons. The mean annual rainfall is 927 mm. the maximum rainfall is received during North East monsoon (October, November, December) followed by south west monsoon (June, July, August & September).

Life History of Thane Cyclone

On 25th December 2011 a depression was formed over south east Bay of Bengal and lay central about 1000 km, south east of Chennai. It gradually moved, North-north west wards and further on testified into a deep depression on the early morning of December 26th 2011. In the same midnight the system has changed into a cyclonic storm "THANE". It then moved west-north westwards and intensified into a severe cyclonic storm on the afternoon. On the evening of 28th December 2011 the system changed into a very severe cyclonic storm. It than moved West-south westwards and crossed north Tamil Nadu of Pondicherry coast between Cuddalore and Pondicherry within 6.30 hrs and 7.30 hrs. IST of 30th December, 2011 with a wind spread of 120-140 kmph.

On 30th December 2011, after land fall, the system rapidly weakened into a severe cyclonic storm over north coastal Tamil Nadu at 8.30 hrs. IST and further changed into a deep depression around noon and into a depression in the same evening over the north interior Tamil Nadu. In the early morning of 31st December, 2011 it further weakened and lay as a well marked low pressure area over north Kerala and neighborhood. The best track and associated parameters are shown in Table-1.

Realised Weather during Land Fall of Thane 2011

Heavy Rainfall

30 December 2011

Heavy to very heavy rainfall occurred at a few places over north Tamil Nadu. The places Kalpakkam and Kelambakkam received 10cm while Cuddalore, Madhuranthagam, Villupuram and Uthiramerur received 9 cm. Chengalpattu and Mahabalipuram received 8cm rainfall, Chennai Airport, Thiruvallur and Chidambaram received 7 cm rainfall.

31 December 2011

After the land fall of 'Thane" the following district Villupuram, Kancheepuram, Cuddalore, Thiruvannamalai district received the very heavy rainfall i.e. >12 cm.

Gale Wind

Pondicherry reported maximum wind of 68 knots (125 kmph) and Cuddalore reported maximum wind of 76 knots (140 kmph) at the time of land fall. Gale wind spread reaching 120-140 kmph prevailed along and off North Tamil Nadu and Pondicherry.

Storm Surge

The storm surge of about 1 metre height imitated the low lying coastal areas of Cuddalore, Pondicherry and Villupuram district at the time of land fall of the cyclone THANE.

Monitoring, Prediction and Warning Services

The system was continuously monitored and predicted since 24th December 2011. Initially, the warnings were issued for Andeman & Nicobar Islands, when the system was closer to it and then it was issued for Pondicherry, TamilNadu, Andhra Pradesh and Kerala. The special weather outlook and Tropical cyclone Advisory were issued during 25-31 December 2011 giving details of the very severe cyclone storm THANE and its forecast warnings and advisories to various natural and international agencies. The bulletin was also advisories control room, National Disaster Management, MHA, Govt. of India.

Forecast Performance

The forecasts and warnings issued by IMD have been verified as detailed below.

- Genesis forecast:

  On 24th December 2011 morning the genesis of depression over the south east Bay of Bengal was predicted 36 hrs in advance.

- Gale wind forecast:

  The actual wind was 120-140 kmph against the forecast wind of 120-130 kmph guessing to 145 kmph 24 hrs in advance.

- Storm surge warning:

  MD predicted storm surge of 1-1.5 metre height above the astronomical tide over Pondicherry Thiruvallur, Villupuram, Chennai and Kanchipuram district of North eastern Tamil Nadu at the time of land fall.

- Heavy rainfall warning:

  The occurrence of heavy to very heavy rainfall over Andamon & Nicobar Islands, Tamil Nadu and Pondicherry, south coastal Andhra Pradesh and Kerala could be very well predicted. However the extremely heavy rainfall as predicted over north Tamil Nadu did not occur.

Cyclone Preparedness

All warnings were being aired over the radio and television. Both Cuddalore and Pondicherry had started announcing the imminent arrival of this cyclone through mass communication channels *viz*., Television and the Radio. In any such crisis situation then, there can be very frequent updates and changes, it certainly makes sense to use such mass communication channels. Hence, although information was being aired very frequently, it was not received by many as the power supply was cut off twenty four hours before the cyclone struck and was restored only after a week or two depending on the intensity of losses.

After Effects

The worst effected part of Tamil Nadu due to thane cyclone was Cuddalore district followed by Villupuram and Pondicherry State, major food crops grown in these area paddy, groundnut, sugarcane, cholam, cumbu, redgram, tapioca, greengram, blackgram, coriander, banana, maize, varagu, cashew nut, Cassuarina, Teak and Coconut. Many avenue trees had been uprooted on the Cuddalore, Chidambaram, Pondy, Villupuram roads, resulting in suspension of vehicles movement. Power production at the Lignite Neyveli Corporation was affected as the mines were sub merged.

At Chennai flight services were also disturbed due to the cyclonic storm. Copious overnight rainfall coupled with strong winds uprooting trees in some places of Chennai. The high speed wind also uprooted hundreds of trees, electric poles, traffic signal poles and mobile phone towers and damaged standing crops across coastal districts of Tamil Nadu and Pondicherry.

The Detailed Cyclone Damage in Tamil Nadu is given below:

S. No.	Types of damages	Units
1.	Agricultural damages	80609 ha
2.	Horticultural crops	28090 ha
3.	Settlement damages	
	i) Thatched houses damages	267925 no.
	ii) Tiled house damages	81292 no.
	iii) Roadways damages	1458 km
4.	Biological damages	
	i) Human beings	46 no.
	ii) Cattles	519 no
	iii) Poultry	52938 no.
5.	Boat damages	4600 no.
	i) Fisher net damages	194949 no.
6.	Electrical goods damages	
	i) Electrical post	45460 No.
	ii) Transformers	4500 no.
	iii) High level towers	27 no.
	iv) Electric line or wires	12100 km

Conclusion

'THANE' the very severe cyclonic storm hit Tamil Nadu badly and the government had taken war foot steps to restore the normality in the storm affected areas. The disaster management committee which draws up the plans consists of representatives at the village level, local authorities, government functionaries including doctors/paramedics/agricultural officers, fire services and primary health centres located in the village etc. The volunteer teams were constituted to render help as and when needed at the effected places. The team also generated awareness among the people on the village about do's and don'ts for specific hazards depending on the vulnerability of a particular area. The village land Disaster Management Committees and Disaster Management Teams have already been constituted.

However, in future, we should approach the disaster as a holistic phenomenon i.e. we should plan in an integrated way covering all relevant aspects of water management, infrastructural facilities, physical planning, land use, agriculture, transport and urban development etc. At the time of decision making especially about rehabilitation the stakeholders and civil society should also be involved for better results.

Best Tract Positions and other Parameters of Very Severe Cyclonic Storm THANE over the Bay of Bengal during 25-31 December, 2011

Date	Time (UTC)	Centre lat. N/long.E.	C.I NO.	Estimated central pressure (hPa)	Estimated Maximum sustained surface wind (Kt)	Estimated pressure drop at the centre (h pa)	Grade
25.12.2011	1200	8.5/88.5	1.5	1000	25	3	D
	1800	9.0/88.0	1.5	1000	25	3	D
26.12.2011	0000	9.5/87.5	2.0	998	30	4	DD
	0600	10.0/87.5	2.0	998	30	4	DD
	1200	10.5/87.5	2.0	998	30	5	DD
	1800	11.0/87.5	2.5	996	35	7	CS
27.12.2011	0000	11.5/87.5	2.5	994	40	8	CS
	0600	12.0/87.0	2.5	994	40	8	CS
	1200	12.5/86.5	2.5	992	40	10	CS
	1800	12.5/86.0	3.0	990	45	12	CS
28.12.2011	0000	12.5/85.5	3.0	990	45	12	CS
	0600	12.5/85.0	3.0	988	45	14	CS
	0900	12.5/85.0	3.5	986	55	16	SCS
	1200	12.5/84.5	4.0	982	65	20	VSCS
	1500	12.5/84.0	4.0	980	65	22	VSCS
	1800	12.5/84.0	4.0	978	65	24	VSCS
	2100	12.5/83.5	4.0	976	65	26	VSCS
29.12.2011	0000	12.3/83.0	4.0	974	70	28	VSCS
	0600	12.0/82.0	4.5	972	75	30	VSCS
	0900	12.0/81.7	4.5	972	75	30	VSCS
	1200	12.0/81.3	4.5	972	75	30	VSCS
	1800	12.0/80.6	4.5	972	75	30	VSCS
30.12.2011	0000	11.8/79.9	4.5	972	75	30	VSCS
	0300	11.8/79.5	-	986	55	16	SCS
	0600	11.8/79.0	-	998	30	5	DD
	1200	11.8/78.2	-	1000	25	3	D
31.12.2011	0000	The system weakened into a well marked low pressure area over north Kerala and neighbourhood.					

D	:	Depression
DD	:	Deep Depression
CS	:	Cyclonic Storm
SCS	:	Severe Cyclonic Storm
VSCS	:	Very Severe Cyclonic Storm

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A STUDY ON CYCLONE PERSUADED HUMAN BEHAVIOURS AND RESPONSES: WITH SPECIAL REFERENCE TO ORISSA SUPER CYCLONE 1999 AND PHAILIN 2013

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Abstract

The fear of cyclone was evident and the memory seemed to be new. The impact on human behaviour depends upon the damage and damage capacity caused to the community. The damage to life was zero as because of everyone was prepared for and the way preparedness was undertaken for averting effects of Phailin 2013. This was reflected in the form of confidence to face any other disaster. Hence the villages required psychoanalysis to prevent the impacts being carried by next generation. There was fear among people when the condition of still air and temperature fluctuation was observed. Despite of the fact various radars are installed. The degree of accuracy of Indian Meteorological Department has increased. This accuracy in forecasting helped a lot in reducing the level of paranormal behaviour of the victims. Proper preparedness, awareness among community people, accuracy in forecasting, technological intervention etc are a few of the factors that reduce the degree and magnitude of the paranormal phase. The level of paranormal of the victims are determined by various stages of human behaviour like shocking stage, suggestive sage and recovery stages and the behaviour of victims of Phailin has been determined by normal and abnormal in nature which has been elaborately explained in the full length of paper.

To test the assumption, a comprehensive case study is conducted in four costal blocks in Paradip areas of Jagatsinghpur districts with help of a corporate i.e. Paradeep Phosphates Limited. The study is purely qualitative in nature. This empirical study has also revealed the corporate intervention as on how it helps reducing the level of psychological trepidation of the victims. The full study has also suggested a model where CSR, preparedness and psychological aspects of victims have been taken together for a better solution.

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Introduction

In the recorded history of cyclones for the State of Orissa, the Super Cyclone of 29-30 October, 1999 was undoubtedly the most intense one. It had some unique features such as rapid intensification, small radius of eye-wall confining the large surge close to the point of landfall and relatively long life after landfall. Climatologically there is a high frequency of dissipation of cyclones in October because of strong easterly winds aloft. Cyclone genesis usually terminates at the stage of marginal cyclones. Occasionally development of cyclones to hurricane force winds and higher occurs in September and October as it happened in 1831 and 1885.

The official death toll was 9,893, but there were difficulties in making accurate estimates and local people insist the final death count was much higher. Whole villages along the sea in Ersama block of Jagatsinghpur district, were washed away - no one knows how many people were lost. The cyclone also destroyed the livelihood of the coastal state's farming community--it saturated more than 1 million hectares of cropland under salty water and killed some 406,000 livestock. Millions of people who eked out their living on the land were left homeless and without a means to survive. The cyclone struck just three weeks before the harvest; almost all the plantations in this mostly agricultural community--paddy fields, sugar cane, and vegetable crops--were destroyed. About 11 million people, nearly a third of the state's population of 35 million, were estimated by the UN agencies to be directly affected, having lost their shelter, crops, cattle and livelihoods.

These resulted in 4 different types of impacts:

- Physical destruction
- Saline inundation
- Flooding
- Psychological trauma

Table 1: Districts with Maximum Human Casualties (OSC 1999)

District	Human Casualties	Population affected		
		Total	Rural	Urban
Jagatsinghpur	**8,119**	**13,62,760**	**15,99,295**	**64,117**
Cuttack	471	24,17,048	18,47,923	5,69125
Kendrapara	469	13,70,000	13,03,200	75,800
Puri	303	15,63,000	13,70,000	1,93,000

Source: Gupta, M. C "Orissa Super Cyclone 1999", National Center for Disaster Management

Table 2: Districts with Maximum Washed away Houses (OSC 1999)

Name of District	Fully washed houses
Jagatsinghpur	**1,2124**
Balasore	11,483
Kendrapara	276
Mayurbhanj	262

Source: Gupta, M. C "Orissa Super Cyclone 1999", National Center for Disaster Management

Table 3: Districts with Damaged Boats and Nets (OSC 1999)

District	Boats	Nets
Chilika Lake	7,560	11,599
Jagatsinghpur	**6,988**	**16,271**
Kendrapara	6,354	8,905
Puri	3,181	7,945

Source: Gupta, M. C "Orissa Super Cyclone 1999", National Center for Disaster Management

Table 4: Districts with Maximum Number of School Damaged (OSC 1999)

Name of Districts	No. of school damaged	
	Primary school	High School
Jajpur	2,115	208
Ganjam	1,972	315
Cuttack	1,617	424
Balasore	1,288	152
Jagatsinghpur	**1,111**	**275**

Source: Gupta, M. C "Orissa Super Cyclone 1999", National Center for Disaster Management

Other sectors which were badly affected by OSC were:

Agriculture Sector: OSC has completely devastated the agricultural base and logistics in the affected areas of Odisha. In coastal belts, due to high tidal waves the standing crops were damaged affected 15 lakh families and worst affected districts were **Jagatsinghpur**, Cuttack, Kendrapada and Puri.

Loss of Livestock: More than 0.4 million cattle were killed by the super cyclone. Cattle death was reported highest in **Jagatsinghpur** (Highest), Kendrapara, Cuttack, Khudra and Puri.

Infrastructure: Complete collapse of communication networks and the surface communication was hampered due to damage to the Road and Rail network. Water supply system and irrigation infrastructure was adversely affected. Drinking water sources were either destroyed or contaminated by strewn carcasses compounded the already vulnerable state of the populace.

Research Institutes: The super cyclone severely affected Research Institutes and facilities in the coastal belt of the state.

Community Based Disaster Preparedness (CBDP) model in Odisha

As a result of the Pilot Orissa Disaster Management Project, a local disaster management (preparedness and mitigation) system was installed within the 10 blocks from the Block level to the GP to the village levels. Increased level of appreciation, especially with case stories of successful disaster preparedness activities in the June 2001 floods and November 2002 cyclone threat, was increased demand for the replication of the preparedness and mitigation activities in other blocks within the coverage districts of the project and for the other districts in Orissa.

Local and Community Based Disaster Preparedness & Mitigation Process

- Training of Trainers and Orientation on Block & Panchayat Disaster Management Plans
- Formation of Block and Gram Panchayat Disaster Management Committees, Working Plans, Training of Task Forces
- Selection and training of Volunteers from each village in CBDP & Mitigation and Community Contingency Planning (preparedness and mitigation measures)
- Hazard Vulnerability and Resources Mapping Discussion, Formulation of CCP and Approval by the Village's Palli Sabha
- Formation & Training of Village Response Groups/Task Forces
- Finalization & Approval of the GP and Block Disaster Management Plans
- Mock Drills, Plan Implementation and Social Mobilization at Various Levels
- Review & Updating of Plans and Continuing Improvement of CBDP and Mitigation.

Objectives of the Study

- To know as on how the proper preparedness and response strategy reduce the level of psychological trepidation of the victims.
- To know the types of corporate interventions in effective disaster response system
- To suggest a model of Cyclone preparedness through which the community can get rid of the psychological apprehension

Research Methodology

Research is based on empirical study and a few observations were made to develop this case. Selection of the test fields were made on the basis of severity of the previous cyclones and degree of cyclone vulnerability.

Vulnerability

Orissa is a state on the eastern seaboard of India, located between $17^0$49 and $22^0$36' North latitudes and between $81^0$36' and $87^0$18' East longitudes. It spreads over an area of 1,55,707 sq km. and is broadly divided into four geographical regions, i.e. Northern Plateau, Central River Basins, Eastern Hills and Coastal Plains. It has a 480 km coastline. Its population was 3.67crore as per the 2001 census. Administratively, the state is divided into 30 districts, 58 sub-divisions, 314 blocks (administrative units in descending order of geographical area and population) and 103 urban local bodies. The average density of population comes to 236 per sq km. with significantly higher density in the coastal areas compared to the interior parts.

Orissa is vulnerable to multiple disasters. Due to its sub-tropical littoral location, the state is prone to tropical cyclones, storm surges and tsunamis. Its densely populated coastal plains are the alluvial deposits of its river systems. The rivers in these areas with heavy load of silt have very little carrying capacity, resulting in frequent floods, only to be compounded by breached embankments. Though a large part of the state comes under Earthquake Risk Zone-II (Low Damage Risk Zone), the Brahmani Mahanadi graben and their deltaic areas come under Earthquake Risk Zone-III (Moderate Damage Risk Zone) covering 43 out of the 103 urban local bodies of the state. Besides these natural hazards, human-induced disasters such as accidents, stampede, fire, etc, vector borne disasters such as epidemics, animal diseases and pest attacks and industrial / chemical disasters add to human suffering

Selection of Place of Study

The multi Hazard map of Odisha demonstrate the vulnerability of Odisha. This overlapping nature of hazardous zone played an important role in selecting the district to consider for our study. This decision was coupled with the Orissa Super Cyclone.

Figure 2: Multi hazard map of Odisha

Jagatsinghpur District was selected for our sudy. To be more precise and the blocks were Kujang, Ersama and Balikuda.

The selection was supported by various factors like:

- Landfall point Orissa Super Cyclone lied between Ersama and Balikuda (South west of Paradeep).
- Paradeep is an industrial area with major industries in that region making the region prone to industrial disasters.
- It is the zone which has overlapped disaster possibilities due to cyclone, flood, moderate earthquake, Tsunami and others due to sea.
- Scope to get to see the development of people in major industrial zone.

Corporate Social Responsibility of Paradeep Phosphates Limited & Its Intervention in Disaster Preparedness

As a responsible corporate citizen, PPL is committed to improving the quality of life in the communities around . PPL recognizes avowed responsibility of being a catalyst in the socio-economic change process, through niche interventions that supplement the government's efforts in different sectors. PPL believes prosperity needs to be shared. Being proactive and conscious of our obligations marks our efforts in addressing inclusive growth - reaching out through innovative community based interventions. With a lens of inclusiveness, a strategy that enables participation of key stakeholders, a proactive approach, and a long term vision of transformation

Activities of PPL could be Categorized under Various Heading like

Peripheral Activities: These activities encompass programmes and interventions for rural upliftment. As a contribution for the welfare of inmates of the Nivedita Ashram orphanage, a community hall with attached toilets, a park for public use, repairing old hospital buildings and providing facilities are just small examples of outreach work.

Health: Various camps concerning general issues of the population. These included free health camp and diabetes camp.

Education: As part of our community outreach activities, 425 school kits containing water bottles, geometry boxes, pencil boxes, notebooks, drawing and painting material, & tiffin boxes etc. were distributed in four primary schools in the neighbourhood of the plant site. The kits were distributed to school children in the presence of local dignitaries.

Community: Child Centric Panchayat Initiative is a unique programme under the CSR framework where children are at the centre of development; each intervention and activity rationalizes the benefit for children as primary stakeholders. No society can think of meaningful development without addressing appropriate development of children and women; 'Invest in children' is our credo and 'ensure participation' is the guiding principle. This sharpens the focus while directing our effort for inclusive development.

Navratna Krishi Vikas Project: Navratna Krishi Vikas Project is a mission towards ensuring wholistic agricultural development of villages adopted by PPL. The project started in Orissa and Chhattisgarh in 2005-06, and now has successfully added two more states, Bihar and Jharkhand. In a span of 5 years, PPL has demonstrated initiatives in 269 villages and has shown villagers the path to development by way of practically demonstrating complete agronomic solutions to farmers. Apart from efforts stated above, the project aims at giving additional income to farmers through income generating schemes like cultivation of tissue culture banana, hybrid papaya, pineapple, mushroom, apiary, fisheries, vermi compost, poultry, duckery and other schemes suitable to the area.Case study method is usually considered to be the effective methodology for research. To test the hypothesis, a few cases were also taken into the consideration. Following Victim Respondents were interviewed to provide some information. Followings are the cases:

Case 1

Mr. Parshuram Behera initiated the discussion by telling us that at the time of Super Cyclone temple was the only pucca building in the village. He narrated the incident as: On 28th October all the animals became restless and came at this place for shelter. We couldn't understand anything but we realized it the next day.

Then we understood that animals get a prior sense of situations like this. From that time till today many pucca houses have been constructed.

Case 2

Mr. Upendra Nath Mishra narrated his bitter experience during Orissa Super Cyclone. He started by saying that any Cyclone like this had never occurred and will never occur also. The destruction created by it can never be compensated for us. We have lost our family members and our lifetime property. I have seen the dead bodies floating all over, animals and human being lying side by side. I cannot forget that smell of the dead bodies. That seven feet wave has taken everything with it. He wrote a poem describing that situation of Super Cyclone. He was crying while narrating the poem. The description was beautiful in terms of making us visualize the actual conditions. The highlight of the poem was that even during that miserable condition few people were busy in stealing things; a man cut the hand of a dead body in order to take out its jewellery.

Case 3

The worst part of the cyclone was that there was no preparedness said by Mr. Bichtra Behera. No news flashes, no warning was announced from the Government. Due to lack of the preparatory measures we didn't got food for a week. He further added that this cyclone was beyond our imagination. Cyclone is a normal phenomenon of a coastal area and we are familiar with it as well but we have never thought of something like this. During the cyclone this area was totally got disconnected from the city thus relief materials do not reached us on time. He also told us about the relief material that they received at that time. It was a packet containing blanket, mosquito net, troch, food (dry materials) and medicines. But the problem was of its proper distribution. PPL also came forward for the help. Today also PPL is working for the betterment of the sanitation status of the village by constructing household toilets. A school safety plan has also been developed for preparing the children for such situations. Now this village is vulnerable in terms of having disasters related to factories because 3 major gas factories are nearby this village i.e, Indian Oil, PPL and IFFCO.

Case 4

Our respondent Mr. Ravindra Nath Mahapatra , Sarpanch of the village told us that this MPCS was constructed after 1999 cyclone. Today villagers take care of this building. In order to prepare the village for such disastrous situation a village rescue committee has been set up. This committee has 50 members and has been trained for three different purposes like rescue, first aid and asset keeping. This is a perfect example which shows that disaster brings development. Explaining the situation during the cyclone he told about the debris clearance, which took almost 2 months. Skeletons were lying on the trees. Even after 15 years of the cyclone the scenes are unforgettable. During super cyclone whoever came forward to help other got drawn. The sea water has badly affected the sources of drinking water like tube well and wells in terms of both quality and quantity. He also brought the cutting of mangrove forest into our consideration which was the major cause for bringing this cyclone. Industrialization is another reason. According to him it's good to have industrialization as it provides employment to millions but playing with nature is not justified. Another key person Mr. Nand Kishore Das told us about the worst condition of livestock. They also need care and protection. For their safety a similar building is also required. Livestock was equally affected as human beings.

Case 5

One of the victim respondents Mr. Nuisingh Senapati told us that after cyclone flood came down. The flood brought acidic water of the industries with it as result of that our agricultural field got destroyed. **Even today fruiting does not occur in the coconut trees which came in contact of the acidic water.** Most of the big trees were uprooted by the cyclone. Even if few survived they became fruitless due to flood having acidic water. The nearness of the village with the industries proved to be a cruse for them. People were affected by skin diseases, malaria and UTI. Due to its connectivity with the city the relief materials were able to reach to them. Sanitation was a big problem for them. School building served as a shelter for the villagers during the cyclone. PPL is helping the villagers in constructing the household toilets under its sanitation project. The status of community ownership is good as people are aware regarding its usefulness. We saw the tube **wells were constructed on height in order to avoid contamination due to flood.** Evacuation is important during such disasters was pointed out by another key person of the village Mr. Babaji Sahoo. He said that these many lives would have been saved if evacuation has taken place on time. **This village do not have MPCS in such a case evacuation is the only option.**

Case 6

Another Victim respondent Mr. Kumar Bar Behera told us about the condition of the village during the cyclone. Since fishing is the main occupation of the village due to cyclone followed by flood has destroyed our lives. It took about almost a year or more in restating our work. Till that time we were jobless, homeless and hopeless. Our nets and boats were damaged. We had received Rs.500 for net repairing and Rs.700 for boat repairing. No pucca building was there in this village at the time of the cyclone. We didn't had any place to keep our boats and nets added by Mr. Arjun Behera. Today we have pucca building so problem of shelter is manageable but we need place to keep our boats and nets safe. During our interaction we came to know that no village level committee has been formed in this village. The relief materials were also not reached on time. They have stopped prawn cultivation due to industrialization because of the construction of the check dams.

Case 7

Mr. Gauri Hari Mohanty has helped us by giving several information about the condition of the village during the cyclone. He said a cyclone with such a great intensity was out beyond imagination of people. It was Thursday when cyclone hit our village. Cyclone is about to come we knew that as the sky had turned red, wind had stopped blowing and temperature has got up. These are the indigenous signals which help us in predicating cyclones. About ten feet high tide came up and took ever thing with it. A tributary of Mahanadi called Mahanga flows through this village. He told us that he can never forget the scene where about 50-60 dead bodies were floating on this river. The bodies were swollen due to water. It was hard to identify the faces. If the cyclone would have come at night then it would have been even more difficult for us to save our lives. No such early warning came due to which we were not prepared. There was no food storage with us.

We were completely dependent on relief materials. The condition of sanitation was also very bad. About 1,000 houses has been damaged, 10,000 people got affected and about 1000 had died from this village only.

Case 8

Another victim respondent Mr. Sameer Ranjan Das helped us by telling us that a village called Sankha comes under Padampur Gram Panchayat has been completely washed away. No one was alive there after that cyclone. Sea coast is about 7 km away from this village even then about 7 feet water has come. Talking about the relief work he told us that Government has Rs.75000 per dead person in a family. Pucca houses has been constructed by Government which came through Indira Awas Yojna. PPL, TATA, Laxmi Narayan Trust, World Vision and Ram Krishan Mission all came forward for help by constructing pucca houses in the villages. This block has been adopted by Maharashtra Government thus aid was coming from there. This village was also suffering from lack of connectivity from the city thus relief materials were not reaching on time. Debris clearance took about a month in the village. The village still suffers from transportation problem. He further added that at the time of Super Cyclone 1999 the predication, preparedness and evacuation was zero which led us suffered this much. He also pointed out at the cutting up of the mangrove forest. Laying stress on forestation he said that trees can save lives since we cut them so we suffered.

Case 9

Here Mr. Tamil Pradhan was our key person. He has his own organization known as Anchalik Surekhsha Sanganthan. He started by saying that this village was saved because it is at height. Destruction took place but the villagers came forward to help themselves. With the help of sand the fill the water digs which has helped in connecting their village with the road. It almost took 2-3 days to complete the work. At the time of the cyclone only 32 houses were pucca houses out of 1200 households consisting about 6000 population during 1999.The awareness regarding the food storage, keeping their. documents safe was not there in people. It is Super Cyclone 1999 which has taught us all this. Now villagers are aware for such situation. The measure issue of this village after the cyclone is health and sanitation. Many died due to diseases. He talked of the intervention of PRIs in managing such situations. He said awareness is the key through which we can execute any plan. It is necessary to have awareness in people regarding these situations. MPCS is in the village which is being maintained by the villagers.

Case 10

Mrs. Nirupama. She told us about the difference in the situation that has come if we compare the situation during Super Cyclone and Phailin. Now Government is very active regarding the disaster management of the state. The predication, preparedness and evacuation were far better during Phailin. Anganwadi workers are also given training for creating awareness among people. Food security during disaster is one of the major focused areas of the Government. Thus special arrangements have been done for pregnant women and children up to 3 years of age. She showed the food packet which is distributed to every pregnant lady (Yellow packets) and women having child up to 3 years of age. These food packets are being made by a SHG group. The SHG which is involved in making these food packets is Ganga Devi. Thus disaster has been nicely linked livelihood and gender. This information has provided us a comparative study between both the cyclones. The way that Orissa Government is handling the situation is worth appreciation. The comparative analysis made us understand that awareness plays such a big role in managing a disaster situation. Being a Disaster Management student it becomes very important for us to understand these dimensions.

Discussion

Psychological: The fear of cyclone was evident and the memory seemed to be new. The impact depends upon the damage caused to the community. During the discussion Phailin was never given any priority. Since everyone was prepared, therefore the damage to life was zero. This was reflected in the form of confident to face any other disaster. Hence the villages required psychological rehabilitation program to prevent the impact being carried by next generation. There was fear among people when the condition of still air and temperature fluctuation was observed. Despite of the fact various radars are installed. The degree of accuracy of Indian Meteorological Department has increased.

Insurance: There was an increased demand of insurance but when compared to the size of community. It was negligible. Hence a wide scope for insurance and a better way of disaster preparedness.

Community Participation: Community participation according to us was more in Nuagaon. Reason for this conclusion: During our visit to Multi Purpose Cyclone Center the condition of toilet and rooms seemed to be degraded. The responsibility for the maintenance was for the officials.

Awareness: Awareness about disaster management was found to be quite high among the masses. The importance of communication channels like roads, tele-communication devices were more. Awareness for forest was observed and its need is being felt. But due to industrial intervention, people are also able to understand the nature and onset of various hazards which are present in the region.

School Based Disaster Reduction Plan: Schools in the villages were found to have a good infrastructure. This followed the guidelines of School Based Disaster Risk Reduction.

Sanitation: Sanitation and other interventions of PPL were appreciable. This ensured control over the diseases caused due to unhygienic sanitation condition and it reduces the other impacts which could be caused after disaster.

Lack of Strategic Interventions: The interventions of PPL and the reputation was found to be far better than the other organizations in the villages. Still the interventions were more philanthropic in nature and increased the dependency of the people on the organization to intervene.

Need of Infrastructure: There is need to build more cyclone shelters which would help will result in both direct and indirect benefits. There is need to build Multipurpose Cyclone Shelters.

Negative Impact of Support and other Government Programs

During disaster, relief activities and other supports are the only support to bring back the life to mainstream. But the negative impact could be observed in long run where people take initiative to build basic requirements. There is lack of coordination when it come to bring any change for preparing a self dependant sustainable model. In terms of financial back up or integrating people to financial system. Maintenance which should be taken by community were seen to be ignored. Even today people seemed to be relaxed by being very sure there is no need to have a developed model which should need least dependence to external relief.

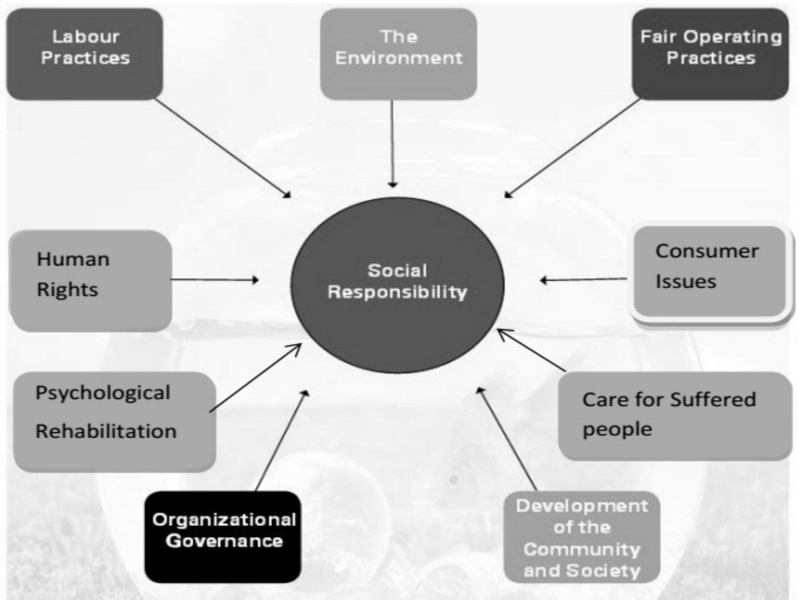
Table 5: Summary of Observations

	Name of Respondent	**Issues Highlighted**
Case 1	Mr.Parshuram Behra (Santara village)	-Animal Behavior - Need of Pakka houses
Case 2	Mr. Upendra Nath Mishra (Santara Village)	- Psychological impact - Inhuman behaviour by some illustrated by responder. Taking jewellery from dead bodies. - Narration of incidence brought tears.

		-
Case 3	Mr. Bichitra Behra (Santara Village)	- Lack of distribution channel during disaster. - Still village lies near Indian oil, PPL and IFFCO. - Vulnerable to chemical disaster. - School based disaster reduction plan. - Increase in non-life insurance.
Case 4	Mr. Ravindra Nath Mahapatra Mr. Nand Kishore Das (Mangrajpur Village)	- Maintenance of MPCS. - Debris clearance took 2 months. - After 15 years the cyclone is unforgettable. - Tube-wells were affected - No provision for livestock safety.
Case 5	Mr. Nuisingh Senappati Mr. Babaji Sahoo (Rayat Village)	- Flood followed cyclone which made soil acidic. - Impact is seen even today where trees do not bear fruits. - More MPCS should be constructed.
Case 6 Baghadia Village	Mr. Kumarbar Behra Mr. Arjun Behera (Baghadia)	- It took almost a year for fisherman community to get into mainstream. - Compensation provided was inadequate (i.e Rs. 1200 for net and boat repairing) - Stopped prawn cultivation
Case 7	Mr. Gauri Hari Mohanty (Balituta Village)	- Strength of cyclone was underestimated. - It was worse due to river near by. - Villages were completely washed away.
Case 8	Mr. Sameer Rajan Das (Balituta Village)	- Compensation of Rs.75,000 was provided. - Houses were built by organizations like Tata, Laxmi narayan trust. - Need of mangrove forest was realized.
Case 9	Mr. Tamil Pradhan (Age 35 years) Nuagaon	- Was responsible to manage post disaster situation in the village. - His preparedness plans and awareness was visible in village.
Case 10	Mrs. Nirupama (32 Years) Nuagaon	- Integration of preparedness to SHG. - Preparation of food packets. - Linking disaster to livelihood to gender.

Disaster Preparedness cum Social Responsibility Model

Figure 4: Aspects of Social Responsibility



Since all the above mentioned aspects are inter-related and any philanthropic intervention will never be sustainable. Since the organizations are well versed with most aspects but to build a reputational shield need to work on "**Development of the community and the Society**"

Major issues to be covered in this social responsibility model:

- To develop a model to utilize the core competency of the organization i.e fertilizers and agricultural products.
- To integrate practical and skill based module in the school curriculum.
- Livelihood generation schemes and the technical and long term based infrastructure for a substantially big projects.
- In spite of spending more on basic infrastructure like toilet They could facilitate in convergence of Government schemes. Help in acquisition of technology and schools infrastructure development (labs, class, food and awareness among students specially girls.) which is not covered in Government Schemes or having flaws when implemented in that region.
- Considering the disaster prone regions of Odisha.

Suggested Model (subjected to refinement, highlighting the major aspects for sustainable model. Linkage and hierarchy depends upon the geographic and demographic conditions of the implementing field.).

Core Competency: The main strengths or strategic advantages of a business. Core competencies are the combination of pooled knowledge and technical capacities that allow a business to be competitive in the marketplace. Theoretically, a core competency should allow a company to expand into new end markets as well as provide a significant benefit to customers. It should also be hard for competitors to replicate. So PPL has its strength in fertilizers giving a cutting edge towards hazards and application researches. Even a cutting edge in consu

Benefits to PPL will be In the form of patents and technological refinement. Redefining new practices in the disaster prone coastal region. Where the people near by will be the primary beneficiary. And most important it will help in building a reputational shield for PPL employee.

Need for Partner Organizations/Village Groups: Since all other interventions will not be included in the competency of PPL so partner and village groups organizations in few vital sectors will be beneficial.

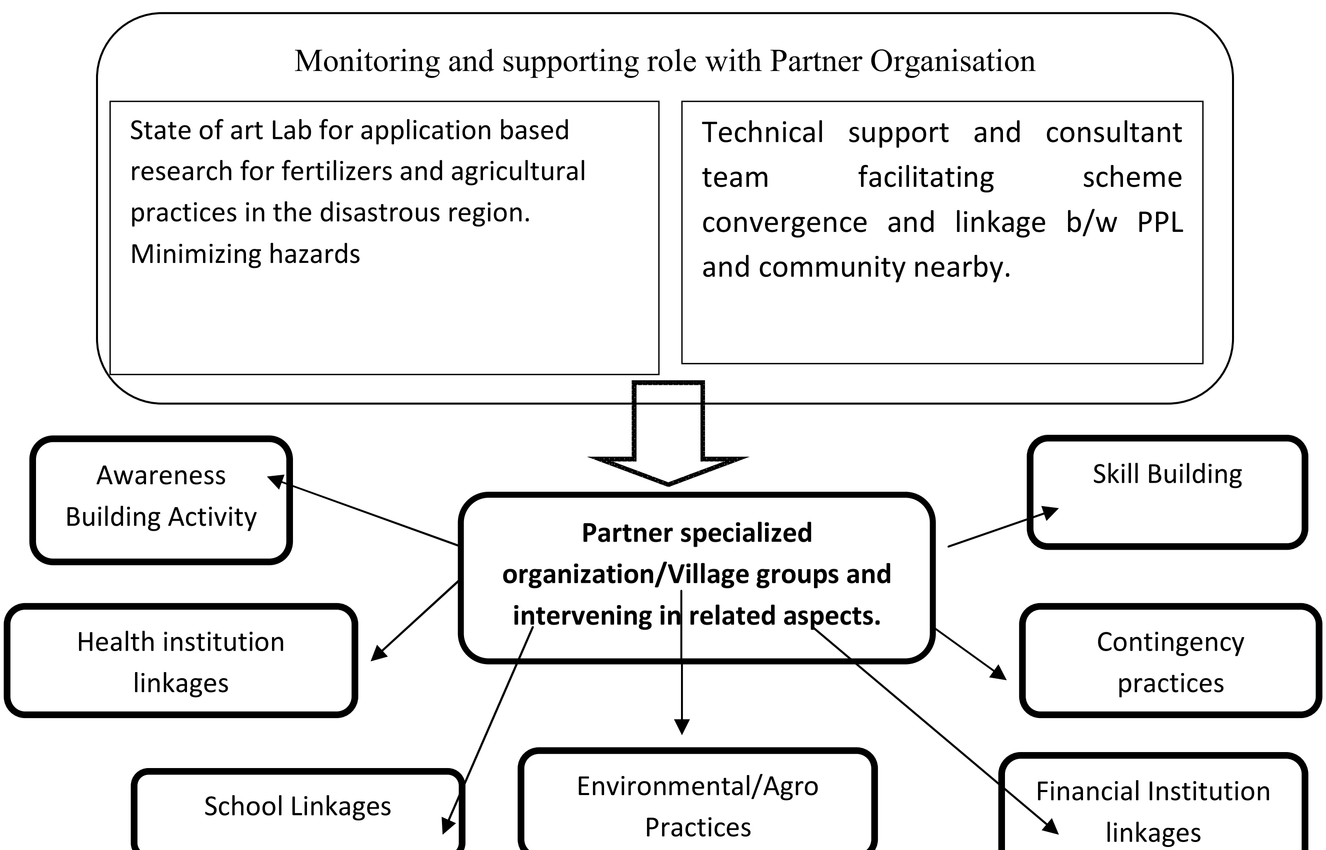
Awareness, Skill Building Contingency Practices : Directly deals in the disaster management practices. Where as skill development could have a diversified intervention in developing skilled labours for the organization and empowering the vulnerable class.

Financial Institution Linkages: Financial literacy and linkages to the financial institution is necessary for any community and upliftment of the groups.

Health and Educational Linkage: There should be a proper link between the institutions functioning in the form of status of equipments and the specializations. School curriculums should have a blend of disaster management and skills like carpentry electricians etc.

Environment/Agri Practices: Here it talks about the awareness for community commons like forests, ponds, rivers etc. Demonstration of new technique for agriculture and other livelihood practices. Eg. Fish processing etc. This also talks about helping community to upgrade and adopt suitable practice as the industrial interventions are affecting the priorities of the population.

Figure 5: Proposed Model



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DISASTER MANAGEMENT AND THANE CYCLONE REHABILITAION IN CUDDALORE DISTRICT OF TAMIL NADU, INDIA

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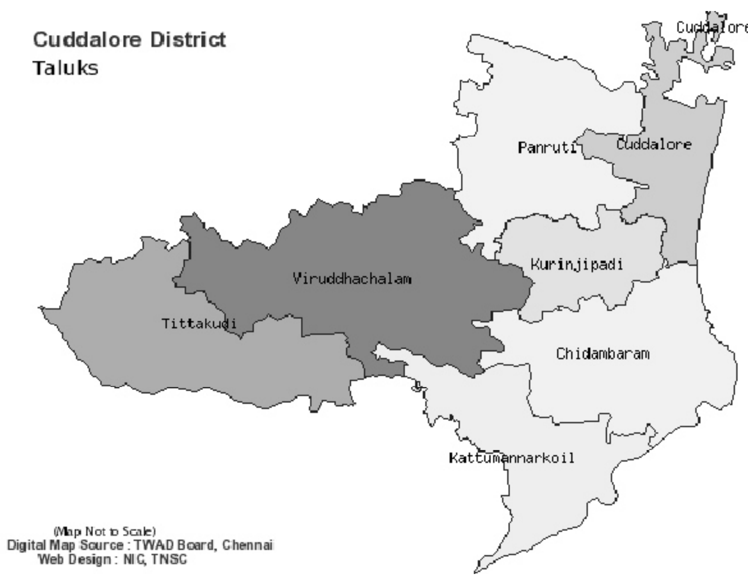
Cuddalore District is situated in between $78^{0}48$ and $80^{0}12$ of East longitude and $11^{0}45$ and $12^{0}27$ of latitude covering an area of 3,698.68 Sq.Km in the state of Tamil Nadu. The eastern side of the district has a coastline of 52.5 Km. covered by the Bay of Bengal. It lies in the **very high damage risk zone of wind and Cyclone.** This district consists of eight taluks viz. Cuddalore, Panruti, Kurinjipadi, Chidambaram, Kattumannarkoil, Virudhachalam, Veppur and Tittagudi of which Cuddalore, Kurinjipadi and Chidambaram are coastal taluks lying in the heavy wind and cyclone zone while other five taluks lye in the flood prone zone.



Area and Population

Area: 3,678 Sq.Km,
Population (2011): 26,00,880
Total Cultivated area (Ha): 2,96,787.350
Paddy, Groundnut, Sugarcane, Cholam, Cambu, Redgram, Cotton, Gingelly, Tapioca, Greengram, Blackgram, Coriander, Banana, Maize, Varagu, Cashewnut, Jackfruit are the important crops grown in the district.

Climate

Cuddalore is in the highly cyclone prone zone of the East coast and its neighborhood falls under rainfall surplus category with an annual precipitation of 1200mm and the temperatures vary between 19.9^{0} C to 26^{0} C.

in winter and 31^0 C to 42^0 C in summer. The district gets rainfall mostly in the months of October to December from the Northeast monsoon recording which accounts for 72 percent of the total rainfall.

Hazard Profile of Cuddalore District

As Cuddalore is situated at the seacoast, it drains water not only within the district, but also from the catchments close by relatively the mid land slopes make drainage difficult. Cuddalore has always been classified as a **multi-hazard prone district**. Cyclones and floods have wreaked havoc in the district several times in the past few centuries. The district also falls within the **Zone-3 with respect to earthquakes**. The problem owes its genesis to the location of the district. The district has a coastline of approximately 52.5 Kms. Therefore the district is **vulnerable to the cyclonic depressions** and the resultant rains, which cause floods.

Heavy rains showers during the months of October, November and December inundates low-lying areas, coastal areas and the areas nearby major irrigation sources. Cyclones are also part of the North East monsoon. Due to floods, sudden outbreak of several water borne diseases was also experienced in the past. This Action Plan has to be implemented keeping in mind the following hazards which also include natural calamities like Drought, Tsunami and Man-made disaster like Chemical Pollution, Fire accidents etc.

Cuddalore District has an area of 3,698.68 Sq.Km. comprising of extremely fertile and well irrigated lands benefiting from water draining over fields and through major and minor river systems. The district however suffers from the flooding when excess water flows down these local rivers and over the fields due to Northeast monsoon rains in the river basins and in the district itself. The drainage is poor and the encroachments over the drought years have lead to a scenario where, even rainfalls, which are slightly above normal, can cause floods disrupting the normal course of work. Coupled with this is the perennial problem of low water carrying capacity of the lakes. Natural disasters often tend to set the clock back in time further accentuating the problem as they lead to serious disruption of the functioning of a society causing widespread losses. These losses far exceed the affected society`s ability to cope with it using its own resources.

Tsunami waves that followed the 2004 Indian Ocean earthquake near Sumatra hit the eastern coast of India on 26 December 2004, resulting in 572 casualties. Several fishing hamlets disappeared, while Silver Beach and the historically important Cuddalore Port were devastated. Cyclone Nisha which occurred on 30th December, 2011 caused widespread damage to crops and buildings. Cuddalore had been the target of several cyclones namely Nisha, Jall, and Thane. Cyclone Thane hit Tamil Nadu coast on 29th and 30th of December 2011 destroyed houses, boats, standing crops, livestock and livelihoods. The name 'Thane' was given simply by weather reporters so as to reach the people easily."The very severe damaged cyclonic storm 'THANE' (Dec 30th 2011) over southwest Bay of Bengal moved further westward and crossed north Tamil Nadu coast between Cuddalore and Puducherry between 6.30 and 7.30 am . It had the speed of 140 kph was recorded during this period.

Power production at the Lignite Neyveli Corporation was affected as the mines were submerged. Puducherry was cut off from the neighbouring districts of Villupuram and Cuddalore, in Tamil Nadu. It has caused to fell several trees across the roads due to the impact of gale. As per the Government sources the cyclone killed 35 people. The tidal surges reached 1.5 metres (5 feet) which forced coastal fishing and farming communities into relief shelters set up in schools. Deaths in Cuddalore occurred mainly due to electrocution, falling of trees and collapse of house or walls. A large number of cows, goats and buffaloes were killed in many villages. Trees, lamp posts and electric poles were uprooted, hand-pumps and bore wells have been damaged that lead to water scarcity and lack of safe drinking water. Major roads were blocked in almost all areas of Cuddalore district for a whole week.

Thane Cyclonic Damage at Vegetable Research Station, Palur

The Vegetable Research Station, Palur was established in the year 1905. It functions under Tamil Nadu Agricultural University since 1981. It's primary mandate is crop improvement in fruits and vegetables to evolve varieties with enhanced yield potential, resistance/tolerance to biotic and abiotic stresses and also evolving improved technologies for the sustainable livelihood of farming community in the North Eastern Zone of Tamil Nadu.

The Thane cyclonic storm which hit the Cuddalore District on 30.12.2011 with wind velocity of more than 125 kmph caused heavy damage to the buildings and allied works, perennial tree crops and other economically important trees, different seed crops *viz*., namely paddy, black gram, sunhemp and vegetable seed crops and ongoing research trials at Vegetable Research Station, Palur. The total rainfall received during the cyclone (30.12.11 and 31.12.11) was 146 mm. The existing office building was constructed during 1923. The Mangalore tile roof of the building was removed and thrown away due to the Thane cyclone. Now the office runs with damaged roofs and further it will not stand for any onto ward natural calamities. The Thane cyclone and heavy rainfall caused the paddy crop which was due for harvest lodged and submerged and severe damage to different seed crops of black gram, sunhemp and vegetables.

Damage to Buildings and Allied Works.

Sl. No.	Name of Building	Nature and extent of damage
1.	Office building	The office building was constructed during 1923. The Mangalore tile roof of the building was removed and thrown away due to the Thane cyclone.
2.	Implement shed	The recently constructed shed was damaged and the roof was thrown away for several meters.
3.	Cattle shed	The old Mangalore tiled roof of cattle shed was severely damaged.
4.	Old godown	The old Mangalore tiled roof of the building was severely damaged.
5.	Jeep shed	The tiles were damaged in the shed.
6.	Labour's shed	The recently constructed shed was damaged and the roof was thrown away for several meters.
7.	Vermicompost shed	The thatched shed was damaged severely.
8.	Seminar hall	The recently constructed seminar hall was damaged and the roof was thrown away. The electrical fittings including fans and glass windows were severely damaged.
9.	Old seed processing godown	The old Mangalore tiled roof of the building and Jolly were severely damaged.
10.	Fence	The newly laid barbed wire fence in road side to the tune of 300 ft. was damaged due to heavy wind and the nearby trees that fell on the fence.
11.	Farm road lights and electrical posts	The lighting poles erected inside the farm (5 nos.) and the tube lights fitted on the poles were damaged.
12	Motor sheds	The motor shed located in orchard was damaged
13.	Video Conferencing tower	Video conference tower of this Research Station has been broken/ uprooted and fallen.
14.	Old tractor	Old tractor also damaged due to trees like Jamun, Neem that fell down on tractor mad
15.	Cement pandal poles (21 nos), wooden poles	The pandals were used to claim the Snake gourd, bitter gourd and bottle gourd fields in field nos. 10-12, 4-7, 53, and 31-34 were broken

	(560)	and damaged severely.
16.	Shade nets/Mist chambers	Three Shade nets located in Fd. Nos 8-9 and 4-7 was severely damaged. The mist chamber and shade net in Fd. 4-7 was totally damaged.

Damage to Perennial Crops

Sl. No.	Name of the crop	Nos.	Nature of damage
1.	Coconut trees	75	Entirely uprooted or damaged severely
2.	Mango	101	Entirely uprooted or $3/4^{th}$ damaged
3.	Jack	39	Entirely uprooted or $3/4^{th}$ damaged
4.	Guava	1	Entirely uprooted
5.	Sapota	8	Entirely uprooted or $3/4^{th}$ damaged
6.	Amla	5	Entirely uprooted or $3/4^{th}$ damaged
7.	Breadfruit	2	Entirely uprooted or $3/4^{th}$ damaged
8.	Jamun	6	Entirely uprooted or $3/4^{th}$ damaged
9.	Tamarind	4	Entirely uprooted or $3/4^{th}$ damaged
10.	Carambola	1	Entirely uprooted
11..	Citrus tree	2	Entirely uprooted or $3/4^{th}$ damaged
12.	West Indian Cherry	3	Entirely uprooted or $3/4^{th}$ damaged
13.	Timla Fig	1	Entirely uprooted
14.	Custard apple	2	Entirely uprooted or $3/4^{th}$ damaged
15.	Neem	25	Entirely uprooted or $3/4^{th}$ damaged
16.	Kapok	12	Entirely uprooted or $3/4^{th}$ damaged
17.	Teak	22	Entirely uprooted or $3/4^{th}$ damaged
18.	Polyalthia	8	Entirely uprooted or $3/4^{th}$ damaged
19.	Prosopis	3	Entirely uprooted or $3/4^{th}$ damaged
20.	Bamboo bush	4	Entirely uprooted or $3/4^{th}$ damaged
21.	Casuarina	2.50 ac	Totally damaged

Damage to Seed Crop

Sl. No.	Name of crop	Area (ac)	Nature of damage
1.	Paddy Foundation seed production	13.5	The crop which was in harvesting stage was lodged and submerged in the water.
2.	Blackgram Foundation seed production	4.0	No germination due to inundation of rainwater.
3.	Sunnhemp TFL Seed Production	1.5	The entire crop was lodged.
4.	Moringa	0.5	Transplanted seedling was damaged.
5.	Snakegourd	2.0	Transplanted seedling was damaged.
6.	Bitter gourd	0.75	Germinated seedlings were damaged.
8.	Brinjal	0.75	The entire crop was lodged.
9.	Onion	0.25	The cyclone affected at seedling stage.
10.	Amaranthus	0.10	The cyclone damaged the germinated seedlings.
11.	Vegetable Nurseries	0.25	The cyclone damaged the germinated seedlings.

Damage to Research Trials

Sl. No.	Name of crop	Area (ac)	Nature of damage
1.	Cabbage	0.15	Transplanted seedlings were damaged
2.	Gourds	0.90	Germination of seeds was affected
3.	Amaranthus	0.25	Germination of seeds was affected
4.	Cucumber	0.30	Germinated seedlings were totally affected
5.	cabbage	0.15	Transplanted seedlings were damaged
6.	Brinjal	0.90	The crop at harvest stage lodged
7.	Papaya	50 Nos.	Entirely uprooted or 3/4th damaged

Damage to Grafts, Layers and Rootstocks of Fruit Plants

Sl. No.	Crop	Damage (Nos.)
1.	Mango Graft	25244
2.	Mango Rootstock	10254
3.	Sapota Graft	3000
4.	Jack graft	5976
5.	Jack Rootstock	1500
6.	Guava	3600
7.	Citrus	100

Thane Cyclone Rehabilitation by the State Department of Horticulture

Cuddalore and Villupuram districts were severely hit by Thane Cyclone on 30-12-11. Agriculture and Horticulture crops were damaged and the area with more than 50% damage was addressed immediately by Agriculture and Horticulture departments in co-ordination with Revenue Department. The Govt. of Tamil Nadu announced the relief amount which was disbursed immediately to the affected farmers.

Details of Crop Damage and Relief Amount Paid

Sl. No.	Department	Area (Ha.)	Relief Amount (Rs. In lakhs)	No of Farmers
1	Agricultural	95555.49	8835.28	153495
2	Horticultural	39004.58	3431.48	58655
Total		**134560.07**	**12266.76**	**212150**

Rehabilitation Activities

Damage to the tree crops like cashew, Jack, Mango and Coconut was very severe and extensive and hence it was felt necessary to implement a rehabilitation package to revive the orchards and thereby helping the farmers to regain their previous strength and bring back green mass in Cuddalore and Villupuram Districts. The Govt. of Tamil Nadu announced rehabilitation package for tree crops like Cashew, Jack, Mango and Coconut crops.

This package includes, distribution of Minikits, assistance for cut and removal of affected trees, ploughing, and assistance for fertilizer and after care for five years. The Govt. of Tamil Nadu announced the formation of Project Management Unit headed by Additional Collector to monitor all the Thane Cyclone Rehabilitation activities.

Accordingly, Project Management Unit started functioning from 02-03-12 under the Chairman ship of District Collector. Additional Collector was posted as Project Director and officials from various departments such as Agriculture, Horticulture, Agricultural Engineering and Rural Development were posted to assist the Project Director.

Cut and Removal of Affected Trees

The Government of Tamil Nadu announced financial assistance of Rs.25000/ha for cut and removal of affected cashew and other Horticulture tree crops and for ploughing and Rs.500/tree for cut and removal of Coconut trees

Rehabilitation of Coconut Areas

For cut and removal assistance, the agriculture department staffs have been instructed to verify actual number of affected trees which are to be cut and removed. The reports received from block Assistant Directors of Agriculture through Joint Director of Agriculture, Cuddalore were super checked by the special teams of PMU comprising Assistant Director of Agriculture, Assistant Director of Horticulture, Agriculture Officer, Horticulture Officer and Agricultural Engineer. Coconut fields of the farmers who received relief amount previously were verified and subsequently assistance for cut and removal at the rate Rs.500/tree was released by the Joint Director of Agriculture concerned.

After cut and removal of affected coconut trees, new seedlings are to be planted. In order to take up planting, Tall and T x D coconut seedlings were distributed to the farmers at free of cost.

Assistance for Cut & Removal of Coconut Trees & Distribution of Coconut Seedlings

Sl. No	Details	Financial Expenditures (Rs. In lakhs)	No of Farmers Benefited	No of Trees/ Seedlings
1	Assistance for Cut & Removal of Coconut Trees	823.295	3534	164659
2	Distribution of Coconut Seedlings	34.128	3528	162086
Total		**857.423**	**7062**	**326745**

Thane Special Package Programme Implemented during 2012-13

Sl.No	Name of the component	Target		Achievement	
		Phy (ha.)	Fin (Rs. In Lakhs)	Phy (ha.)	Fin (Rs. in Lakhs)
1	Pulses Minikit Phase-I (Green gram)	16505 Nos.	125.438	16505 Nos.	138.640

	Pulses Minikit Phase-II (Black gram)	20500 Nos.	181.830	20500 Nos.	123.011
2	Vegetale Minikits	6362 Nos.	48.618	6362 Nos.	44.000
3	Vegetable - Tapioca Inputs Distribution	647.20	59.607	577.18	54.887
4	Spices - Turmeric Inputs Distribution	16.80	3.108	16.80	3.091
5	Flowers	157.30	45.000	157.30	45.944
6	Replanting - Other Perennial Crops Inputs Distribution	127.18	9.549	127.18	8.872
7	Non Perennial Fruits Crops - Banana Inputs Distribution	2602.00 ha.	195.026	2602.00 ha.	184.853
	Total		**668.176**		**603.298**

Rehabilitation of Cashew and other Horticulture Tree Crops

Lumpsum for Cut and Removal.

Thane affected cashew trees were cut and removed by the farmers in 8200 ha in Cuddalore district. 100% cut and removal in 1200 ha and partial cut & removal in 7000 ha. An amount of Rs.2050 lakhs was disbursed to 30,272 farmers as Lumpsum grant @ Rs.25,000/ ha.

Cashew VRI-3 Replanting

About 14 Lakhs of VRI-3 cashew grafts were distributed to the thane affected farmers to take up planting in 7000 ha of partially cleared fields.

High Density Planting

It was programmed to take up high density planting with a spacing of 5x4 m in 850 ha. So far 450 ha was covered under high density planting and 2,25,000 cashew VRI-3 grafts were distributed to the farmer @ 500 grafts/ha.

Horticulture - Thane Rehabilitation Programme 2012-13 & 2013-14

Name of the component	Target		Achievement	
	Phy (ha.)	Fin (Rs. In Lakhs)	Phy (ha.)	Fin (Rs. in Lakhs)
Cashew, Mango, Jack - Lumpsum Grant for Removal of Stumps and Roots				
(i) 100% Area	1200.00	300.00	1200.00	300.00
(ii) Partial Area	7000.00	1750.00	7000.00	1750.00
Total	**8200.00**	**2050.00**	**8200.00**	**2050.00**

Cashew Replanting / VRI-3 Graft Distribution Details

100% Area	Ha.	No. Of Grafts	Fin (Rs.in lakhs)	Ha.	No. Of Grafts	Fin (Rs.in lakhs)
i. HDP	850	425000	204.00	450	225000	102.295
ii. Normal Planting	350	70000	52.50	350	70000	51.787
Total	**1200**	**495000**	**256.50**	**800**	**295000**	**154.082**
(ii) Partial Area	7000	1400000	1050.00	7000	1400000	1024.775
Total	**8200**	**1895000**	**1306.50**	**7800**	**1695000**	**1178.857**

Disaster Management Plans in Cuddalore District

DISASTER MANAGEMENT ORGANISATION

The district Disaster Management Organisation was formed with the Collector as its Chairman, the District Revenue Officer as Vice- Chairman and the officers from various departments as members.

01 Collector of Cuddalore District, Cuddalore Chairman
02 District Revenue Officer, Cuddalore Vice Chairman
03 Superintendent of Police, Cuddalore Member
04 District Revenue Officer, (L.A), Neyveli Member
05 Project officer, D.R.D.A, Cuddalore Member
06 Superintending Engineer, P.W.D.(W.R.O), Cuddalore Member
07 Superintending Engineer, T.W.A.D.(Urban), Cuddalore Member
08 Superintending Engineer, T.N.E.B,Cuddalore Member
09 Executive Engineer, P.W.D. (WRO), Chidambaram. Member
10 Executive Engineer, P.W.D. (WRO), Virudhachalam. Member
11 Executive Engineer, P.W.D. (Buildings), Cuddalore. Member
12 Divisional Engineer, Highways(Regular), Cuddalore Member
13 Divisional Engineer, Highways(Projects), Cuddalore Member
14 Asst. Executive Engineer, P.W.D.(Electricals), Cuddalore. Member
15 Regional Manager, T.N.C.S.C, Cuddalore. Member
16 Joint Registrar of Co-operative Societies, Cuddalore Member
17 Joint Director of Medical Services, Cuddalore. Member
18 Joint Director of Animal Husbandry, Cuddalore. Member
19 Joint Director of Agriculture, Cuddalore Member
20 Deputy Director of Horticulture, Cuddalore. Member
21 Deputy Director of Health Services, Cuddalore. Member
22 Deputy Director of Primary Health Services, Cuddalore. Member
23 Divisional Fire Officer, Cuddalore. Member
24 Chief Educational Officer, Cuddalore. Member

25 Municipal Commissioner, Cuddalore Member
26 Municipal Commissioner, Nellikuppam Member
27 Municipal Commissioner, Panruti Member
28 Municipal Commissioner, Chidambaram. Member
29 Municipal Commissioner, Virudhachalam Member
30 Asst. Director of Fisheries,(Marine), Cuddalore Member
31 Asst.Director of Fisheries, (Aqua), Chidambaram Member
32 Regional Transport Officer, Cuddalore. Member
33 Regional Manager Co-optex, Cuddalore. Member
34 District Social Welfare Officer, Cuddalore Member
35 Asst.Director of Panchayats, Cuddalore Member
36 Asst. Director of Town Panchayats, Cuddalore Member
37 District Differently Abled Persons Welfare Officer, Cuddalore Member
38 Project Officer, Child Welfare, Cuddalore Member
39 Project Officer, Vazhinthukattuvom, Cuddalore Member
40 Project Officer, Mahalir Thittam, Cuddalore Member
41 Personal Assistant (P.D) to Collector, Cuddalore Member
42 Personal Assistant (N.M.P) to Collector, Cuddalore Member
43 Personal Asst. (Small Savings) to Collector, Cuddalore Member
44 Personal Assistant (Agri) to Collector, Cuddalore Member
45 Public Relation Officer, Cuddalore Member
46 Commanding Officer, N.C.C, Cuddalore Member
47 Company Commander, Home Guard, Cuddalore Member
48 Personal Assistant (General) to Collector, Cuddalore Member
49 Addl.Personal Assistant (Lands) to Collector, Cuddalore Member
50 Personal Assistant (Accounts) to Collector, Cuddalore Member
51 Special Deputy Collector, (SSS), Cuddalore Member
52 Assistant Commissioner, (Excise), Cuddalore Member
53 Special Deputy Collector, (C.T.V), Cuddalore Member
54 Special Deputy Collector (Stamps), Cuddalore Member
55 Special Deputy Collector (R.R), Cuddalore Member
56 District Supply Officer, Cuddalore Member
57 Dist.Backward Classes Welfare Officer, Cuddalore Member
58 Dist.Adidravidar Welfare Officer, Cuddalore Member
59 Special Deputy Collector (L.A), Neyveli Member
60 Revenue Divisional Officer, Cuddalore Member
61 Revenue Divisional Officer, Chidambaram Member
62 Revenue Divisional Officer, Virudhachalam Member

The District Management organization meets during August or September every year, under the Chairmanship of Collector and detailed discussion takes place with respect to the precautionary measures to be taken in the event of any emergency during the monsoon season.

Mitigation Measures Under Taken

After the devastating "Thane Cyclone", Tamil Nadu Government approved construction of 90,000 Concrete houses in rural areas which would replace the existing thatched roof huts.

Training and Mock Drills

As Cuddalore District is a coastal district, all the Taluk Tahsildars have been directed to conduct a mock drill for evacuation during the month of September every year under the head of Revenue Divisional Officers concerned. In the coastal taluks of Cuddalore and Chidambaram the District Collector and the District Revenue Officer respectively will preside over the mock drill function. In order to create mass awareness among the public, the B.D.Os have been specifically instructed to utilize the "GRAMA SABHA" meeting.

Disaster Warning System

A flood control room has been opened in the Collector's Office, Cuddalore with a direct/line phone similarly flood control rooms are opened in Divisional and Taluk officers also. This setup will function round the clock and any emergency will be reported to the Collector's office and concerned Taluk and Divisional Officers.

There are two kinds of warning system viz.

- Warnings of threatened calamities sent from the area cyclone-warning centre, Chennai (India Meteorological Department)
- Information about and actual occurrence of calamity sent from the local VAOs.
- The Government has introduced a new system of communication from the year 1985 called "DISASTER WARNING SYSTEM". Under this system, cyclone warning will be received directly by the officers where these sets have been installed at Collector's Office, Cuddalore, Taluk Office, Chidambaram and Panchayat
- Union Office, Parngipettai.

On receipt of warning message from the meteorological Department in the Collector's office, the same will be communicated to the R.D.O's, the Tahsildar and the (BDO's) Panchayat Union Commisioners. The Tahsildars and Pt.Un.Commissioners will on receipt of the first warning, which is issued as far as possible 48 hours before the storm and wind and follow bad weather, communicate the same to their subordinates and follow it up with the instructions received from the Revenue Divisional Officers.

The second stage of the warning issued 24 hours prior to the commencement of the expected bad weather and subsequent bulletin will be broadcasting through AIR. These bulletins will be broadcasted at frequent intervals by interrupting routine programme and will contain the latest information about the position and intensity of the storm, its movement and details of the expected adverse weather. When the storm comes within the coverage of the coastal radar's it is continuously tracked and whether bulletins on the same are broadcasted every hour from the nearest AIR Station.

Mitigation Plan

Mitigation embraces all measures taken to reduce both the effect of the hazard itself and the vulnerable conditions to it, in order to reduce the scale ofa future disaster and its impacts. Mitigation also includes measures aimed at reducing physical, economic and social vulnerability. The following are the points which reduce the risk on the occurrence of the disaster:

- Restore communication networks and ensure the integrity of the communication network;
- The Task Force in association with the Search & Rescue Teams of the Police and Fire should thoroughly
- search the affected area for survivors, injured and the dead if any;
- In case of heavy flooding and inundation, vehicular access may be restricted and hence suitable rafts/boats should be used to rescue the marooned people and evacuate them to safer places;
- The water logged in the habitation should be pumped out and to see that the pumped out water is let through the nearest channel or canal.
- If required fire engines should also be utilized for sucking water from the inundated area.
- The breaches of channels, rivers shall be protected with the sandbags.
- The power supply in areas likely to be hit by gale shall bed is connected. Arrangements should also be made to move generators to such power disconnected areas within short notice.
- The marooned peoples should be evacuated to the relief camps.
- When the Primary Health Center is overcrowded by the affected/admitted victims, the excess population has to be shifted to the nearest General Hospital.

Disaster Task Force by Women Groups

After the tsunami disaster in 2004, a large number of self help groups of women were actively involved in relief and rehabilitation process. They were also active after Nisha Cyclone in 2006. Subsequently these groups have undergone several training programmes on disaster risk reduction offered by SSP and Grouts' International. These trained women's groups came together and formed a Federation to work and offer their knowledge on disaster preparedness and risk reduction on a sustained basis. There are two such Women's Federations; one in Cuddalore and another at Nagapattinam.

Disaster Task Force: Right after Tsunami 2004, SSP facilitated women groups to form disaster task force in many villages. The first task force team was formed in 2008 with 6 groups of 30 members (15 men and 15 women) in Keelamoovarkarai village, Nagapattinam. The experienced team successfully intervened in Nisha cyclone and other disaster events. Now they are providing training to other village communities to form such task forces. They have given training and formed task force team at Savadikkuppam, Thennampattinam, Kuravaloor, and Vanagiri. Drawing the lesson from Nagapattinam Cuddalore women groups also formed task forces in 4 villages at Akkarappettai, Thazhanguda, Kandankadu and Puthuppettai. The Task Force women members are well experienced in understanding community needs, negotiating with govt, preparing community to reduce risk, train them in search, rescue, warning, and rehabilitation. On 7th January 2012, the Women's Federations did needs assessment of living conditions of the affected communities with the support of SSP. The purpose of the visit was to see the impact of cyclone, discuss with affected communities and identify priorities for immediate action. The grassroots team was led by Federation leader Chitra, carried out this exercise in Nochikadu, Singarathoppu, Kandankadu, Tsunami Nagar and Thazhankuda villages. The team met affected people, analysed the situation, provided moral strength and confidence especially for women and children. Using the evidence collected, they met with local Panchayat leaders and Government officials to jointly evaluate the response and action taken/planned to rehabilitate the displaced communities.

The families who lived in thatched houses were the most affected. They lost their entire homes and are staying in temporary halls like schools or government buildings. There is no electricity and people face severe drinking water problem. Since all the roads are blocked, basic supplies such as rice, milk, grocery items and vegetable cannot be reached to the affected people. Due to nonavailability of petrol/diesel transportation is at a standstill; buses and lorries were not on the roads.

Nochikadu: Federation leaders from Cuddalore informed us in advance about Cyclone Thane on 27th December. So we have alerted our group members and neighbors in the village. At the same time we also received messages from local panchayat and TV channels", said Rajeshwari from Nochikadu. Nochikadu village is totally depends on agriculture. But the Thane cyclone played havoc in the village by uprooting their major cash crop of cashew nut trees. Most of the houses were fully or partially damaged, entire electrical lines and drinking water supply was totally broken. According to a women leader "the village has gone back by 30 years. Now we have to start from the scratch."

Singarathoppu: Singarathoppu, a fishing village near Cuddalore Old Town was worst affected in the cyclone. The Federation members have made several efforts to pass cyclone warning messages "We sent SMS messages and made phone calls to many our group leaders to alert their communities on the cyclone," said Mohana, leader of Women's Federation in Cuddalore. As a result, women, children and the aged were alerted, this saved several lives. But they lost their houses and livelihoods due to heavy wind and rainfall. Without waiting for the government agencies, Mohana a federation leader with a group of women, evacuated some families from low-lying area in Singarathoppu village. Those who were relocated to government schools and cyclone centre for nearly three days struggled for basic needs like food, milk and water. Women and young girls were the most vulnerable group due to lack of toilets and privacy in public building.

Kandankadu: People in Kandankadu village were also suffered for basic needs like food, drinking water, transportation etc. Sudha, a women leader from this village has mobilized other SHG members to get basic food materials from NGOs and distributed to people. They also helped to get drinking water. "The day after the cyclone, our women's group met the Village Administrative Officer (VAO) and requested for arranging drinking water but we didn't get any good response from him. So we locked the officer in the room. We held negotiation with higher officials and after they promised to address the water issues, we released the VAO in the evening." Said Sudha.

At Kandankadu 400 houses were damaged, more than 400 acre crops were lost, 18 goats and cows died. Many trees were uprooted. Three bore wells, and 20 hand pumps have collapsed, Lamp posts and wires were lying on the road. At Thazhankuda 600 houses were damaged. At Sonankuppam 1100 houses were damaged and 200 livestock were killed. At Singarathoppu 2 persons died in this village, 1150 houses were damaged and 100 - 120 boats (including S.T.P Boats, I.B boats, Fiber Boats, F.R.B boats) were damaged. At Nochikadu 550 150 100 20 goats, 10 cows, 100 hand pumps, were damaged, 150 Trees were Uprooted. More than 1000 acre crop damaged. All Electricity posts and telephone lines have broken up. Most of the trees including coconut trees, jack fruit trees have fallen down. Hand pumps have broken or uprooted. Kitchen gardens have been washed out.

Women's Federation helped Cuddalore municipal officials and voluntary organizations to distribute drinking water, food materials in Singarathoppu and Tsunami Nagar villages. They also insisted with the officials to immediately clear trees and electric posts which was lying on the road. Some of the government officials went to Nochikadu village for damage assessment. But people did not allow them because they came after three full days. Finally they called higher officials and allowed them on 5th day to assess the damage and repair electrical work.

Revised Norms of Assistance by the State Government

Gratuitous Relief

Ex-Gratia Payment to Families of Deceased Persons. - Rs. One Lakh per deceased: It would be necessary to obtain a Certificate of cause of death issued by an appropriate authority designated by the State Government certifying that the death has occurred due to a natural alamity notified by the Ministry of Finance in the scheme of CRF / NCCF. In the case of a Government employee / relief worker who loses his / her life, while engaged in rescue and relief operations, in the aftermath of a notified natural calamity or during preparedness activities like mock drills, etc., his / her family would be paid ex-gratia @ Rs.1.00 lakh per deceased In the case of an Indian citizen, who loses his life due to a notified natural calamity in a foreign country, his family would not be paid this relief. Similarly, in the case of a Foreign citizen, who loses his life due to a notified natural calamity within the territory of India, his family would also not be paid this relief.

Ex-Gratia Payment for Loss of a Limb or Eyes

- Rs.35,000 per person (when the disability is between 40% and 75% duly certified by a Government doctor or doctor from a panel approved by the Government)
- Rs.50,000 per person (when the disability is more than 75% duly certified by a Government doctor or doctor from a panel approved by the Government)

Grievous Injury Requiring Hospitalization for more than a week

Rs.7,500 per person (grievous injury requiring hospitalization for more than a week)
Rs.2,500 per person (grievous injury requiring hospitalization for less than a week)

Relief for the old, Infirm and Destitute, Children.

Rs. 20 per adult, Rs. 15 per child, per day.

Clothing and Utensils for Families whose Houses have been washed away / Fully Damaged /Severely Inundated for more than a week due to a Natural Calamity.

Rs.1,000 for loss of clothing per family and Rs.1,000 for loss of utensils / household goods per family

Gratuitous Relief for Families in Dire Need of Immediate Sustenance after a Calamity.

GR should only be given to those who have no food reserve, or whose food reserves have been wiped out in a calamity, and who have no other immediate means of support. Rs.20/- per adult, and Rs.15/- per child per day
Agriculture input subsidy where crop loss was 50% and above.

For Agriculture Crops, Horticulture Crops and Annual Plantation Crops.

Rs.2,000 per hectare in rainfed areas
Rs.4,000 per hectare for areas under assured irrigation

- No input subsidy will be payable for agricultural land remaining unsown or fallow
- Assistance payable to any small farmer with tiny holding may not be less than Rs.250

II) Perennial crops Rs.6,000 per hectare for all types of perennial crops

- No input subsidy will be payable for agricultural land remaining unsown or fallow
- Assistance payable to any small farmer with tiny holding may not be less than Rs.500

Input Subsidy to Farmers other than Small & Marginal Farmers

Assistance may be provided, where crop loss is 50% and above, subject to a ceiling of 1 ha. per farmer and upto 2 ha. per farmer in case of successive calamities irrespective of the size of his holding being large, at the following rates:-

Rs.2,000 per hectare in rainfed areas
Rs.4,000 per hectare for areas under assured irrigation

Rs.6,000 per hectare for all types of perennial crops
No input subsidy will be payable for agricultural land remaining unsown or fallow

Assistance to Small & Marginal sericulture farmers

Rs.2,000 per ha. for Eri, Mulberry and Tussar
Rs.2,500 per ha. for Muga

Employment Generation (only to meet additional requirements after taking into account, funds available under various Plans / Schemes with elements of employment generations e.g. NREGP, SGRY) Daily wages to be on a par with minimum wage for unskilled labourers notified by the State Govt. concerned. Contribution from Calamity Relief Fund be restricted upto 8 Kgs of wheat or 5 Kgs of rice per person per day - subject to the availability of stock in the State. The cost of the food grains is to be worked out on the basis of "economic cost". The remaining part of the minimum wages will be paid in cash. The cash component should not be less than 25% of the minimum wage.

Animal Husbandry Assistance to Small and Marginal Farmers/Agricultural Labourers.

Milch animal

- Replacement of draught /milch animals or animals used for haulage
- Buffalo / cow / camel / yak, etc. @ Rs.10,000
- Sheep / Goat @ Rs.1,000

Draught Animals

- Camel / horse / bullock, etc.@ Rs.10,000
- Calf, Donkey and pony @ Rs.5000

Poultry
Poultry @ 30 per bird subject to a ceiling of assistance
of Rs.300 per beneficiary household.

Provision of fodder in cattle camps
Large Animals Rs.20 per day
Small Animals Rs. 10 per day

Assistance to Fishermen

- For repair/replacement of boats, nets and damaged or lost
  Rs.2,500 (for repair of partially damaged traditional crafts (all types) plus net)
  Rs.7,500 (for replacement of fully damaged traditional crafts(all types) plus net).
- Input subsidy for fish seed farm - Rs.4,000 per hectare

Assistance for Repair / Restoration of Damaged Houses

The damaged house should be an authorised construction duly certified by the Competent Authority of the State Government The extent of damage to the house is to be certified by a technical authority authorised by the State Government

- Fully damaged houses / destroyed houses
  - Pucca house Rs.25,000 per house
  - Kucha house Rs.10,000 per house

- Severely damaged houses.
  - Pucca house Rs.5,000 per house
  - Kucha house Rs.2,500 per house
- Partially Damaged Houses -
  both pucca / kutcha (other than hut) (where the damage is minimum of 15%)
  Rs.1,500 per house

Huts: damaged / destroyed Rs.2000 per hut
(Hut means - Temporary, make shift unit, inferior to Kutcha house, made of thatch, mud, plastic sheets, etc. traditionally seen & recognised and known as Hut by the State / District Authorities)

- Provision of emergency supply of drinking water in rural areas and urban areas
- Provision of medicines, disinfectants, insecticides for prevention of outbreak of epidemics.
- Medical care for cattle and poultry against epidemics
- Evacuation of people affected /likely to be affected
- Hiring of boats for carrying immediate relief & saving life.
- Provision for temporary accommodation, food, clothing, medical care, etc. of people
- Air dropping of essential supplies.

Repair/Restoration of Immediate Nature of the Damaged Infrastructure in Eligible Sectors

- Roads & bridges
- Drinking water supply works
- Irrigation
- Power (only limited to immediate restoration of electricity supply in the affected areas)
- Primary Education,
- (6)Primary Health Centres
- Community assets owned by Panchayats

Time period

The following time limits are indicated for undertaking works of immediate nature:-
For Plain areas

- 30 days in case of calamity of normal magnitude
- 45 days in case of calamity of severe magnitude

For Hilly areas and North Eastern States

- 45 days in case of calamity of normal magnitude
- 60 days in case of calamity of severe magnitude

(Sectors such as Telecommunication and Power (except immediate restoration of power supply), which generate their own revenues, and also undertake immediate repair / restoration works from their own funds / resources are excluded)

Assessment of Requirements

- Replacement of damaged medical equipments and lost medicines of Government hospitals
- Operational cost (Of. POL.only) for Ambulance Service, Mobile
- Medical Teams and temporary dispensaries.
- Cost of Clearance of debris
- Draining off flood water in affected areas.
- Costs of search and rescue measures

- Disposal of dead bodies / carcasses
- Training to specialist multidisciplinary groups/ teams of the State personnel

Awareness on Disasters

Awareness generation is the key to disaster risk reduction. Aneffective disaster risk mitigation may be developed in consultation with all stake holders for public education to take preventive measures in the event of any disaster. Massive and sustained awareness campaigns may be taken up throughout the UT for preparedness through various mass medias, rallies, mass meetings, audiovisual shows, distribution of pamphlets, posters covering various aspects of disasters, their effects, Do's and Don'ts in local language to create awareness among the people about vulnerability to disasters.

An Overview of Do's & Don'ts

Before Flood Occurs

- Know local flood plans (or records) with details of vulnerable areas and evacuation routes
- Keep a list of emergency phone numbers on display
- Keep an emergency kit on hand which includes :
    - Transistor radio, torch and spare batteries
    - Stock of canned food and fresh water
    - First aid kit, manual and gloves
    - Waterproof bags for clothing and valuables.

Do's & Don'ts

- Tune to your local radio for warnings and advice
- Prepare to move vehicles, outdoor equipments, garbage, chemicals and Poisons to higher locations.
- Disconnect all electrical appliances
- Turn off electricity and gas if you have to leave the house.
- Do not allow children to play in, or near, flood waters.
- Never wander around in flooded area
- Don't dive into water of unknown depth and current.
- Don't eat food which has come in contact with flood waters.

During Cyclone

The actions that need to be taken in the event of a cyclone threat can broadly be divided into four classes, viz.,

- immediately before the cyclone season;
- when cyclone alerts and warnings are on;
- when evacuations are advised; and
- when the cyclone has crossed the coast.

Before the Cyclone Season

- Check the house; secure loose tiles, carry out repair works for doors and Windows
- Remove dead woods or dying trees close to the house; anchor removable objects like lumber piles, loose
- tin sheds, loose bricks, garbage cans, signboards etc., which can fly in strong winds
- Keep some wooden boards ready so that glass windows can be boarded if needed

- Keep a hurricane lantern filled with kerosene, battery operated torches and enough dry cells
- Demolish condemned buildings
- Keep some extra batteries for transistors
- Keep some dry non-perishable food always ready for emergency use

When Cyclone Starts

  - Listen to the radio (All India Radio stations give weather warnings).
  - Keep monitoring the warnings. This will help you to prepare for a cyclone emergency.
- Pass on the information to others.
  - Ignore rumours and do not spread them; this will help to avoid panic situations.
  - Believe in the official information
  - When a cyclone alert is on for your area continue normal working but stay alert to the radio warnings.
  - Remember that a cyclone alert means that the danger is within 24 hours. Stay alert. Get away from low-
- lying beaches or other low-lying areas close to the coast.
  - Leave early before your way to high ground or shelter gets flooded
  - Do not delay and run the risk of being marooned
  - If your house is securely built on high ground take shelter in the safer part of the house.However, if asked
- to evacuate do not hesitate to leave the place.
  - Board up glass windows or put storm shutters in place.
  - Provide strong suitable support for outside doors.
  - If you do not have wooden boards handy, paste paper strips on glasses to prevent splinters. However, this
- may not avoid breaking windows.
  - Get extra food, which can be eaten without cooking. Store extra drinking water in suitably covered
- vessels.
  - Move your valuable articles to upper-floors to minimize flood damage.
  - Have hurricane lantern, torches or other emergency lights in working conditions and keep them handy.
  - Small and loose things, which can fly in strong winds, should be stored safely in a room.
  - Be sure that a window and door can be opened only on the side opposite to the one facing the wind.
  - Make provision for children and adults requiring special diets.
  - If the centre of the cyclone is passing directly over your house there will be a lull in the wind and rain
- lasting for half and hour or so. During this time do not go out; because immediately after that very strong
- winds will blow from the opposite direction.
  - Switch off electrical mains in your house. Remain calm.

When Evacuation is Instructed

- (a)Pack essentials for yourself and your family to last you a few days, including medicines, special foods for
- babies and children or elders.
- Head for the proper shelter or evacuation points indicated for your area.

- Do not worry about your property
- At the shelter follow instructions of the person in charge.
- Remain in the shelter until you have been informed to leave

Post-Cyclone Measures

- You should remain in the shelter until informed that you can return toyour home.
- You must get inoculated against diseases immediately.
- Strictly avoid any loose and dangling wires from the lamp posts.
- If you are to drive, drive carefully.
- Clear debris from your premises immediately.
- Report the correct loss to appropriate authorities.

In conclusion, it can be stated that in Cuddalore district of Tamil Nadu where the cyclonic disasters are inevitable and recurring, the Government takes sufficient precautionary measures to check damage to human life and domestic animals and also offers timely support to rebuild their infrastructure and livelihood every time as the first time.

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DISASTER MANAGEMENT THE CASE OF GUINEA-BISSAU

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Abstract

The Guinea-Bissau is situated in the northern hemisphere, particularly on the west coast of Africa between Senegal's north, the Republic of Guinea to the east and south and the Atlantic Ocean to the west. Is between the parallels 10 ° 59 'and 12 ° 20' north latitude and between the meridians 13 ° 40 'and 16 ° 43' west longitude.

The total area of the country is 36,125 square kilometers, consisting of the mainland and a group of adjacent islands (Jeta, Pecixe and fall in the North, Bissau, Sands, Bolama, Caiar, Komo and Melo in the South) and an insular set more away Archipelago of Bijagos, comprising 88 islands and islets of which only 21 are inhabited. The Archipelago covers an area of 10,270 square kilometers, with 1600 square kilometers of sedimentary islands and 8670 km² sea views. The coast of mainland Portugal has a length of 180 km from Cape Roxo to Cajete tip.

Fortunately the country has not had major problems with disasters; however due to its geographical location and the nature of its coastline the country has known individual cases of disasters from different sources, such as: Natural disasters, which can be characterized those caused by insects, periodically, mainly affecting agriculture, with capacity limitadade combat without support from abroad.

Hydrological and Meteorological: floods caused by heavy rains that have caused destruction of homes and property in well-located areas.Maritimes: Shipwrecks that have happened sporadically at the country level.

The 2009 caused the loss of many human lives, which led to decision making by the then Prime Minister to the creation of the National Service of Civil Protection, which I will integrate the services of Humanitarian Firefighters.

In 2012, the level of Rio Cacheu the local population was faced with the death of fish at least Polydactylus species Pseudotolitus, among others.

The country could not know the cause of this mortality despite having sent samples to a laboratory abroad (Portugal) but without the ostension result.

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DISASTER MITIGATION AND MANAGEMENT A FUTURISTIC APPROACH

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Abstract:

Disaster management plans are traditionally made to manage disasters. Effective management of disasters requires getting information to the right place at the right time using latest technologies. Leverage learning by local organizations, NGO's and youth is one effective tool to improve disaster management outcomes. However, there are cognitive, organizational and social barriers that prevent these organizations from learning. Organizational culture is another important aspect to enhance learning and learning literature. In this connection, this paper emphasizes the need for National Disaster Management Force at all levels of society similar to the NSS and NCC in achieving effective disaster management. The necessity of need based systems and procedures, to expedite the transfer of technology to each and every citizen of the country; to implement effective rules and regulations; to design policies; to improve interdisciplinary approach in combating disasters are discussed. An effort is made to propose a futuristic approach to cater the challenges in disaster mitigation and management for safe and resilient India.

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Introduction

Every country wants to be resilient towards disasters but without the effective implementation of disaster management it becomes a myth. Disasters cause sudden and extreme effects which results in loss of lives and assets. India, being a disaster prone region, is plagued by various kinds of natural disasters such as floods, earthquakes, cyclones, droughts, landslides and avalanches affecting millions of people. These will destroy the development achieved by a country over several years and withhold the future enhancements.

The safe and resilient India can be made with perfect visualization of importance of disaster mitigation. Government has to take steps for the development of the nation in this direction. Meanwhile, press and media have to support government policies by publicizing their benefits, which facilitates the government to make a free action plan towards sustainable development.

National integration is the only solution in mitigating the damage due to disasters. In this connection, it is inevitable to improve the participation of people at all levels of society by volunteering, in all the stages of disaster mitigation and management.

Establishing the National Disaster Management Force (NDMF) from school level will reduce the intensity of disasters and gives enormous support to National Disaster Response Force, Civil Defense Force and many more government agencies. This idea will help to increase the effective disaster management out comes.

Disaster Management Approach

A vision for dealing with disaster starts with data procurement, awareness, planning & prevention, risk pooling during the time of disaster, response and ends with recovery.

Data: Many issues can be solved like risk identification, awareness, contingency planning and adaptation, with the preparation of proper data. It is crucial for increasing awareness, implementing effective measures, early warning systems, low disaster response and resilient rebuilding. Satellite observations and ground-based observations help in risk identification and assessment**.**

Awareness: With an effective data, the public understand need for preparation and risk preventive measures. National Disaster Management Force will help in promoting awareness programs in schools, colleges, community programs and therefore communication gap will be reduced.

Planning and Prevention: Govt. of India has taken many measures to protect the public from disasters whereas a lot to be done in preventing disasters by implementation of effective mitigation measures. Preventing risk through enhancing resilience requires an integrated planning process to establish resilient structures to current and future catastrophe. This involves land use management, building codes through an efficient code improvement, supervision of construction and retrofitting existing structures for increased resilience. Financial preparedness will protect the people's livelihoods by transferring risk. This increase cost initially but reduces the damage cost later. Establishing an international response measures with standardized guidelines for disaster risk reduction could reduce adverse impact on society**.**

Risk Pooling: Risking pooling is vital to the recovery of individuals, firms and economies. Actions or steps taken immediately before and during an event are very crucial for limiting impact on lives and livelihoods. Early warning prior to an event (Disaster), Mobile warning cascade and Fast-evacuation warnings will reduce the intensity of Disaster.

Response: It begins after the stabilized post-disaster situation to focus on restoring law and order, secure environment and distributing resources and supplies. The government needs to give priority to establish rules and regulations in order to minimize the damage due to disasters by adding Disaster Management and Mitigation into the Seventh Schedule (Article 246). Government should provide the advance technology to local organizations and local bodies for better communication, information sharing and transfer of technology. These organizations will work in eradicating social barriers among the people, leading to better results. Leverage learning by local organizations, NGO's and youth is one effective tool to improve disaster management outcomes.

Recovery: It focuses on returning people and the economy to pre-disaster situation. By using aerial and satellite photography, loss adjusters decide whether they can pay claims partially or fully. Both public and private sectors play a major role in generating the required funding and resources. Microfinance and structured loans for resilient structures to overcome future risks will provide a better solution.

Transfer of Technology

The revolution of science and technology changed the human life as better as possible. Now, it's time for us to bring that revolution in making India digitalized, resilient and developed one. Transferring abilities, knowledge, technologies, samples and methods of manufacturing and facilities among local organizations and government bodies at district level and state level; among state governments nationally and among nations globally is essential to combat disasters effectively. This will ensure proper dissemination of technological and scientific development all over the country, even in the remote areas.

Transnational Corporations (TNCs) are the foremost sources of new technology for developing country like India; transfer technologies directly to foreign host countries in two ways:

- Internalized to affiliates under their ownership and control.
- Externalized to other firms.

A Futuristic Approach

According to the Sendai Framework [1], to reduce the intensity of disaster, there is a need for focused action within and across sectors by national, state and district levels in the following four priority areas.

- Understanding disaster risk.
- Strengthening disaster risk governance.
- Investing in disaster risk reduction for resilience.
- Enhancing disaster preparedness for effective response.

National Policy on Disaster Management need to include the disaster risk in all its dimensions of vulnerability, exposure of persons and chattels, threat characteristics and the environment which can be leveraged for the purpose of pre-disaster risk assessment, for mitigation and prevention. Perfect vision, plans, guidance and coordination within and across various sectors and also participation of significant stakeholders are needed.

National Disaster Management Force (NDMF)

India, a country with most of its population is youth. Youth are looking forward to empower the Nation in all fields. They have the ability, enthusiasm and power to create or to utilize an opportunity in every sector. Youth can transform anything with better guidance. A perfect supervision is required to lead the Nation towards the sustainable development. Govt. of India has taken many steps like Smart Cities, Make in India, Swachh Bharat plans etc., to create likelihoods and livelihoods for younger generations. Country like India, most of its land is prone to earthquakes, cyclones, landslides, floods, man-made disasters will drawback the nation from development. In this world, everything is possible with motivation and desire why not mitigation of damage due to disasters? The concept of disaster management and mitigation came into picture to protect the nation from natural and man-made disasters. To practice disaster management and mitigation effectively, an integrated approach is essential involving youth, local bodies and NGO's which will nullify the intensity of disasters. A one man army is always a failure when compared to a team work. Present disaster management frame work mainly concentrates on rescue and rehabilitation both at state level and national level only. Hence, it is the time to focus on disaster mitigation measures by involving each and every stakeholder without compromise. In this connection, an idea of National Disaster Management Force (NDMF) similar to National Cadet Corps (NCC) and National Service Scheme (NSS) at all levels of society will be effective to combat disasters. NDMF is aimed at disaster mitigation and management by inculcating national integrity, discipline, commitment, smart thinking, sharp response, motivation, leadership, charity, human values, ethics, knowledge on latest technologies and above all patriotism among youth.

Why National Disaster Management Force?

National Disaster Management Force (NDMF) will create a great impact on policy framing by the Govt. of India and during the time of disaster, the people need not to wait for the special team or force to help them. It will provide the basic knowledge what to do, what not to do when hit with a catastrophe and itself will reduce the intensity of disaster. NDMF provides an equal opportunity to each and every individual in general and students in particular, for their active participation in an emerging well-developed society.

Implementation of National Disaster Management Force

At School Level: The initiation for NDMF should start from the secondary education itself where young minds are ready to know the importance of the Disaster Management and Mitigation. The NDMF will concentrate on the basic knowledge on disasters, moral and ethical values, establishing unity, motivating people, physical and mental stamina towards disaster mitigation and management.

At College Level: NDMF provides field experience to the interested people; establish linkage to higher authorities and assigning the zones whichever is nearer to them. NDMF will organize campaigns, workshops to mobilize people together and to guide school level teams.

At Municipal and Rural Offices: Establishing a team of officers, irrespective of their position to chaperon the youth during the time of disaster will ensure proper disaster management.

NDMF and other Important Institutional Arrangements

NDMF will simplify the job of various central government agencies working on disaster mitigation and management.

National Disaster Response Force – Their role will make much easier with National Disaster Management Force and increases effective management.

NCC – National Cadet Cops, NSS – National Service Scheme and NYKS – Nehru Yuva Kendra Sangathan encourages youth to get trained and to provide the effective service to the nation during the time of disaster and emergency.

Armed Forces – These play a vital role during the disasters and can sometimes be the only means of transport for the relief funds, food and civil supplies to reach the rehabilitation centers, along with search and rescue operations.

Civil Defense and Home Guards – They support to maintain civilized environment to create peace and confidence to the people affected by the disasters.

United Nation Disaster Management Team – India, represents various UN agencies and functions for the effective improvement of disastrous situations.

Role of NGOs in Disaster Mitigation and Management

A safety study on disaster management helps to acquire the skills and attitude necessary to protect their own lives and raising awareness among society. Efforts to provide disaster prevention education in schools have served as opportunities to pass on disaster prevention know-how not only to students, but also to their family members via students. Moreover, disaster prevention drills jointly carried out by schools and community are enhancing their mutual relationship. An overall commitment and involvement of public and private sectors, regional and international organizations, civil society, including volunteers will give a substantial reduction of disaster losses.

In every phase of disaster management, the role of NGOs is crucial, essential and vital; in the relief and response efforts, especially to reduce the communication gap through coordination between the administration and the affected community. In present scenario, the role of NGOs has changed from post disaster relief to strengthening disaster preparedness and mitigation.

Role of NGOs in Preparedness: To mobilize and organize the community, from village disaster management committees; establishment of community level coordination mechanisms with Panchayat and their link with block and district level line departments; training of community volunteers and linking them with the local administration to act in the time of disaster; facilitate detailed assessment of current needs and capacities at district, state and national level; participating in national, state and district level task forces; Emergency Operational Center (EOC) level meetings; linkages with stakeholders for hazard monitoring and provide last mile connectivity for Early Warning (EW) dissemination and collect, manage, process and share data during and after disaster.

Role of NGOs in Mitigation: Promoting disaster mitigation awareness, inclusive disaster management approaches, strengthening disaster preparedness measures, improving water and sanitation systems, construction of shelters, public buildings and other crucial infrastructure safe from disasters and assisting in risk assessments and action planning.

Role of Print and Media in Disaster Mitigation and Management

Print and Electronic Media play a vital role during disaster management. They reduce the bridge gap between the government sectors and calamitous bodies. Huge relief funds released during post-disaster should reach rehabilitation centers on time, during which media's communication sector would enhance the effective performance of government, non-government and welfare associations to not only reduce the redundant support but also to create awareness among the people. Despite raising a controversy against the malfunctioning of government, they can act as source in identifying the risks of the disaster and telecast the crisis situation not for the TRP but for the life of the people. Rather than being inquisitive with government bodies regarding the failure of functioning, they can extend their effective support in the welfare activities which in turn would support the relief operations.

Media not only show cases the disastrous events to public but also communicates the effectiveness of the country to tackle situations during the post-disaster time, to foreign countries. This might in turn communicate the country's infrastructural and industrial well-being which sometimes might impact the country's foreign policies.

Instead of media's proactive participation in after effects, it can enhance the reduction of loss with its effective participation during the disaster mitigation. Media, now being part of society can educate people at disaster prone areas to migrate to safe regions before the calamity hit them along with the preventive measures to be taken pre and post disaster to reduce the effect of damage to their living by conducting drills and promoting awareness.

An Interdisciplinary Approach

To reduce intensity of disaster or to prevent the disaster, an interdisciplinary approach is required where the complex situations can be solved easily. An approach from different streams of private and public sectors and educational institutions will give an option to choose an enhanced way to prevent disasters.

An interaction with central ministries and departments of space, science and technology, industry, health, environment and forests, earth sciences, atomic energy, agriculture and with all academic institutions like IITs, NITs and universities, etc., will be maintained to solve teething troubles.

Recently, the approach in which military and government-derived institutional models predominate has been challenged by the sociologists and psychologists, who are developing more critical, interpretive and integrative approaches considering the social capital and community competence in the field of disaster management. Disaster Management is better served by interdisciplinary approaches which not only improve the development of disaster management knowledge, but also increases the transfer of knowledge from the context into the essential so that a better disaster mitigation and management framework is developed.

Conclusion

Developing countries like India are taking measures towards the disaster resilient nations. Disaster mitigation plan is more effective than disaster management. Government, non-government agencies and public should function effectively with coordination to face the disasters. Financial, infrastructural and industrial aspects of the nation need to be reconsidered for the effective growth. Developing country would stay as a developing country until we identify a solution to reduce the effect of the disasters. Best practices and codal provisions need to be followed for constructing any structure or development across the nation to effectively withstand the disaster effect and reduce both civil and financial loss. Leveraging technological advancements in pre and post disaster situations is vital in disaster mitigation and management. Awareness and preparedness among the society towards the disasters would help in the overall development of the nation. In conclusion, it proposed to establish the National Disaster Management Force (NDMF) at all levels of society to combat disasters effectively. NDMF will ensure awareness, prevention, preparedness, mitigation and management of disasters. NDMF will play a vital role in nation building. Hence, the authors opine that the Government of India should consider NDMF similar to NCC or NSS for safe and disaster resilient India.

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STRATEGIES TO REDUCE IMPACT OF DISASTERS CAUSED BY NATURAL HAZARDS IN INDIA

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Abstract

The paper deals with the present state of disaster caused by natural hazards in India. In this paper effort is made to study about existing disaster management structure in India; existing rules regulations for construction of buildings and actual ground reality in execution/implementation on ground in India. In last number of years, India is experiencing heavy floods, cyclones, landslides and earthquakes almost every year. The number of death, destruction and loss because of natural and man-made disasters are becoming more rather than less frequent. Disaster Risk reduction is increasingly becoming more important because climate change is expected to result in more frequent & severe hazards. It is expected to increase people's vulnerability, resulting in even more disasters. It has also been experienced that the country is not adequately prepared to deal with consequences of these disasters. The experience suggests that there is an urgent need for a proper disaster management planning/strategy that is focused, well co-coordinated & prepared for all obvious eventualities so that its impact is reduced. The paper mainly focused on requirement of planning & implementation on ground considering various aspects of disaster management & has finally recommended various comprehensive measures to be taken. The author was actively associated with surveying/assessment of large number of earth quake affected buildings in various places in India. The major reasons leading to failures of large number of structures have been analyzed, their remedial measures discussed, & deliberated by special emphasize on planning & actual implementation on ground, for reduction of its impact in future.

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Introduction

A hazard leading to an event of any kind of destruction, loss of life, damage or drastic change to the environment can be called as "disaster". There is a great requirement of analyzing and mitigating the disasters, in order to minimize the loss of life as well as the property. A hazard is the occurrence of a physical phenomenon at a given site that is capable of causing loss and damages. If a hazard such as cyclone hits an unpopulated coastal area, it will not be considered as disaster. It is always the unmanaged hazards that result in disaster. Natural disasters in India, many of them related to the climate of India, cause massive losses of Indian life and property. Droughts, flash floods, cyclones, avalanches, landslides brought on by torrential rains, and snowstorms pose the greatest threats. Other dangers include frequent summer dust storms, which usually track from north to south; they cause extensive property damage in North India and deposit large amounts of dust from arid regions. Hail is also common in parts of India, causing severe damage to standing crops such as rice and wheat. Landslides are common in the lower Himalayas. The young age of the region's hills result in labile rock formations, which are susceptible to slippages. Rising population and development pressures, particularly from logging and tourism, cause deforestation. The result is denuded hillsides which exacerbate the severity of landslides; since tree cover impedes the downhill flow of water. Parts of the Western Ghats also suffer from low-intensity landslides. Avalanches occurrences are common in Kashmir, Himachal Pradesh, and Sikkim.

Floods are the most common natural disaster in India. The heavy southwest monsoon rains cause the Brahmaputra and other rivers to distend their banks, often flooding surrounding areas. Though they provide rice paddy farmers with a largely dependable source of natural irrigation and fertilisation, the floods can kill thousands and displace millions. Excess, erratic, or untimely monsoon rainfall may also wash away or otherwise ruin crops. Almost all of India is flood-prone, and extreme precipitation events, such as flash floods and torrential rains, have become increasingly common in central India over the past several decades, coinciding with rising temperatures. The floods in Uttarakhand caused one of the biggest disasters in the history of India in 2013. It caused huge loss of life & property. Again in 2014, the floods in J & K caused similar type of loss. Disaster of all types e.g., earthquakes, floods, cyclones, drought, cloudbursts accidents , etc. have been occurring since time immemorial , etc. have been occurring since time Immemorial.. However, their frequency, magnitude & area have increased many times in all parts of world, in recent times. They may be broadly classified as natural disasters such as earthquakes, floods, droughts & cyclones, manmade disasters such as riots, conflicts, refugee situations & environmental disasters, like fire, epidemics, industrial accidents & environmental fallouts. Often difference between them is marginal. Natural disasters can be perceived as an "extreme natural event", which, may affect different places singly or in combination (Coast line, hillsides earthquakes prone areas, etc.) at different time's & different duration, etc. The hazard has varying degrees of intensity & severity. Any natural hazards become disasters, when they come in contact with vulnerable social setting of human population. Human settlements, structure & centres of economic activity increase the damages caused by disasters. Globally, natural disasters account for nearly 80% of all disaster affected people. In this paper i will focus on Natural Disaster.

Over the last century, about 75% of fatalities attributed to earthquakes have been caused by the collapse of buildings. India's substantial percentage ones (59%) continue to live in the non-engineered weak buildings, due to absence of knowledge, poverty & awareness about compliance of appropriate buildings regulations and legislation. In the construction industry, there are various types of professionals required. These include those are at Senior Management, Managerial, Supervisory level as well as Trades man & worker. Till recently Indian Construction Industry (barring few major contactors) was in the hands of small contractors. The project being constructed were mainly labour oriented and therefore not exposed to specialized equipments & mechanized construction. Unskilled worker mostly remained unskilled throughout their lives. These have affected our quality construction very badly & thereby impact of disaster is so heavy in developing country like India. Further our implementation machinery is weak & lack firm commitment.

Existing Policy for Disaster Management

National Policy on Disaster Management-2009 was approved by GOI on 22nd Oct 2009, based on Disaster Management Act, 2005. The NDMA, as the apex body for disaster management, headed by the Prime minister. It has the responsibility of laying down policies, plans & guide lines for Disaster Management (DM) in the country. The guidelines will assist the central Ministries, Departments & States to formulate their respective DM plans. It approves the National Disaster Management plans & DM plans of the Central Ministries/Departments. NDMA take such other measures, as it may consider necessary, for the prevention of disasters or mitigation or preparedness & capacity building, for dealing with a threatening disaster situation or disaster. Central ministries/Deptt. & State will extend necessary cooperation & assistance to NDMA for carrying out its mandate. NDMA will oversee the provision & application of funds for mitigation & preparedness measures. NDMA has the power to authorize the Deptt's or Authorities concerned, to make emergency procurement of provisions or materials for rescue & relief in disaster.

At state level, the SDMA, headed by the Chief Minister, will lay down policies & plans of DM in the state. It approves the state plan in accordance with the guidelines laid down by the NDMA. SDMA Coordinate the implementation of the state plan, recommend provision of funds for mitigation & preparedness measures and review the development plans of the different Departments of the state to ensure the integration of prevention; preparedness & mitigation measures. The State Govt. constitutes State Executive Committee (SEC) to assist SDMA. DDMA (District Disaster Management Authority) headed by District Collector act as planning, coordinating & implementing body at District level. DDMA ensures that the guide lines for prevention, mitigation, preparedness & response measures laid down by the NDMA & the SDMA are followed by all the Deptt's. Of state Govt.

There are other institutional arrangements for disaster management in India. Armed Forces – Called to assist Civil Administration, when situation is beyond their coping capability .Central Para-military Forces (CPMFs) - which are also the Armed Forces of the Union, play a key role at the time of immediate response to disasters. State Police Forces & Fire Services- are crucial immediate responders to disasters.

- Civil Defence & Home Guards
- State Disaster Response Force (SDRF)
- Role of NCC; NSS (National service Scheme); & NYKS (Nehru Yuva Kendra Sangathan) & other NGO's.
- International cooperation & coordination in all spheres of DM.

The functioning of all these Institutes' need to be evaluated & possible improvement need to be carried out, for reducing impact of disaster. India has advanced considerably in developing earthquake resistant codes of practice and guidelines for constructing RCC and steel framed buildings, brick or stone masonry buildings and combination of clay, wood, bamboo and thatched houses. Yet high level of earthquake risk in our country's context is mostly attributed to the unplanned and ill planned urban infrastructures developments. In order to reduce vulnerability it is important to create proper awareness about earthquake induced damages and their mitigation measures. India Govt. is looking forward to establish the necessary techno-legal and techno-financial mechanisms in order to ensure that all stakeholders like owners, builders, architects, engineers and government departments, responsible for regulation and enforcement adopt earthquake-safe construction measures in all design and construction activities. The main focus shall be:

- Earthquake resistant design and rehabilitation of structures
- Indian standards and guidelines on earthquake technology
- Seismic evaluations and retrofitting of selected lifeline buildings
- Disaster safe construction practices and issues
- Techno-legal and techno-financial framework for earthquake protection compliance
- Training and Capacity building of masons, architects and engineers

Building Construction

The Expert Committee was constituted by Ministry of Home Affairs to Develop Model Building Bye-laws and the review of City, Town and Country Planning Act & Zoning Regulations. The Committee based on lesson learnt about the damages in buildings during various earthquakes had observed that the main reasons of wide spread damage was due to faulty design and bad construction practices. The earthquake resistant features specified in Indian Standards and Building Codes were not followed. The Committee in its final Report had made detailed recommendations for modification in existing Town & Country Planning Act, putting Land use Zoning Regulation in place and additions to Development Control Rules and Bye-laws. The Ministry of Home Affairs, Govt. of India had recommended the same to the State Govt. & UT Administration for early adoption. The National Building Code prepared by BIS are advisory in nature and not been made mandatory so far. The seismic Strengthening of Existing Building has been also recommended. As per recommendation, prior to seismic strengthening/retrofitting of any existing structure, evaluation of existing as regards structural vulnerability in the specified wind/seismic hazard Zone shall be carried out by a registered structural Engineer. Further, Review of structural Design by the Senor Structural Designer also been recommended. For the implementation of the recommendations the series of workshop in all states & UT have been planned to disseminate the recommendations of the Model Techno-legal Regime so as to help them to actually modify the Acts/Development Control Rules/Bye-laws as applicable. However lot of works need to be done to lead Building a New Techno-legal Regime for a safer India against the natural hazards. The Building Bye-laws and BIS Codes need to be critically studied/examined & possible modifications/improvement need to be evolved for reducing impact of Disasters. All codes needs to be periodically updated/revised based on experience ganed during various disasters.

Disasters caused in Gujarat & other Places

Earthquakes are known to occur since time immemorial. As we are aware that out of the many types of disasters, an earthquake is the most deadly catastrophe, which strikes within seconds without any warning. The earthquake, which rocked Gujarat on 26 Jan 2001, varying assessed to measure, 6.9 to 8.1 on richer scale, left behind heavy toll of life & property. At least 20,000 people were killed and 1.66 lakhs injured in the quake, which flattened almost the entire Kutch region & parts of other districts, extending from Bhuj & Jamnagar in the north to Ahmadabad & Surat in the south. In Kutch area of Gujarat, many towns are destroyed & some villages are wiped off the map. Most precious human lives are lost, injured & huge properties destroyed or damaged, mainly due to not taking into account, the earthquake resistance features, while constructing the houses. Overall loss of human lives & properties due to this earthquake has exceeded the loss suffered in any other earthquake in our country in living memory. It was estimated by the Gujarat Govt. that the total loss of property was to the tune of Rs.20, 875 Crores. However, almost everybody, except those were in power, admits that many more lives & property could have been saved, provided we would have taken certain preventive measures. What was especially sad is that while the world was willing to help the victims, the Govt. faltered.

India had experienced five great earthquakes, each with richer magnitude exceeding 8; 1819 Gujarat, 1897 Assam, 1905 Himachal Pradesh, 1934 Bihar & 1950 Assam. Apart from these, there have been other divesting earthquakes in the Indian sub-continent, which have created public awareness about this problem. In 1967, earthquake in Koyna (6.3R), in 1993 earthquake in Latur (6.2) area of Maharashtra surprised everybody, as no such shock struck until then. In 1991, a damaging earthquake occurred in Utter-kashi (6.5R), in 1997 we had earthquake at Jabalpur (6R) & in 1999 Garhwal region of Western Himalaya (6.8R). After Bhuj earthquake (7.6) on 26 January 2001, we had earthquake (7.6) in Kashmir, Himachal Pradesh on 08 Oct 2005; Andaman Islands (7.5R) on 11Aug 2009 and on 18 Sept 2011 earthquakes (6.9R) in Sikkim. In all these earthquakes, the majority of the structural damages that observed in the affected areas are due to non-compliance of earthquake resistance features, and poor construction practices using locally available building materials. In Gujarat, also we have observed similar pattern of destruction of much bigger scale. Having simple and economical earthquake resistance structure has advantage even over prediction of earthquakes, which would minimize considerable losses of property & lives. Though number of teams from foreign countries rushed to India to help, duly equipped with flying hospitals with necessary medical support, and sniffer dogs etc, but unfortunately coordination from Govt. side was totally missing.

The havoc created in Uttarakhand due to heavy rainfall, which caused landslides and flood in the whole state on June 13. According to official figures, more than ten thousand were declared dead, but according to local media & certain assumptions, more than a lakh people are assumed to be dead. State Govt. estimated a loss of Rs. Sixty thousand crores. After one year almost similar situation has arisen in Jammu & Kashmir region, in Sept 14, due to devastating floods. Though death figure is low here in terms of few hundred only, but the loss of property and infrastructures are huge. Based upon the study of Gujarat Disasters and experiences of other disasters in India, the reasons for unsatisfactory state of affairs & major causes of failures are brought out below:

Lack of Effective Coordination among various agencies resulting into in-efficient rescue operations and delays in release of relief materials, suffering of people, chaos & confusion. It is a fact that lot of human life could have been saved, had the Govt. could pulled the right string timely particularly in Gujarat & .Uttarakhand.

Lack or Complete Absence of Inter-Agency Flow of Information, pertaining to the official plan of action, procedures regarding receipt and distribution of material, nature & quantity of relief material being distributed to the effected people and the place of distribution.

Lack of Transparency and Accountability, regarding the money and material distributed to the effected people as well as left as unused. Therefore, there is a general lack of trust between the administration and the people.

Delays in Release of relief materials & funds and there-by-ultimate sufferings of the people.

Bureaucratic Management Approach that is top-down, non-integrated & piecemeal. There was generally no devolution of authority to take decisions at mid & lower levels. Roles & responsibilities were not clearly specified. As a result there was a general lack of confidence among staff to handle post- disaster situations.

Past Experience in Disaster Management was not Institutionalized and documented for use. It was lost with the individual, when he left the assignment on normal transfer. Thereby lessons learnt is not being utilised properly for future planning & implementation on ground.

Lack of Comprehensive Disaster Mitigation Plan (DMP) at national, state, district & local levels. The Contingency Action Plan available with some states is not effective in affected states.

Lack of Public Participation in Reconstruction Programmes, because of which, the houses constructed is not getting adequate acceptance of the people and failed to serve the desired purpose. Basic knowledge about rehabilitation of structure is missing most of the cases.

Lack of Effective Rehabilitation Policies & Programmes as a consequence, a large section of the people is left to fend for themselves & struggle to rehabilitate their family.

People's Attitude & Behaviour is casual & directed to short-term personal gains. They do not take early warning seriously & are caught in disaster situation/ conditions. In Gujarat & other disaster affected states, it is reported that the people insisted on cheaper buildings even at the cost of quality construction.

Failures of Professionals (architects & engineers) in advising the people on magnitude of damage, if quality of building is compromised for cost considerations. Engineers do not feel accountable for damage to the buildings due to their faulty design or supervision. There is no proper implementation of regulation in this respect.

Builders are not Accountable for quality of construction once building is handed over & mandatory six/ twelve-month's period is over. There are no laws to regulate builders & their performance properly.

Failures of Planners to evolve rural housing models acceptable to the local People & commensurate with their community living pattern where both Animals & people live on the same compound.

Lessons Learnt

The major reasons for heavy losses occurred during various Natural calamities, are listed below:

- Lack of efficient organizational set up, particularly at state level.
- Lack of effective Administration to deal with disaster issues from all angles.
- Apathy on the part of top Bureaucracy & key political Elite.
- Lack of effective leadership & communication to deal with disaster issues.
- Total Lack of Co-ordination among all Agencies engaged in Relief works.
- Lack of positive interest among Universities, Research institutes & UN system in Dissemination of Disaster Management knowledge, based on Research, practical Experience & observations.
- No dedicated attempt by Govt. & Urban authorities to make safe buildings on ground to withstand the effects of disasters (as already brought out earlier).
- Lack of action in Right Earnest: Mere paper planning to impress the press & people.
- No sincere efforts & attention to post Recovery disaster victims.
- No sincere effort to keep up the morale of the community, so that they can take care of themselves.

- Though number of instructions available & various institutions are working on various areas, our implementation on ground is grossly inadequate.

Proposed Strategy & Recommendations

Based on the study carried out after analysing various aspects the following Measures are recommended: -

- Comprehensive National Policy framed on disaster management after considering the various Recommendations made by the HPC & suggestions made in this paper, is to be implemented on ground. The culture of preparedness, quick response, strategic thinking & prevention, as brought out by the HPC, should be evolved and implemented on ground. The Centre's role in combating disasters needs to be enhanced.
- Disaster Management aspects like preparedness response etc should form part of curriculum in primary, high schools and colleges. Education and training in disaster prevention, preparedness and Mitigation is necessary for minimizing effect of disaster.
- Identification & net-working of existing Centres of Excellence is to be done so as to enhance disaster prevention, reduction and mitigation Activities. A National Institute for Disaster Management (NIDM) needs to be strengthened as a centre of excellence. NIDM is to be geared up towards emerging as "Centre of Excellence" at National and International level.
- Involvement and active participation of the community in combating disaster Needs to be increased. The local bodies must be given additional role in this Regard. The local level plans need to be prepared in detail and rehearsed in the Disaster prone areas, all state Govt. should reorganize their disaster management mechanisms taking into account the Maharashtra model. Panchayat and village disaster Management communities should be established.
- A formal mechanisms to co-ordinate activities of NGOs to be evolved, to Avoid duplication of work and formalized, as has been done US model for Disaster relief operations.
- Alternative means of communications/stand-by communication System should be given high priority.
- There is an urgent need for careful study of all existing structures in Earthquake prone areas specially, based on various Indian Codal requirements And identifies the structures, which do not conform to Engineering Requirements. The strengthening measures are to be incorporated for all future Constructions and also for existing structures, without any further loss of time. The requirement of strengthening existing old structures, which were not designed as per present Coadal requirement needs to be identified immediately & suitable alteration/ rehabilitation work is to be carried out to avoid huge loss of life.
- The use of Indian Standard codes of practices & building bye-laws in the Construction of Government & private buildings is to be made compulsory and enforced properly. The hazard Zonation map of the country need to be upgraded regularly.
- To establish a creditable R & D organizations, under the new Ministry to develop modern mechanisms, in the field of disaster management. Further, as Recommended by eleventh Finance Commission, National Centre for Calamity Management (NCCM) should be set up at the earliest.
- The Central Govt. should publish & circulate all the lessons learnt in the Post disaster, to the states that are prone to specific disasters. This can be done by NDMA.
- The existing warning systems, including infrastructure in disaster prone areas should be improved.
- The Armed Forces being a major player in Disaster Management in India need to look inwards and formulate their own response mechanism including procurement of State of Art equipments and skill improvement, to maximise the utilisation of their resources and effort. Further, there should be synergy between Armed Forces and Civil Administration (Including NGOs) towards providing efficient response.
- Whilst the formal education whether it is at the graduate/post-graduate level, diploma level, equips with certain amount of basic knowledge and skill, education of any one is not adequate unless his knowledge and skill are updated periodically through continuing education & training in one form or other, particularly in the aspect of various disaster management. It must be made mandatory for college faculty

to possess a minimum experience in design & construction of earth-quake proof structures, so that they are capable imparting knowledge to students at various level.

Conclusion

All state governments and all local bodies (urban & rural), development authorities, special and new town development agencies, etc need to modify, revise, revamp the existing building byelaws; development control rules; planning standards; town planning rules; special regulations for fire, structural health, construction, electric and life safety, in line with the NBC-2005 by suitably adopting fully or adapting it with local variation as may be needed. NBC-2005 to be adopted as the basis for all structural design, fire protection, building and plumbing services, building materials and construction practices (and construction safety) and for proper protection, upkeep & maintenance of water bodies by modifying the departmental construction codes/ specifications/manuals of Govt. construction departments.

The strengthening of all building development and regulating agencies with the right level of professional human resources to deal with proactive responses needed with the building professionals and builders. The professional human resource pooling for contiguously situated human settlements and the related regulating agencies should be attempted, considering the socio-economic and budgetary constraints of smaller level local bodies dealing with building regulation work. Strategies to be made for pre and post event data collection and further instrumentation of the affected area for understanding unique tectonic features by reputed Indian organisations such as NGRI, GSI, IMD, NEIST, WIHG, IIG, IITs. To provide a forum for inter-changing of ideas and views pertaining to earthquake risk mitigation, capacity building of mason, architect, engineers, town planners, contractors and other stake holders. Workmanship, supervision, and construction methods must be revised in the form of strict regulation and implementation drives. Thus, strict adherence to prescribed standards, of construction materials and processes is essential in assuring an earthquake resistant building. Regular testing of materials to laboratories, periodic training of workmen at professional training houses, and on-site evaluation of the technical work are elements of good quality control.

The various measures recommended in this study are an absolute necessity, if we want to bring more professionalism & effectiveness in our system to combat disasters and to reduce impact of loss of human life & property due to natural disasters in India. There is an urgent need of nationwide mass awareness generation activities as a foundation layer of earthquake preparedness in the country, so that the impact of disaster can be reduced substantially.

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NATIONAL LEVEL DISASTER MANAGEMENT WORKING MECHANISM

Naresh Jain

Abstracts

Even after the multiple efforts by government the disaster management is big issue till now due to lake of proper mechanisms. And in my paper I want to present the complete mechanisms of government system that how disaster situation (including pre and post) can be managed.

An independent body should be developed like Election Commission for disaster management with full power to utilise other government offices, resources, man power etc during disaster (like election commission can govern during election).

This independent body should have separate budget allocation and must be self-powered to take action for disaster management. This body may be asked for help by any district collector, state governor, president of India, Judiciary, chief minister, prime minister etc.

The mechanisms starts with taking care of proper communication, data collection, transport, power, earth moving / special tools, food, medical, rescue, first relief, final rehabilitation, settling compensations, information and records about victims, etc. The mechanism should work from village, Tehsil, district, state, national head quarter and end to the world community. The voluntary team of people, designated government officials, politically elected people at every stage should be involved in this mechanism.

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THE DISASTER MANAGEMENT ACT, 2005: A SOCIO LEGAL ANALYSIS

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Abstracts

This paper discusses the disaster management system in India in the light of the Disaster Management Act, 2005. The three consecutive disasters in India related to Cyclone (1999), Earthquake (2001) and Tsunami (2004) made us realize the urgent need of a comprehensive and holistic disaster management system. This need was realized by the State also which paved the way for the enactment of Disaster Management Act, 2005. However, this Act is not holistic in its approach. This paper argues that the Disaster Management Act passed provides for detailed action plan right from the central government to the district and local levels to draw, implement and execute disastermanagement plans. However, it overlooks significant aspects,such as classification of disasters, declaration of disaster-pronezones, streamlining of responsibilities and involvement of local communities. It works only one aspect of Disaster Risk Reduction (DRR) i.e. management of disasters but squarely ignores the other aspects of mitigation and preparedness against disasters. Moreover, it seems to be an isolated piece of legislation which doesn't link itself to the penal laws against crimes which can occur during disasters like trafficking, rape etc. It overlooks the special needs of vulnerable groups like women, disabled, dalits etc. The act falls short of the expectations inall aspects, considering the time involved in the making of the legislation. Finally, it may be concluded that it will spell a greater disaster if there is no careful formulation of rules and regulations. It is better if the act goes for some amendments.

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DISASTER MANAGEMENT -NEED FOR SOCIAL WORK APPROACH

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Abstract

The aim of the study is to understand the perception and beliefs of Master of Social Work students towards disaster management. The study explores (i) different perspectives of social work students towards disaster management. (ii) Implication for teaching disaster management concepts in future studies of social work (iii) integration of disaster management concepts in social work curriculum and (IV) the student's interest to take up disaster management in social work Practice. The current exploratory study was conducted in four schools of social work in India. In two schools a Semi structured questionnaire was administered to the Master of Social Work students, while in the other two schools of social work responses were collected through focus group discussions.

Key words: *Disaster Management, Social Work Approach, Social Work profession, vulnerability.*

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MANAGEMENT AND MITIGATION OF NATURAL DISASTERS IN TELANGANA, ANDHRA PRADESH AND ODISHA

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Abstract

The states Telangana, Andhra Pradesh and Odisha are prone to multiple disasters. Every year innumerable number of lives and property is getting lost in these disasters. Few districts are suffering from cyclone & floods and at the same time other districts are prone to severe drought, etc. Pre-disaster planning i.e., mitigation and preparedness can have a good impact on minimizing the post-disaster response i.e., emergency, rescue and rehabilitation. It also reduces tragedy and suffering to a great extent.

In this paper disasters like cyclone, floods, storm surges, drought, earthquakes, tsunami, fire, etc., with statistics relevant to each disaster are discussed. Efficient strategies for disaster risk mitigation are suggested keeping in view the broad guidelines laid out by National Disaster Management Authority (NDMA).

Keywords: *Natural Disaster, Flood, Cyclone, Drought, Earthquake, Disaster Management*

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DISASTER MANAGEMENT:
"MANAGING THE RISK OF MINING DISASTER"

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Abstract

It is an accepted fact that mining is a hazardous occupation. To exploit mineral mean to fight against the nature, and that is why there is a chance of an accident at any moment during the mining operation. We have to produce mineral resources from the womb of mother earth to meet the nation's demand. But at the same time, it has to be kept in mind that nothing can compensate the loss of a human life.

In the last few years, there has been a remarkable change in economic, social and technological environment in our country. Indian Economy has been revamped by changing its age old attitude and mind set. These waves of change have provided a lot of opportunities as well as challenge before every section of society. The contribution of mining Industry to the economy of our country is un - questionable. Mining Sector has to increase its production substantially to meet the demand of coal supply for energy sector and other sectors in future years.

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Introduction

When a disaster occurs in a mine it leaves little or no time to discuss the steps to deal with the situation. In most cases the work done in first few hours is the most vital for saving lives. Decision taken on the spur of the moment will not bring in as good result as properly planned procedures. Advance planning is the most logical way of minimising the affects of a sudden and drastic emergency, the intensity of an emergency in mine and the procedures to deal with it in the best possible manner.

The intensity of any emergency or disaster can be minimized by adopting a properly designed emergency response plan, which details the organization required to deal with an emergency in time and the procedures to deal with it in the best possible manner.

The object of a disaster management plan is to protect the employees against loss of life or damage to property by;

- Making the employees and response authority aware of hazards within the work domain.
- Developing a co-ordinated emergency response which effectively handles accidents that could develop into major disasters.
- Periodic Mock drills and training the employees on how to act in the event of a disaster emergency.

Definition of a Mining Disaster: Disaster in general is a event or series of event, which gives rise to casualties and damage or loss of life, properties, environment on such a scale which is beyond the normal capacity of the affected community to cope with.

Disaster is also sometimes described as a "catastrophic situation in which the normal pattern of life or eco-system has been disrupted and extra –ordinary emergency interventions are required to save and preserve lives and environment".

A mining disaster is defined as "accident with 10 or more fatalities". However, it may also be defined as "an unexpected, sudden occurrence, including in particular a major emission of gas, fire, explosion or inundation, resulting from abnormal developments in course of mining activity, leading to a serious dangers to workers, public or the environment, whether immediate or delayed, inside or outside the mine or involving one or more hazardous substances".

There may also be an emergency which may not cause loss of life, but may result in trapping of workers, or affecting persons requiring emergency actions as in case of a disaster. These incidents have potentials of a disaster in the mine for e.g., (Jharia fire, subsidence under built up areas, etc. has similar disaster potentials). The whole cycle of disaster management can be depicted by following figure1.1

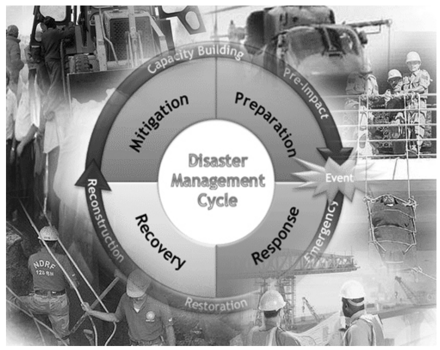

Figure1.1

Classification of a Mining Disaster among others may include:

- Disaster due to inundation
- Disaster due to fire
- Disaster due to Explosion (Coal dust or Fire damp)
- Disaster due to gas (Sudden Outburst of gas)
- Disaster due to sliding of overburden dumps
- Disaster due to fall of roof and sides
- Disaster due to off-site emergency, subsidence, ground movement, release of gases from mine fires etc.

Institutional and Statutory Arrangements of Mining Disaster Management

In 1895, the Government of India initiated steps to frame legislative measures for safety of workmen. In 1897 first major disaster in mining hit the kolar goldfields killing 52 persons, which was followed by the Khost coal mine disaster in Baluchistan killing 47 persons. These disasters hastened the process of formulation of safety laws and the first "Mines Act" was enacted in 1901.

With further experience, this act was superseded by the Indian Mines Act, 1923, which was again replaced by the present mines Act, 1952. This act came into force on the 1st July 1952.

"The Mines Act, 1952" applies to mines of all minerals within the country including the oil mines within the limits of territorial water.

The basic objective of the mines act is to provide for the health, safety ad well being of persons employed in mines. The act regulates the working conditions and environment in mines with a view to making work more humane and to provide for measures to prevent accidents to mine workers

Rules and Regulations Framed under the Mine Act, 1952

- The Mine Rules, 1955 - All Mines
- The Coal Mine Regulation, 1957 - All Coal Mines
- The Metalliferous Mine Regulation, 1961 - All Mines other than
  - Coal and Oil Mines
- The Oil Mine Regulation, 1984 - All Oil Mines
- The Mines Rescue Rules, 1985 - All Belowground
  - Mines
- The Mines Vocational Training Rules, 1966 - All Mines
- The Mines Crèche Rules, 1966 - All Mines
- The Coal Mines Pitted Bath Rules - All Coal Mines

Employing more than 100 persons.

The Rescue Rules, 1985 provide for the establishment of rescue stations and conduct of rescue work in mines affected by an explosion or fire, an inrush of water or influx of gases. To operate under these conditions services of especially trained men with special rescue apparatuses are required.

Rescue stations equipped with prescribed rescue equipment and apparatus were established by mining companies to deal with emergency in mines. These rescue equipment with trained rescue personnel's can be utilized to deal with offsite emergencies, if a dedicated trained bridge is prepared for the purpose.

Working group formed by Govt. of India, on disaster management for the twelve five year plan (2012 – 17), agreed upon to formulate a scheme to provide for specific interventions of other ministries for disaster reduction in respect of the target area they serve.

It has been said, that a national mine disaster management centre may be established under department of mines to plan the emergency response and coordinate with stake-holders under a unified command structure. Its term of reference may include among others, drawing up of a national policy pertaining to emergency preparedness ad response system in mines. Its function may include setting up of establishments stocking critical equipments like heavy duty pumps for quick drainage of water from underground mines, at appropriate locations managed by respective mine management. Its mandate may incorporate a charter of extending assistance to other government departments, agencies and civil society in tackling other natural and manmade disasters. A centre of excellence may also be set-up in Indian School of Mines, Dhanbad.

The Indian Scenario: Mining Disaster Statistics

Cause	Number of incidences	Percentage of total incidence	Fatalities	Percentage of total fatalities
Explosion	39	14.03	1267	37.85
Inrush of water	34	12.23	833	24.89
Roof/side fall	160	57.55	882	26.35
Mine fire	4	1.44	104	3.11
Suffocation of gas	4	1.44	21	0.63
Winding in shafts	11	3.96	63	1.88
Explosives	5	1.80	41	1.22

Miscellaneous	21	7.55	136	4.07
Total	278	100	3347	100

Table 2.2: Major Accidents (more than four fatalities) in Indian Coal Mines – Cause Wise (1901-2015)* * Data for the year 2011-2015 are provisional and up to 31.08.2015.

Table 2.3: Cause Wise Disasters (ten or more than ten fatalities) in Indian Coal Mines

Period	Cause				
	Explosion/Fire	Inundation	Fall of roofs/ sides	Others	Total
1901-1925	10	02	02	03	17
1926-1947	05	02	01	02	10
1947-1973	05	05	02	00	12
1974-2000	03	05	03	02	13
2001-2015*	02	03	01	00	06

Data for the year 2011-2015 are provisional and up to 31.08.2015.

International Practices

International mineral producing countries operate regional mine rescue training facilities. They are centrally located in the middle of coal fields/Mineral industry or between groups of mines to keep travel time from each other mine to a minimum.

Highly specialized and all inclusive centre's exist in USA, South Africa, Australia, China, UK, Germany and Eastern Europe (Russia, Poland and the Ukraine). They provide physical, and sometimes rigorous, hands on training in mines or simulated real life environments, the full time staff at these facilities are highly experienced mine emergency response specialists and provided expertise and leadership during mine emergences. It is common in some countries to utilize specialized medical personnel as full time staff and trained members of the mine rescue teams.

Emergency Readiness Module for Mines

In the event of an emergency in a mine, the emergency response experts were immediately summoned to the affected mines. All the work of dealing with emergency is carried out under the control, supervision and direction of the incident command centre. Mine rescuers travel miles in the dark, navigating underground mine workings filled with debris, amid poisonous and explosive gases trying to find missing miners or recover those who have died. The dangerous work they do after mine fires, explosions or cave-ins is challenging, grueling, and remarkable. They continue their services till the mine is completely recovered.

An Integrated Emergency Response System (IERS) is practiced to deal emergencies of diverse kind in mining industries. This system mainly consists of four components, namely

Preparation and Prevention: This includes "Risk assessment" exercise to identify the hazards in a mine. Hazards so identified be ranked and a series of controls and procedures be outlined to keep the same within acceptable level.

Detection and Classification: This includes regular inspections to be made as per the established protocol to identify the possible sources of hazards and initiate remedial measures by activating mechanism of control.

Response and Mitigation: the twin philosophy of 'Self Rescue' and 'Aided Rescue' form the basis of a response and mitigation scheme.

Re-entry and Recovery: As per devised rescue protocols and guidelines, the whole event of re-entry and recovery was undertaken. The hierarchy of response actions begins with self-escapes and then first responders and finally mine rescue teams. If there is a breakdown in self-escape and first responders are not successful, then the deployment of mine rescue teams, under control of incident command centres, is necessary for a safe rescue to be accomplished.

Simulated Emergency Exercise

The concept underlined in the integrated emergency response system (IERS) (Sinha,2003), is being utilized to assess the emergency preparedness and response systems in vogue, by conduct of simulated emergency exercise in mines.

Conclusion

Efficient management of disaster, rather than mere response to their occurrence has, in recent times, received increased attention both in India and abroad. Thus, in the event of a disaster, experience and expertise of highly trained mine emergency response specialist assistance may be utilized to build a safer and disaster resilient Indian Mines.

Dr. Ashim Kumar Sinh, Director (S&T), DGMS, Dhanbad

Mr. Ashim Kumar Sinha is a National merit scholar with degree in mining engineering, who obtained Post Graduate Diploma (DISM) and M. Tech (Mine Planning & Design) with first class and distinction, and awarded Ph. D in mining engineering by Indian School of Mines, Dhanbad. He has over thirty four years experience in Mining operation & applied Research, Policy formulation, Curriculum development in technical education, Project planning including finance and execution at national/international level, Administration of Mining Law, Human Resource Management, Legislative reforms, Framing and Amendment of Law. He is also a qualified First Class Mines Manager (coal & metal) and elected as a Fellow, Institution of Engineers (India) and member, Institution of Surveyors.

He has exposure in strategic policy frame work planning, development of occupational Safety & Health (OSH) legislation including amendment of the Mines Act. As Secretary to the statutory committee coordinated base work for amendment of coal, metalliferous & oil mines regulations.

He has taken part in policy debates in Parliamentary Standing Committee/Consultative committee, National Human Rights Commission and as a member of committee constituted under direction of Hon'ble Supreme Court, relating to compliance monitoring and improvement of working conditions and effect strategic policy interventions. He facilitated preparation of The Occupational Health Regulatory Authority of India Bill, 2012 (draft).

Under the initiative of Performance Management Division, Cabinet Secretariat he drafted the Result Framework Document (RFD) and Innovation Action Plan for Directorate General of Mines Safety.

He has insight in Project development, management and execution at International level, while working as (i) Project Manager of an Indo-Australian aid project (Aus-AID) and (ii) project coordinator in the Coal Mine Safety and Health Project, sponsored by United States Department of Labor. He was responsible for conceptualizing and framing series of customized guidelines on emergency response, safety and strata management assimilating project outcomes.

As Head of a Planning Commission, Govt. of India sponsored project, "Augmentation of S&T Capabilities, Mine Rescue services, and Human Resource Development", has exposure in dealing finances and facilitated programme implementation in keeping with stated outcomes, indicators and targets. Under his supervision, state-of-the-art Mine research laboratory facilities were developed with modernization of Mine Safety and Health Academy.

He has experience as officer-in-charge, general administration and drawing & disbursing officer.

He worked as Regional Inspector/Inspector for administering and enforcing the provisions of the Mines Act, 1952 & allied legislation in coal, metalliferous & oil mines, having jurisdiction in nine states of India.

Dr. Ram Madhab Bhattacharjee

Dr Ram Madhab Bhattacharjee is a qualified Mining Engineer with more than 29 years of post qualification in the mining industry in India and abroad. After graduating in Mining Engg from Indian School of Mines, Dhanbad in 1984, he joined Indian Coal Industry and served the industry in various capacities like Junior Executive Trainee, Mining Engineer, Sr Mining Engineer, and Superintendent of Mines including statutory roles of Assistant Manager, Ventilation Officer, Safety Officer, Project Manager and Mines Manager in different collieries of Eastern Coalfields Limited. He worked for more than seven years in one of the most successful mechanised longwall project of India, Jhanjra Project in ECL and was involved in successful development and extraction of 10 longwall panels, few of them under the shallowest cover from surface.

Meanwhile obtaining his first class mine manager's certificate of competency in coal and M.Tech. in Ind Engg & Mgt from Indian School of Mines and serving the coal industry for more than 13 years, joined ISM, Dhanbad as a Faculty in the Dept of Mining Engg in 1997 and taught subjects like Method of Mining (Coal), Mine Legislation and Safety, Mine Planning, Innovative Mining to UG and PG students and supervised many project works. He also obtained his Ph. D in Mining Engg in 2003.

After that Dr Bhattacharjee joined Directorate General of Mines Safety as a Dy Director after getting selected through UPSC and worked in S&T Division of DGMS, in HQ and Western Zone for more than seven years. During his tenure in DGMS was involved in developing guidelines and test protocol for indigenous development of longwall equipment. He was member of Watch Dog Committee for Powered Support Manufacturing, Testing etc. and also involved in the development of the First Guideline for Risk Assessment in Mines. He worked as a coordinator for development of Mine Safety Information System Software in DGMS. Dr Bhattacharjee was also involved in the amendment of Mines Act and Coal Mines Regulation. He also acted as coordinator in different Parliamentary Standing Committees related to Mines Safety, MOC Standing Committee on Safety in Coal Mines, Working Group of Coal and Lignite for Planning Commission.

After serving DGMS for more than seven years, he went overseas and joined the Department of Mines and Energy, Queensland, Australia as an Inspector of Mines and worked for more than four years in the Central Queensland. During his tenure in Queensland Inspectorate, Dr Bhattacharjee was exposed to the best Safety and Health Management System in Central Queensland mines of different MNCs like BMA, Peabody, X-strata, Rio Tinto, Anglo Coal etc. Got his expertise in Establishing Safety and Health Management System based on the Principle of Risk Management, in Accident Investigation, Safety Audit, Emergency Management.

Dr Bhattacharjee returned to the country and is currently working as associate professor in ISM since July 2013. He also visited PR China for 3 weeks in Academic Exchange Programme. Dr Bhattacharjee has more than thirty published articles in National and International Conferences, Journals. He was guest lecturer in many training program organised by Mining Companies, IICM, Ranchi, ESCI, Hyderabad, VVGNL Institute, Noida.

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MANAGEMENT OF HYDRO-MET DISASTER SUPPORT FROM ARMED FORCES

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Introduction

A disaster is an event triggered by natural or man-made causes that leads to sudden disruption of normalcy within the society, causing widespread damage to life and property. Disasters due to earthquakes, landslides, draughts, floods, cyclones, tsunamis and occasional man-made tragedies have led to widespread loss of life and property. Certain factors are consistent in all calamities i.e. degradation of health care and sanitation, lack/ shortage of food and shelter, breakdown of power and communication systems and non-availability of potable water; which are required to be addressed on priority to avoid complex humanitarian crisis. The relative degree of disaster may vary but the basic problems remain the same in all such calamities.

Considering the requirement and urgency of assistance on such occasions, which involves safety of life or property, or both, it is essential that the actions taken are well planned, coordinated and expeditious. It goes without saying that measures undertaken by responsible Authorities go a long way in making Disaster Management, more effective. The provision of 'right item at the right place and at the right time' is the essence of disaster relief operations.

Objective of the Paper

This paper aims to examine disaster preparedness especially the hydro-met disasters in India and the related role of the armed forces with special emphasis on the Indian Navy. It also analyses the active role played by the armed forces in disaster management so far and seeks to make recommendations based on the lessons learnt.

Hydro-Met Disasters

The process or phenomenon of atmospheric, hydrological or oceanographic nature that may cause loss of life, damage to property, loss of livelihoods and services, damage to environment and social and economic disruption can be termed as a Hydro-Met disaster. In India, hydro-met disasters due to drought, floods, cyclone, cloud burst and manmade tragedies are frequent. Disasters like tsunamis and earthquakes, which have been the most destructive, along with the floods and droughts that arise from extreme weather conditions, are expected to get worse due to adverse impact of climatic changes taking place. In the 21st century, the 2004 tsunami, the 2005 earthquake in Kashmir, the 2006 deluge in Mumbai, the August 2010 cloud burst in Leh, the Jun 2013 cloud burst followed by landslides in Uttarakhand and most recently the Oct 2014, Hud Hud super cyclone are amongst the worst hydro-met disasters the country has seen in recent past.

From time immemorial, the Indian armed forces have always been in the forefront of the disaster relief operations, when called upon to aid civil authorities, especially, in the wake of natural calamities or man-made disasters. The armed forces are at the core of the government response capability and are invariably the first responders in a major disaster. Both the government and the public repose tremendous faith in the armed forces.

Management of Hydro-Met Disaster in India

The vulnerability of mankind to disasters of various types has increased considerably all over the world. It has posed new and unconventional challenges to the nations and even compelled the policymakers to redefine the concept of disaster management. In such an evolving environment, the concept of Disaster Management has gained much significance especially in India because of its geography. India is relatively prone to disaster since 55 per cent of India"s landmass is in the seismic zone; 68 per cent is vulnerable to drought; 12 per cent is prone to floods; and 8 per cent to cyclones apart from the heat waves and severe storms. However, the approach towards combating disasters with a policy framework is of recent origin in India. The concept of handling disasters with appropriate programmes on disaster management based on the fundamental elements of prevention, mitigation, preparedness, response, relief, and recovery is of recent origin. Significantly, with frequent occurrence of disasters, there is an increasing consensus amongst the stakeholders for setting up an effective disaster management mechanism.

In the past, when disaster struck, the department of relief and rehabilitation of the Union Ministry of Agriculture was given the charge of providing relief material. Its approach had primarily remained post-disaster management centric. However, with the enactment of the Disaster Management Act of 2005, there has been a paradigm shift from response and relief to mitigation and preparedness. The Government of India has undertaken various measures to mitigate the impact of disasters.

Although the responsibility for coordinating disaster response and relief operation is that of the Union Ministry of Home Affairs (MHA), it is invariably the armed forces under the Ministry of Defence who are the first to assist and manage the situation because of the resources, manpower and speed available with them. Generally, the armed forces respond to disasters as a part of their mandate to aid civil authorities during calamities. Their involvement, however, is meant to work on the principle of being the „last to enter and the first to leave". Conversely, in most post-disaster operations, the armed forces have been the first to enter and the last to leave.

The purpose of Disaster relief operations is to „Mitigate the suffering of people and restore communication activities expeditiously". Each crisis has its own peculiarities and hence relief activities are largely a matter of improvisation. Assistance from local authorities/ local population contributes immensely towards the success of the disaster relief operations. When calamities occur, speed of rendering aid is of paramount importance. Under such circumstances, prior sanction for assistance may not always be possible. In such cases, when approached, the armed forces provide assistance without delay. No separate government sanction is necessary for rendering aid during natural disaster and other calamities.

Armed Forces in Disaster Relief Operations

Humanitarian Assistance and Disaster Relief (HADR) operations is one of the most important benign roles that the Armed Forces is expected to perform in peace time. Disaster relief is predominantly civilian function; however, humanitarian principle also dictates that all available resources, including military assets should be used to minimize the human cost of a natural disaster. The experience from the Asian Tsunami, cyclone “Nargis” in Myanmar, cyclone “Sidr” in Bangladesh and cyclone Hud Hud vindicates the participation of military forces for disaster relief missions, as also reaffirm their ability to muster assets and capacities to respond in a timely manner to reduce human sufferings by rendering effective relief efforts in the affected areas.

The Armed forces rendered yeoman‟s service during the disaster operations when the tsunami hit the Indian coast on 26 Dec 2004. The Indian armed forces, co-coordinated by the Integrated Defence Staff (IDS), efficiently handled relief, rescue, and evacuation work under Operation Sea Wave, including extending aid to Sri Lanka and Maldives under Operation Rainbow and Operation Castor respectively. Similarly in the Kashmir earthquake in 2005, the armed forces played a pivotal role in handling the disaster relief operations. In August 2010, when Leh, the capital of Ladakh region, was hit by flash floods which killed at least 103 people and left 370 injured.

Although, the disasters have been striking us from time immemorial, our wakeup call can be attributed to the Tsunami in Dec 2004 wherein, we as a nation were suddenly faced with a calamity extending thousands of kilometres, covering the coast of Andhra Pradesh to that of Tamilnadu, Andaman and Nicobar Island chain in the east including our friendly neighbours who faced an unprecedented destruction. The Indian armed forces were immediately deployed simultaneously to all the affected areas including our friendly neighbours for relief operations. The armed forces have participated in various disaster relief missions in India and friendly foreign countries and earned goodwill.

Armed Forces in International Disaster Response. The Indian armed forces have,in the last one decade, been involved in disaster response at the international level, especially in South Asia. With growing regional and global cooperation on the agenda, many countries look up to India in case of emergency. Recent instances of rendition of aid further underline the international dimension of the Indian armed forces response and relief capacity. The Armed forces have participated in the following disaster relief operations in the last decade:-

- Katrina Disaster. In Sep 05.
- Philippines Mudslide. In Feb 06.
- Indonesia Earthquake. In May 06.
- Lebanon. In Aug 06.
- Neighboring Countries. Additionally, our armed forces have, on a number of occasions, assisted Pakistan, Sri Lanka and Bangladesh and other neighboring countries, as in the aftermath of the tsunami (2004) and the Kashmir earthquake (2005).

Role & Chain of Command of the Indian Armed Forces for Disaster Management

The Disaster Management Act enacted on 23 Dec 05 changed the approach of disaster relief operations from relief-centric to a holistic, multi-dimensional, and multi-disciplinary approach involving diverse scientific, engineering, social, and financial processes. It encompasses the entire scope of disaster management activities i.e. prevention, preparedness, mitigation, response, relief, and rehabilitation. On most occasions, since the civil administration remains under equipped for quick response to major disasters, the armed forces have been the primary option. As one of the most dedicated, professional, and modern armed forces in the world, the Indian armed forces respond to any disastrous situation with all their might. It is due to their technical competence, trained manpower, and logistical capabilities that they are always ready to rapidly undertake any kind of disaster related rescue and relief operations. They are also located in most remote areas where natural calamities are frequent.

Disaster Management Policy for Armed Forces. The National Disaster Management Policy approved by the Union Cabinet on 22 Oct 09 acknowledges the role of the armed forces in disaster management and states that "the armed forces are called only when the coping capability of the civil administration is exhausted. It, however, mentions that in practice (as has been in the past), the armed forces are deployed immediately and they have responded promptly". The armed forces have shown their capabilities in communication, search and rescue, health and medical facilities, and transportation by air and have even been mobilised for assisting neighboring countries. They also train instructors and disaster management coordinators especially on chemical, biological, radiological, and nuclear (CBRN) aspects, heli-insertion, high altitude rescue, watermanship, and training of paramedics. At the national level, the Chief of the Integrated Defence Staff and the Chairman, Chiefs of Staff Committee are part of the National Executive Committee (NEC) of the NDMA. Since 2006, the Government of India has issued number of guidelines related to disaster management, but those that concern the armed forces are the guidelines on medical preparedness, mass casualty management, biological disasters, nuclear and radiological emergencies and chemical disasters (either industrial accidents or terrorism).

Legal Provisions. The constitution and the legal framework provide for the Armed Forces to render assistance during disasters/ calamities when the situation is beyond the capability of the Local Civil Administration. This is enunciated under the subject "Aid to Civil Authorities by the Armed Forces". This enables organised and clearly defined support from the Armed Forces, as also provides the necessary sanction (financial and otherwise) for deployment of defense resources. The armed forces may also be called upon to render such assistance to another friendly country, on request.

Chain of Command. Headquarters Integrated Defence Staff (HQIDS) is nodal agency of the Armed Forces for disaster relief operations. At the apex level, Joint Operation Committee (JOCOM) coordinates the emergency response for disaster management. JOCOM is assisted by the Operations division of the Army, Navy and the Air Force.

Nodal Points of Indian Navy. Maritime Operation Room (Delhi) at Integrated Headquarters of MoD (N) acts as the nodal point for overall coordination of Naval relief operations. Maritime Operations Center (MOCs) at Command Headquarters, Relief Operations centre (ROC) at Operation Rooms of respective Naval Officer In-charges (NOIC), Local Relief operations centre (LROC) at each affected area act as coordination centers at their respective levels.

Assistance Rendered by Armed Forces. The nature and extent of military assistance in disaster depends on the type of disaster and the assistance envisaged. The following assistance may be rendered by the armed forces during disaster relief operations:-

- **Rescue Operations**. The Armed Forces are capable of rescuing water bound people from flood affected areas or the open seas using different kinds of water transport and helicopter.
- **Relief and Rehabilitation Work**. Members of the Armed Forces with their better mobility can reach at every corner of the country rapidly to start relief and rehabilitation work in disaster and crisis ridden areas.
- **Medical and Sanitation Services**. Members of Army Medical Corps can provide all kinds of emergency and general medical services including vaccines and setting up of sanitation facilities through active participation, to the affected people.
- **Pure Drinking Water**.The armed forces can undertake the task of ensuring the supply of water through water bowsers/ trailers. Besides, they can also assist in sinking tube-well for this purpose.
- **Communication**. Restoration of normal communication becomes a very important task of the Armed Forces in flood affected and cyclone hit areas. They also perform this important task in areas where sabotage or subversive activities are carried out. Members of the Signal Corps of the

Indian Army as well as communication branch personnel from Navy and Air Force undertake this responsibility and urgently rebuild the communication system. The Corps of Engineers of the armed forces undertake emergency repair and reconstruction work of the roads and bridges damaged by flood, earthquake, accidents etc and help restore effective and workable communication system.

- **Provision of Shelter**. Armed Forces also at times participate in construction of shelters in areas severely hit by natural disaster. Mostly this is done through the active participation of the affected people.

- **Transportation of Relief Materials**. Armed Forces render great help in transporting relief materials to the affected areas. For this purpose, they use different kinds of transport aircraft/ vehicles.

- **Loading & Unloading of Food Grain & Relief Materials**. Armed forces may be employed for loading and unloading and guarding of food grains and relief materials in sea-port and different river ports.

Coordination of Armed Forces and Civil Organisation. "First responders - last resort", is the basic principle for employment of the armed forces in disaster rescue and relief operations. First responder, meaning response by troops in the close vicinity of the disaster location first, on their own as was the case in the earthquake in Gujarat (2001), tsunami (2004) and Kashmir earthquake (2005). There has been a perceptible improvement in coordination between the armed forces units/ formations and local civil administration in the last few years.

Planning and Execution of Disaster Relief Operations

Planning is carried out by the armed forces at the national, state and field level. The Ministry of Defence including HQIDS (Headquarters Integrated Defence Staff) and the Services Headquarters are involved at the highest level. At the State Government level, the Command/ Area Headquarters of the Services interact through periodic civil-military conferences with the Local Administration, police and other organisations. Once contingency plans for Disaster Management have been prepared incorporating various agencies, regular rehearsals are carried out and the contingency plans are periodically updated.

Damage Assessment and Restoration Inspection. On occurrence of disaster, the damage assessment and restoration team is the first to move into the area and make an on spot assessment of the damage. Based on the damage, the DCG (Destruction Crisis Group) and DECR (District Emergency Control Room) put into effect the immediate containment and restoration plans. The relief operation is carried out accordingly. The Damage Assessment Team is required to be realistic and efficient whilst rendering their report.

Damage Assessment and Restoration Team (DART). This is the reconnaissance party which comprise of experts in the field of disaster management, local administration, Police, Home Guard, NGO"s and Reps from the local area. The Reps from the armed forces are incorporated on their arrival. The group is dispatched to the disaster site on occurrence. Its task is to assess the damage and assistance required and give feed back to the District HQs. Passage of information to District and State HQs is an important requirement to mobilise adequate and timely efforts from within and outside agencies.

Stages of Response during Disaster Management.
There are four stages of a disaster relief as follows :-

- **Preparation Stage**. This corresponds to the pre-disaster period and includes disaster prediction, warning and alert systems, preventive measures, capacity building, issue of contingency plans and checklists for potential disasters. These include:-

- Establishment of liaison with state and local authority for mapping of resources.
- Identification of possible areas of employment.
- Understanding overall relief plan and formulation of own contingency plan.
- Tasking and preparation for execution of plan.
- Local liaison and reconnaissance.
- Briefing of transports and rehearsals.

- **Emergency Stage**. This stage commences from warning of disaster to the period immediately after the disaster and aims at providing immediate relief to the affected populace and bringing a semblance of order in the affected area. These include:-

    - Being prepared for the task.
    - Grouping and organizing of forces.
    - Final tasking and coordination.
    - Movement to the disaster Area.
    - Establishment of Joint Contingent Headquarters to commence work.
    - Dividing of area as per task and prioritising it.
    - Assisting in bringing a semblance of order in the affected areas.
    - Providing of medical aid and other relief.

- **Rehabilitation Stage**. This period covers short term measures to restore normalcy in the affected area, restore essential services, communication and normal community life.
- **Reconstruction Stage**. This is a long term measure aimed at providing adequate relief to the affected people.

Effective Disaster Relief Management. the following principles are adhered to whilst planning for an effective Disaster Relief operation: -

- **Primacy of Civil Administration**. Disaster Management is the primary responsibility of the Civil Administration both at the Centre and State levels. All other organisations are to function in supplementary role.
- **Organisation.** To be effective, disaster relief arrangements must be supported by an organisational structure in which they should operate.
- **Command and Control.** Prior to the disaster relief, the responsibility of overall command and control with all involved elements would need to be clearly specified in the disaster plan as also communicated to all concerned Agencies.
- **Co-ordination and Support**. Resource management and co-ordination is essential for its optimal and speedy application.
- **Information Management.** Effective management of information is essential for dealing with disaster. Communication network between Organisations and Agencies is essential to ensure that preparedness measures and responses are properly coordinated.
- **Timely Activation**.Timely activation of plan is vital to DisasterManagement..

Assistance by the Armed Forces. Armed forces are called to provide the following assistance:-

- Infrastructure of Command and Control
- Evacuation of people to safer Areas
- Relief
- Medical Aid.
- Setting up of Relief Camps.
- Assistance in construction and repair of roads/bridges
- Assistance in restoration of essential services

Principles of Employment of the Armed Forces. The operations of the armed forces whenever called upon to assist the civil authorities in rendering relief are governed by certain guiding principles. These are as follows:-

- **Judicious Use**. The assistance by the armed forces should be requisitioned only after it becomes absolutely necessary and when the situation cannot be handled by civil administration within its resources.
- **Immediate Response**. When natural and other calamities occur, the speed for rendering aid is paramount importance. It is clear that under such circumstances awaiting formal sanction for assistance may not always be desirable. In such case when the armed forces are approached for assistance, the concerned HQs will obtain telephonic sanction from their higher authority and provide assistance with least delay. Formal sanctions would follow.
- **Command of Troops**. The Unit while operating for disaster relief continues to be under command of their own commander as the aid would be on task basis. These units are not placed under Command of any other organisation.
- **No Menial Task**. While assigning tasks to the troops, it must be remembered that troops are not to be utilised for menial tasks. Troops should not be utilised for disposal of dead bodies.
- **Requisition of Aid on Task Basis.** There quisition of armed forces should not be in terms of number of men/ medical teams. Instead the civil administration should spell out the task and leave it to the Commander to decide the force level and methods to tackle the situation.
- **Regular Liaison and Coordination**. In order to ensure that optimum benefit is derived out of armed forces employment, regular liaison and co-ordination is mandatory at all levels and contingency plans made and disseminated to the lowest level of civil administration.
- **Advance Planning and Training**. The armed forces units located in disaster prone areas must have detailed plans worked out unit wise to cater for all possible contingencies.
- **Utilisation of Available Resources**. All available resources, equipment, accommodation and medical resources with Civil Administration, Civil Firms, NGO etc need to be taken into account and integrated while evolving disaster relief plan. All these resources should be utilised prior to requisitioning the aid/ concurrently to achieve optimum results.

Early Derequisitioning. Armed forces should be derequisitioned as soon as the situation in disaster affected area has been brought under control.

Procedure : Provision of Aid by the Armed Forces.

- Request may be sent to the MoD directly or through Ministry of Affairs and Communication. (MOA & C).
- The channel of request would be; Chief Secretary of state Ministry of Defence Service HQs

Concerned Command HQs

- Within a State the channel would be; Chief Secretary of state/ District Magistrate Local Military Commander (Inform immediately to the service HQs through proper channel, to regularize).

Disaster Relief by Indian Navy

Whilst Army and Air Force have contributed immensely in disaster relief operations, world over, Indian Navy have been at the forefront of effectively providing disaster relief, mainly because of the reason that large disasters have struck littoral regions. Some of the capabilities required for a naval disaster relief effort include, large cargo carrying capacity (dry goods, fuel, fresh water, refrigerated goods etc), personnel transfer (high speed shallow draft vessels), fresh water production (ability to produce and transfer much beyond ships own requirements), self-sufficiency during operations, medical support (ability to carry out surgeries and treat and admit many patients), quick and efficient survey of the affected coastline, search and rescue (preferably with multiple helicopters), lift capability (landing craft support), aircraft (multiple helicopters with sustained effort), large number of extra berths on board and reasonably high transit speeds. Indian Navy is well equipped and capable of undertaking the above mentioned roles.

Stocking and Ready Availability of Relief Material. In order to ensure ready availability of relief material, the Indian navy has formulated the relief store stocking policy. IN stocks the relief material in Pallets and Bricks. There are five types of pallets and each Pallet caters for 100 persons. 10 Pallets constitute a Brick that is 1000 personnel can be provided relief by using one brick. Pallets are embarked on nominated ships as per an authorized entitlement at all times. Various classes of ships are authorised to carry certain quantities of these pallets depending on their size, capability, space etc. These bricks are stored in the shore depots in various Naval Commands and are loaded onto the ships in addition to the ready stock available on ships in case of any requirement. Therefore, the time delay in making good the availability of relief stores has been greatly reduced and even the distribution of relief stores is now easier as the packing in each pallet is further sub divided into 25 packets, one packet each for a family of four.

Action being Undertaken by IN for Conduct of Effective Relief Operations. Post incorporating lessons learnt from past experience, the IN is undertaking following measures to achieve fruitful results in any disaster relief ops:-

- **Speed of Deployment**. The relief teams are deployed to the affected area in minimal time, as the level of calamity increases exponentially with passage of time unless controlled at the earliest. The aim is that the relief should commence before the populace comes out of the shock and starts showing anguish, anger and despair. It is endeavoured that the relief teams are visual to the affected populace, so that they get a feeling of confidence and relief.
- **Reconnaissance**. In order to achieve quick assessment of damage and for the relief operation to be effective, It is endeavoured to quickly integrate the local government officials for the initial assessment during reconnaissance.
- **Food**. Since the local food habits do vary it is endeavoured that the type of food in the relief food packets is in general consonance with those of the local populace, to the extent feasible. Air-dropping of packaged drinking water and food in inaccessible areas during the reconnaissance itself is a primary consideration. One of the preliminary tasks on arrival after providing critical care and life saving has been found to be the restoration of electricity and potable water.

- **Medical Camp**. In any disaster relief operation, the Medical Camp is the Centre of Gravity. Thus, depending on the type of disaster, IN endeavours to make the availability of suitable specialists and the appropriate medicines that may be needed to be worked upon/adjusted to suit the circumstances including the availability of pediatric medicines. Further, it is also endeavoured to involve the local medical fraternity and exploit their facilities for the medical camp to be successful.

Media Involvement. There is no escape from the prying eyes of the Media. Involvement of the Media is not an option. IN endeavours to ensure that positive atmosphere is created and a feeling is spread that relief ops are being undertaken to take care of near and dear ones of all effected people. This helps in molding the public opinion to better undertake the Relief Operations and help restore normalcy. IN facilitates the media in undertaking the coverage, provides adequate video clips and at the same time ensures that the interaction is undertaken centrally though trained personnel only.

Command and Control. The Maritime Operation Centres (MOCs), in the various Coastal States, by virtue of their communication links with higher formations, surface combatants, aircraft and personnel deployed in the field, as also with New Delhi and other MOCs, are the control centres for coordinating relief operations. The ships themselves are also mobile Command platforms, which have advanced communication terminals and were effectively used in the past, especially where communication links have broken down ashore. In addition, local control centres are established in the affected area either alone or as part of the centre established by the other Services or the State Government, as applicable.

The Indian Navy is employed in the following roles:-

- Infrastructure for Command and Control.
- Medical Aid.
- Transportation of relief material.
- Establishment of relief camps.
- Construction and repair of roads and bridges (incase of joint operations).
- Maintenance of essential services.
- Maintenance of essential supplies.
- Evacuation of people to safer areas.
- Mobilise international relief.

The following resources of the Indian Navy are augmented towards disaster relief operations:-

- **Manpower**. There is a concentration of naval manpower and resources at the three major bases viz; Mumbai, Vizag and Kochi. Besides these there are other areas where there are Naval establishments, many of them have contributed their might to relief Operations in the Coastal states. In the case of large-scale disasters, the entire Command is galvanised into action and everything is done on a war footing, with relief Ops accorded top priority.
- **Power**. Naval ships have high capacity Diesel Generators which could provide critical power ashore through cables.
- **Diving**. The divers are deployed for disaster relief operations. In addition, naval Physical Training Instructors are trained lifeguards and are dispatched in the case of water related calamities. Naval diving teams and their equipment including inflatable boats are a resource often deployed during floods as also during any accident at sea or in a river/ lakes. These divers, being good swimmers are deployed in a variety of contingencies both at sea for SAR and at times ashore for rescue of marooned personnel.

They are also utilised in :-

- Salvaging sunk or damaged mercantile ships especially in harbours and port areas which are hazardous to navigation.

- Repair of underwater damage to mercantile ships and underwater fittings in dams/ sluice gates, lock gates in harbours and dockyards.

- **Survey.** One of the most crucial, time sensitive jobs in the aftermath of a sea storm, which hits a port, is ensuring that the channels of navigation of the mercantile marine are safe. This is done by the Naval hydrographic teams both by naval survey vessels and by boats who are equipped with state of the art equipment. In fact, they are among the first units to be sent to the affected areas; they check the entire approach channel by sonar for underwater obstructions, which is a very painstaking, tedious task. This has to be done very quickly in order to re-open the port.

- **Salvage**. At sea, in the aftermath of a storm, there are often sunken boats, stranded mercantile ships, which are a hazard and could be a cause of an environmental disaster, on account of oil pollution etc. These boats/ ships therefore need to be cleared away at the earliest, especially in harbour areas, where ship traffic is high. Naval diving teams, preceded by survey work done by Naval survey teams, using side scan sonars, to pin point the sunken dangers, can help clear these wrecks.

- **Fire Fighting.** All Naval personnel are trained in fire fighting.They are trained at tackling all sorts of fires and also to contain flooding of sea-water in the compartments.Hence in a fire related contingency like a blast at a petroleum storage depot etc, naval personnel are appropriately trained to handle such emergencies. Also, the naval ships, submarines and the Depots ashore, are equipped with varied fire fighting equipment, ranging from fire suits to foam guns, to tackle all kinds of fires.

- **Search and Rescue (SAR).** Storms at sea can be a cause for a major disaster. Among the storms at sea, cyclones are among the most dangerous. In fact the Indian Ocean is one of the six major cyclones-prone regions of the world. Storms at sea would call for SAR if there are mercantile ships, coastal vessels and boats at sea in that area. Similar contingency may arise from not only boats/ ships struck by storms but also with ships having fire or flooding onboard, run aground or with a medical emergency.

- **Ecological Disaster**. Such disasters at sea can have far reaching repercussions. The case of the Exxon Valdez is well known wherein the ship had caused a monumental environmental disaster along the American coast owing to oil spillage. The damage to marine life and to the coastline can be of catastrophic proportions and also adversely affect the fishing community. Whilst the Coast Guard is the maritime agency responsible for prevention/ checking of marine pollution in the maritime zones of India, the Navy also has a role. In order to keep a check and monitor shipping in our waters, there are ship reporting procedures instituted wherein the Naval Organisation, obtains reports from Indian and foreign mercantile ships transiting our waters, which are analysed and monitored. Similarly, Naval Officers in charge of coastal states monitor and report the shipping movement in the ports in their States on a daily basis. It has also been mandatory for merchant ships with dangerous cargo to report their positions. These are closely monitored by the Naval Commands and Naval Headquarters.

Recommendations and Conclusion

There is great amount of awakening by all the stakeholders for disaster management in India. Comprehensive policy guidelines and orders have been put in place to ensure an effective disaster management organization. While some of the measures/ recommendations may already be in practice, what is lacking is the implementation and seriousness with which these are executed on ground. Based on the experiences and lessons learnt through recent disaster relief operations, the following are recommended as far as support from armed forces are concerned:-

- A graduated/ sequential response in disaster management should be avoided and the armed forces should be deployed well in time to be effective. If the situation warrants, the civil administration may warn/ requisition the armed forces‟ assistance in anticipation of a major disaster. However, deployment in anticipation of a major disaster should only be resorted to in exceptional circumstances post a comprehensive assessment of emergency.
- A post-disaster analysis should be carried out to ascertain if the disaster could have been managed by the civil administration. However, this should be only done if ambiguity exists and if there are varying views on the issue.
- The armed forces units and formations should be kept in the picture and informed by the local civil administration about a developing disaster situation.
- The armed forces should be deployed as a last resort but not always in the last. An assessment of the situation and need for assistance of the armed forces must be anticipated / ascertained by the civil administration. The civil administration should carry out a comprehensive analysis and "Scenario building exercise" to be able to take decisions before requisitioning the assistance of the armed forces in case of a disaster.
- Joint mock exercises involving the local armed forces units and other stakeholders, based on various contingencies, should be organised to develop rapport and synergise the effort of disaster response. This is a major grey area which needs immediate attention.
- The civil administration should to prepare a disaster management data base including a compendium of all agencies involved in disaster relief (DR) along with their contact phones/ Fax/ E-mail/ Web site addresses on a DR web site and nominated person should be responsible for it‟s updation in real time. There is no time to update records/ dissemination of letters etc, once a disaster strikes. Each concerned organisation must earmark a DM Cell, which is dedicated to maintain the database and should actively involve throughout the year during planning and execution stages.
- The internet can be used to connect up various agencies in India. An appropriate web page giving access to concerned agencies for viewing and only to authorised personnel for updating/ maintenance is important in the pre-disaster stage so that records are updated and also during the disaster so that all concerned agencies can play an effective and coordinated role.
- There are various organisations imparting courses in DM in the country. The content of these courses must be updated by the Centre/ State for use towards disaster mitigation. These institutes must be accessible to all through the DM web site.
- The best help is "SELF HELP". Communities which are disaster prone must assist in preparing of disaster. They must be made to participate as they are one of the most important Relief Teams. The under preparedness of the communities results

in increased losses of life and property. Hence, the local population in the vulnerable villages/ areas has to be strengthened. Local armed forces units of the States could explore the feasibility of starting Community Development Programmes involving more of Ex-Servicemen, as they would be easier to manage. The aim is to help develop a base of trained personnel in coordinating relief measures in each village in a State. Initially, pilot project could be undertaken in any one of the vulnerable coastal districts, to be subsequently followed upon a lager scale. The following areas which could be considered in this programmes:-

- **Survival Training**.The community members needs to be trained in survival skills including first aid, resuscitation, attending to fractures, injuries, fire fighting etc. Swimming classes need to be imparted to those in flood/ cyclone prone areas; if necessary. Suitable training could also be conducted to strengthen them mentally to deal with trauma post disaster.

- **Core Teams of Ex-Servicemen**. A selected core team of ExServicemen in each of the District/ villages must be formed and entrusted with the responsibility to conduct the training/ achieve preparedness levels and, in times of need, co-ordinate relief activities. Their remuneration could be worked out in conjunction with the State.

Conclusion

The armed forces would remain in the forefront and a play a key role in major disaster relief operations in the country as well as outside. The resources in terms of speed of mobilization, lift capability, trained manpower remains an asset which needs to be judiciously utilized. The civil administration must conduct periodical review and coordination meets to fine tune processes and optimize resources. Joint training and mock exercises between the civil disaster management apparatus and local troops should be carried out from time to time to review operational preparedness and identify infirmities in the joint response to a disaster. These exercises will help review the procedures, communications, and develop mutual faith and rapport.

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DISASTER MANAGEMENT – INDIAN RAILWAYS

Mr.Muralidhar Gangichetty

Indian Railways have been the lifeline of the nation since 1853 and maintained a track record of being in the forefront and leadership role in rendering invaluable support during disasters by various ways within its jurisdiction, primarily in transporting relief material to the affected areas and evacuating the people, if needed.

Railways have institutionalized system to take care of train accidents with its own resources. In-house Disaster Management Committees were constituted and their recommendations related to faster Relief, Rescue and Restoration, by and large have been implemented to the satisfaction of the Ministry. The wave of development within the Government and Private sectors narrowed down the disparity between Railways own resources and elsewhere. Attention of Railways has been mostly concentrated in handling conventional train accidents such as; collisions, derailments, level crossing accidents, fire including rendering relief and rescue measures apart from faster restoration using railways own resources.

Railways are looking to identify and prevent all untoward incidents including accidents on account of act of nature / god and security related accidents apart from indicative / consequential train accidents. Co-ordination and liaison with NGOs, NDRF and other non-railway institutions in relief and rescue operations of train accidents is strengthened and this conceptual change has boosted the morale of Indian Railways.

Strengths of the Railways to Handle a Disaster

In handling disasters, Indian Railways is in a unique position as it has a well defined support system for rescue and relief. These include:

- Railways' own Communication Network.
- Operating Control on each Division linked with each Station.
- Territorial Army Units.
- Uniformed force of RPF / RPSF
- Railways' own Medical Infrastructure
- Civil Defence Organization
- An army of Trackmen spread out all over the Indian Railways.
- Scouts and Guides (they can at best provide background support).
- Dedicated rescue / restoration and medical equipment on rails.

Self-propelled Medical Relief Van

Self-propelled Accident Relief Van

Each of the above can be made use of to handle adversities depending upon requirement to handle the disaster.

Types of Disasters

Disaster in the Railway context was traditionally a serious train accident, caused by human / equipment failure, which may affect normal movement of train services with loss of human life or property or both. This is now extended to include natural and other manmade disasters. Different types of disasters are described along with examples, below;

- **Natural Disaster**: Earthquakes, Floods, Cyclones, Land Slides, Tsunami etc.
- **Train Accident related Disaster:** Collisions involving casualties, Train marooned in floods, derailments on a bridge and coaches falling down; train washed away in cyclone, derailment of a train carrying explosives or highly inflammable material, tunnel collapse on a train, fire or explosion in trains etc.,
- **Man Made Disasters:** Acts of Terrorism and Sabotage, i.e. causing deliberate loss of life and/or damage to railway property such as;Setting fire to a Train, Railway installations, bomb blast, CBRN Disaster.

Changed Philosophy of Disaster Management in the Railways

With the enactment of the Disaster Management Act, 2005 and other developments at the national level, DM philosophy has also changed to adopt the latest concepts.

New Philosophy

- Serious train accidents, not the only events termed as disasters.
- Other events, e.g., terrorist attack at station / train, marooning of train, disruption to traffic due to natural factors like earth-quake, cyclone, floods etc.,
- No more Relief and Rescue Centric.
- Holistic Approach adopted to incorporate :-
    - Prevention
    - Mitigation
    - Preparedness
    - Rescue, Relief
    - Rehabilitation

New Philosophy gives more emphasis on prevention and mitigation as under:

- Prevent and mitigate disasters
- Audit existing systems for disaster resistance, disaster prevention and mitigation on the basis of NDMA's and self prepared guidelines
- Disaster Management in developmental planning – New activities should be disaster resistant
- Preparedness, Rescue, Relief and Rehabilitation - Dimensions of DM
- Expertise based response from all stake holders
- Pooling of resources from agencies like, local administration, community, defense, hospitals and other Govt. Organizations.

Definition of a Disaster on Railways

Based on the definition of the Disaster Management Act 2005, Ministry of Railways has adopted the following definition of Railway Disaster:

"Railway Disaster is a serious train accident or an untoward event of grave nature, either on railway premises or arising out of railway activity, due to natural or man-made causes, that may lead to loss of many lives and/or grievous injuries to a large number of people, and/or severe disruption of traffic etc, necessitating large scale help from other Government/Non-government and Private Organizations."

Authority to Declare a Disaster on Railways

General Manager, Additional General Manager or Chief Safety Officer (when GM/AGM are not available) for declaring an untoward incident as Railway Disaster. With the adoption of the above definition of railway disaster, it needs to be appreciated that not only a serious train accident may turn into a railway disaster, if not handled and managed properly, there may be many more railway related events which may not even involve human lives but may turn into disasters for which necessary prevention and mitigation measures are to be taken by the railways beforehand. Zonal Railways will ensure that prevention, mitigation, preparedness, rescue and relief related issues covering all types of disasters affecting railway system are addressed and their details are also appropriately incorporated in the DM Plans.

Important Provisions in the Disaster Management (DM) Act, 2005 Concerning Railways

Sections 35, 36 & 37 of the DM Act, 2005 detail the responsibilities of Ministries and Departments of Central Govt. as per which a number of measures / actions are to be taken either on their own or in consultation with NDMA. Drawing up mitigation, preparedness and response plans, capacity building, data collection and identification and training of personnel in relation to Disaster Management is one of the key responsibilities.

DM Plans

- DM Plan is prepared in two parts.
- First part shall contain general information, duty list, role and responsibility of Departments, guidelines issued by NDMA & Railway Board from time to time, etc.,
- Second part shall contain contact details of Para-military forces, State Administration, Hospitals, Bus Depots, Fire Services, NGO's, earth moving equipment suppliers, etc.,
- First part of DM Plan should be reviewed and updated as and when fresh instructions are received from NDMA or Railway Board or any other concerned Organisations. This part need not be published / printed every year.
- Second part which generally consists of contact details shall be updated annually and the same should be circulated to 'all-concerned'. Corrections / additions / deletions on the first part may be incorporated as a correction slip.
- At the national level, Ministry of Railways have prepared national level DM Plan. Zonal Railways have prepared DM Plan at Headquarter level and at Divisional level by the Divisions.
- Provisions of Disaster Management Act, 2005 is incorporated in the DM Plans, apart from this, these Plans will encompass all types of disasters that can occur on the Railway system had mainly dealt with the upgradation of Railways relief / rescue facilities to handle train accidents. The Plans of the Zonal Railways should detail for all types of disasters, the preventive, and mitigation and preparedness measures being taken by the railways and also the rescue, relief and restoration systems in place to meet with them.
- NDMA guidelines, instructions issued by the Boards Office from time to time and the action plan as framed by the Zonal Railways will form the backbone of the Plans. These plans must be dovetailed with the State and District Disaster Management Plans. Zonal Railways will keep their focus on the developments happening in their local area in the Government, non-govt. and private sector to build on the expertise-based on all inclusive approach as envisaged in the DM Act.

- Divisional DM Plans will contain divisional specific information. It will generally contain divisional action plan for dealing all types of railway disasters. It should focus mainly on new developments of sharing of resources with all stake holders. It should divisional specific information like road maps, etc., Information common to all divisions of a Zonal Railway may be replicated uniformly in DM Plans.
- Headquarter level DM Plans will have information common to all divisions of Zonal Railway. It will generally contain Railway's action plan for dealing with all types of railway disasters. Contrary to the Divisional Plan this will be most centric towards prevention, mitigation and preparedness than rescue and relief. Information like formation of relief and rescue teams at the accident site, Disaster Management Control Management, Duties of various officers/officials etc., in addition to the information specific to headquarter will be contained in this plan.

Objective of the DM Plan is to Achieve

- Instant Disaster Trigger Mechanism
- Rapid Access to reach the site of accident within "GOLDEN HOUR".
- Minimising disaster effects using GIS, data bank, quicker means to call for data logistics and infrastructure to redress the human calamity.
- Saving lives by quick extrication of victims and effective on–site Medical Management.
- Stabilisation of condition by quick restoration.
- Expeditious extraction and shifting to rescue vehicle(s).
- Care and concern for the affected customers.
- Speedy transportation to hospital.
- Proper and timely dissemination of information to public.
- Defining responsibilities of various staff/departments.

Key Concepts

- Disaster & Disaster Management, DM Act 2005
- Golden Hour
- Trigger Mechanism
- Incident Command Control System
- NDRF
- Triage – a) Site Triage & b) Hospital Triage
- Psychological rehabilitation
- National Building Code-2005

Golden Hour Concept

"If a critical trauma patient is not given definite medical care within one hour from the time of accident, chances of his ultimate recovery reduce drastically, even with the best of medical attention thereafter. This initial one hour period is generally known as The Golden Hour"

- Render definite medical care within Golden Hour.
- Stop bleeding and restore BP within an hour.
- Persons under shock shall immediately be relieved of shock.
- Transport the casualties to the nearest hospital.

Trigger Mechanism (Emergency Response System)

Trigger Mechanism has been conceptualised as an emergency quick response mechanism which on energising would, spontaneously set the vehicle of management into motion on road to disaster management process. The underlying assumptions behind this concept is that the process and mechanism of responding have been planned earlier and response activities would start as soon as the information is received about a disaster or impending disaster by any point in the whole mechanism. To have an effective Trigger Mechanism, High Power Committee has identified functions for the Managers dealing disasters:

Disaster Preparedness on Indian Railways

Railway is a well disciplined and organised setup to carry out the relief and rescue operations in train accidents. However, serious accidents involving heavy casualties at remote locations or in difficult terrain or under adverse weather conditions are necessarily to be managed efficiently by co-ordinating with non-railway organisations. The resources available with Railways in relief and rescue operations in a train accident are by moving SPMRV (Self-propelled Medical Relief Van), SPART (Self-propelled Accident Relief Trains), 140T Crane which are alerted by hooting a siren and started in a target time of 20 minutes for SPMRV and 30/45 minutes for SPART during day/night. These relief trains are loaded with various types of relief and rescue equipments from Mechanical, Engineering, Electrical and Signal & Telecommunication Departments. The effective preparedness is achieved by

- Evolving an effective warning mechanism
- Identifying activities and their levels
- Identifying and specifying sub-activities under each activity / level of activity with a predetermined response time.
- Working out individual plans of each specified authority to achieve the activation as per the response time
- Having quick response teams for each specified authority
- Having alternative plans and contingency measure
- Providing appropriate administrative and financial delegations to make the response mechanism functionally viable and
- Undergoing preparedness drills.

Safety Information Management System (Sims)

IR being the largest railway network under a single management in the world. With such a massing utilisation of assets, safety is of paramount importance for operational efficiency. A very high priority is accorded to safety to enable railways to achieve still greater heights of performance. Railway Safety is concerned with the protection of life and property through regulation, management and technology development of all forms of rail transportation. Various activities / functions like; Disaster Management, Accident Reporting, Ex-gratia announcement/payment, Public Information with reference to accident, Accident Inquiry (Commissioner of Railway Safety / Departmental), Discipline & Appeal Rules Inquiry, Safety MCDO, Safety Drive, Safety Shield, Inspections, Level Crossings, etc. are covered under Railway Safety.

An IT-based system to keep a record of all accidents and unusual incidents taking place on IR is developed in the form of SIMS and updated information on the subject is available on internet. The site is accessible for internal users of Railways and also to general public. However, some information is viewable only under user ID and password for Railway Officials only and not for general public. Some of the features of the site are;

Every accident / unusual incident uploaded into the system carries an unique ID and the follow-up action is monitored by the Ministry. The site also contain the signal diagrams of all stations, GIS mapping etc., There is also a sub-page in the site called as SMDMS (Safety Messaging & Document Management System) which is used for correspondence between Zonal Railways and the Railway Board. This site is used for uploading all Safety Audit inspection reports and safety drives ordered along with the compliance report by the Zonal Railways as ordered from time to time.

Incident Command System (ICS):

Introduction: The Incident Command System (ICS) is an on-scene, all-risk, flexible modular system adaptable to any scale of natural as well as man-made emergence / incidents. The ICS seeks to strengthen the existing disaster response management system by ensuring that the designated controlling / responsible authorities at different levels are backed by trained Incident Command Teams (ICTs), whose members have been trained in different facets of emergency / disaster response management. The ICS will not put in place any new hierarchy or supplement the existing system, but will only reinforce it. The members of the ICT will be jointly trained for deployment as a team. When an ICT is deployed for an incident, 'all-concerned' agencies of the Government will respond as per the assessment of the Team. This system therefore enables proper co-ordination amongst different agencies of the Government. The five command functions in the Incident Command System are:

- **Incident Command** – Has overall responsibility at the incident. Determines objectives and establishes priorities based on the nature of the incident, available resources and agency policy.
- **Operations** – Develops tactical organisation and directs all resources to carry out the Incident Action Plan.
- **Planning** – Develops the Incident Action Plan to accomplish the objectives. Collects and evaluates information, and maintains status of assigned resources.
- **Logistics** – Provides resources and other services needed to support the organisation.
- **Finance / Administration** - Monitors costs related to the incident, provides proper accounting, procurement, time recording, cost analysis, and overall fiscal guidance.

Types of Disasters Causing Interruption to Train Services

Human / Equipment Failure:

The disasters/accidents may be caused by human / equipment failures, which may affect normal movement of train services with loss of human life or property or both. These include:

- Collisions
- Derailments
- Accidents at manned or unmanned level crossings.
- Fire or explosion in trains
- Other accidents affecting the safety of rail operation.

Natural Disasters

Natural disaster in general like floods, cyclones is forecasted whereas earthquakes & landslides are difficult to forecast. But preparedness for floods & cyclone will help in tackling situation for other natural disasters also.

Landslide

- Whenever landslide is experienced due to heavy downpour, all train services to be regulated.
- Rescue team to be rushed for restoration work.

Floods

Based on the weather forecast, following steps are taken:

- Watchman at important bridges and at vulnerable points are posted.
- Shifting of all movable equipment around the bank.
- If time permits, sandbags, dykes can be constructed to ensure safe passage of trains.
- Regulate the train service
- Evacuate people and move them to a safer place.

- Contact Fire brigade, Naval, Army, Air force, Local boatman and arrange Divers and boats.
- Arrange temporary shelter.
- Arrange coaches to accommodate the affected.
- Seek assistance from voluntary organisation and arrange safe drinking water and catering.
- Arrange protection with RPF and GRP.
- Keep constant communication with ontrol Office.
- When people are marooned, arrange air dropping of food packets with the assistance of Civil Administration.
- Contact St. John Ambulance, local doctors and provide medical care.

Cyclone / Storm

When a train is caught in a cyclonic storm at mid section / station:

- Stop the train clear of cuttings, bridges and embankments.
- Guard, Loco-Pilot and other Railway servants on train shall open windows and doors of coaches.
- At stations where Anemometer is installed, shall act as per the warning related instructions. At other stations when the wind velocity exceeds safe limits, SM must consult with Control and GLP of the train.
- Make announcement to warn the public.

Preparedness for Natural Disaster from Departments

Engineering Department

- Identify Risk Zones prone for natural disasters.
- Identify major infrastructures, like track, bridges and buildings and such inventory analysed for its strength to withstand disasters.
- Keep sufficient stock of track materials.
- Ensure arrangement of essential items like empty bags, sand, dust, cinders etc. ready to be moved to vulnerable locations.
- Intensify Patrolling of track.

Mechanical Department

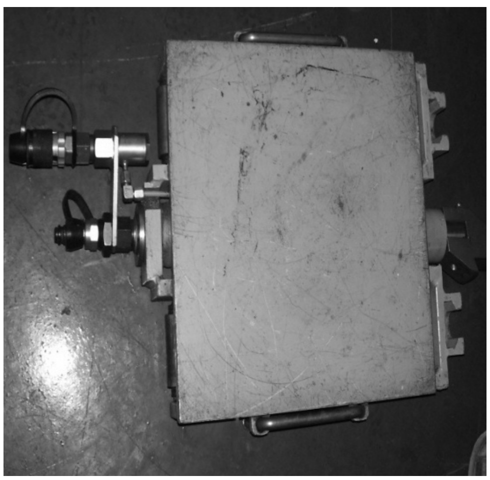
- Shall ensure that ARTs, ARMVs are equipped with adequate tools.
- Staff of proven caliber nominated to man ARTs/ARMEs

Power Pack (diesel)

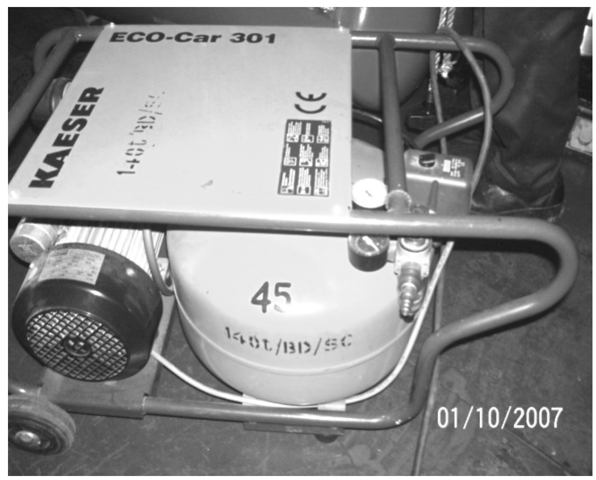
Power Pack (petrol)

LUKAS Hydraulic Hand Pump

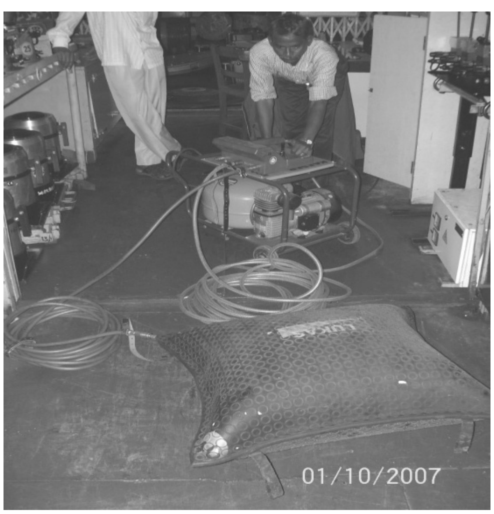
LUKAS Hydraulic Jacks



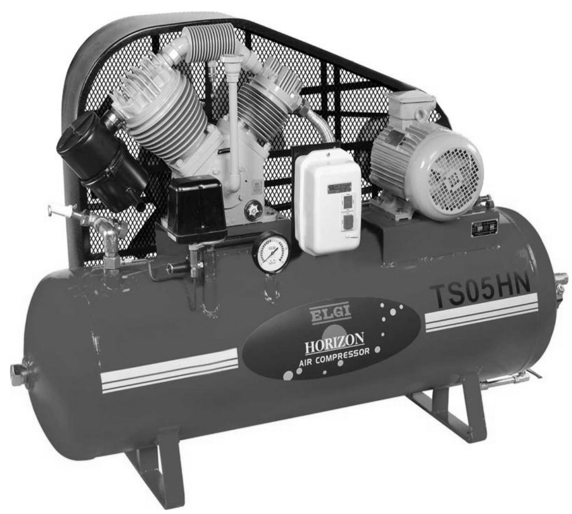
LUKAS Hydraulic Roller Carriage with Jack



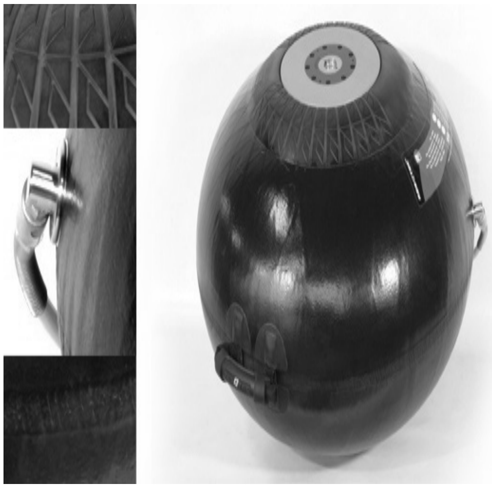
Air Compressor



Air bags



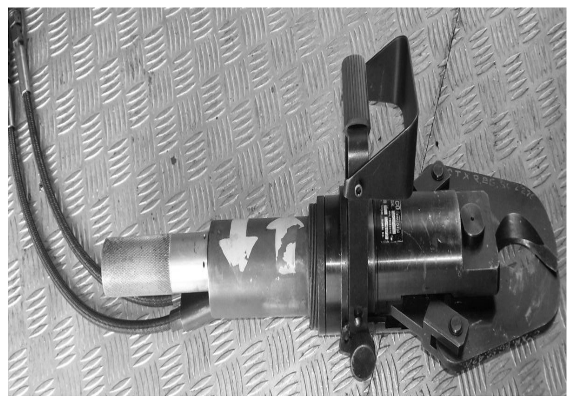
Air Compressor



Air bags

Rescue Platform

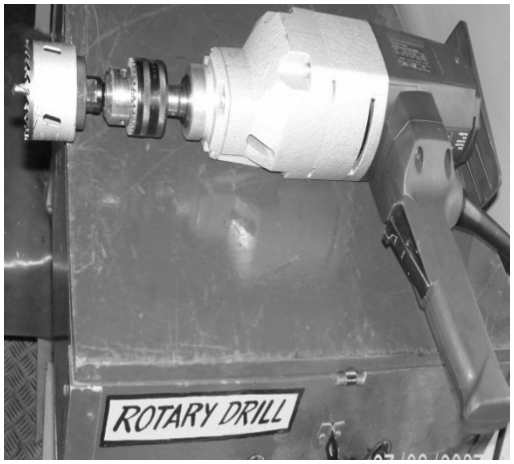
Spreader



Cutter

Lukas cutter

Lukas spreader-cum-cutter

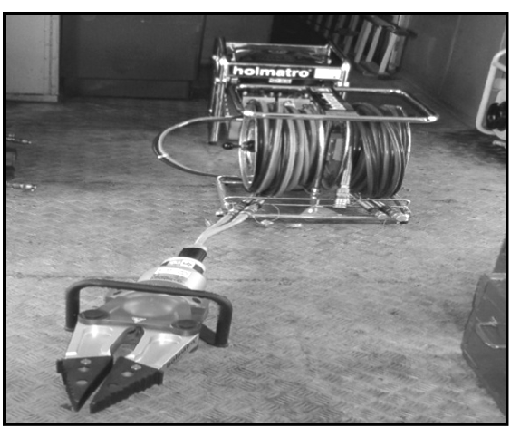


Rotary drill

Electrical nibbler

Jigsaw electrical

Breathing apparatus



Spreader and cutter

Underwater cutting equipment

Medical Department

- Shall ensure availability of medicines and materials, disinfectants etc. at Health Units / Hospitals near the vulnerable places.
- Take measures to prevent epidemics, in co-ordination with Engineering Department for sanitation and disinfection of drainage and public places.

Electrical Department

- Ensure availability of standby power at strategic locations.
- In OHE area, sufficient stock of relief materials shall be kept.
- Tower Wagons with quick mast erection facilities and sufficient spares should be kept ready.

Telecommunication Department

- Ensure proper communication with adequate facilities like Wireless Communication, Satellite phones etc.

Transportation Department

- Requirement of essential staff and their deployment shall be assessed.
- SMs in co-ordination with assistance from respective Departments, shall ensure all station equipments like Generator, Emergency light VHT sets, First Aid equipment are fettle.
- SMs shall ensure securing of stabled vehicles.
- COM will issue instructions regarding regulation, diversion or cancellation of trains in the warned section.

Commercial Department

- Open enquiry booths.
- Ensure arrangement for food, water etc.,

Security Department

- Security personnel to accompany relief material trains and render assistance.
- Arrange for crowd control and also prevention of theft.

General

- Apart from the above, each PHOD/DRM shall nominate an officer to monitor warned location and order arrangement.
- A monitoring cell shall be formed at Divisional / Zonal level to ensure proper co-ordination and planning.

Man Made Disaster & Post Disaster Management

Following disasters / accidents may be caused by human activities, which may affect the normal movement of train services with loss of life or property or both.

Sabotage causing deliberate loss of life/damage to property or both.

- Bomb threat / blasts.
- Setting fire to Train.
- Tampering with Railway fittings.
- Placing of obstructions on track

Bomb Threat / Blast:

Person receiving call regarding bomb threat:

- Should attempt to gain as much information as possible from the caller ID devices, time set, location, reason / purpose of the act, dialect mannerism and identity the caller.
- Person receiving call should inform higher ups who in turn alert the DM team (Bomb detection squad).
- Also, alert Police, Fire Brigade and Explosive Department.
- Take initiative for evacuation of all.
- Person noticing a bomb like object, should bring it to the notice of the nearest available Officer.
- Inform Railway Police, RPF, and Bomb detection squad.
- Ensure all persons are away from the spot and to avoid unnecessary crowding near the area.
- Inform control to take further steps of regulating the train services.
- Wait for clearance from the Police Department.

Tampering of Railway fittings

- A staunch vigil should be kept by introduction of special patrolling over the area as and when warranted with assistance of RPF.
- Specially trained persons shall be drafted for duty.

Radiation Emergency / Personal Injury Involving Radioactive Material Contamination

- Render first aid immediately.
- As far as possible, without causing harm to the victim and remove contaminated clothing and gross personal contamination.
- Remove all contaminated clothing.
- Call Fire Station, bomb squad, and police.
- Skin contamination should be cleaned using mild soap and warm water. Use portable survey meter to monitor for remaining contamination. If not free of contamination, re-wash and re-survey.

What to do upon suspected letter / package receipt?

- Call Police / Fire Service / Bomb Squad.
- Handle with care
- Don't shake or bump
- Isolate and look for indicators
- Don't open, smell, or taste

If Parcel is Open and / or Threat is identified for a Bomb

- Evacuate immediately
- Call Police / Fire Service / Bomb Squad.

Disaster Response

Instant Action Team – Loco-Pilot / Assistant Loco-Pilot, Guard & other on-board staff – their duties.

Duties of LP & ALP:

- Switch 'on' flasher light.
- Note the time, location and weather condition.

- Secure the formation, protect the train.
- Inform the Guard, SM and Controller by quickest means of communication.
- Render first-aid and assist Guard in saving the lives.
- Freeze speedometer memory.
- Ensure the important documents such as Brake Power Certificate, Vehicle Guidance, Caution Order and other train passing documents given en-route is handed over to the Inspector / Officer who arrives first.
- In case of fire related accidents, make use of the fire extinguishers.
- Ensure the clues are preserved.
- Do not allow the unaffected wagons / coaches from the site of accident unless they are certified after examination.

Duties of Guard:

- Ensure LV board / flashing tail lamp is available.
- Note down the time, location and weather condition.
- Ensure the formation is secured. Protect the train.
- Inform the SM and Controller by the quickest possible
- Make a quick survey of the accident site and ask for relief accordingly.
- Render first-aid and assist / co-ordinate with loco crew in saving the lives, transport the injured to the nearest hospitals / nursing homes / clinics.
- In case of fire related accidents, make use of the fire extinguishers.
- Ensure clues are preserved.
- Ensure important documents / registers are seized from Gate lodge, in case of accidents involving road-users.
- Do not allow the unaffected wagons/coaches from the site of accident unless they are permitted after examination and certification by appropriate authority.

Duties of TTE and Pantry Car staff:

- Avail the services of the doctors and other paramedical staff travelling by the train in rendering first-aid to the injured and in transporting the injured to the nearby hospitals / clinics / nursing homes.
- Render first-aid.
- Prepare a list with the details of the injured passengers such as name, age, sex, ticket no., along with coach no./ berth no. and contact telephone no., etc.,
- Assist in transporting the injured to the nearby medical facility locations.
- Co-ordinate with local volunteers and other Railway officials.
- In case of fire related accidents, make use of the fire extinguisher units kept in the AC Coaches, Pantry Cars and at stations.

Duties of AC Mechanics and Coach Attendants:

- Switch 'off' the power supply and avoid short circuiting.
- Assist the LP, Guard, TTE or any other Railway official at the site of accident in saving the lives and in transporting the injured.
- Render first-aid to the injured by using the first-aid boxes available with the in-charge of the Pantry Car and from the Guard.
- Make use of the fire extinguishers kept in the AC coaches.

Duties of Security staff on escorting duty:

- Render first-aid and help in extricating the entrapped passengers.
- Ensure safety and security of the relatives / dependants of injured passengers and also the security of railway property.
- Protect the clues and collect such P. Way material and Rolling stock parts including that of locomotive which would contributed for the accident.
- Protect the bag and baggage of the train passengers.
- Ensure crowd control by providing plastic tape barricades and give warning messages through hand-held loud speakers.
- Assist Civil Police and GRP.

First Responders –Nearest Gang, Station Masters, other Departmental Officials – Duties

Duties of Engineering Gang:

- The Gang in-charge and his team of Trackmen should rush to the accident site immediately.
- Render possible help to the injured passengers and co-ordinate with other Railway Officials in relief and rescue.

Duties of Gatemen:

- Keep the LC Gate in 'closed' condition, if the train is stopped within the gate portion.
- Exhibit danger signal to trains coming on adjacent lines.
- Inform the SM of the station.

Duties of Station Masters / Managers:

- Do not allow any train into the affected block section on the same line and also on adjacent line.
- Inform the SM of the adjacent block station, Controller, Medical Authorities and other Officials stationed at the station.
  Mobilise all kinds of medical resources available at the station, i.e., Railway and non-Railway to go to the accident site and to take care of the injured passengers brought to the Civil Hospitals / Nursing Homes / Clinics, etc.,
- Inform the Civil, Revenue, Police, Transport, NGO Organisations, Political dignitaries, fire fighting officials, etc.,
- Seize the registers and records from the station / cabin.
- In case of accident at station, note down the position of points / signals/ block instrument position, Relay Room position, data logger condition, etc.,
- Co-ordinate in making catering arrangements.
- Ensure that Public Assistance booth is opened and manned continuously with details of dead, injured, locations where they are undergoing treatment, details of cancellation/termination/diversion of trains.
  The necessary infrastructure required to man the booth also to be arranged.
- Call the 'off' duty staff to assist.
- Assist the stranded passengers by arranging catering, transport, medical, shelter arrangements, etc.,

Duties of Permanent Way Officials:

- Proceed to the spot immediately.
- Seize the documents from the LP.
- Secure and preserve the gang diary, gang chart, curve register, etc.,
- Assess the accident site and call for the assistance accordingly.
- Assist and co-ordinate with other officials in relief and rescue work.

- Preserve all the clues at the site of accident.
- Prepare the accident sketch.
- Execute other functions as ordered by Officers at the accident site.

DM Team – Duties at Accident Site

Nominated officials from various Departments arriving at site by Medical Relief Trains form part of the DM Team. Officials representing each Department are responsible to ensure that assigned duties of their respective Departments are efficiently carried out. Senior officers of each Department shall also ensure that their work is synchronised with that of functionaries of other Departments for quick rescue, relief and restoration operation.

Members of DM Team: Disaster Management team normally comprises members of following Departments.

- Trained men from Medical, Commercial, Mechanical, Electrical, Engineering, Security, Operating, Safety and S&T Departments.
- In case of fire related accidents, fire service personnel shall also form part of the team.
- In case of water-logged accidents, water body, divers and naval cadets will also form part of the team.
- In case of suspected sabotage or bomb explosion – bomb disposal squads, forensic lab officials (central and / or state) and GRP/local Police authorities shall also form part of the team.
- Various rescue units shall accompany Medical Relief Trains or move by quickest possible means to site of accident.

Officer in-charge of site (OIC site): On arrival of MRV at the site of accident, Divisional Railway Manager of the Division shall take over as OIC site from the senior most officer. He will be responsible for forming core groups as required and direct them to carry out efficient rescue, relief and restoration operations.

Rescue, Relief and Restoration operation: DM team on arrival shall undertake the following action;

- Crowd control and law & order
- Rescue operation
- Clearance from State Police for restoration, where required.
- Relief operations
- Installation of communication network
- Video coverage of accident site
- Preservation of clues and evidences
- Media management
- Salvage operation
- Restoration operation
- Lighting arrangements
- Catering facilities, etc.,

Photography and Videography: Prior to restoration work, Divisional authorities shall undertake suitable video coverage if the complete restoration work. Still photographs by digital camera shall also be undertaken extensively. The coverage and photographs shall be taken from a vantage point and from different angles apart from close-ups and Birdseye view filming. Such photographs shall clearly indicate;

- Severity of the accident
- Illustrate the damage to P. Way, rolling stock, signal, Overhead Equipment and other structures.
- Victims and unidentified bodies should also be extensively photographed for easy identification, payment of ex-gratia, etc.,

General: For efficient Disaster Management, responsibilities of various Departments are to be executed by deputing responsible Officers and Supervisors. Important duties of such Officers and Supervisors are enlisted below:

- Ensuring the setting of Unified Command Centre
- Collecting the information on progress of restoration from OIC site.
- Take stock of the situation and plan for effective and efficient rescue operation.
- Estimate the quantum of assistance required from the resources available with in the Division, adjoining Divisions, non-Railway agencies and from State/District authorities.
- Ensure general co-ordination from various Departments.
- Intimation to District Civil, Revenue, Police authorities.
- Given prima-facie cause of the accident and probable time of restoration.
- Total no. of dead, injured with complete details.
- No. of wagons/coaches involved in the accident, their details and position.

  Forecast for completion of each activity such as rerailment, track fitness, OHE fit, points and interlocking, clearance of section and movement of first train.

Formation of Two Teams at Accident site for Round the Clock Working:

- At the accident site, Officers available from the Division shall be formed into two teams for round the clock working in 2 shifts.
- PHODs/HODs shall take decision regarding composition of the team for night shift for their respective Department.
- Supervisors of the Division shall also be divided into two teams by their Controlling Officers.

Co-ordination Centres – Role of Divisional Control, Central Control and Disaster Control

Divisional Control

- Stop movements of trains into the affected block section including adjacent line trains on double and multiple line sections.
- Order MRTs on either side of the affected section and in case of more casualties order the adjoining Division's relief trains. Also ensure to order and move the crane specials.
- Allow only relief trains and give top priority to Accident Relief Medical trains and other relief trains. As a rough thumb rule, the scale of assistance required would be one relief train from a Division for every 50 injuries.
- Inform DRM, ADRM and other Divisional Officers
- Inform SMs at either end of the block section, Central Control, Civil Authorities, State Government officials.
- Maintain a log of events till the complete restoration.
- Advise Civil, Military, Private hospitals apart from Railway Hospitals to rush medical aid to the site of accident.
- Arrange for despatching the rescue and relief equipment.
- Inform the NGO Organisations to solicit their help in relief operations.
- Run the special trains with injured to the originating / destination of trains.
- Arrange for running of duplicate trains for clearing stranded passengers.
- Arrange for regulating traffic by diverting / cancelling / terminating trains duly advising the stations.
- Collect the details of dead and injured.
- Liaison with Commercial Department and ensure that information centres are opened.
- Do collect the voice logger CD for the benefit of the Accident Enquiry Committee.
- Do pass clear remarks on the chart along with timings about all instructions given to various agencies.

Central Control

- As soon as the information about the accident is received from the Divisional Control, inform all the Officers of Headquarters immediately in the order given along with timings and keep a record of the same.
- Central Control shall inform all concerned at Headquarters office including GM, PHODs, HODs.

Resource Units

UNIT – I (In Train, at Surroundings, at Adjoining Stations)

1. First-aid box available with the Guard & Train Superintendant.
    - Portable Control Telephone.
    - Fire extinguishers loaded in Guard compartment, in loco, in AC Coaches and in Pantry Cars.
    - Walkie talkie sets with LP and Guard.
    - CUG mobiles phones with LP, ALP and Guard.
    - Information about the doctors travelling in the train.
    - Information about Railway officials in the train 'on' / 'off' duty.
    - Volunteers.

UNIT II Non-Railway Resources:

- Volunteers from nearby villages and towns.
- NGO Organisations.
- Transport vehicles passing nearby, owned by all Contractors and Private / Public transport.
- Tractors for transporting both men and material.
- Station staff shall mobilise medical assistance and transport. Mobilise non-Railway resources.
- Moving the relief trains.
- Inform 'all-concerned'.
- Station staff shall give medical succor, mobilise manpower, moving rescue equipment, arranging lighting, transport, mobilise fire fighting services, etc.,
- Resources as mentioned in the DM Plan.
- Contact Civil Authorities who could be of much help for relief and rescue operations.

UNIT III Railway Resources:

- Mobilise the Engineering gangs, OHE and S&T staff to be alerted.
- Mobilise Medical staff.
- Arrange Communication network at the station and as well as at the site.
- Security Officials to be informed and moved to the site.

UNIT IV Accident Relief Trains & Medical Rlief Trains:

Location name, type of relief equipments available of the Divisions and adjoining Divisions.

UNIT V NDRF (National Disaster Response Force) Units:

Help is also sought from nearby NDRF Units when the situation is beyond Railways capability to handle, particularly in case of major accident and accident caused due to natural calamities, like cyclones, floods, landslides, fire etc.,

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WORLD CONGRESS ON DISASTER MANAGEMENT, VISAKHAPATNAM, ANDHRA PRADESH, NOV 19-22, 2015 DEVELOPMENT OF MULTI-TERRAIN VEHICLE SYSTEMS FOR DISASTER MANAGEMENT

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Abstract

In an effort to access difficult terrain and navigate in water-logged regions, CSIR-NAL have been engaged in the development of land-water capable multi-terrain vehicle systems which are often needed during floods. Having facilitated by the Integrated Defence Head Quarters, the air-propelled-ferry systems (Hamsa versions) of assorted specifications, developed as technology demonstrators, were successfully field tested with the support of Madras Engineering Group (MEG) and Centre, Bangalore.

As part of CSIR planned project, the main focus of the innovation has been improvisation of traditional float-vessel (handcrafted coracle country boat) by installation of streamlined safety outriggers, rendering the boat not only almost uncapsizable but also Out-Board Motor (OBM) compatible. User trials, in coordination with Karnataka State Natural Disaster Monitoring Center (KSNDMC) were successfully carried out in North Karnataka when River Krishna was in spate in the year 2011. Arguably, when scale-up, this frugal innovation of coracle with outriggers has the potential not only to evolve as major utility vehicle systems in most of situations during floods but also in inland water applications, including river cleansing.

The development of industrial version of the versatile coracle float-boat out of Bamboo Mat Board (BMB) material is perceived as a disruptive technology not only for the benefit of fishermen communities but also to serve as 'personal boat' for flood-affected people of the world at large.

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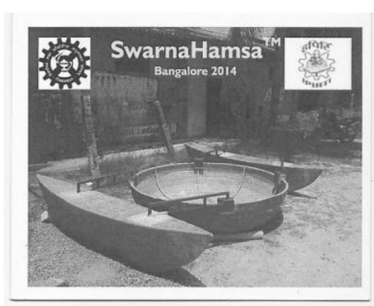
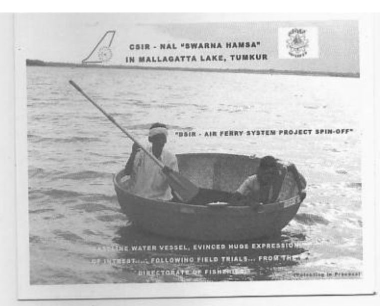


Safety outrigger installed coracle boat



Industrial version of coracle

Introduction

Department of Scientific and Industrial Research under Ministry of Science and Technology, Government of India has been engaged in addressing the problems of ever course changing rivers of North and North Eastern regions of India by way of development of suitable transportation systems.

Inland waterways although the most economical of all, remain under developed and are so far unable to improvise on traditional water vessel systems in any significant manner. With the Government's initiatives of cleansing river Ganga in progress, there is a need for development of indigenous traditional knowledge based systems for application by concerned agencies in a routine manner.

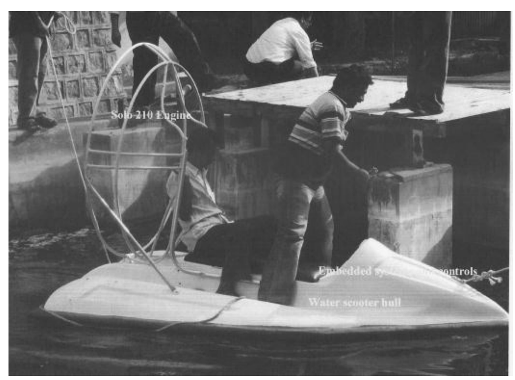
In the present work, versions of airboats, with different aero engines and base vessels including the traditional inland water vessels have been designed, developed, realized, system integrated and field tested at MEG and Center (Army Defence Training Center), Kensington Park, Halasuru lake, Bangalore.

As part of CSIR supra-institutional project (SIP) under 11th Five-Year-Plan programme a number of land-water (multi-terrain) vehicle systems have been developed and field tested as listed below:

CSIR Hamsa boat versions:

S.No	Name of product developed and description	List of Items integrated	Utilization
1	AamRath: 6-seat coracle based airboat with side-triggers and an aero-engine at the rear. All the engine controls are shifted at the rear.	Version 2: 1. Engine Simonini 2. Coracle Boat with Outriggers	Developed for multi-role activities: - AamRath Version1: land-water vehicle was demonstrated successfully in K R Puram lake (Fantasy lagoon). - Field trials with full capacity demonstrated with the support of MEG and Center. Appeared in DNA (India positive) [1]. - Expression of Interest by Department of Fisheries (Inland) received and also demonstrated for weed clearance [2].

			 CSIR Hamsa - AamRath Version I Version 2: Field tested at MEG and Center, Ulsoor lake. The frugality of the innovation attracted inquiries from Indonesia, Philipines and paramotor manufacturers from Europe.
2.	Ni-Hong Float system	Float- Cylindrical Floats HKS700E engine…Integrated systems with deflection vanes, engine propeller guard, seating arrangement, mechanism for controls and instruments like the fuel gage, CHT temperature measuring instrument, struss work for water	On top of four cylindrical floats, a simple platform was constructed. Powerful, commercially available HKS 700 E aero engine was assembled at the rear. The seating arrangements were appropriately fixed to maintain equilibrium at all speeds. The air ferry system also features deflection vane control along with the propeller cage. With four seats, the air ferry system performed commendably attaining maximum speed of 18 kmph during trials at MEG and Centre, Ulsoor lake. The airboat has a struss-work attached at the front for weed clearance.

		weed clearance, etc.	 Photo.3 Ni-Hong
3	Neer Jinkae Aero Engine for Neer Jinkae	Water vessel (Delta Type) Engine 210cc SOLO…	A 'Delta' shaped water scooter vessel is the base vessel. SOLO 210cc paramotor engine is used for the airboat application. The throttle and deflection vane controls were brought to front for a single seat handling. This high speed version was demonstrated at MEG and Centre. The system can perform in any adverse, disaster situation for reconnaissance purposes. Photo 4 shows Neer Jinkae performing field trial activities  Photo 4

4	Advanced CSIR Hamsa with aero engine	Water vessel with landing skid float based, Rotax engine powered, twin seater, high speed version of airboat.	The advanced version of airboat is built around a pair of ultralight aircraft landing floats which provides bare minimal contact with water. It is powered by Rotax 502 engine. With 2 - seat capacity the maximum speed attained was over 30kmph. The technology demonstration was carried out at MEG and Cenre Ulsoor lake premises. Photo 5 shows advanced CSIR Hamsa airboat performing field trial activities.  Advanced CSIR Hamsa- Airboat
5	Spin-off Products: RajDhoni V1 (without top cover) Float-boat for RajDhoni 7hp… Engine system RajDhoni V2 (With top cover)	Bamboo Coracle with FRP lining Engine Diesel Boat-Coracle…	The installation of outriggers at the sides of coracle is the baseline contribution in the project work. The use of outriggers provides stability and control to the coracle. With adequate counter balancing buoyancy rendered by the outriggers, capsizing possibility is almost nil. 4.4hp engine is normally used as the out-board motor for propusion in water. Both with and without top cover versions were field tested in KR Puram and Ulsoor lakes. Most interestingly it performed very well during trials at Bagalkote, wherin River Krishna was in spate during June 2011.

			The users likened the vessel to a ‘water auto’. The vessel finds application in inland water transportation. Photo 6 and 7 illustrate the system utilization during field trials  Photo 6 Safe-RajDhoni without top cover  Photo 7 RajDhoni with top cover
6	NaviluDhoni with motor	Boat-Coracle—with 4hp OBM	The baseline coracle is a FRP construction with 4 - seat arrangement. The vessel with in the presence of outriggers is both unsinkable and uncapsizable. It crossed the River Krishna the most elegantly and effortlessly with four persons onboard, powered by just 4.4hp motor. Ideal system for disaster management.

			MEG and Center may employ this system during the disaster situations and qualify for wide spread usage. MEG and Center and CSIR NAL may work together to get the system certified for the end use, -i.e inland water transportation and to employ in disaster management situations. Photo 8 shows the system performing during a field trial.  Photo 8
7	JodiHamsa V1 Motor Version	Twin coracles integrated side-by-side Yamaha OBM 25 hp	The JodiHamsa V1 is a twin coracle boat, side-by-side, along with outriggers, with capacity over 1500kg. With 10hp OBM mounted at the center, it could navigate across Krishna River in Bagalkote.  Photo 9 The versions of JodiHamsa built around the traditional coracle float boats may be utilized for inland water transportation of cattle, men and

			material and also employed as a utility vehicle during disaster situations. Sensationally, 'JodiHmasa sighted in Ghatta Prabha..', described one local News Daily in Bagalkote. No wonder, this the most popular vessel built around the coracles. Photo 9 illustrates the field trial with the MLA of Bagalkote.
8	Jodihamsa V2	Coracle-Bamboo… Coracle Bamboo…	The JodiHamsa V2 is a twin coracle boat, in tandem configuration with outriggers at both sides. This articulated FRP lined coracle is powered by a 25hp motor. The functional aspects may be augmented with necessary attachments built around the coracle floats.
9	DiamondHamsa	Four coracles integrated by a frame-work	The highly efficient float vessel such as a coracle may be augmented in numbers with an appropriate struss-like frame-work. The 4-float-boat-system in Diamond formation may appropriately be powered by an Out-Board Motor (25hp) and navigated during rescue operations. A network of such floating arrangements may prove to be useful float bridge sustaining even river flows. However, this aspect remains to be field tested. MEG and Center is likely to utilize these systems to the maximum. Photo 10, illustrates the field trial activities of JodiHamsa

			
10	SwarnaHamsa	Fabricated out of BMB sheets	Photo 10 Of all the traditional coracle based innovations, the most viable water vessel is the industrial version of the Bamboo Mat Board based coracle built by the CSIR NAL team. During the field trials at Mallaghatta, Tumkur Dt, the fishermen communities have taken a great liking for the product. Based on their feedback, the Directorate of Fisheries have indicated a huge Expression of Interest (EoI) With the R & D efforts still continuing in various forms, potential exists for this product to 'reach' to people..  Photo 12 CSIR SwarnaHamsa undergoing field trials at Mallaghatta, Tumkur.
11	Rescue Boat / Master Control Boat Motor for powering the rescue boat	Fibre-glass water vessel-4.7m length… Yamaha OBM 9.9hp…	Used as a standard lead vessel or master control vessel during field trials. Yamaha Out-Board Motor (OBM) 9.9hp is extensively used in all field trials.

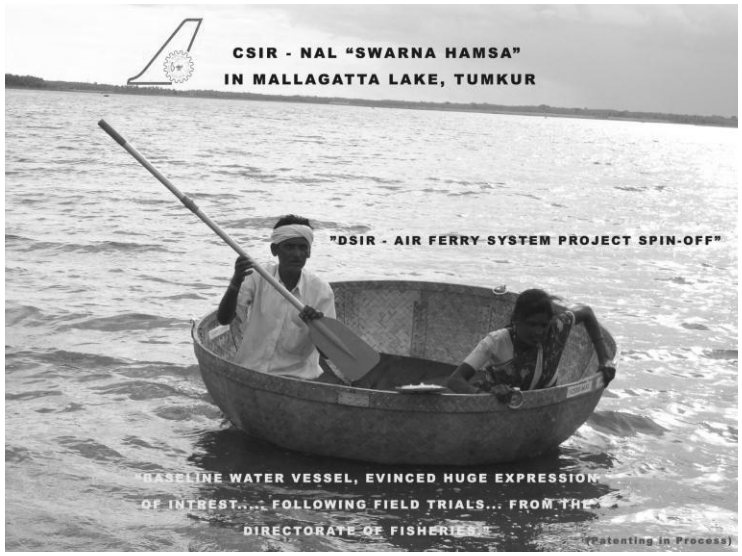
			 CSIR NAL Rescue Boat - Photo 1

Lessons Learnt from Field Trials

- Sustained over a period of 5 years, research and development project activities with understanding across different ministries (DST and MoD) have been very beneficial in terms of product development and testing.

Field trials at Kensington Park, MEG and Centre, Halasuru Lake (2008-2013)

Even participation by industry, HINDALCO and Aluminium Association of India (AAI) in the field trials were observed [3]. However, as it appears, scale-up to industrial production is entirely a different proposition. A great deal of entrepreneurship, inclusive innovation policies of R & D institutions, and progressive state schemes can considerably accelerate the process of product reach to the general public.



Field trials at Mallaghatta (2011) http://scm.niscair.res.in/videos/189/csir-nal-swarna- hamsatm:-a-spin-off-product-of-dsir-project

- State authorities such as Karnataka State Disaster Monitoring Center (KSNDMC), including MLAs and District commissioners and the media also enthusiastically participate in the field trial activities. However, the survival of the product versions, however, depends very much on the end users. The absorption of the product to the general public is a long drawn process.

- During Jammu and Kashmir Floods in September 2014, the float boat systems were the most wanted items by the marooned people. It was suggested that country boats with a float capacity of 1.0 tonnes could be made available [4]. As it appears, while one can donate funds, giving away disaster items pose considerable administrative difficulties. Indeed after the flood disaster NDRF aggrieved that the need of the hour was airboats and that they still to acquire one, as far as I could gather.

- In a recent field trial carried at Hogenekkal (Oct 2015), one of the tourist locations in Tamil Nadu, after a coracle capsizing disaster incident that killed a family of 5 [5], although inherent safety features of side-triggers borne out of the present innovation were easily demonstrated, as the technology borders on being ‘disruptive’, gaining acceptance by the local operators and implementation by retro-fitting of the safety side-triggers to their rustic coracle may pose considerable challenges for the State authorities.

- As it was also been demonstrated, the safety side-trigger installed fiber coracle with a Yamaha 4.4 hp out-board motor was able to penetrate against the flowing water to the fullest extent, it was observed that this improvised traditional coracle system might be worthy of scale-up and application in real life inland water ways and even in flood situations.

Field demonstration of safety outriggers for coracle boats at Hogenekkal (2015)

- The attitude towards flood disaster does call for a drastic change. Even Japan, in tackling its recent floods in Sep 2015 was found wanting. Designing a land vehicle system which is also float-capable in any eventuality is not too much to ask. A tourist bus in Venice does traverse in land and water. If one were to seek minutes before a flood situation, it had to be a dependable float-boat. In my view, highly maneuverable strong 'personal coracle boat' may indeed be the right choice for survival.

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A NEW APPROACH TO POST-DISASTER RELIEF AND RECONSTRUCTION
A CASE STUDY OF JAMMU AND KASHMIR FLOODS

Himanshu Shekhar Mishra, *Editor (Government Affairs) NDTV India.*

The devastating floods in Jammu and Kashmir in September 2014 changed the discourse on disaster management in India. Considered the worst in more than a hundred years in the State, it destroyed 2.54-lakh houses and made millions homeless. Importantly, it received unprecedented attention from the Government and the media which relayed images of devastation caused by the floods for many weeks. Unfortunately, the slow and tardy post-disaster reconstruction and rehabilitation of the affected populace has not received the special attention that it deserved.

In recent months, the flood victims have repeatedly raised the issue of Bureaucratic apathy and red-tapism. NDTV aired a news report on 3rd June 2015 which showed that flood-affected villagers in Saroora village in Jammu had received cheques worth Rs 47 to Rs 400 as relief from the State Government for their crop and poultry losses! Also, ten months since the floods destroyed critical infrastructure in the State, the Home Ministry is still in the process of releasing funds for what it calls a "short term relief/reconstruction". As a Home Ministry release issued on 16th June, 2015 said, "… a total of Rs.5039 crore has been provided for short term relief / reconstruction measures for the flood affected State of J&K". Significantly, the Central Government is yet to initiate the process of formulating a long-term reconstruction and rehabilitation package for Jammu and Kashmir.

Considering the structural weaknesses in the post-disaster relief, rehabilitation and reconstruction efforts initiated in Jammu and Kashmir, following questions have become important today:

- Should India development a new legal framework to streamline the process of reconstruction and rehabilitation of disaster victims?
- Should the Disaster Management Act be amended to grant a legal Right to every disaster victim to seek a relief, rehabilitation and reconstruction package from the State?

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EFFECTIVE HANDLING OF DISASTERS AN INDIAN ARMY PERSPECTIVE (WITH SPECIAL REFERENCE TO UTTARAKHAND TRAGEDY 2013)

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Introduction

India, due to its geo-climatic conditions is prone to many disasters, this is further compounded by its high degree of socio-economic conditions. A disaster is an extreme disruption of the functioning of a society that causes widespread human, material or environmental losses that exceed the ability of the affected society to cope with its own resources. Disasters are either "**natural**" or "**human-made**". Disasters caused by natural sources such as floods, earthquakes, tsunami, volcanoes, droughts etc are "natural disasters". Disasters such as chemical / industrial / biological / nuclear accidents, environmental pollution, fires, transport accidents etc are due to human action, such disasters are called as "human-made" or "human induced". Source: (http://www.ekalavvya.com/disaster-management-in-india-volume-i-free-ebook/)

Nowadays with clear understanding of the social fabric, the distinction between the two is very thin since most disasters are due to the action / inaction of people as a direct result of their social / economic structures, by adopting ways of living that overpopulate the urban areas which finally result in **degrading the environment**. Due to socio - economic conditions, a certain percentage of population are **highly vulnerable** such as those settled next to raging rivers or in areas prone to earthquakes. Their vulnerability is further increased by the **unpredictability** aspect of the nature as regards magnitude, frequency along with the timing.

In India **disaster safety** is of paramount importance since with just 2 percent of landmass, it supports one-sixth of the population of the world, who suffer from a variety of natural disasters which hit the poorest of the society. With this in mind and after a lot of bad experiences the "**Disaster Management Bill 2005"** was passed by the parliament in India. According to the Bill No: LV5: (d) "**disaster**" means a catastrophe, mishap, calamity, grave occurrence affecting any area, arising from natural / manmade causes or by accident or negligence which results in substantial loss of life or human suffering or damage to and destruction of property or damage to or degradation of environment and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area. Source: (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3696225/). With its highly diversified natural, geographical, climatic conditions India is susceptible to some of the worst natural disasters, however though the population and society have adapted themselves, but still the **economic and social losses** are increasing year after year. Further to add to the misery are some of the "**man - made**" disasters are cause substantial loss of lives and damages to property.

In India disasters continue to strike **unabated** and at will. They are on the increase in magnitude, frequency, complexity and financial impact. Civil administration is development oriented hence can best tackle low and moderate emergencies depending on the capabilities and available resources. For a long time, Indian Armed Forces have always done a commendable job when called upon in "**Aid to Civil Authorities**". Although the Armed Forces are supposed to intervene for specific tasks only when the situation is beyond the capacity of Civil administration, however they have always been the "**Core of Government Response Capacity**" in any major disaster.

The **Armed Forces** are trained to react in emergencies are the **biggest rescue** / **succor providing organizations**, capable of moving swiftly to any part of the country in the shortest possible time. The ability to react in the emergencies and work against time is inbuilt in their **training schedule**. In the past few years the country has seen intense natural disasters leading to large scale destruction, death, diseases, fear and panic among the people at risk. The growing tendency of over ensuring and not having faith in own civil setup to deal with emergencies has led to **frequent deployment** of Armed Forces sometimes unjustified. Both the Government and the **public repose tremendous faith** in the Armed Forces and believe that all emergencies and crisis can be handled by the Armed Forces.

Scenario in Uttarkhand before the Tragedy in 2013

History: On 9th November 2000, **Uttarakhand** (formerly **Uttaranchal)** was carved as the 27th state of Indian Republic, from Himalayan and nearby northwestern districts of Uttar Pradesh. Called as the **Devbhumi** (meaning "**Land of the Gods**") the state has numerous Hindu temples along with pilgrimage centres. Uttarakhand is famous due to its natural beauty among the Himalayas, Bhabhar, along with the Terai. Having bounded in north by Tibet, east by Nepal, south by Uttar Pradesh, west and northwest by Himachal Pradesh, south western corner by Haryana, the state is bifurcated into 13 districts in **Garhwal and Kumaon** divisions. Dehradun with a rail head, is the largest city and is the interim capital, however Nainital is the home to the High Court.

Tourism in Devbhumi: Tourism has always been the **major source of economy** of the state. Due to its unique location in **Himalayas**, many tourist attractions are there in Uttarakhand. Large numbers of tourists visit Uttarakhand because of its mountain peaks / national parks / hill stations / forest reserves / ancient temples. **Ganges** and **Yamuna**, which are the **holiest rivers** in Hinduism originate in Uttarakhand. There are also 44 nationally protected monuments the highest in any state.

Visiting **Devbhumi** "**Land of the Gods**" for more than thousand years, pilgrims have been hoping to achieve **purification from sin** and **salvation,** as some of the holiest Hindu shrines are located in Uttarakhand. Ganges and Yamuna sources called **Gangotri** and **Yamunotri** are in Uttarakhand which fall in the upper reaches of the state alongwith Badrinath (dedicated to Vishnu) and Kedarnath (dedicated to Shiva) form the **Chota Char Dham**, one of Hinduism's most spiritual and auspicious pilgrimage circuits. **Haridwar**, meaning "**Gateway to the God**", is a prime Hindu destination. Haridwar hosts the **Kumbha Mela** every twelve years, in which millions of pilgrims take part from all parts of India and the world. **Rishikesh** near Haridwar is known as the pre-eminent **yoga centre** of India. Uttarakhand is however a place of pilgrimage not only for the Hindus. **Piran Kaliyar Sharif** near Roorkee is a pilgrimage site to Muslims, **Gurdwara Hemkund Sahib**, nested in the Himalayas, is a prime pilgrimage center for the Sikhs. Tibetan Buddhism has also made itself felt with the reconstruction of **Mindrolling Monastery** and its Buddha Stupa, described as the world's highest at Clement Town, Dehradun.

Some of the **most famous hill stations** in India are in Uttarakhand. Mussoorie, Nainital, Dhanaulti, Lansdowne, Pauri, Sattal, Almora, Kausani, Haldwani, Bhimtal, Ranikhet are some popular hill stations in India. The state has 12 National Parks and Wildlife Sanctuaries which cover 13.8 percent of the total area of the state. The oldest national park on the Indian sub-continent, **Jim Corbett National Park**, is a major tourist attraction. **Rajaji National Park** is famous for its elephants. In addition, the state boasts **Valley of Flowers** National Park and **Nanda Devi National Park** in Chamoli District, which together are a **UNESCO World Heritage Site**. The state has always been a destination for mountaineering, hiking, and rock climbing in India. A recent development in adventure tourism in the region has been **whitewater rafting** in Rishikesh. Due to its proximity to the Himalaya ranges, the place is full of hills and mountains and is suitable for trekking, climbing, skiing, camping, rock climbing, and paragliding. Source: (https://en.wikipedia.org/wiki/Uttarakhand)





YAMUNOTRI GANGOTRI KEDARNATH BADRINATH HEMKUND SAHIB

Valley of flowers in Uttarakhand

Not a 'Freak' Incident: In the aftermath of the floods in Uttarakhand in 2013 it is imperative to examine the kind of development the Himalayan states should follow specially towards its tourism. Before pondering into the above it is also necessary to understand the nature of the **rainfall that engulfed** Uttarakhand during June 2013. Many are of the opinion that the rainfall of 2013 is a **random**, '**freak**' event. However Odisha's super cyclone 1999, torrential rains in Mumbai in 2005, the Uttarakhand downpour 2013 and Kashmir floods 2014 constitute **four clear weather related events** in less than 15 years, which have caused massive destruction / dislocation, can hardly be called '**freak**' events. Source: (http://www.thehindu.com/opinion/lead/the-untold-story-from-uttarakhand/article4847166.ece)

Due to increase in **global warming** alongwith the upward trend of the **global warming curve, Intergovernmental Panel on Climate Change** (**IPCC**) had warned repeatedly that frequency of **extreme weather incidents** would drastically increase. While planning development in fragile zones such as in Himalayas, in-depth consideration of likelihood of more **frequent "extreme weather events"** is a must, since in case of an extreme event, the crumbling mountains become more murderous. Source: (http://voices-and-visions.com/tag/floods-impact-indian-people/)

Consciousness of the **special character of the region**, was always created by the **Uttarakhandi** people in the 1990s, by "**Chipko Andolan**" movement in various seminars / workshops / conferences / meetings, which also enhanced the aspirations of the local village women that the new state would be on **green development path** of afforestation and watershed development, which would add life to dying rain fed rivers / dry springs, hence their own village forests would be abundant with fodder, fuel and wood along with forest based products, to give **adequate employment** to their men folk by **community ownership** and finally would stop them, to migrate to the plains in search of livelihood.

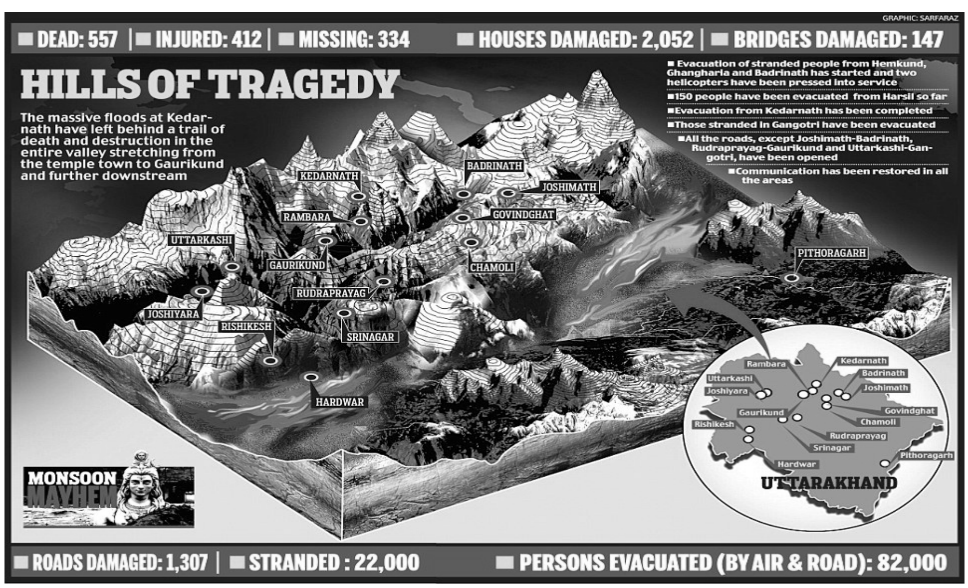
"**Chipko Andolan**" was the uniting factor for all the demonstrators in towns, villages and cities, demanding the mountain state. The **vision of development** to enhance the natural, human and social capital, was to set an example to the world, that **people-centric development** was possible in today's economic environment. Despite the formation of the state with a lot of fanfare, along with tremendous aspirations of the local population, the political leadership had **succumbed** to the modern economic goal of **creating monetary wealth,** hence after 15 years of the state formation construction of dams, roads, bridges, tunnels went unabated with **utmost disregard** to fragile slopes / regions / eco-systems resulting in further deforestation of the depleting mountains endangering human lives with weakened slopes. The State's mountain nature along with the **fragile ecosystem** was totally disregarded, with **tunnels blasted** into the mountains, **ill conceived hydro projects** and **encroachments** on river banks to accommodate the rising demand of tourist hotels / resorts causing un-repairable damage to the local fauna and delicate eco-systems, endangering human lives with **unsafe roads and buildings** designed to reduce expenditure.

Though the **wealth** was created, but it went into the **pockets of only few people**, in the southern **terai** plains. Sadly, for villages in the mountains, the agricultural produce **drastically reduced**, with women fork that fought for the new state, still looking for food, water, wood, fodder hence desperately waiting for a chance to escape to the plains.

Interesting Facts & Possible Causes of Uttarakhand Floods 2013

- **Unprecedented record monsoon rains** which were unseasonal resulting in **cloud burst** along with flash floods, possibly **climate change induced glacier lake outburst floods** (**GLOFs**) were the main causes of the **Uttarakhand Tragedy 2013**. The humanitarian disaster killed several thousand people, affected millions specially large number of pilgrims who were caught unaware / stranded in the Himalayan religious spots.
- Termed as "**Himalayan Tsunami**" the tragedy due to the landslides and floods in Uttarakhand was the **worst natural disaster** in the **Himalayan region** for the **last 100 years**. Despite the normal rainfall during the period of June being **71.3 mm**, the **actual rainfall** from 1st to 18th June 2013 was **385.1 mm**, **440% above the normal**, the **highest in last 80 years**.
- India despite having an extensive multi-agency / multi-tier natural disaster warning system in place along with an elaborate flood EW system at the Central and the State levels, it was only the **Indian Meteorological Department** which had provided **early warning** of the **Himalayan Tsunami** that struck in June 2013. (http://iasexamportal.com/civilservices/current-affairs/public-administration-uttarakhand-disaster). However the nodal agencies which were responsible for providing early warning were:

  - Floods – (CWC) - Central Water Commission
  - Landslide hazard - (GSI) - Geological Survey of India
  - Avalanche - (DRDO) - Defence Research & Development Organization
  - Disaster Management Support (DMS) - (ISRO) - Indian Space Research Organization
  - Weather - (IMD) - Indian Metrological Department



Reasons for Situation beyond the Handling Capability of Civilian Administration

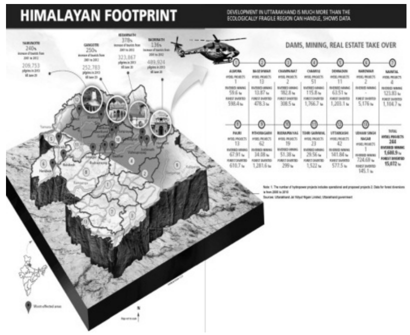
Certain inherent reasons for the 2013 disaster situation in Uttarakhand, which became beyond the handling capacity of the civil administration, are as under:-

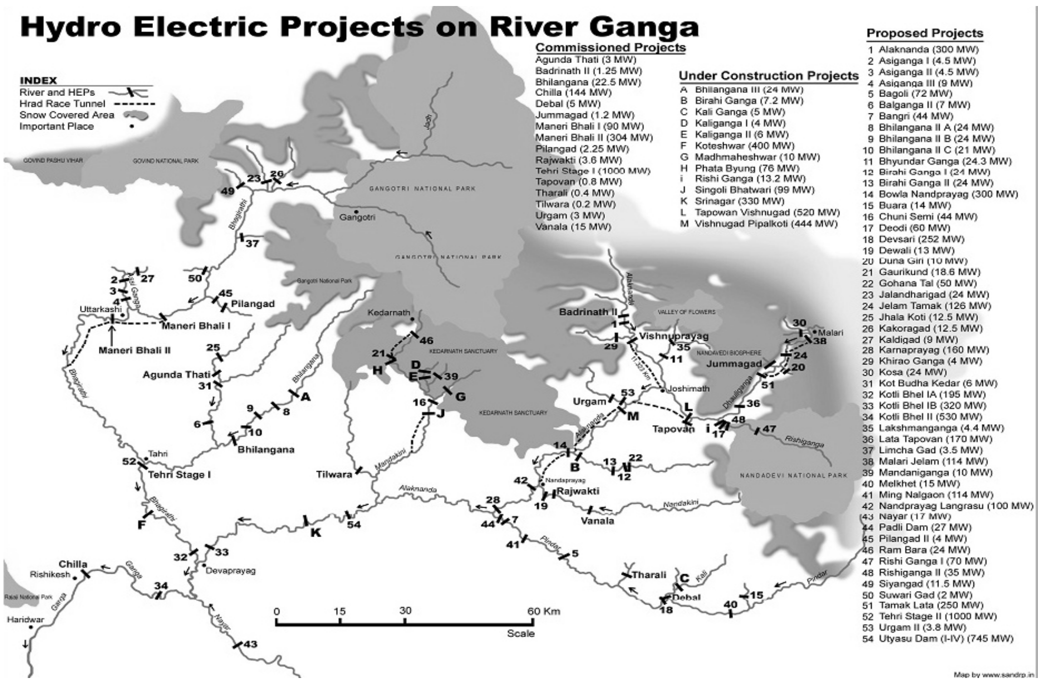
- **Surprise**: Neither Central nor State Government expect such a massive calamity.
- **Implementation of plans**: Implementation of plans with iron hand was missing..
- **Preparedness** / Mitigation were ignored. Nobody expected such a tragedy to happen.
- Lack of **integrated efforts** to collect / compile data, information / local knowledge on disaster history and traditional response patterns.
- **Standardised efforts** in compiling / interpreting geo-spatial data, satellite imagery and early warning signals were missing.
- Weak areas were **forecasting**, modeling, risk prediction, simulation and scenario analysis, etc.
- Absence of a state level, and district level directory of experts and **inventory of resources**.
- Absence of a concrete State level and District level **disaster management plans**.
- **Emergency medicine**, triage, critical care medicine, first aid.
- **Sustainability** of efforts.
- Effective **Inter Agency Co-ordination** and Standard Operating Procedures for stakeholder groups, especially critical first responder agencies.

Why was the tragedy an eye opener?

- It was for the first time since the **media revolution** in this country that a **religious area** was affected by a **disaster of a massive scale** and **information was available** to all in few hours.
- It was also for the first time that it was universally felt that the disaster, though, was due to **natural reasons was compounded by human activities** such as:-
  - Huge amount of Dams. (Tunnels built and blasts undertaken).
  - Unchecked Tourism.
  - Unauthorized / Illegal Constructions along the fragile river banks.
  - Unregulated cutting of mountains for road construction in haphazard style.
  - Massive Deforestation / cutting down of trees to increase tourist resorts / hotels.
  - Illegal Sand Mining along the river banks altering the course of river.
  - River Pollution.

It was a Disaster waiting to Happen





Role of Armed Forces

Every unit of **Indian Army** has an official plan in place for “**Aid to Civil Authorities**” that is meticulously prepared at par with its plans for war. When **requisitioned** by the local government each unit exactly knows what is to be done during earthquake, flood, any calamity or breakdown of public order. When officially requisitioned by “**the civil administration**”, the Indian Army **deploys all its might** and all its equipment to assist the **people of the nation**.

The Indian Army has inbuilt capabilities to **quickly react** in mobile fashion, because they are self sufficient / self contained, hence are best organized to act as “**First Responders**”, in case of any disaster situation, beyond the capabilities of Civil administration and immediately provide a variety of public services such as search / rescue, medical, relief camps, transport, communications etc. To restore emergency services, due to their **unflinched** / **uncompromised training**, to perform their professional activities, without any strings attached, they can operate under any **flexible integrated management system** hence possess **inherent enormous capacity** to immediate restore emergency services. The Armed Forces have always been called, in many parts of the country, during the natural calamities, to organize rescue and relief when the situation is beyond the local administration capability as in Uttarakhand Tragedy 2013.

Year after year, to render assistance to civil administration, due to floods during the monsoon season, Indian Armed Forces have always called upon for providing rescue and relief. The role of the armed forces during relief / rescue operations after Uttarkashi earthquake, Latur earthquake, Chamoli earthquake, floods in Orissa, Uttarakhand and Kashmir are well known.

In Uttarakhand floods 2013, for such a major disaster, the armed forces were the **primary option**, for undertaking **quick response** since the civil administration was ill equipped. The Indian Armed Forces **responded** to the disastrous situation with **all their might** since they were one of the most modern, **professional** and **dedicated** armed forces in the world. They are always ready due to their **trained manpower**, **logistical capabilities** and **technical competence** to rapidly deploy in any kind of disaster-related rescue and relief operations. Due to their "**Pan - India**" presence in most remote areas where natural calamities are frequent they are **best suited for the task**.

The role played by Indian Armed Forces whether, it was Kashmir earthquake of 2005, Sikkim earthquake of Sep 2011, Uttarakhand floods of 2013, Kashmir floods of 2014, Nepal Earthquake of 2015, are unending. Indian Armed Forces timely response brought the situation in Leh under control after it was hit by flash floods during August 2010, since they had **sufficient logistic backup**. Truly the Indian Armed Forces have **risen on all occasions** and have shown "**extraordinary dedication to the call of the hour**".

Assistance Provided by Armed Forces. The Armed Forces may be called upon to render following type of assistance during natural calamities:-

- Evacuation of stranded victims to safer areas.
- Medical assistance.
- Transportation of relief material.
- Establishment of relief camps.
- Construction / Repair of roads / bridges.
- Maintenance of essential services like communication etc.
- Infrastructure for Command and Control.

(http://www.ukessays.com/essays/tourism/role-of-armed-forces-during-disaster-relief-tourism-essay.php)

Principles of Employment of Armed Forces: The basic principles of judicious employment of Armed Forces in disaster relief operations are as under.

- **Judicious Use of Armed Forces:** Assistance by Armed Forces should be requisitioned only when it becomes **absolutely necessary** and when the situation cannot be handled by the civil administration from within its resources. However, this does not imply that the response must be graduated. If the scale of disaster so dictates, all **available resources** must be requisitioned simultaneously.
- **Immediate Response:** When natural and other calamities occur, the **speed** for rendering aid is of paramount importance. Maximum lives are generally saved during the "**Golden Hour**" which is generally not wasted by the Armed Forces. It is clear that, under such circumstances, prior sanction for assistance may not always be forthcoming. In most cases, when approached for assistance, the Army has always been providing the same **without delay**
- **Command of Troops:** Army units while operating under these circumstances continue to be under command of their own commanders, and assistance rendered is based on **task basis**.
- **No Menial Tasks:** While assigning tasks to troops, it must be rendered that they are not **employed** for menial tasks e.g. troops must not be utilized for disposal of dead bodies.
- **Requisition of Aid on Task Basis:** The assistance should not be asked for in terms of number of columns, engineers and medical teams, the- civil administration should **spell out tasks**, and leave it to army authorities to decide on the force level, equipment and methodologies to **tackle the situation**.

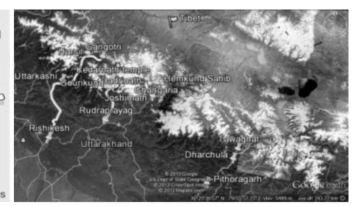
- **Regular Liaison and Co-ordination:** In order to ensure that optimum benefit is derived out of Armed Forces employment, regular liaison and coordination needs to be done at all levels and contingency plans made and disseminated to the lowest level of civil administration and the Army.
- **Advance Planning and Training:** Army formations located in areas prone to disaster, have detailed plans worked out to cater for all **possible contingencies**. Troops are generally well briefed and kept ready to meet any contingency. Use of the **Vulnerability Atlas** where available is also made.
- **Integration of all Available Resources:** All available resources, equipment, accommodation and medical resources with civil administration, civil firms and NGOs needs to be taken into account while evolving disaster relief plans. All the resources should be **integrated** to achieve **optimum results**. Assistance from outside agencies can be **superimposed** on the available resources.
- **Early De-requisitioning:** Soon after the situation in a disaster-affected area has been brought under control of the civil administration, Armed Forces should be de-requisitioned.

Indian Army plan during the rescue and relief operation in Uttarakhand Tragedy 2013: The Indian Army Central Command under "**Operation Sahayata** / **Operation Surya Hope**" was responsible for the relief and rescue operations. Army divided the affected areas into **four axes** or sub sectors:

- Rishikesh - Uttarkashi - Harsil - Gangotri axis
- Rudraprayag - Kedarnath axis
- Joshimath - Badrinath axis
- Dharchhula - Tawaghat axis and Pithoragarh district in Kumaon division.

(https://en.wikipedia.org/wiki/Operation_Surya_Hope)





Indian Army Central Command Affected areas of Uttarakhand




Uttarakhand Tragedy 2013 – Indian Army Rescue and Relief operation "Op Sahayata"

Guidelines of the Rescue and Relief Ops – "Op Sahayata": The Armed Forces were called upon to render following **type of assistance** during Uttarakhand Tragedy 2013:-

- Evacuation of stranded people to safer areas / Rescue the victims and stranded people.
- First aid / Medical care / Minimise the casualties / Prevention of further casualties.
- Establish of relief camps with overhead shelters, food, clothing and sanitation
- Transportation of Relief Material.
- Proper accounting of stranded / dead personnel / hand over same to civil administration.
- Establish of trauma centres for those who lost their loved ones.
- Provide communication facilities for stranded personnel to make immediate calls.

- Repair of damaged bridges and roads / Construction of temporary new bridges and roads / tracks to join disconnected villages.

Principles of Management implemented in Disaster Management by Armed Forces: The management principles implemented by Indian Armed Forces in "**Op Sahayata**" during Uttarkhand Tragedy 2013 were as under.

- **Bureaucracy Approach**:The Commanders at all levels implemented the plans with **iron hand**.
- **Division of Wk**: The overall objective was **divided** into smaller objectives at each level and the same was further sub divided down below.
- **Unity of Command:** Instructions were always received from **one superior** only.
- **Unity of Direction**: Complete Indian Army works only for **one goal** set by the Government.
- **Responsibility & Authority**: Huge **responsibility** with adequate **authority** was given all levels and no excuses were accepted for non completion of the assigned task.
- **Discipline**: Total discipline was maintained by all, all times and at all places with the sole aim of achieving the objective. **No case of indiscipline / insubordination was accepted** at any cost.
- **Order**: People / Material were maintained and **accounted properly**. The right man for the right job was always selected.
- **Centralization**: There was only **one central source of power** i.e GOC-in-C, Command.
- **Scalar Chain**: To avoid confusion of orders the information **flowback** (feedback) was same as that of the information **flowin** (orders). However commanders at all levels **interacted** with their counterparts to ensure better coordination of all operations.
- **Initiative**: Initiative at all levels especially from people on ground was **encouraged** so as to do the job better, faster, effectively and responsively. **Regular precise meetings** at all levels on daily basis ensured that the task was performed better.
- **Espirit-de-Corps**: The complete Army was thoroughly **convinced of the cause** for which they were there and they knew the whole **nation trusted them** with the task.
- **Equity**: Each soldier had a share of the **overall respect** earned by the Army from the nation.

Humanitarian and Supply Chain Management: Humanitarian and Supply Chain management formed a very important aspect of Disaster Management operations which were efficiently and effectively used by the Armed Forces to its maximum potential.

- **Responsive System**: Cost was not a consideration, **timely relief** was more important.
- **Pull process** was followed for demand of rations, clothing, tentage, medicines, fuel etc. However preparation like placement of "**Disaster Relief bricks**" before any such tragedy was **Push process**.
- Each of the axis had their own **complete logistic backup** / **supply chain**.
- **Central depots** were already available at **nodal points** which were beefed up fully from mother depots on regular basis.
- **Important relief materials** which were required immediately were **air lifted** and other less imp materials were despatched by road to the closest depot.
- **Hub and spoke model** was used where all **road axes** had a central depot from where all the dependent axis were fed.
- On the first day itself the **approx requirement** of rations, clothing, tentage, medicines, fuel etc was calculated based on inputs from the state authorities.
- Indian army troops on rescue missions were given **dry rations for 96 hours** to stay self sufficient which they carried with them.

- No stranded personnel were left to starve despite the fact that many army personnel **went hungry** during the rescue ops. However **this was done with pride**.




Lessons Learnt

- **Awareness**: **Educating** the masses at **all levels** for example at community level, district level etc. Compulsory basic disaster management in curriculum.
- **Timely seeking of Armed Forces assistance**. **Three crucial days** were lost and there were missteps in the search, rescue, and evacuation priorities.
- Development versus **environment balance** to be maintained.
- The Armed Forces performance and **discipline**, in the response to the Humanitarian crisis was widely applauded. Lessons learnt from the Armed Forces as regards **dedication**, discipline and **service before self** were implemented by all.
- The **NDMA** became very important and more **NDRF Bns** were raised.
- The **tourism industry** though was in shambles was **regulated**.
- **Disaster Management** became an important aspect in all Government's budget planning and became a **training curriculum** for all Government officials.
- **Environmental clearances** were made **compulsory** for all projects beyond a certain area.

Drawbacks of the Existing System in Employment of Armed Forces. In Uttarakhand Tragedy 2013, the Army and Civil coordinated response along with the intimate interaction was responsible for the **successful accomplishment** of the task. It was proved once again that in a disaster scenario, for speedy rescue, relief and rehabilitation of victims, **perfect synergy** of capabilities between the elements of the Army and Civil is must. The deployment of Indian Army under "**Op Sahayata**" in Uttarakhand in 2013 highlighted certain problematic areas which need to be addressed:

- **No Representation at the Apex**. Despite an **important role** played by the Indian Army in all rescue / relief operations in the country there is **no representative** of Indian Army in the **National Crisis Management Committee**, which only consists the Secretary of Ministry of Defence as member.
- **Lack of Joint Planning**. Since the Army units are **not place bound**, move every two to three years as per their peace / field profile it is absolutely necessary for the civil administration to identify the threatened / sensitive / high risk areas, to include the type of threat along with the local military which is **not being done** as of now. This is alarming since they do not have any **previous background knowledge** of the place.
- **Resource Management**. The major drawback in disaster management has been one of resource management, both of human resource and of equipment. Due to **ignorance** of each other's resources, lots of precious lives are lost and also leads to **duplication of efforts**.
- **Lack of Joint Meeting**. Due to nature of work and busy schedule on routine basis of people at the helm of affairs, the Military and Civil administration **hardly meet**, the gravity of which is realised only after the disaster strikes.
- **No Sharing of Information**. It is absolutely necessary to share the information at the very outset, since **divulging of information in piecemeal**, adversely affects the preparation of the critical plans.
- **No Rehearsals and Mockup Exercise**. Pre-disaster mockup exercises are **rarely**

- **conducted** at any level. It is a must to set the ball rolling in this direction since laxity in this issue would result in loss of "**Golden Hour**" and the affected common man has to suffer till both the agencies put their **act together** which takes considerable time.
- **Location of Area of Responsibility**. Disaster profile of the nation is not the **prime factor** for the **stationing** of Army units. The far away area of responsibility of military units prohibits frequent liaison visits which is resource / time consuming finally leading to a certain degree of **communication gap** between the two agencies.
- **Ego Clashes**. The harmonious environment between the Army and Civil is always disturbed by the "**One Man ship**" factor which is a major irritant. Ego clashes that each one is superior to the other can be avoided by **proper interaction** between the two agencies.
- **Bureaucratic Delays**. The procedures of Civil administration which are slightly cumbersome can be amended so as to avoid delays at all levels.

The above lacunae in the present plans of disaster management are **not so grave**, hence can be resolved amicably by deliberate thought process in the right perspective by both the agencies so as to increase their **efficacy and synergy**. However the system to provide rescue and relief at the earliest has follow the **"KISS" (keep it simple and straight)** formula, so that each one is aware of what to do in the given time frame. These were some of the alarming lacunae in the present system of our plans of disaster management.

Conclusion

Natural disasters cause a massive loss of lives / property / agricultural crops along with large-scale displacement of population leading to severe economic burden. Indian Armed forces disaster management operations offered several lessons to learn. Some of which are:-

- **Response time**. The most prime aspect of an effective disaster management is the response time. Any delay in response time would lead to loss of "**Golden Hour**" when maximum lives can be saved which was realised by the Indian Armed Forces and hence there was no delay in implementation of the plans. The plans were put in place in less than an hour which was possible only because the Armed forces had disaster and emergency preparedness plans in place, stocks of relief supplies were available and **periodic training** / drill of the personnel along with the medical corps was undertaken as a routine.
- **Prompt activation of disaster management plan**. Due to proper command / coordination structure of the Indian Armed forces, along with the Standard Operating Procedures (SOPs) and training, they have always **efficiently managed** the disasters, since the same were activated **without any time lag**.
- **Hospitals** which were an important link in the chain of disaster response played a vital role in mass casualty management especially by the **Military Hospitals**. They were **very forthcoming** and assumed great importance, as advanced pre-hospital care capabilities lead to improved **survival rate**.
- **Standard operating procedures** (SOPs) and disaster preparedness plans need to be prepared for the civil administration and the health systems with focus on **Quick Response Teams** inclusive of healthcare professionals, rescue personnel, fire-fighting squads, police detachments, ambulances, emergency care drugs, and equipments. These teams should be **trained** in a manner so that they can be activated and deployed within an hour following the disaster.
- **Effective communication system** is of paramount importance in coordination of relief operations. In the Uttarakhand Tragedy, although the main network with the widest connectivity was **extensively damaged**, the Armed Forces communication system along with the other private mobile network **tided over the crisis**. It took over 10 days for reactivation of the main mobile network through satellite communication system.
- Disaster management involves a number of departments / agencies spanning across various sectors of development. The National Disaster Management Authority of India, set up under National Disaster

Management Act 2005, has developed **disaster preparedness** and **emergency protocols**. It would be imperative for the civil administration at the state and district levels in India to develop their disaster management plans using these protocols and guidelines.

- **Training** is an integral facet of capacity building, as trained manpower **respond much better** to calamities and is able to appreciate the need for preventive measures. Training of healthcare professionals in disaster management holds the key in successful activation and implementation of any disaster management plan.
- **Building confidence** of the public to **avoid panic** situation is critical. Community involvement and awareness generation needs to be emphasized. Increased public awareness is necessary to ensure an organized and calm approach to disaster management. Periodic **mock drills** and exercise in disaster management protocols in the general population can be very useful.

Over the years, the Indian Armed Forces involvement in aid to civil authority **has been increasing** and the administration too has steadily increased its **dependence** on the Armed Forces resources. Government of late, has **arrested this trend** and has reviewed its policy, which now envisages the development of a more self reliant administrative structure, through a **pro-active strategy**. However, the Armed Forces continue to maintain themselves in a **high state of preparedness**, so as to save that **crucial day for the Nation**. Therefore there is a need to factor the employment philosophy of Indian Armed Forces in the national disaster mitigation plan so as to employ them in a more effective fashion to augment the civil disaster mitigation effort.

Uttarakhand Tragedy 2013 has also sounded an **alarm bell** that to pursue development without concern for the **fragile Himalayan environment** is to invite disaster. **Eco-sensitive development may mean a slower monetary growth rate but a more sustainable and equitable one**.

"HELP EVERYONE SO MUCH THAT EVEN GOD WILL WONDER WHETHER I CREATED THIS PERSON IN MY HEAVEN OR HE IS THE ONE WHO IS RECREATING ME ON EARTH"

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SONAR SYSTEMS WITH REFERENCE TO DISASTER MANAGEMENT

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Abstract

For effective mitigation of undesirable trends or effects of natural disasters in coastal areas, it is necessary to critically analyse the coastal and near shore areas for the causes and impact. Natural or manmade disasters are occurring at coastal areas and offshore regions, severely affect the marine ecology and socio-economy. Ocean Modelling and sonar systems play a significant role, particularly in prediction, preparedness and recovery operations to some extent in the marine and coastal disaster management. Offshore mining, oil sleeks, shipwrecks, dredging activities, offshore constructions, channel clearance, dumping of dredged material have direct/indirect impact on environment. Indirect impacts also manifest through a knock-on effect from reduced economic resources caused by the disaster and disrupted ecosystems.The present paper highlights various types of marine hazards and lays down the strategies for disaster management with an emphasis on the role of sonar systems and their variants used both in civil and military applications such as recovery, reconstruction, search operations, monitoring and environment assessment. It is also important to create awareness of availability and utility of such hi-tech equipment in disaster management operations.

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Introduction

A Disaster is a serious disruption of the functioning of a society, causing widespread human, property or environmental losses which exceed the ability of the affected society to cope using only its own resources. Disasters in coastal areas can be due to either natural hazards or manmade. The effect of a disaster on populations may either be direct or indirect.

Natural disasters can be categorised into three major types i.e. geological, biological and meteorological. Earthquakes, volcanoes and resulting landslides, snow avalanches, coastal flooding, and ocean process like storm surges, tsunamis etc are categorised as geological disasters, while disease epidemic and epizootics like malaria invasion area by insects etc come under biological disasters. Floods, lightning strikes and resulting fires, droughts, thunderstorms, tropical cyclones, tornados, hailstorms, sandstorms, frost, etc due to extreme climatic events are classified as meteorological disasters. At times the disasters are as a result of a combination of two or all three of these processes. Artificial and manmade disasters are mainly associated with the accidents and activities in coastal areas as well as offshore regions, which severely affect the marine ecology and socio-economy.

For example offshore mining, oil sleeks, shipwrecks, dredging activities, offshore constructions, channel clearance, dumping of dredged material have an indirect impact on various aspects of economy and environment. Indirect impacts are through a knock-on effect from reduced economic resources caused by the disaster and disrupted ecosystems. Surface processes or land use/cover changes (agriculture, mining) can cause river flooding, soil erosion, mudslides (collapsing soils) water and soil pollution.

Disaster Management

For an effective disaster management & planning, various activities associated with preparedness, mitigation or prevention, recovery and response have to be strengthened. It requires acquiring relevance data, effective knowledge management, dissemination and execution using contemporary technology. Besides, hazard analysis, hazard mapping, vulnerability assessment, warning systems, timely and accurate forecasts and warnings of natural hazards coupled with adequate local preparedness planning are fundamental requirements for disaster reduction. Natural disasters due to geological or meteorological or combination of these process, particularly, storm surges, cyclones, earthquake and tsunamis cause major devastation in the coastal regions and nearby offshore regions.

Relevance of Sonar Systems to Coastal Disaster Management

Sonar (an acronym for Sound Navigation and Ranging) is a technique that uses sound propagation (usually underwater, as in submarine navigation) to navigate, communicate with or detect objects on or under the surface of the water. Sonar uses piezoelectric ceramics made of lead zirconate titanate (PZT) as a pressure sensor material. PZT crystals will generate measurable piezoelectricity when their static structure is deformed by about 0.1% of the original dimension due to any pressure acted upon.

Civilian Applications

Sonars have been highly exploited in tsunami detection systems, identification of seismic zones, marine geophysical studies, marine archaeology, underwater communications, marine ecology studies, dredging, offshore construction, search operations for shipwrecks and offshore engineering applications. Possibility of usage of a sonar depends on the need and extent of damage that happens near off shore regions. Therefore sonars play significant role in generating vital underwater environment data essential for disaster management, in preparedness, recovery, rebuilding, monitoring, and damage assessment directly or indirectly to both marine and human life.

Earthquake and Tsunami

Earthquake : As on today, there are no means of prediction of earthquakes, but one can identify the probable regions of their occurrence by mapping the past events and continuous monitoring of seismic intensity. The seismicity maps reveal that the regions of lithospheric plate boundaries defined by plate tectonics, are associated with the most of the earthquakes reported.

Tsunami : A series of travelling ocean waves of extremely long length generated primarily by earthquakes, volcanic eruptions, or landslides occurring below or near the ocean floor. Tsunamis are a threat to life and property for all coastal residents living near the ocean. Although 80% of the tsunamis occur in the Pacific, they can also threaten coastlines of countries in other regions, including the Indian Ocean, Mediterranean Sea, Caribbean region, and even the Atlantic Ocean. Therefore a knowledge of spatio-temporal variability in oceanographic parameters is essential to continuously monitor the ocean conditions. Due to constraints in real time monitoring of these parameters over a large area, a limited network of pressure sensor arrays/sensor buoys deployed at strategic location can provide a reasonably good information in conjunction with oceanography prediction models. These models based on theoretical /climatological data are being continuously updated and validated for better predictions.

Detection of Tsunami generation through a network of 10-12 bottom pressure recorders (that could detect and measure a change in water level of 1 cm at water depths of up to 6 km of water) around the tsunamigenic zones. Based on the intensity levels of the earthquake, and observed pressure changes and geographical location, possibility of Tsunami and its level will be assessed instantaneously from readily available scenarios.

Bathymetry, Seafloor Topography Mapping

It is important note that any oceanography phenomenon/ process and their spatial extensions/variability highly depends on the geographical location, seafloor morphology, continental slope particularly at shallower/coastal regions. Therefore, high resolution bathymetry information defining the topography is key input to any ocean model. Preparation of hazard maps for different scales of ocean conditions for specific earthquake intensity levels have to be prepared for vulnerable regions to get better preparedness and planning. Different variants of sonar are being used for acquiring the basic information on seafloor and subsurface geophysical information such as seafloor topography features, bathymetry, subbottom structure, etc. Similar data acquired at offshore coastal areas are useful in preparedness and hazard analysis and recovery applications apart from other civilian applications and environmental studies. Different applications of sonar are given in the following.

Civilian Applications

Sanjeevani – Life Saving Detector Sonar

Naval physical and Oceanographic laboratory, DRDO has developed a portable handheld sonar device to sense even a very week acoustic signals generated from human breathing. The device has been customised and successfully used to save a few people trapped under debris during Lathur earthquake and other instances. The equipment was productionized through M/s Keltron and supplied to many organisations for using in disaster management.

Fisheries - Detection of Fish Population Density: Echosounder (HF)

Acoustic technology has been one of the most important driving forces behind the development of the modern commercial fisheries. Sound waves travel differently through fish than through water because a fish's air-filled swim bladder has a different density than seawater. Today, commercial fishing vessels rely almost completely on acoustic sonar and sounders to detect fish. Fishermen also use active sonar and echo sounder technology to determine water depth, bottom contour, and bottom composition.

Seafloor Topography, Features, Navigation and other Geophysical Applications

Single beam echo-sounder: This sends an acoustic pulse directly downwards to the seabed and records the returned echo. Based on the travel time of the returned signal, the depth of the seabed is estimated. This is a very common acoustic device installed on board any ship/boat for safe navigation to provide depth along the track. Both hullmounted and portable echosounder are available and cost effective. For coarse bathymetry measurement along ship track or in area these are most suitable.

High Resolution Bathymetry: Multibeam Echosounder System

Unlike single beam echo-sounder, multibeam echo-sounder, provides a swath coverage of approximately five time the depth along the track. It is possible to map the seafloor topography at high resolution and even it can map seafloor features of a few centimetres dimension. High resolution data are in great demand for both military, civilian applications and scientific studies.

Search Operations -Seafloor Imaging: Side Scan Sonar System

Side scan sonar is used to derive maps of the topography of an area by moving the sonar across it just above the bottom. It provides high resolution seafloor image based on the backscatter intensity levels. Therefore it is capable of distinguishing the objects by its smoothness, soft/hardness apart from the dimensions of the target. High frequency sonars (500-900kHz) provides highe resolution of the order of centimetre comparative to low frequency sonar(50-100kHz). The backscatter information obtained from these sonars used for classification of the objects. Even it can map the density of flora and fauna. Some side scan sonars are forward looking, fitted near the bow of the ship used in mine hunting in military application.

Search operations, wreckage identification, monitoring dredging, u/wcable/pipe routing, conditions, assess the dames of underwater structures are the other applications. Changes in the seabed sediment type can be mapped. Any changes in the sediment and its turbidity will cause the depletion in nutrients availability and, affect the fishing and marine life. Tsunamis can cause change in the seafloor geology by transportation of large amount of sediments to shallower regions, resulting severe effect on marine flora and fauna.

Estimation of Sediment Thickness and Layering/ Siltation: Sub-Bottom Profiler

Powerful low frequency echo-sounders (subbottom profilers) have been developed for providing profiles of the upper layers of the ocean bottom. These can be used to assess the subbottom structure, layering and their thickness. This provides information on the neotectonic activity in shallow layers, which can be used to study the dynamics of sedimentation/siltation in the vicinity. For offshore geotechnical studies, the information is vital for any construction for its stability.Tsunami like hazard can cause large sedimentation making obstacle in navigation and at times causes severe changes in underwater dynamics leading to other process like soil erosion.

Under Water Currents: ADCP

Acoustic Doppler Current Profiler (ADCP or ADP) is a sonar that attempts to produce a record of water current velocities for a range of depths. ADCPs to accommodate a range of frequencies from 38 kHz to several megahertz.ADCPs are currently used for oceanography, estuary, river and stream flow measurement. ADCP is used in diverse ways, from locating underwater "tornadoes" that might damage deep water oil drilling activity, to measure water flow through sewer pipes.

Seismicity: Ocean Bottom Pressure Sensors (OBP)

These have effectively being used to measure the pressure variation in water near the sea bottom deployed in vulnerable regions of seismic activity and in prediction tsunamis.

Navigation to UUV/ROV & Ship Velocity Measurement

Sonars have been developed for measuring a ship's velocity either relative to the water or to the bottom. ROV and UUV Small sonars have been fitted to Remotely Operated Vehicles (ROV) and Unmanned Underwater Vehicles (UUV) to allow their operation in murky conditions. These sonars are used for looking ahead of the vehicle. The Long-Term Mine Reconnaissance System is an UUV for MCM purposes.

Vehicle Location: Acoustic Beacons

Sonars which act as beacons are fitted to aircraft to allow their location in the event of a crash in the sea. Short and Long Baseline sonars may be used for caring out the location, such as LBL.

Biomass Estimation: Side Scan Sonar

Detection of fish, and other marine and aquatic life, and estimation their individual sizes or total biomass using active sonar techniques. As the sound pulse travels through water it encounters objects that are of different density or acoustic characteristics than the surrounding medium, such as fish, that reflect sound back toward the sound source. These echoes provide information on fish size, location, abundance and behaviour.

Monitoring the Dynamics of Marine Ecosystem and Assessment

Eco-acoustics is a relatively new inter-disciplinary science that involves ecology and acoustics. It differs from the closely related field of bioacoustics, measuring the acoustic properties of a whole environment (instead of isolating one life form or another) in order to understand the complex dynamics of an ecosystem. It can be very useful in tracking populations of fauna that would be otherwise nearly unmeasurable.

Eelgrass is a vital aspect of many coastal ecosystems as it provides productive habitats for fishery resources. With the threat of global climate change comes the need for a more comprehensive understanding of marine ecosystem. Side-scan sonar imagery, towed/ROV video observations and acoustic seafloor classification techniques are easily integrated to delineate and study eelgrass beds.

Military Applications

Two types of technology share the name "sonar", ie.,passive sonar and active sonar.Passive Sonar : Passive sonar, as the name implies, simply involves listening. Marine biologists use passive sonar techniques to locate and study life in the oceans. Ships and submarines use passive sonar to locate ships and subs and other threats.

Active sonar: Active sonar uses a sound transmitter and a receiver. When the two are in the same place it is monostatic operation. When the transmitter and receiver are separated, it is bistatic operation.

Warfare

Sonar plays a major role in naval operations, used for detection of submarines, torpedoes, mines and in navigation.Modern naval warfare makes extensive use of both passive and active sonar from water-borne vessels, aircraft and fixed installations. The relative usefulness of active versus passive sonar depends on the radiated noise characteristics of the target, generally a submarine.

Underwater Mines

Mines Sweepers are fitted with a sonar are used to detect, localize and recognize the required target. Mine Countermeasure (MCM) Sonar, sometimes called "Mine and Obstacle Avoidance Sonar (MOAS)", is a specialised type of sonar used for detecting small objects. Most MCM sonars are hull mounted but a few types are VDS design (Mine Sweepers)

Anti-Submarine warfare

Until recently, ship sonars were usually with hull mounted arrays, either amidships or at the bow. Towed arrays (linear) or variable depth sonars (VDS) with 2/3D arrays altogather enhance capability of detection in complex scenarios.

Underwater Security/ Harbour Surveillance Systems

Sonar can be used to detect frogmen and other scuba divers. This can be applicable around ships or at entrances to ports. Active sonar can also be used as a deterrent and/or disablement mechanism.

Submarine Navigation

Submarines rely on sonar to a greater extent than surface ships as they cannot use radar at depth. The sonar arrays may be hull mounted or towed.

Conclusion

Sonars have been well exploited for both civil and military applications at different circumstances either during peace or in emergency. Sonars play significant role at different stages of disaster management, particularly in case ocean related hazards. Sonar data provides vital information in improved hazard analysis and hazard mapping and helps in regular assessment and better planning of offshore coastal regions as part of preparedness and recovery operations.

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DISASTER HANDLING PREPAREDNESS INDIAN RAILWAY'S LESSONS

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Abstract

Best of preventive measures cannot ensure that disaster would not happen. Therefore it is essential to be prepared for emergency response through having an effective "Disaster Management Plan", backed by provision of adequate support capacity and empowered delegation to enable response team to tackle the situation.The Plan should serve the primary purpose of making all concerned personnel aware of their emergency roles and duties, equipping them with ready information to provide a fast well co-ordinated disaster response.Plan should be supported by provision of requisite infrastructure, reserved and kept spare in readiness for emergency and otherwise.Human disaster support, to act as per plan and to operate the provided infrastructure, also needs to have special empowerment which should kick in automatically should the need arise.Indian Railways emergency response system has all these elements. The system is also periodically rehearsed to test response and readiness, and can serve as a base for other organisations.

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Introduction

Indian Railway (IR) is the principal mode of transport of the country. For last over 160 years, IR, in its various forms, has played a vital role in the overall development of the country and national integration. IR has a vast network of more than 65000 route kilometres, moving an average 3 million ton of freight and 23 million passengers per day with the assistance of over 1.3 million direct employees. In any national level crisis, where major transport requirements are envisaged, IR will have to play an important role. IR itself can also get involved in a crisis situation having national level repercussions needing assistance of other ministries/ departments of Govt. of India and / or State.

With such a historical background IR has evolved time tested practices and procedures to ensure safety of passengers and freight entrusted to it for transportation. Its safety record compares favourably with the best in industry. However, best of preventive measures cannot ensure that disaster would not happen. Therefore it is essential to be prepared for emergency response through having an effective "Disaster Management Plan", backed by provision of adequate support capacity and empowered delegation to enable response team to tackle the situation.

This paper intends to share with the participants the Indian Railway experience towards having an effective disaster management mechanism in order to help them in developing required capacities and capabilities, as well as to gain from their expertise to further bring about improvements required.

Disaster Management Plans on Indian Railways

Indian Railways is structured with Railway Board at apex level as the policy making and monitoring unit, with mainstream operations organised in the form of 16 Zonal Railways. These zones are further having Divisions as the smallest complete operational entity with a Zonal Railway having minimum three to a maximum of six divisions. The command and control flows from the Railway Board.

The Disaster Management Act, 2005 has widened the definition of disaster by including those events which require co-ordination, cooperation and assistance from non railway organization also. The object of

Disaster Management Plan is to create a defined drill so that in case of such an unforeseen eventuality, the consequences to people's lives and property may be minimized.

Therefore, the Government of India, Ministry of Railways, Railway Board has spelt out its "**Crisis Management Plan**" (CMP) to deal with **National level crisis** situations. Different kinds of crisis situations have been identified including where Railways have to help other ministries by way of rail transport.

CMP clearly spells out the authority to deal with specific situations, instructions to deal with crisis situation and contact details of relevant personals. The instructions include flow of information and crisis specific actions. Similarly, the relevant contact persons are organised specific crisis wise for ease of access.

The CMP is followed by "**Zonal Disaster Management Plan**" (ZDMP) at the Zonal Railway level to serve as an aid in achieving a quick disaster response. The ZDMPs incorporate guidelines on management of different type of disasters from CMP. It also provides useful information for handling other natural calamities viz. Floods, Earthquake, Cyclone, Landslide, Chemical and Nuclear disaster, fire and man-made disaster like terrorism etc.

The ZDMPs are designed to serve its primary purpose of making all concerned railway personnel aware of their emergency roles and duties, and equip them with ready information to provide a fast and well co-ordinated disaster response in face of a railway accident or any other calamity to save precious lives and ensure immediate attention to injured persons in case of a railway mishap. Efforts are made for compiling as current a statement as possible with a view to ensure least response time in case of mishap. **Salient features of ZDMP of Northeast Frontier Railway (NFR) are brought out in annexure 1.** Based on ZDMP each division of a railway has its own disaster management plan at the divisional level.

Indian Railways has its own chain of hospitals, primarily for health care and well being of its employees. The hospitals also follow similar chain, with a Central Hospital at New Delhi, and at Zonal Headquarters as well as Divisional headquarters. Hospital care is central to any disaster relief. Therefore these hospitals have also have their own **Hospital Disaster Management Plans**.

Train accidents include mishaps like collision, derailment, fire in train, road vehicle colliding with trains at level crossings. These are further classified in terms of Major Train Accident or Minor Train

Accident in terms of loss of human life or injury, damage to railway property or interruption to rail traffic above or below certain pre-specified threshold levels. The detailed guidelines for managing railway accidents are mentioned in **Accident Manual** of each Zonal Railway, which brings together in a comprehensive manner all the procedures, rules and regulations for dealing with train accidents.

One of the most important aspects to reduce evacuation of the victims / injured persons to nearby hospitals in case disasters occurs, contact information for nearest hospitals is updated after verification. This helps Railways to plan activities at the time of crisis and handle them efficiently.

In the event of a serious accident for arranging quick evacuation of critically injured passengers to the nearest well equipped hospital in the region, a list of possible emergency helicopter landing locations near the railway track for all the Divisions of N.F. Railway is also provided.

Indian Railways, being a Government of India unit, has a written delegation of financial powers, **Schedule Of Powers** (SOP). It also has simplified and enhanced SOP, in case of accidents, emergencies and disasters, which automatically kick in according to the circumstances. The SOP for Accidents and Emergencies is regularly revised and updated whenever fresh delegation is communicated from Railway Board or if an emergent need is felt as a consequence of experience gained out of an incident. For reference purpose sample edited pages of **SOP of NFR are placed at annexure 2**. It can be seen that sections have been structured as Safety, Accident and Emergencies and Disaster Management for ease of reference.

The Crisis Management Plan at Railway Board level, Zonal Disaster Management Plans at Zonal Railway level, Divisional Disaster Management plans at the level of Divisions and Hospital Disaster Management Plans are reviewed and revised every year to incorporate latest developments including updated locations of relief & rescue related railway and state government infrastructure, and contact details of concerned authorities.

Support Infrastructure for Disaster Management:

The objectives to be achieved in case of a train accident are:

- Save life and alleviate suffering,
- Protect property including mails,
- Provide succour and help to other passengers at the site of accident,
- Ascertain cause of the accident, and
- Restore through lines of communication.

In order to make the above expeditiously possible, **all railway resources in men and material, as warranted specific to the situation, are required to be promptly made available**. This is **legislated as written instructions**. It is also strictly observed should the situation so require.

In case of a railway accident, railway's rolling stock, being of special nature, requires special equipment to clear the site. Railway tracks also pass through non-habited zones. Therefore, IR has provided specialised rail mounted Accident Relief Medical Vans (ARMVs) and Accident Relief Trains (ARTs). These can be either self propelled (SPARMVs / SPARTs) or locomotive hauled. The self propelled units are highly mobile with superior speed potential. Therefore increasingly these units are being provided to replace conventional units except in case of ARTs having heavy lift 140T crane in its composition.

The Accident Relief Medical Vans (ARMVs) are specialised two or three coach units. In a two-coach format one coach has emergency medical relief including a mini operation theatre, while the other coach carries required rescue equipment including portable hydraulic and / or electrical cutters to cut open railway coaches for rescuing trapped passengers should the need arise. The third coach in three-coach format is used to carry additional equipment and staff.

Depending on the location of the accident, ARMVs may not be able to reach the site within the "golden hour" considering the fact that these are rail mounted and located at the stations where railways have suitably trained staff to maintain and operate these units. Movement to the site of accident is also dependent on their distance from site and several other factors including obstruction of the railway tracks due the accident.

Keeping above in view Railways have co-ordination with various non-railway, government / non-government agencies so that their resources can be requisitioned immediately to help the affected persons. This information has been made a part of ZDMPs. The Disaster Management Act 2005 envisages participation by all stake holders based on their expertise. It has also been the experience that the golden hour is invariably managed by few on-board railway staff, railway staff working in vicinity, unaffected train passengers, local police and fire brigade, local hospitals and doctors and other rescue workers in the nearby areas.

The Accident Relief Trains are provided with necessary re-railing / handling equipment to clear the site of accident. These are also equipped with bare requirements so as to attend to damage to fixed infrastructure at site in order to restore through communication expeditiously. This is to start immediate emergent restoration while the backup is being mobilised and made available.

The location and beat of each ARMV and ART is clearly laid down and well publicised for information of all concerned. This is also available at all control rooms for requisitioning in case of need. ARMV and / or ART of adjoining and other beats can also be requisitioned should the need arise. Whenever any unit is not available for maintenance or any other reason the same is pre-informed to similar adjoining units so as to be available in readiness.

In order to keep ARMVs and ARTs in good fettle and readiness certain minimum staff is available with these, whereas other required pre-nominated staff is normally employed in their regular duties. In case of requirement these staff is automatically called. This system of dedicated staff supported by sufficient trained additional manpower, when needed, ensures provision of requisite resources, reserved and kept spare in readiness for emergency.

Training and Preparedness:

Documentation of procedures, provision of enabling environment and availability of required resources, including manpower does not guarantee a reliable and effective disaster management system. Cyclic training and retraining of manpower, system of periodic inspections of the resource and rehearsing and examination of preparedness through mock drills are essential ingredients of a sound disaster response mechanism.

These all elements are provided in railways disaster response system. The dedicated and nominated staffs for ARMVs and ARTs have specific work assigned to them in case called for. For example if the break down crane has to be brought in use pre-assigned staff by himself takes over the duty of watching supports ensuring stability of the crane. Both kinds of staff is sent for periodic training and knowledge up gradation to zonal as well as divisional training schools. Even the officers are given training on disaster management at National Academy of Indian Railways at Vadodra. Active assistance of NDRF is also being taken for four week training of trainers on disaster management, who in turn becomes nodes for imparting further awareness among frontline staff. Extract from the relevant paras pertaining to disaster management training are at annexure 3 for reference purposes only.

There is a well laid out system of periodic inspections of both ARMVs and ARTs at various levels with frequency increasing from weekly inspections at supervisory level to quarterly inspections at divisional officers level. This is also a scheduled item of inspection during safety audit of the division and / or inspection at zonal level by Principal Head of Department of concerned officer who is invariably an HAG level officer.

The preparedness of system is practiced through "**mock drills**". These are planned/ "surprise" exercises wherein a situation is artificially created and ARMV / ART 'ordered' to carry out prescribed task. The exercise is also carried out at a larger scale involving other participants like NDRF and other stake holders in order to have synchronisation and co-ordination should the need arise. The system is tested for response from time to time by actual ordering of the ARMV and / or ART in day as well as night to check actual response in terms of available of manpower, readiness of system to turn out required unit in specified time etc. Incidentally the prescribed time for turning out ART during day and night is 30 minutes and 45 minutes respectively. Similarly the ARMV is to be turned out in 25 minutes and 15 minutes depending upon single exit or double exit irrespective of day or night.

Conclusion:

Inspite of the best of planning and preparations, real life experiences have a unique way of throwing up surprises. Therefore, preparation for and practicing every action, in the manner army perfects its drills, is required in order to have an speedy and effective response to anticipated disasters and to take care of any contingent action which may be warranted due to typicality of the situation. This requires each experience to be examined for additional learning points and incorporation of the same to further improve the provisions both in terms of disaster infrastructure as well as training procedures.

Let me end with cliché: "Practice makes a man perfect, but life is known to throw surprises". Therefore "Hope for the best but be prepared for the worst".

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TALENT NEEDS ASSESSMENT OF HUMANITARIAN LOGISTICIAN AN EMPIRICAL INVESTIGATION

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Abstract

The last decade has experienced disasters which differ in nature & intensity increasing the vulnerability of the disaster prone areas in India. Though the number is a noticeable one, the disaster management did witness a ripple in different phases of disaster management process. Be it the Indian Ocean Tsunami or the recent Hud-hud Visakhapatnam Cyclone, be it the failure in the pre or post disaster phase, the emergency relief paid a prominent role.

The current study attempts to understand the major competencies required for an emergency relief worker through an extensive review of literature. Also, the job advertisements of relief personnel shall be put through content analysis to rightly assess the competencies that are expected by research and are required by the employers. The study shall be both qualitative and quantitative in nature. The findings of the study can be used as a basic competency model that shall help these organizations to achieve sustainable solutions.

Keywords: *'humanitarian logistics', ' competency models', 'skill development', 'disaster management'*

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Introduction

Ever since the seminal paper of David McClelland (1973), organizational people research moved towards building competencies to achieve a competitive advantage over the competitors. Boyatzis(1982) defines competency as the behavior of the individual which contributes to the improved performance of the incumbent on the job. According to Pickett (1998), competencies are knowledge, skill and attitude combined with experiences which are expressed as an outcome relative to the workplace and not a process.

Since the Indian Ocean Tsunami in 2004 and a series of disasters that followed in the last decade, triggered the nations around the world to focus on emergency relief operations. Be it the cloud burst in Uttarakhand, a cyclone in Visakhapatnam, floods in Jammu & Kashmir or the massive earthquake in Nepal, emergency aid played a crucial role in the disaster management process and so did the emergency relief worker.

In the hyper-competitive environment, there is a need for developing 'mutually reciprocate' approach creating value to both employee and employer. One such model borrowed from the military, by Leavy (2015) mitigates risks for both the stakeholders yet it is beneficial for defined 'tours of duty'. When a disaster strikes, the 'tours of duty' adjust to the situation and might not anytime follow a pattern. This is when the 'tacit knowledge model' helps organizations respond accordingly.

Competencies of Humanitarian Logisticians

Top of the critical success factors (Pettit & Beresford, 2009), an emergency requires gathering skilled workforce to work in teams who almost know nothing about each other but it is the intrinsic motivation that makes them perform better (L. Hester, 2005). In an emergency, the major challenge is to best match the labor supply with right competencies according to the unexpected labor demand. Any model or a human capital strategy (Chapple, 2012) can be proved wrong when the nature and intensity of the disaster is worse and high. Hence it is crucial to hire, develop and retain the "right" person at the "right" time in "right" numbers.

Lack of resources, trained personnel, accurate information or all together worsens the disaster situation converting it into a crisis. Also, providing rapid response following the principles of humanitarian logistics – humanity, neutrality, impartiality (Tomasini& Van Wassenhove, 2004) – makes it more complex requiring the field workers to be 'skilled decision makers'. Lack of competent personnel is one of the major vulnerability factors that impacts the emergency relief besides the location of the disaster, post-disaster environment etc. which led to increased focus of researchers in understanding what kind of competencies make a good relief worker.

Research Methodology

The current research was conducted in different stages.

Stage I: A comprehensive review of literature was conducted through research databases like Proquest, Google Scholar, Emerald etc. and the literature was put through content analysis

Stage II: Job advertisements were collected through the internet using keywords like 'humanitarian worker' emergency relief' 'humanitarian logistician' 'relief worker' etc. 35 such jobs were collected and put through content analysis. In order to eliminate the perceptual differences of in the identification, 53 independent coders were identified who had similar knowledge of identifying competencies from job analysis out of 23 were received (43%).

Analysis of the data

In order to establish a competency framework, the model from Katz(1955) was adopted which contains three main clusters: Human, Technical, Conceptual competencies. However, to make it more relevant to the area of study one more cluster is added i.e., competencies specific to the disaster and the cluster names are renamed as Personal, Technical, Functional respectively. The proposed competency framework of humanitarian logisticians is as follows:

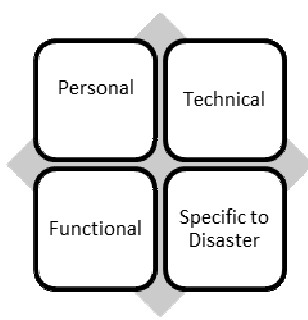

Fig.1: Competency cluster for humanitarian logistician

Stage I

Of the literature review that was conducted, it is understood that researchers have identified certain competencies that are required by the emergency relief worker for the effective rescue of the affected. 26 such competencies were identified. These competencies were not independent to each other

Personal	Technical	Functional	Specific To Disaster
Communication	Analytical Thinking	Coordindation	Knowledge About The Disaster
Interpersonal Skills	Technology	Decision Making	Multi Cultural Sensitivity
Integrity	Financial Literacy	Planning	Previous Experience
Multi Tasking		Compliance	
Empathy		Negotiaiton	
Leadership		Customer Focus	
Personal Credibility			
Adaptability			
Service Orientation			
Mentoring			

Table 1: Competencies identified through literature review

Stage 2

35 job analyses were collected and put through content analysis by 23 independent coders. These coders had enough knowledge of identifying competencies from the job analysis. The data thus collected was compiled resulting in 109 competencies. But it was observed that the coders used different words for similar competencies. Also, there were certain competencies that can be combined into one which converted the 109 into 34 major competencies. These are all independent to each other and were further arranged in the proposed framework as follows.

Personal	Technical	Functional	Specific To Disaster
Integrity	Financial Literacy	Statutory Compliance	Knowledge Related To Disaster Management
Communication	Analytical Thinking	Decision Making	Field Experience
Leadership	IT Knowledge	Coordination (Internal & External)	Multi-Cultural Sensitivity
Openness	Risk Evaluation	Stakeholder Management	
Interpersonal Skills	Attention To Detail (Accuracy)	Resource Management	
Adaptability	Presentation	Capacity Building	
Ability To Prevent Exploitation & Abuse	Documentation	Strategic Orientation	

Service Orientation	Logistics And Supply Chain Management
Stress Management	Business Process Knowledge
Management Conflict	
Mentoring	
Multi Tasking	
Personal Credibility	
Approachability	
Empathatic	

Table 2: Competencies identified through content analysis of job advertisements

Different coders have identified these competencies differently. Each time a competency is identified, a weight is assigned and hence the total weight of all the competencies is calculated. The analysis is illustrated in the following sections.

Personal Competencies: It is observed, from both the literature and the data, that the personal attributes of the worker are given higher importance in the field of emergency relief.

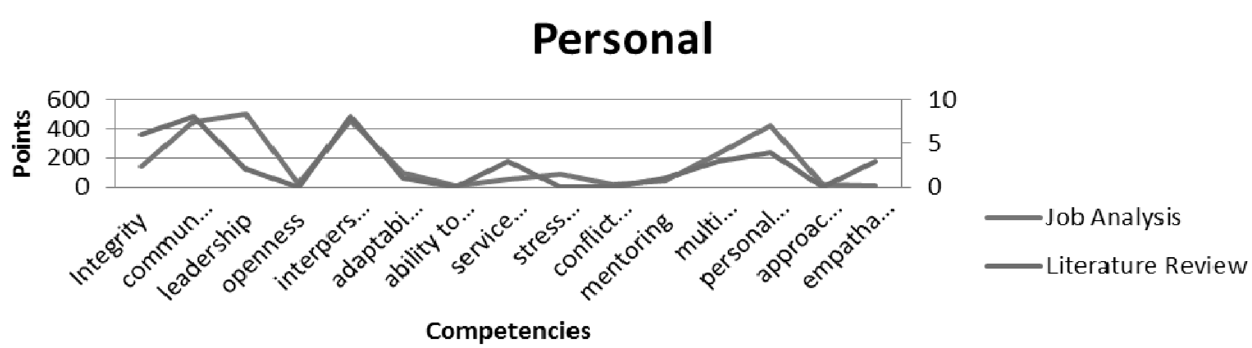

Fig.2 Personal Competencies from data and review of literature

15 competencies are categorized into personal competencies as they define the personal attributes of an emergency aid worker. Considering the relative weights, five competencies were identified the most important and necessary attributes of a candidate to be eligible for being an emergency relief worker.

Technical Competencies: In the era driven by technology, getting things done has been relatively faster and cost effective. However, this is not possible without human intervention. Humanitarian logistics today is driven by technology in the planning, delivery, logistics etc. and hence, these competencies play a critical role.

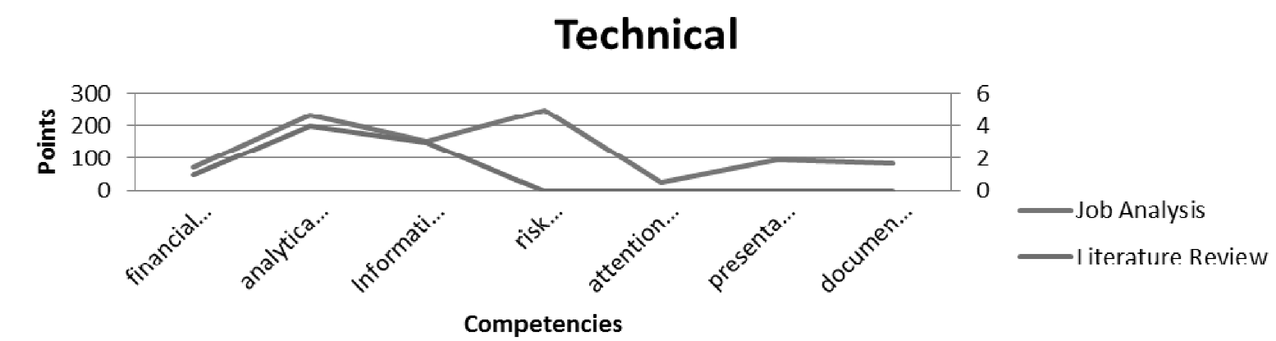

Fig.3: Technical competencies from data and review of literature

7 out of 34 competencies are classified as technical competencies out of which analytical thinking, information technology knowledge and risk evaluation are the most important based on the relative weights assigned by the coders.

Functional Competencies: Humanitarian logistics is a multi-disciplinary management process which includes almost every function of management. The existing literature & job analysis collected also emphasizes on the requirement of functional competencies in the emergency relief worker.

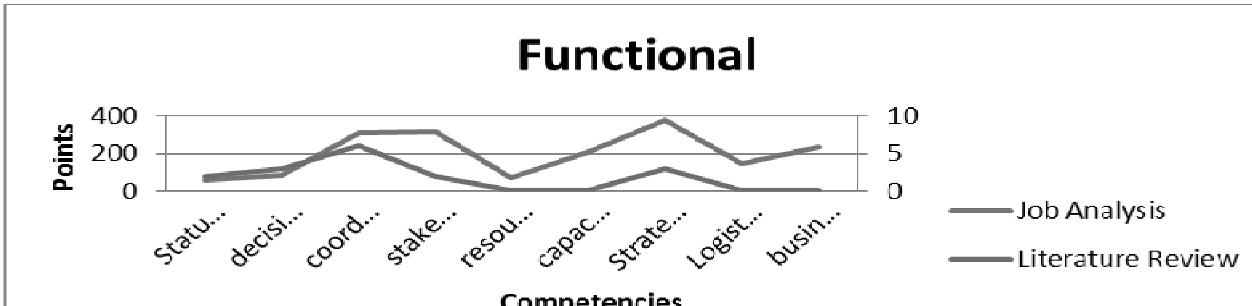

Fig.4:Functional competencies from data and review of literature

Out of the 34 competencies identified, 9 of them are classified as functional competencies relating to different processes in emergency relief. Internal & external coordination, stakeholder management, capacity building, strategic orientation, logistics and supply chain management, business process knowledge are relatively important competencies.

Competencies Specific to Disaster: cyclone, tsunami, drought, floods, chemical accident etc, requires different nature and level of emergency relief based on the character and intensity of the disaster. However, there are certain competencies, which are required for different reasons.

Three competencies were listed under this category out of which knowledge related to disaster management is relatively important.

Fig.5: Competencies specific to disaster from data and review of literature

Hence out of the competency model defined presented in table 2, the relatively important competencies in different categories can be presented as follows:

Personal	**Technical**	**Functional**	**Specific To Disaster**
Communication	Analytical Thinking	Coordination (Internal & External)	Knowledge Related To Disaster Management
Leadership	Information Technology	Stakeholder Management	Multi-Cultural Sensitivity
Interpersonal Skills	Risk Evaluation	Capacity Building	
Multi Tasking		Strategic Orientation	
Personal Credibility		Logistics And Supply Chain Management	
		Business Process Knowledge	

Table 3: Relatively important competencies of humanitarian logistician.

The competencies presented in table 2 are the competencies that are definitely required by the humanitarian logistics organizations identified both from literature and job analysis data. This model can be used by the emergency relief organizations for defining the jobs, selecting the right relief workers, for capacity building of the local communities for effective management of a disaster.

Scope for Further Study

The competencies identified in this study are based on the job analysis and review of existing literature. In real time disasters, the behaviors may differ with respect to the nature and intensity of the disaster. Hence, a study to validate the findings through primary research is required so as to strengthen the model and suggest a usable model for the emergency relief organizations.

Conclusion

In the highly dynamic business environment, competency mapping plays a very crucial role as the concept emphasizes on developing individuals on necessary competencies which are required to face the challenges of ever changing role of individuals in the organizations. Such a competency model is definitely required for emergency relief organizations which operate in a highly challenging environment where sudden onset of disasters of unexpected nature and intensity may question any level of preparedness. The study presented here has a developed such a model by identifying competencies from the review of literature and analysis of data collected from the independent coders of the job analysis of a relief worker jobs of different humanitarian organizations. The model thus developed can be used for all the employee related activities of the relief organizations so as to improve the effectiveness of disaster relief.

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RELIEF WORK MANAGEMENT OF POST EARTHQUAKE IN NEPAL

Bishnu H. Bhatta

Abstract

Two devastating earthquakes struck Nepal on the 25th of April and 12th May 2015 due to which, many children were rendered either homeless or were orphaned. This presentation will highlight experiences of families and children from the most affected areas of Nepal during and after the earthquakes. The presentation will also emphasize the affects of psychosocial trauma on children and how collaborative efforts are being utilized to bring relief to families with young children. Children, especially, very young ones are the most vulnerable when natural disasters such as this, strike communities and often they do not possess the maturity, skills, knowledge or the language to deconstruct the magnitude of the calamity. Therefore, it is essential to understand the outcomes of traumatic experiences in order to assist them in developing positive behaviors in the future. Relief efforts by numerous NGOs and INGOs have been successful in bringing immediate solace to several villages but the work is ongoing and many children have yet to be reached. This presentation will conclude with a focus on the different therapeutic workshops being conducted by collaborative partners for the families and children who were affected by the natural disaster.

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MULTI-ATTRIBUTE DECISION MAKING APPROACH TO PREPOSITION FACILITY LOCATION IN HUMANITARIAN RELIEF OPERATIONS

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Abstract

Over the years, many countries are facing problems with man-made (e.g. terrorist attacks) as well as natural (e.g. earthquake) disasters. It is becoming one of the reasons for the economic slowdown. Effective logistics management is necessary to cope up with these problems. Therefore, humanitarian logistics (HL) is gaining attention from researchers and practitioners. The overall objective of this study is to explore the warehouse location decision problem by considering specific site attributes in the unique context of humanitarian relief operations. It is one of the strategic decisions to be taken at the preparedness phase of the disaster management. Prepositioning of the warehouse is done to pre-stock relief materials and quick dispatch of them to the disaster site. Commercial supply chains do not preposition warehouses; therefore, it is one of the important distinguishing factors. Prepositioning is not much studied in HL literature, in that also, very few studies are focused on developing countries like India. Previous models developed were based on the computerized optimization, ignoring qualitative aspects. In real life, manager's decision is based on experience and intuition. Therefore, this study is to investigate humanitarian prepositioned location decision problem with qualitative attributes based on human judgements. In this study, managerial level officers participate to construct the warehouse location decision attributes and evaluated the warehouse location for prepositioning. Analytic Hierarchy Process (AHP) is to acquire criteria weights and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to obtain the final ranking of the warehouse locations. Fuzzy set theory is adopted in the evaluation to deal with the fuzziness of decision-makers preferences in decision making.

Keywords: *Humanitarian Logistics, Facility Location, Prepositioning, Disaster Management, Multi-Attribute Decision Making (MADM), Fuzzy AHP-Fuzzy TOPSIS*

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CRITICAL ROAD PATH IDENTIFICATION POST DISASTER FOR VIJAYAWADA CITY

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Abstract

Performance of the lifeline systems such as transportation system during a disaster is complex due to the spatial and network characteristics. Also, the multiplicity of the users makes it difficult for the post disaster response and recovery operations. During the past earthquakes 1995 Kobe, 1999 Turkey, 2001 Bhuj and quite recent 2011 Tohoku, 2010 Christchurch, the damages to road transport systems was prevalent. For the planning of disaster response operations, the vulnerability of road network is crucial and it impacts the response time. So, the design engineers have to take into account the possible disruption of a road network during a disaster as well as for recovery. This paper addresses the critical road transportation path system after there is an earthquake disaster in the city of Vijayawada (IS 1893:2002) with a potential of causing liquefaction. The study mainly focuses on the disruption of major roads and highway connecting the city considering, liquefaction hazard, approachability to hospitals and population density distribution of the city. The paper analyzes different road paths in the city using edge weight estimation method in which weights are assigned to the different factors considered. Different paths for the evacuation were proposed. Results suggest that the measures may be used advantageously in further study of the economic impact of highway damage during earthquakes.

Keywords: *Critical path, Earthquakes, Liquefaction, Dijkstra's algorithm*

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COMMUNITY PARTICIPATION IN POST DISASTER RECOVERY: LOCATING THE ROLE OF SOCIAL CAPITAL

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Abstract

Many places of the world are upsetting by extreme weather events due to global warming. Bangladesh is one of such countries that face different types of natural disasters almost every year that include floods, cyclones, droughts, tornadoes, river erosion etc. Although the geographical settings of the country make it vulnerable to natural disasters, global warming added additional risk to be affected frequently. Among the natural calamities, floods are more or less recurring phenomena that create immeasurable human sufferings, cause loss of lives and livelihoods and halt development process. Therefore, the government and non-government organizations provide material and non-material support services along with emphasizing people's participation in accordance with the spirit of paradigm shift in disaster management to recover from flood. But to what extent people have participation to recover from flood in rural Bangladesh? How do they participate in recovery process? And what enhances their participation? To address these research questions an exploratory study was carried out in Sirajganj district, a flood-prone area of Bangladesh, by using qualitative approach. The findings show that local people play an important role to recover from flood by using their indigenous knowledge, skills and mechanisms while social capital enhances people's participation and recovery process.

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COORDINATION IN DISASTER MANAGEMENT
CASE STUDIES IN THE COASTAL AREAS IN BANGLADESH

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Abstract

The discourse of disaster management has undergone significant changes in the recent decades and their effects have been profoundly felt in the developing world, particularly in terms of coordination. The focus of this paper will turn into a specific form of coordination challenges and how the complexity of institutions affects the capacity to coordinate in the coastal areas in Bangladesh. This paper examines the concept of coordination and investigates its components in terms of disaster management in the coastal areas in Bangladesh. In the recent days, disaster management is not the responsibility of any particular agency or organization. It requires well-coordinated efforts from all concerned bodies. Therefore, coordination is needed for architects, civil engineers, private builders and policy makers, community representatives and other professionals from different relevant agencies with a view to making their roles and responsibilities related to disaster management. However, there are sectoral polices in Bangladesh to address these issues, but a lack of integration and overlapping of responsibilities prevails among those agencies. Furthermore, there is a lack of coherence among policies, and no holistic approach to mitigate disaster in the coastal areas in Bangladesh. However, this paper will be descriptive in nature. Principally, secondary data will be used to collect information and that will be collected from the existing published literature on disaster management in the coastal areas in Bangladesh.

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MANAGING NATURAL DISASTER IN HIMALAYAS: DIBER (DRDO) EXPERIENCE

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Abstract

Defence Institute of Bio Energy Research (formerly Defence Agriculture Research Laboratory), Haldwani has contributed tremendously since its inception in 1962 in relief and rehabilitation of various natural disasters occurred in the country through its far flung stations in deep Himalayas. Major challenges faced during various Disasters occurred in Himalayan region are lack of coordination, connectivity, remote area linkage, communication problem etc. DIBER has contributed in relief operations during Malpa (Pithoragarh, Uttarakahnd) landslide of August 1998, Orissa super cyclone in October 1999 and Kedarnath-Badrinath disaster (Uttrakhand) in June 2013. DIBER has coordinated the relief camp during these natural disasters with participation of other DRDO laboratories. The experience gained during these relief camps will be of immense usefulness in better planning, coordination and execution of relief operations in more better way in future specially in the Himalayan regions.

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Introduction

India has been traditionally vulnerable to natural disasters on account of its unique geo-climatic conditions. Floods, droughts, cyclones, earthquakes and landslides have been recurrent phenomena. About 60% of the landmass is prone to earthquakes of various intensities; over 40 million hectares is prone to floods; about 8% of the total area is prone to cyclones and 68% of the area is susceptible to drought (Annual Report 2004).

The State of Uttarakhand, being part of the Himalayan region, is extremely vulnerable to natural disasters. Natural hazards, like earthquakes, landslides, avalanches, cloudbursts, hailstorms, Glacial Lake Outburst Floods, flash floods, lightning, and forest fires, etc. have been a cause of major disasters in the State (Satendra et al, 2014). On 16 June 2013, the State suffered yet another mega disaster, one of the worst disasters in the living memory, causing widespread damage and destruction, besides heavy casualties. The entire State was hit by very heavy rainfall and flash floods. Though all the thirteen districts of the State were hit, five districts, namely Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi were the worst affected. The disaster coincided with the peak tourist and pilgrimage season, significantly enhancing the number of the casualties and adversely affecting the rescue and relief operations.

Disaster management is important during and after natural calamities as all sections of society including poor and the under-privileged are the worst affected in absence of such measures. Post-disaster relief and rehabilitation have a consoling effect of the people perception towards government sensitivity during and after disaster.

India’s Disaster Profile

The Indian subcontinent is among the world’s most disaster prone areas. Almost 85% of India’s area is vulnerable to one or multiple hazard. Of the 28 states and 7 union territories, 22 are disaster-prone. All 7 North East states of India – Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura and Meghalaya; Andaman & Nicobar Islands; and parts of 6 other states in the North/North-West (Jammu and Kashmir, Uttaranchal, and Bihar) and West (Gujarat), are in Seismic Zone V.

What is Disaster Management?

Disaster management Act, 2005 defines Disaster Management as, a continuous cycle and integrated process of planning, organizing, coordinating and implementing measures which are necessary for-

- Prevention of danger or threat of any disaster;
- Mitigation or reduction of risk of any disaster or its severity or consequences;
- Capacity-building;
- Preparedness to deal with any disaster;
- Prompt response to any threatening disaster situation or disaster;
- Assessing the severity or magnitude of effects of any disaster;
- Evacuation, rescue and relief;
- Rehabilitation and Reconstruction.

DIBER (DRDO) Experience during Relief Camps

Defence Institute of Bio Energy Research Haldwani with its other research stations at Auli (9000 ft MSL), Pithoragarh (5500 ft MSL) and Harsil (7800 ft MSL) has contributed tremendously in relief and rehabilitation of various natural disasters occurred in the country specially in Uttarakhand through its far flung stations in deep Himalayas. During last decade, DIBER has contributed in relief operations of following disasters-

Malpa (Pithoragarh, Uttarakahnd) Landslide of August 1998

The Malpa village is located on the right bank of River Kali in the Kumaon. Before the landslide tragedy struck at Malpa, there were base camps of Kumaon Mandal Vikas Nigam (KMVN), Public Works Department (PWD), Indo-Tibetan Border Police (ITBP) and local residential houses of the Malpa Tribal people. A sudden landslide took place on August 17, 1998 burying the Malpa village. The reactivation of old landslides in lieu of human interference led to unforeseen disasters. Director and team members were awarded with commendation certificate by Dr. A.P.J. Abdul Kalam, SA to RM in recognition of their devotion and yomen service done by laboratory during Malpa Disaster Relief 1998.

- Distributed processed food (4.5 q) and food grains (4.0 q) among 70 victimized family of 13 villages.
- Cooked food was provided to thousand persons engaged in rescue operation at Malpa
- 4.0 q processed food provided by DFRL was air dropped by Helicopter at Malpa
- Distributed medicines for first-aid and relief to various victims as well as water decontamination tablets as provided by INMAS and DRDE..
- Established Satellite communication facility.

Earth Quake Relief in Chamoli

An earthquake of more than 7.0 magnitude trembled the hilly area of Chamoli district during April 1999. DRDO laboratory DARL coordinated the immediate relief activity during 1 to 6 April 1999 to provide immediate relief to victims of disaster. Following items were distributed.

- Distributed 15 q processed food among 300 victimized families of 22 villages.
- Provided agricultural materials like seeds/seedlings to restore agriculture production

Orissa Super Cyclone in October 1999

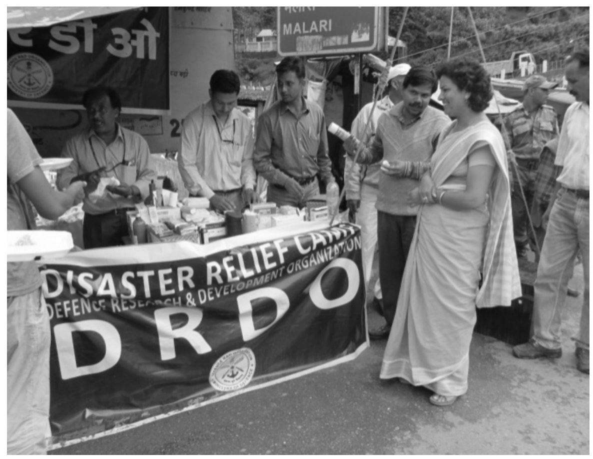
A super cyclone slammed the state of Orissa on October 29, 1999, with wind speeds of 270-300 kmph, accompanied by torrential rain ranging from 400 mm to 867 mm continuously for three days. The turbulent sea surged up to 7 m high, with waves that rushed in and traveled up to 15-20 km inland. The super cyclone caused extensive damage. About ten thousand were killed, while over 1.6 million houses were damaged. The sectors of agriculture, livestock, village industries, infrastructure and environment were badly devastated. A team of DIBER staff contributed in relief and rehabilitation of affected people as well as restoration of agriculture activity through distribution of high yielding seeds and technology demonstration. Following relief and rehabilitation work were done in **Chaulnigaon, Balasore, Orissa.**

- To support and rehabilitate the rural farmers, 102.5 kg seed of various vegetables, 200.4 q seed of paddy var Lalat, 334 q urea and 68 q muriate of potash to restore the soil fertility was provided.
- To rehabilitate the animal husbandry, 09 camps were conducted to monitor the health of animals and to prevent the spread of epidemic as lot of animals were dead.
- A total of 3629 animals were Vaccinated to reduce the risk of FMD and other communicable diseases.
- A total of 1.0 lakh Fingerlings were distributed to restore the back yard fishery.
- Total 629 families got benefited through the DRDO relief camp.

Kedarnath-Badrinath Disaster (Uttrakhand) in June 2013.

On 16 June 2013, the State suffered one of the worst disasters in the living memory, causing widespread damage and destruction, besides heavy casualties as was termed as 'Himalayan Tusami'. As per Government estimates, a total of 169 people died and over 4,021 people were reported missing (presumed to be dead). About 4200 villages were affected, 11091 livestock were lost and 2513 houses were completely damaged affecting more than 9.0 million people. The five districts namely, Bageshwar, Chamoli, Pithoragarh, Rudraprayag and Uttarkashi were the worst affected.

DRDO relief camp at Joshimath during 2013 DRDO Relief camp at Govindghat during 2013



DRDO relief camp being coordinated by DIBER Smt. Rohini Rawat, Chairperson, Municipal Corporation Joshimath appreciating the efforts

Following services were extended through camp in Joshimath and Govindghat area-

- A team of DIBER and sister labs reached disaster site Joshimath on 22 Jun 2013 with 5000 litres of mineral water and essential relief items like food articles, biscuits, candles, matchboxes, digging and leveling implements, ropes and warming fuels of LPG and Kerosene, First aid kit, ORS Packets, Detection kits, insect repellants etc.

- 3.0 tons of processed food (from DFRL) was distributed to the victims as well as handed over to army and local administration for further air drop to inaccessible areas.
- More than 700 pilgrims rescued from the Badrinath area were given first aid (from INMAS), food (cooked rice and dal) and snacks.
- 800 water testing kits and more than 5000 chlorine tablets were distributed for decontamination of water to avoid water borne diseases from DRDE.
- DIBER coordinated the relief operation and camps on behalf of DRDO where various DRDO laboratories participated.

Challenges Faced and Observations made

A team of scientists and technical staff along with relief items were sent to provide immediate relief to the victims and suffering children as well as team of experts was also detailed with high yielding seeds of various cereals, pulses and vegetables to rehabilitate the local people so that normal life can be restored during such natural calamities. Major challenges faced during various Disasters occurred in Himalayan region are lack of coordination, connectivity, remote area linkage, communication problem etc. The thrust has always been on alleviation and relief of disaster but most of the time it is not quick and adequate. The following weakness has been observed in the disaster management plan.

- Inadequate Early Warning System
- Lack of Pre-disaster Preparedness
- Inadequate and Slow Relief
- Lack of Co-ordination
- Slow Rehabilitation
- Lack of proper Administration
- Poor Management of funds and resources

Suggestions

Considering the frequency and magnanimity of disasters striking India, there is a need for continued vigilance, preparedness and systematic efforts to reduce the impact of natural disaster on public life and property. The following suggestions may be useful

- Organizational structure responsible for the overall management at national, state, districts and village levels.
- Development of network to share the experiences and utilize the expertise available around us.
- Training of personnel in disaster prone areas and those who deal with the relief operations.
- Development of minikits for distribution/airdrop to victims in inaccessible areas which must include ready to eat items without cooking or warming, tablets for water purification or decontamination, unbreakable/ non-bursting pouches of potable water, match box and candle, few medicines for dysentery and fever and blood clotting.

Conclusion

DIBER has been instrumental in taking up relief operations during various disasters events through its motivated staff as a part of service to the nation. With our rich experience in taking up relief activities as well as strategic advantage of our locations in far flung areas of Himalaya, DIBER can put an impact during managing such natural calamities and taking up relief and rehabilitation work.

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DISASTER RISK REDUCTION

- Disaster Management And The Hyogo Framework Within the Humanitarian World Summit: Challenges For 2016 - *Paloma Serra Robles*
- Post Disaster Reconstruction and Geoinformatics for Disaster Risk Reduction (DRR) for 2013 - Flash Floods in Uttarakhand, INDIA – A case of Rudrapryag District - *Dr. Indrajit Pal a, AbhinavWaliab*

DISASTER MANAGEMENT AND THE HYOGO FRAMEWORK WITHIN THE HUMANITARIAN WORLD SUMMIT: CHALLENGES FOR 2016

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Spanish Agency for International Cooperation

Abstract

The United Nations defines a disaster as a serious disruption of the functioning of a community or a society. Disasters involve widespread human, material, economic or environmental impacts, which exceed the ability of the affected community to cope using its own resources. There are several types of disaster, and we all agree if we say that there is no country that is immune from disaster, though vulnerability to disaster varies. Traditionally, disasters can be classified 1) natural disasters: floods, hurricanes, earthquakes and volcano eruptions 2) environmental emergencies: technological or industrial accidents, usually involving the production, use or transportation of hazardous material, and occur where these materials are produced, used or transported, and forest fires caused by humans.3) complex emergencies: including conflict situations and war and last by not least :4) pandemic emergencies: involving a sudden onset of contagious disease that affects health. As far as disaster prevention: HYOGO: in January 2005, 168 Governments adopted a 10-year global plan for natural disaster risk reduction called the Hyogo Framework. In 2016 the 1st World Humanitarian Summit will be held In Turkey and it should address these issues if we want to be prepared for the challenges of disaster management in the future.

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POST DISASTER RECONSTRUCTION AND GEOINFORMATICS FOR DISASTER RISK REDUCTION (DRR) FOR 2013 FLASH FLOODS IN UTTARAKHAND, INDIA

A CASE OF RUDRAPRYAG DISTRICT

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Abstract

Around the world a number of technological applications are available to help recovering quickly through the widespread connectivity and hence better resource planning and management. It is an established fact that reconstruction phase for disaster-affected areas could be effectively governed by the Geographical Information System (GIS), Global Positioning System (GPS) and Remote Sensing (RS) technologies for efficient Disaster Risk Reduction and Management. In June 2013 unprecedented rain and subsequent catastrophic flash floods swept away hundreds kilometre of road connectivity throughout the state of Uttarakhand, INDIA. NH 109, which is the vital road approaching to Kedarnath Temple not only for the sacred shrine of Kedarnath but also the lifeline for number of villages in Rudraprayag district. The present research study is aimed to emphasise the role of GIS / GPS / RS to map the landslides affected locations on NH 109 between Rudraprayag and Guptkashi, which is extensively damaged in several places due to the 2013 Uttarakhand flash floods. Indepth analysis of the present landslide affected locations along with the DEM and LULC depicts the holistic measures for the reconstruction and management of landslides, hence effective Disaster Risk Reduction (DRR) in post disaster reconstruction phase. The first hand study for the devastated road span between Rudraprayag and Guptkashi would also explore the relation between slope, river flow direction and flash flood induced landslides though Geoinformatics. In this paper an attempt has also been made to estimate the extent of hazard occurred due to flashflood in Rudraprayag on June 2013. Geo-informatics applications was also exercised to analyze and estimate the spatial extent of landslides and its implications for Disaster Risk Reduction approach through post disaster reconstructions.

Keywords: *Disaster Management, Disaster Risk Reduction (DRR), Landslide, Flash Flood, Geographical Information System (GIS), Remote Sensing, Global Positioning System (GPS).*

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Inaugural Photo Gallery

Inaugural

Photo Gallery

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Plenary

Photo Gallery

Plenary

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Technical Sessions

Photo Gallery

EARTHQUAKES

- Simplified Procedure For Seismic Vulnerability Assessment
  Of Soft Storey Buildings - *G.V. Rama Rao†, N. Gopalakrishnan†, K. Sathish Kumar, J. Prakashvel*
- Simulation Of Ground Motions For Different Indian Cities Due To 25th April 2015
  Main Shock Of Mw 7.8 Nepal Earthquake - *Kamatchi, P. & Balaji Rao K.*
- Seismic Risk Assessment for Aqaba city in Jordan. Case study - *Dr. Adnan Khasawneh, Eng. Naela Al Daoud ,Dr. Rasheed Jardata, Dr. Muheeb Awawdeh (Yarmouk University)*
- Study of Different Staggered Shear Wall Configurations on Seismic
  Performance of RCC Framed Buildings - *Bajarang Gupta 1 and S.K. Madan*
- A Study On Sequence Of Plastic Hinge Formation In RC Frame By Nonlinear
  Static Analysis - *Ravikumara H S1, Supriya R Kulkarni ,Babu Narayan K S*

SIMPLIFIED PROCEDURE FOR SEISMIC VULNERABILITY ASSESSMENT OF SOFT STOREY BUILDINGS

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Abstract

Bhuj earthquake had witnessed spectacular failures of a class of reinforced concrete multi-storied buildings termed as soft storey buildings or Open Ground Storey (OGS) buildings, necessitated by a functional demand to provide a parking space within a building plan. These buildings have reduced stiffness at the ground storey due to absence of in-fill walls. The abrupt change in the stiffness of the open ground storey compared to the stories at the top result in huge seismic displacement demand, to be borne by the ground storey itself. Conflict demand between seismic safety and functional requirement,and moreover huge number of OGS buildings in urban areas in India, necessitates the seismic vulnerability assessment of OGS buildings. There is an urgent need to retrofit such existing soft storey buildings.Due to huge number of OGS buildings in urban areas in India, a simplified and quick procedure to assess the severity is very much necessary. In the present paper a simplified procedure to assess the level of severity of OGS building is developed using plastic hinge concept.The simplified procedure is validated with the nonlinear static analysis and the shake table experiment conducted on three storey model OGS building. A programme is developed with graphical user interface to assess the seismic vulnerability of OGS buildings based on simplified procedure. The simplified procedure will help to identify the urgency for repair and rehabilitation of OGS buildings.

Keywords: *Soft storey, Open ground storey, Seismic vulnerability assessment, Shake table*

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Introduction

Before the 2001 Bhuj earthquake, constructions with poor seismic resistance were assumed to be a feature of non-urban areas; urban structures were considered safer due to the use of engineering knowledge and modern construction materials. However, the Bhuj earthquake shattered the myth of urban seismic safety through wide-spread damage to Reinforced Concrete (RC) buildings. It may be noted that a class of building type, termed as "Open Ground Storey (OGS) buildings" bore the brunt of seismic damage in the Bhuj earthquake. Open ground storey structures are reinforced concrete frames consisting of beams and columns with in-filled walls made of masonry available only in the top stories and left open (without in-fill) at the ground storey. These structures characterized by sudden reduction of stiffness at the ground floor level of building causes dis-continuity in force and displacement flow and causes excessive displacement demands from the ground floor during seismic actions. Open ground floor kept for the purpose of parking of vehicles is a typical example of a soft storey structure ("soft" denotes reduced stiffness at the open ground storey level). Upper floors have more stiffness due to in-filled masonry. Bhuj earthquake, shown the damage of such structures is concentrated in the ground floor and none of the other elements show any sign of damage. This is in sharp contrast to the capacity design concept of structures, wherein ductility and energy dissipation is primarily expected from pre-dominant flexural elements (like beams) and not from the structural actions of compression dominated columns or other shear dominated elements.

Street parking is difficult in many urban areas, where the available road widths are small. Hence, between the municipal authorities and architects, a solution was achieved to take motorized vehicles off the road, and move them to the ground storey of the buildings. To a large extent, this has helped overcome the parking problem. Having parking in the ground storey is not a concern, but removing all masonry walls in the ground storey and leaving the exposed slender 230 mm wide columns, is the crux of the matter. Removing all of them together suddenly makes the whole building flexible and weak in that storey.It is important to sensitize the general public (stake holders), approving agencies and construction contractors about the high vulnerability of these classes of structures to lateral seismic loadings. Along with that, existing municipal and urban rules that govern the construction of new apartment buildings in India also tempt the builder to choose parking space within the building, make highly vulnerable situation.

IS 1893(Part 1): 2002 defines soft storey,as one in which the lateral stiffness is less than 70 percent of that in the storey above or less than 80 percent of the average lateral stiffness of the three storeys above.Because of such a configuration, more seismic force is attracted in the ground storey level and the displacement demand has to be realized fully from the ground storey. A high level of ductility (with associated damage and in-elastic rotations) is expected from axially loaded compressive members, which are in-capable of giving such a demand (columns).P-Δ effects, Secondary moments are generated in these columns due to their large deformation resulting in lack of stability.Due to all these reasons, the damage is sudden, catastrophic and without warning.

The usual way to address and solve the soft storey is to avoid, by introducing the in-fills in the soft storey. However, IS 1893(Part-1): 2002 suggests the columns and beams of the soft storey are to be designed for 2.5 times the storey shears and moments calculated under seismic loads specified in the other relevant clauses. But this may not solve the full problem, as displacement demands are not satisfied by the above suggestion. Addition of shear walls throughout the height of the building will solve the problem. After retrofit it is necessary to check the displacement behaviour through proper nonlinear analysis.

Internationally, quite a number of literatures on the performance and retrofit of open ground storey structures emanate from Turkey and Greece (Arslan and Korkmaz, 2007). But there is not much published guidance on how to carry out quick assessment of soft storey buildings. Chopra et al., 1973 and Arlekar et al., 1997 explains the behaviour of soft storey buildings. The literature Kaushik et al., 2009 and Sahoo&Rai, 2013 discuss about the strengthening options for soft storey buildings.

OGS buildings stock is the majority of the class of buildings in Indian urban places, which are highly vulnerable to earthquake. Conflict demand between seismic safety and necessitated by a functional demand to provide a parking space within a building plan, the OGS buildings seismic vulnerability assessment is gaining importance. Due to huge stock of OGS buildings, a simplified and quick procedure to assess the severity is very much necessary. In the present paper a simplified procedure to assess the level of severity of OGS building is developed using plastic hinge concept. The simplified procedure is validated with the nonlinear static analysis and the shake table experiment conducted on three storey model OGS building. A programme is developed with graphical user interface to assess the seismic vulnerability of OGS buildings based on simplified procedure. The proposed simplified procedure will help to identify the urgency for repair and rehabilitation of OGS buildings.

Simplified Procedure for Assessment of Soft Storey Buildings

The main assumption in this method is that the whole structure behaves as a single degree of freedom system as an inverted pendulum with a heavy mass at the top such that the entire elastic deformation of the structure is felt only by the OGS columns. Further the columns in the OGS are rotationally restrained at top of the stilt floor and at the foundation level. They are free to translate at top of the stilt floor only. The displacement demand capacity ratio is used to evaluate the severity of risk of an OGS building for local seismic hazard. The displacement demand capacity ratio is calculated using yield and ultimate curvature of the representative column section in the open ground storey. The moment & curvature at yield and ultimate for the representative column can be obtained using section analysis by using modified mander's model (Mander, et al., 1988) for confined concrete and suitable model for steel reinforcement. As the OGS column bent in double curvature the force at it yield will be yield moment divided by half of the height of column. A check should be made to avoid premature shear failure; the yield (or Ultimate) force should be lower than the shear strength of column.

As the representative column is free to translate at top of the stilt floor only, the yield displacement (Δ_y) of the soft storey representative column can be calculated using the yield curvature (ϕ_y) by the following expression (Eq. 1).

$$\Delta_y = \frac{\phi_y h^2}{6} \qquad \ldots (1)$$

Where h is the height of the open ground storey. The displacement capacity (Δ_u) of the soft storey is the sum of yield displacement and the plastic displacement due to post-yield plastic rotation of the soft storey columns and it can be worked as the function of the ultimate and yield curvature, plastic hinge length and total height of the open ground storey.

$$\Delta_u = (\phi_u - \phi_y) l_p (h - l_p) + \frac{\phi_y h^2}{6} \qquad \ldots (2)$$

Plastic hinge length (l_p) can be estimated using expressions given in the literature or it can be assumed that it is half the depth of the section. Displacement ductility capacity(μ) of the over-all structure is derived only from the ductility of soft storey columns and can be estimated using Eq. 3

$$\mu = \frac{6(\phi_u - \phi_y) l_p (h - l_p)}{\phi_y h^2} + 1 \qquad \ldots (3)$$

The seismic demand on the soft storey building for the local seismicity can be estimated using IS 1893(Part-1): 2002 by assuming total displacement demand of OGS columns are equal to their elastic displacement demand (R=1), such that the equal displacement rule applies and not equal energy rule. The time period of the structure can be estimated from the total stiffness of the columns in open ground storey and the total mass of the above structure. The stiffness can be calculated using the above estimated force and displacement at yield. The force demand can be obtained by multiplying the mass with the horizontal acceleration (A_h) correspond to Maximum Considered Earthquake (MCE) obtained from the spectrum given IS 1893 for corresponding calculated time period of the building. The force demand to yield force is similar to response reduction factor, which should be less than the available displacement ductility capacity. The displacement demand (Δ_d)can be calculated using Eq. 4

$$\Delta_d = \frac{1}{4\pi^2} \frac{A_h}{f^2} \qquad \ldots (4)$$

Where the '*f*' is the natural frequency of the building, which is inverse of the time period of the building. The displacement Demand Capacity Ratio (DCR) is used to evaluate the severity of risk of an OGS building for local seismic hazard and is given in Eq. 5.

$$DCR = \frac{\Delta_d}{\Delta_u} < 1.0 \qquad \ldots (5)$$

The DCR above one indicates that the building requires retrofit to avoid the soft storey mechanism. The proposed simplified procedure is validated with the pushover analysis made on typical multi-storied building model using SAP software and a shake table experiment conducted on a three storey model OGS building. The proposed simplified procedure fairly gives good matching in case of plan symmetrical buildings. If the DCR is more than one, it indicates that the building requires retrofit to avoid the soft storey failure mechanism, and precisely it indicates that urgent detailed evaluation is required before decides its vulnerability.

Validation of Proposed Simplified Procedure

In order to understand the importance of soft storey effect and ductile detailing, a half-scale model of three storey RC building with soft storey is constructed and tested on 4 m X 4 m, 30T shake table at Advanced Seismic Testing and Research Laboratory (ASTaR Lab), CSIR-Structural Engineering Research Centre, India. The buildingis three storied with a total height of 4.8m, two bays in X-direction and single bay in Y-direction. Storey height of the specimen at each floor is 1.6 m. The RC building is OGS frame having in-fills at higher floors and kept open at the ground floor. Non-ductile detailing is incorporated by means of large stirrup spacing (6 mm ϕ @ 150 mm c/c) and 90° hook. The dimensions for beam and column are 150 X 150 mm. The reinforcement details are for column 4#12mm ϕ, 6mm ϕ stirrups @ 150 mm c/c, with 90° hook (weak column) and for beam 4#16mm ϕ, 6mm ϕ stirrups @ 150 mm c/c, with 90° hook (strong beam). The slab thickness is 100 mm and base is a raft foundation, which is used for connect the model to shake table. Fig. 1 shows the shake table test of OGS model frame. Materials used are M 25 grade concrete and Fe 415 steel. Additional mass of 1200 kg has been added on each floor to represent an equivalent live load. The length of the beam in shorter direction is 2 m. The length of the continuous beam in longer direction is 3 m. Displacement and Acceleration at each floor level is measured. The earthquake time history compatible to response spectrum given in Indian standard code of practice IS-1893(Part 1): 2002, for soft soil spectrum for zone V is used and it is modified by considering frequency scaling of $\sqrt{2}$ by similitude law for the half scale model of reinforced concrete frame. The earthquake time history is applied in longer direction (uni-axial excitation), progressively increasing the acceleration levels (PGA levels) and the response is measured. Muthumani et al. (2011) have given details of experimental programme and results.OGS behaviour is clearly depicted wherein the drift value is very high for the ground storey compared to the second and third storey. The test building failed at a maximum peak ground acceleration value of 7.99 m/s^2 (0.814 g). The corresponding response acceleration value at the third storey level is 11.44 m/s^2, with an amplification of 1.43. Maximum base shear is 116.48 kN. The RC frame model has undergone a maximum displacement of 48.75 mm at third storey level at final failure stage.

The force and displacement capacities of the reinforced concrete model frame are determined analytically as follows. Analytical simplified procedure, already outlined in a previous section can be used to evaluate the force and displacement capacity of the experimental OGS reinforced concrete model frame building. Based on the concrete grade, reinforcement detailing, cross section and the weight (axial load) of the reinforced concrete frame model, the following moment-curvature values are determined, using a section analysis. Yield Moment (M_y) is 13.17 kN-m, Ultimate moment (M_u) is 13.58 kN, Yield curvature (ϕ_y) is 0.000048 rad/mm and Ultimate curvature (ϕ_u) is 0.000275 rad/mm.

l_p is taken as D/2 (D-depth of column). Total displacement capacity, $\Delta = \Delta_y + \Delta_p = 46.55$ mm**.** The force capacity and the maximum displacement obtained from the shake table experiment is 11.65 t as against 11.075 t from the analytical method and 48.75mm as against 46.55 mm from the analytical method respectively. Table 1 shows the validation of simplified procedure with shake table test of OGS model frame

Fig. 1 Shake table test of OGS model frame

Table 1 Validation of Simplified Procedure with Shake Table Test of OGS Model Frame

	Experimental	Simplified procedure
Natural frequency	3.196Hz	3.045 Hz
Displacement capacity	48.75 mm	46.55 mm
Force capacity	11.65 tons	11.07 tons

Also, the simplified procedure is validated with the nonlinear static analysis conducted on five storey OGS building using SAP software. Pushover analysis is done for better understanding the behaviour of soft storey buildings using SAP software. A five storied building is modeled in SAP 2000 software (Fig. 2). Beams and columns are modeled as 3D frame elements. The material properties of concrete and steel rebar including unit weight, modulus of elasticity, poisson's ratio, shear modulus, characteristic compressive strength, yield stress and ultimate stress has been provided. Beams and columns are then assigned the respective cross section dimensions, materials and reinforcement.

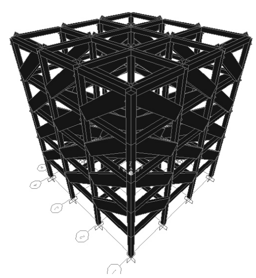


Fig. 2 Five Storey OGS Building – SAP Model

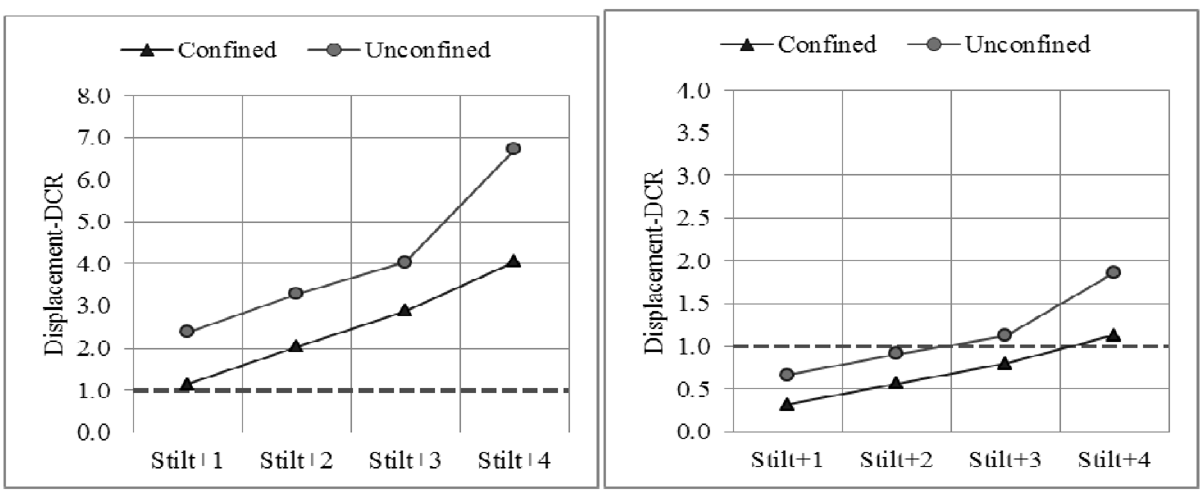
A design is made using IS 456: 2000. Rigid beam column joints have been modeled by giving end length offsets to the frame elements. To take into account the structural effect of slabs, diaphragm constraint has been assigned at each floor level. The brick in-fill is modeled as equivalent diagonal compression strut elements. Rigid joints connect the beams and columns, but pin joints at the beam-to column junctions connect the equivalent struts. The considered building model is identical in plan, consisting of 3 bays in both X-direction and Y-direction with a bay width of 4 m. The storey height is 3 m. Dead load and live loads are applied as gravity loading. Table 2shows validation of simplified procedure with nonlinear static method.

Table 2 Validation of Simplified Procedure with Nonlinear Static Method

	Pushover Analysis - SAP	Simplified procedure
Natural frequency	3.623Hz	3.717 Hz
Displacement capacity	95.2 mm	98 mm
Force capacity	106 tons	120 tons

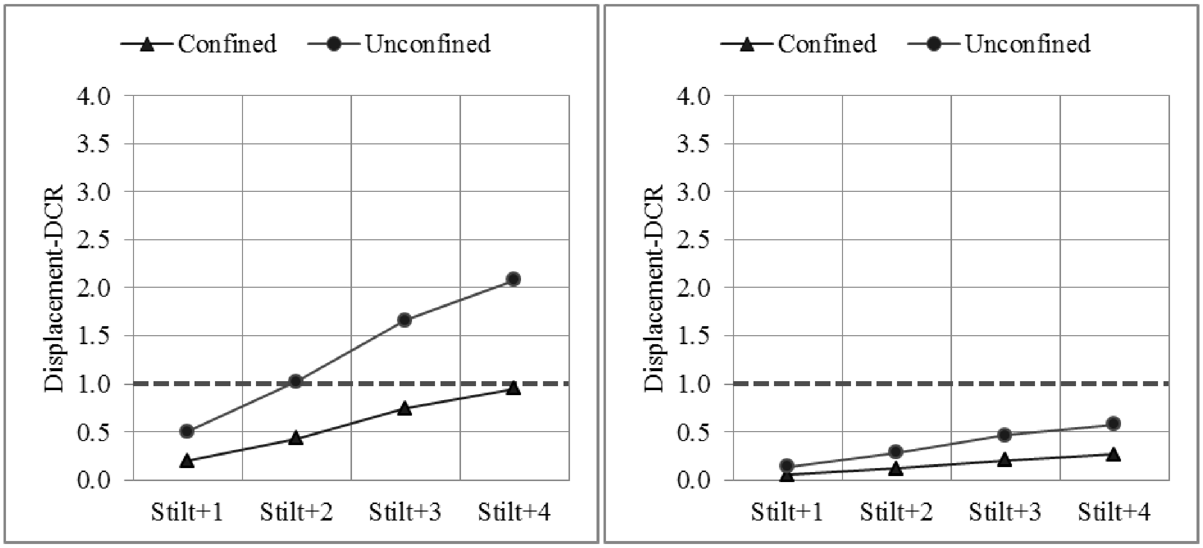
Parameteric Study using Prescrpitive Dimensions

A parametric study is carried out considering the prescriptive reinforcements and dimensions of ground floor columns of the OGS buildings in India. The study made for stilt+1 storey building to stilt+4. The column sizes are varied between 230 to 450 mm, commonly used, and considered as prescriptive dimensions. The reinforcement is varied between 1 to 2%, which is also considered based on prescriptive reinforcement used for various dimensions of the column. The height of the OGS is considered as 3m and 2.4 m cases. Axial load on OGS columns are calculated approximately by assuming 4 m bay width in both directions. The material and other data are considering prevailing site conditions. Two cases of shear reinforcements are considered, these are confined case and unconfined case. Detailed as per IS 13920: 1993codal provisions,is considered as confined case. Non-compliant shear reinforcement with 90 degree hooks are considered as unconfined case. The study made to various zones and by varying the soil type. The displacement Demand Capacity Ratio (DCR) is used to evaluate the severity of risk of an OGS building for local seismic hazard. Typical out come from the study is given in Fig. 3 and Fig. 4, the red line above DCR indicates the OGS building is vulnerable. Ductile detailing plays a role in controlling the soft storey mechanism. Fig.3 and Fig.4 from this parametric study is made on an assumed building for the purpose to showthe effect of zone location and ductile detailing. These can't be directly applicable to the other buildings. Aprogramme is developed in Visual Studio platform using Visual c# with graphical user interface to assess the seismic vulnerability of open-ground storey apartments based on above methodology.



(a) Zone – V (b) Zone - II

Fig. 3 Soft storey Building with 230 X 230 mm Column



(a) Zone – V (b) Zone - II

Fig. 4 Soft Storey Building with 450 X 450 mm Column

Summary

OGS buildings are highly vulnerable to earthquake, since it is conflict demand from the function requirement point and huge stack of OGS buildings existed in Indian urban places, makes the assessment and retrofit is a major challenge. In this paper a simplified procedure to assess the level of severity of OGS building is proposed using plastic hinge concept. The simplified procedure is validated with the nonlinear static analysis and the shake table experiment conducted on three storey model OGS building. The simplified procedure will help to identify the urgency for repair and rehabilitation of OGS buildings.

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SIMULATION OF GROUND MOTIONS FOR DIFFERENT INDIAN CITIES DUE TO 25TH APRIL 2015 MAIN SHOCK OF M_W 7.8 NEPAL EARTHQUAKE

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Abstract

Ground shaking was felt at different Indian cities during and after 25th April 2015 main shock of M_w 7.8 Nepal earthquake, whose epicenter was located at latitude 28.15 °N and longitude 84.71 °E. In the present study, artificial earthquake ground motions are generated for 14 Indian cities using extended finite source stochastic model for hard rock site condition. For this purpose, seismological parameters reported in literature for main shock are adopted. The average peak ground accelerations (PGA) computed from twenty five simulations are compared for different cities with (a) the design PGA as per existing seismic zone map of India IS 1893-2002, (b) PGA as per probabilistic seismic hazard analysis for mean return periods of 475 years and 2475 years for hard rock site conditions with average shear wave velocity of top 30 m equal to or greater than 1500 m/s. Average pseudo spectral acceleration spectra for different cities are also obtained for different cities. Pseudo spectral acceleration spectra for Kathmandu is generated and comparisons are made with Pseudo spectral acceleration spectra for a recorded ground motion. From the comparisons, importance of generation of site-specific surface level response spectra including the effect of depth of soil stratum has been demonstrated.

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Introduction

As it is reported by seismologists (Bilham et al., 2001, Mitra et al., 2015) the rate of convergence of Indian plate with Tibetian plate at locked portion of Himalayan Arc is 20±3 mm per year. This has resulted in major earthquake of Moment magnitude (M_w) 7.8 at Nepal on 25th April 2015, followed by many aftershocks (41 in 26 hrs) with three events of M_w greater than 6.5 (6.6,6.9 and 7.3). Seismological parameters of main shock is reported by different researchers (Mitra et al., 2015, Yagi and Okuwaki 2015, USGS 2015) and organizations as given in Table. 1. In the present study seismological parameters adopted from literature are used along with empirical models and strong ground motions are generated for different Indian cities using extended finite source stochastic model (Motazedian and Atkinson 2005) for hard rock level. Average peak ground acceleration (PGA) values from 25 earthquake simulations are obtained and comparisons are made with design basis PGA as per Indian seismic code IS 1893-2002 (Part 1) and the PGA values corresponding to risk levels of 10% probability of exceedance in 50 years (mean return period 475 years) and 2% probability of exceedance in 50 years (mean return period 2475 years). Pseudo spectral acceleration spectra are also obtained for the different cities for hard rock site conditions. Pseudo spectral acceleration spectra for Kathmandu is generated and comparisons are made with Pseudo spectral acceleration spectra for a recorded ground motion for Kathmandu city.

Table 1 Seismological Parameters of 25th April 2015, M_w 7.8 Nepal Earthquake (Main shock)

	Latitude	Longitude	M_w	Depth	Strike	Dip	Seismic moment (N-m)
USGS(2015)	28.147°N	84.708°E	7.8	15	295	10	8.1e20
Mitra et al (2015)	28.14°N	84.7°E	7.8	17±3	299	5	1.30E21±1.98E20

Yagi and Okuwaki (2015)	280147°N	84.708°E	7.9	15	285	10	9.09E20

Recorded Ground Motion at Katmandu

Time history record of strong ground motion of main shock which struck Nepal on 25th April 2015 for KATNP (USGS station) located at city center of Kathmandu is published by EERI (2015) as shown in Fig. 1.

Epicentral distance of the KATNP station is said to be 59.9 km. The depth of sediments above bedrock at Kathmandu city is reported to be 550 to 650 m. The average shear wave velocity of the site of KATNP station is reported to be 250 m/s. From the response spectra of the horizontal components of recorded earthquake from Fig. 1 two peaks can be observed, one in the short period region near 0.5 s and another in the long period region near 4 to 5 s. Peak in the long period region indicates the amplification of long period waves due to the deeper soil stratum/basin effect resulting in a scenario like 1985 Mexico city earthquake (Kramer, 1996). However, in Nepal no or not many structures are with the time period in the long period (4 to 5 s) range. Many of the structures were having time period less than 1 sec and the peak in the short period range near 0.5 s might have caused major damage. Another important observation made by Goda et al., (2015) is that, the difference in amplitudes of 0 degree and 360 degree component of horizontal acceleration record which indicates the orientation dependency of peak displacement demand of near fault region.

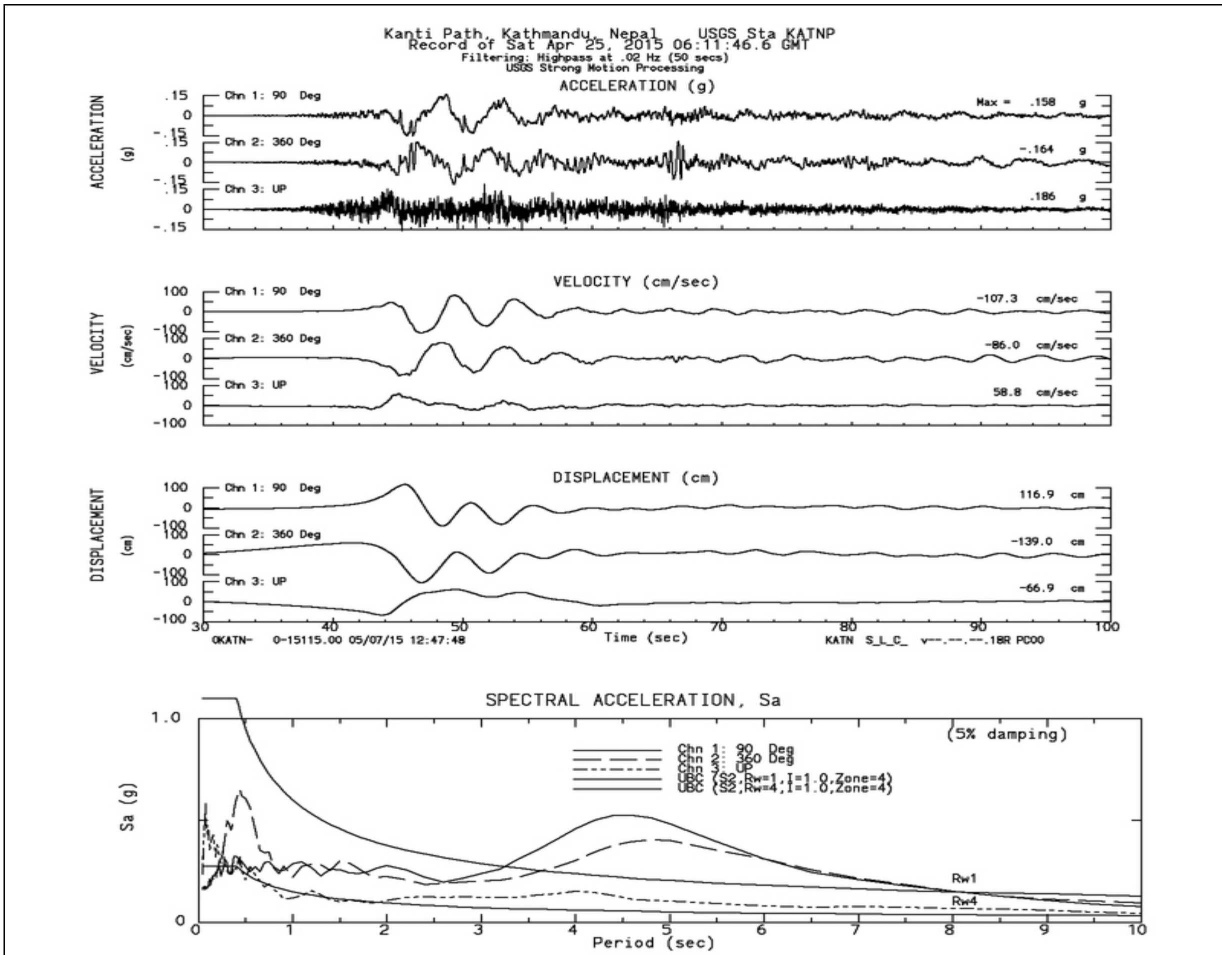


Fig. 1 Strong Ground Motion Records for Acceleration, Velocity, Displacement and Comparison of Response Spectra with UBC Design Spectra for KATNP Station at Kathmandu Nepal (EERI, 2015)

Stochastic Simulation of Earthquake Ground Motion

Stochastic simulation procedure for ground motion generation based on seismological models using point source model has been proposed by Boore (1983, 2003). In this procedure the band limited Gaussian white noise is windowed and filtered in the time domain and transformed into frequency domain. The Fourier amplitude spectrum is scaled to the mean squared absolute spectra and multiplied by a Fourier amplitude spectrum obtained from source path effects. Then, the spectrum is transformed back to time domain and the time history is obtained.

From the analysis of recorded ground motions, it has been reported (Beresnev and Atkinson., 1997) that point source models are not capable of reproducing the characteristic features of large earthquakes (Mw > 6) viz., long duration and radiation of less energy at low to intermediate frequencies (0.2-2 Hz). Simulation of strong ground motion from finite fault model has been developed by Beresnev and Atkinson (1997, 1998). In this model, fault rupture plane is represented with an array of sub-faults and the radiation from each sub-fault is modeled as a point source similar to Boore's model (1983). According to finite source model, the fault rupture initiates at the hypocenter and spreads uniformly along the fault plane radially outward with a constant rupture velocity triggering radiation from sub-faults in succession. The improved version of finite source model viz., extended finite source model (Motazedian and Atkinson 2005) which includes the effects of radiated energy on sub-fault size and dynamic corner frequency has been adopted for the generation of strong ground motion. However, in the present study corner frequency is assumed as static and pulsing percentage is assumed to be 50%.

Seismological Parameters for Simulation of Artificial Ground Motions

Mitra et al. (2015) have reported that fault rupture area for main shock to be 8376 km. USGS has reported the rupture dimension for finite fault to be 100 km x 80 km and sub fault dimension as 20 km in each direction. In the present study fault area (A) and sub-fault length ((Δl) are calculated corresponding to a moment magnitude of earthquake using empirical Eqs. 1 and 2(Beresnev and Atkinson 1998). Seismological parameters adopted in the present study for the generation of earthquake simulations are given in Table 2.

$$\log A = M_w - 4.0 \tag{1}$$

$$\log \Delta l = -2 + 0.4 M_w \tag{2}$$

Table 2. Seismological Parameters Adopted in the Ground Motion Simulations

Parameters	
Moment magnitude	7.8
Fault orientation	Strike 299° Dip 5°
Fault dimension along strike and dip (km)	80 x 80
Depth of focus (km)	17
Stress drop (bars)	200
No. of sub-faults	7x7
Duration Model	$1/f_c$ +0.05R
Quality factor	$508f^{0.48}$
Windowing function	Tapered Boxcar
f_{max} (Hz)	15
Crustal shear wave velocity (km/s)	3.6
Crustal density (g/cm^3)	2.85

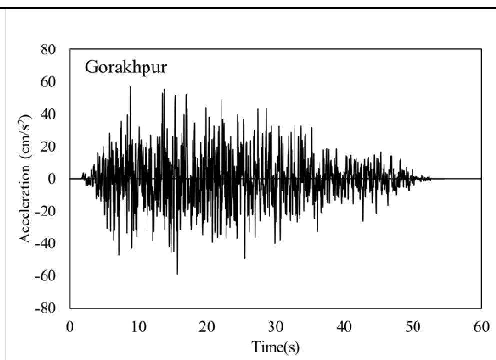
Average Peak Ground Accelerations for Different Cities

Earthquake strong ground motions are generated for fourteen Indian cities with seismological parameters given in Table 2. Typically one simulation of ground motion for Gorakhpur, Patna, Lucknow, Kanpur, Ranchi and New Delhi are shown in Fig. 2. The average PGA for the fourteen cities obtained from twenty simulations are compared with the design PGA values corresponding to IS 1893-2002 (Part 1) and design PGA values are found to be conservative. However it may be noted that the simulations are for rock site conditions, hence the PGA values for soil sites will be 2 to 4 times more depending upon the nature of the soil site. Hence the difference in values between the simulations and design PGA values are justified.

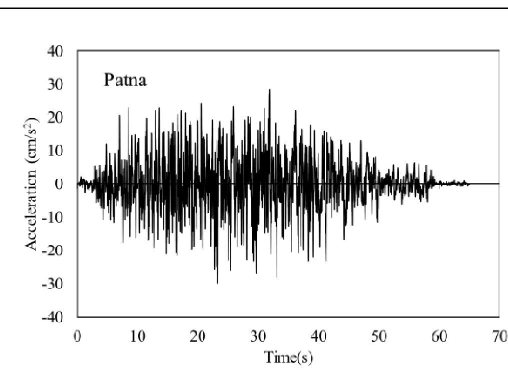
Further PGA values from simulations are compared with PGA values corresponding to Probabilistic Seismic Hazard Results (NDMA 2010) for risk levels of 10% probability of exceedance in 50 years (mean return period 475 years) and 2% probability of exceedance in 50 years (mean return period 2475 years) for hard rock site conditions with average shear wave velocity of top 30 m equal to or greater than 1500 m/s. From the comparisons it is seen that for Goraphpur and Varanasi average PGA values obtained from simulations are higher than the PGA corresponding to mean return period of 475 years, however the for all the sites, average PGA from simulations are lesser than the values corresponding to 2475 years mean return period.

Pseudo Spectral Acceleration Spectra for Different Cities and Katnp Site

Pseudo spectral acceleration (PSA) spectra of different cities for hard rock site condition are obtained from simulations for different cities as given in Fig. 3(a) to 3(c). Further the comparison of PSA spectra obtained for one typical earthquake simulation for hard rock site condition for KATNP station latitude and longitude with the PSA spectra for the recorded ground motion of KATNP soil site is given in Fig. 3(d). As it is already stated, KATNP station is located in the basin of Kathmandu with average shear wave velocity 250 m/s and depth of soil stratum 550 to 660 m. Two predominant peaks in the recorded ground motion one in the 0,5 s time period range and another in the 4 to 5 s time period range indicates the importance on local soil effect on the damaging effect of earthquake. Hence generation of surface level site-specific ground motion including the effect of depth of soil stratum is found to be essential for getting realistic response spectra for a soil site.



(a)



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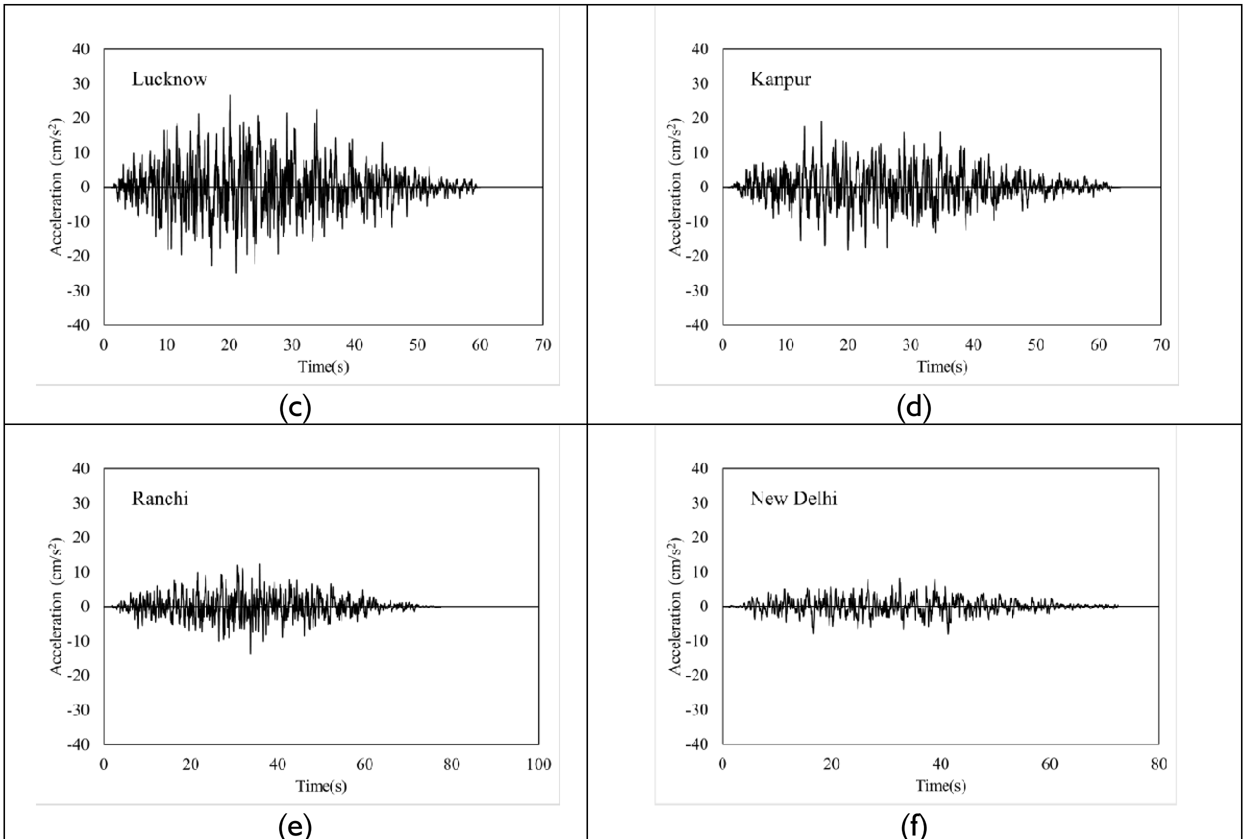

Fig. 2 Typical One Simulation of Ground Motion for Different Cities for Due to 25th April 2015 Main Shock of M_w 7.8 Nepal Earthquake(a)Gorakhpur (b) Patna (c) Lucknow (d) Kanpur (e) Ranchi (f) New Delhi

Table 3 Comparison of Average PGA from Simulations with PGA values from IS 1893-2002 (Part 1) and Risk Consistent PGA values from PSHA Results for 475 and 2475 years Mean Return Period

	City	PGA at hard rock level - average of 25 simulations (cm/s^2)	PGA from IS 1893-2002 (Part 1) Design Basis Earthquake (cm/s^2)	PGA from Probabilistic Seismic Hazard Analysis Results(NDMA, 2010) (cm/s^2)	
				Mean return period 475 years	Mean return period 2475 years
1	Gorakhpur	59.5	117.72	48.95	101.46
2	Patna	35.7	117.72	43.65	85.98
3	Lucknow	28.1	78.48	36.93	88.04
4	Varanasi	26.9	78.48	23.01	44.89
5	Gaya	23.5	78.48	26.19	48.15
6	Kanpur	20.2	78.48	30.39	76.37
7	Agra	10.8	78.48	53.62	132.24
8	Jabalpur	7.1	78.48	77.73	180.66
9	Ranchi	13.0	49.05	29.84	62.12
10	Kolkata	7.1	78.48	76.04	163.01
11	Jamshedpur	9.6	49.05	53.51	112.96
12	Bhubaneswar	4.5	78.48	23.61	39.87

13	Raipur	5.08	49.05	10.1	15.5
14	New Delhi	9.0	117.72	78.98	180.60

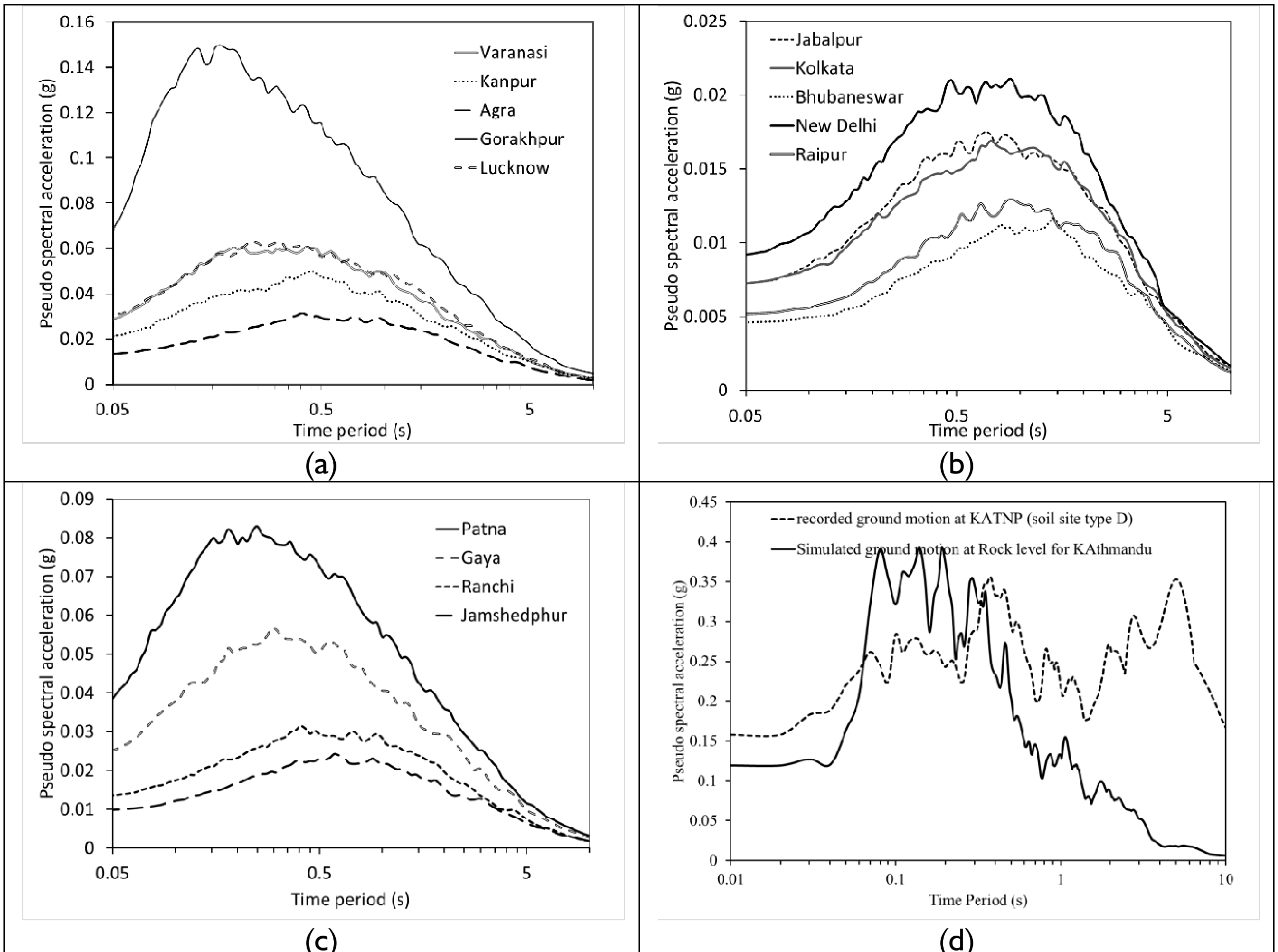

Fig. 3 (a) to 3(c) Pseudo Spectral Acceleration Spectra for Different Indian Cities (d) Pseudo Spectral Acceleration Spectra for Rock Level(simulated) and Surface Level(recorded) for Kathmandu

Summary

In the present study, rock level earthquake ground motions due to April 25th Nepal earthquake of M_w 7.8 are generated for fourteen Indian cities using extended finite source stochastic models. The average PGA for the fourteen cities obtained from twenty simulations are compared with the design PGA values corresponding to IS 1893-2002 (Part 1) design basis earthquake and design PGA values are found to be conservative. Since there will be spectral amplification due to local soil effect upto the order of 2 to 4, conservativeness of Indian seismic code is justified. Further, PGA values from simulations are compared with PGA values corresponding to Probabilistic Seismic Hazard Results (NDMA 2011) for mean return period 475 years and mean return period 2475 years for hard rock site conditions. From the comparisons it is observed that, for Goraphpur and Varanasi average PGA values obtained from simulations are higher than the PGA corresponding to mean return period of 475 years, however the for all the sites, average PGA from simulations are lesser than the values corresponding to 2475 years mean return period.

Pseudo spectral acceleration (PSA) spectra of different cities for hard rock site condition are obtained from simulations for different cities. From the comparison of PSA spectra obtained for one typical earthquake simulation for hard rock site condition for KATNP station at Kathmandu with the PSA spectra for the recorded ground motion of KATNP site, the importance of generation of surface level site-specific ground motion including the effect of depth of soil stratum for getting realistic response spectra for a soil site is demonstrated.

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SEISMIC RISK ASSESSMENT FOR AQABA CITY IN JORDAN
CASE STUDY

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Abstract

Aqaba Special Economic Zone (ASEZ) is a world class Red Sea business hub and leisure destination located on the Red Sea and represent Jordan's sole seaport.

This study came to assess earthquake hazards for ASEZ, and to stand on the expected risks and losses due to proposed earthquake scenarios.

The main focus was to use different steps and procedures to achieve accurate seismic hazard assessment. These include the preparation of an earthquake catalogue, mapping earthquake source zones, earthquake sources parameters definition, defining attenuation relations to be used in estimating the ground motions, the selection of earthquake scenarios, shear wave-based surface soil classification, and investigation of urban exposure to existing seismic hazards.

The results of seismic hazard analysis showed that the Aqaba Fault system is recognized as the main seismic source within the region, which runs through the offshore-onshore boundary of the northern gulf region across the city of Aqaba. Revision of historical and recent instrumental earthquake catalogues, tectonics of the region has led to the identification of the various seismogenic zones that can potentially cause seismic damage to the region.

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Introduction

Aqaba has been an inhabited settlement since 4000 BC profiting from its strategic location at the junction of trading routes between Asia, Africa, and Europe, Aqaba probably dates back to Iron Age. Jordan's first free zone was set up in Aqaba in 1973, when a small facility was established at the port to serve transit trade, while in August 2000, the Aqaba Special Economic Zone Authority (ASEZA) Law was passed by the Jordanian Parliament.

This study used an integrated approach to provide an accurate assessment of seismic risk assessment and loss estimation of Aqaba Special Economic Zone. Detailedseismological, geophysical, geological and geotechnical investigations been assembled, quality Controlled and/or conducted whenever needed. Figure 1.6 shows a schematic flowchart outlining the workflow adopted in this study. The proposed methodology is composed of the following components:

- Earthquake hazard analysis.
- Raw data acquisition and establishing a spatial database (GIS).
- Elements at risk mapping (Buildings, population, lifelines, transportation, critical facilities, and high loss facilities).
- Vulnerability analysis.

- Estimation of risk and loss.
- Dissemination of results and maps generation.

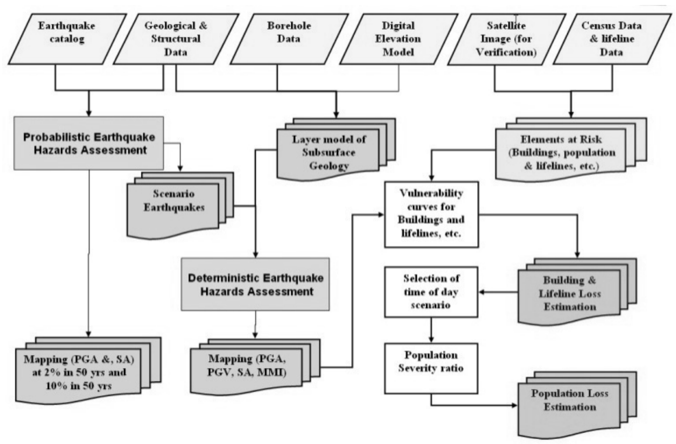


Figure 1: Schematic overview of the seismic hazard and risk assessment procedure.

Aqaba's City Situation

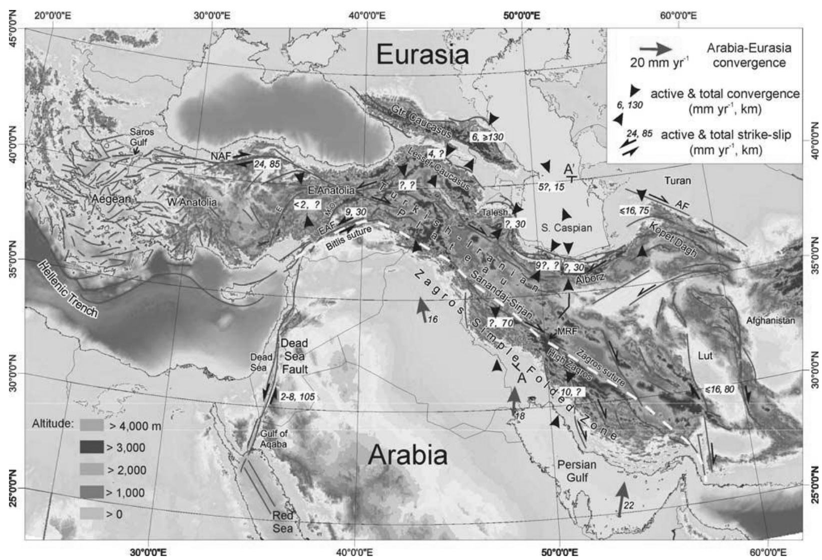
Background

The Hashemite Kingdom of Jordan is located on the northwestern part of the Arabian plate and has an area of about 89,206 Km^2. The western side of the country is a mountainous region rising up to a height of 800 to 1500 m above sea level. Between the two mountain areas of western Jordan and the east of Palestine; lies a north-south striking transform fault; the Dead Sea Transform fault system (DST).

The DST, also named as the Dead Sea Rift (DSR), is 1100 Km long sinistral strike-slip fault system that connects the Gulf of Aqaba-Red sea spreading system to convergence zone in the Taurus-Zagrous Mountains (Figure 2). The DST is a tectonically active structure that is considered as a plate boundary that formed as a relict of the opening of the Red Sea. According to McCluskey et al. (2003) slip rates along the Gulf of Aqaba and the Jordan valley equal to (5.6 $\pm$ 1) mm/yr, and (6 $\pm$ 1) mm/yr, respectively, while it's equal to (4 $\pm$ 2) mm/yr along the Wadi Araba fault system (Klinger et al, 2000).

Seismicity of the DST Region

The DST region and its vicinity is one of the most interesting regions on earth where evidences of earthquake activity have been documented for periods that date back to several thousand years. The pioneering researchers faced the difficulty of gathering information from ambiguous historical records.



The Arabian-Scientist As-Soyuti was one of the first to collect and document historical earthquakes of this area during the period from the seventh to the eighteenth century in his book Kashf as-Salsalah and wasf az-Zalzala (Al-Sa'adani, 1971). This work and later catalogs were of great importance as they helped to trace the strongest earthquakes and provided detailed description of material damage and featuring deformation due to earthquakes in the region (e.g., Willis, 1928; Sieberg, 1932; El-Isa, 1981; Abou Karaki, 1987, 1992; El-Isa and Al Shanti, 1989; Ben-Menahem, 1991; Al-Tarazi, 1992; Ambraseyes et al., 1994; Klinger et al., 1999; Sbeinati et al., 2005). As a result, the DST fault system was identified as the major seismogenic element in the area, an idea previously suggested by Montessus de Ballore (1906).

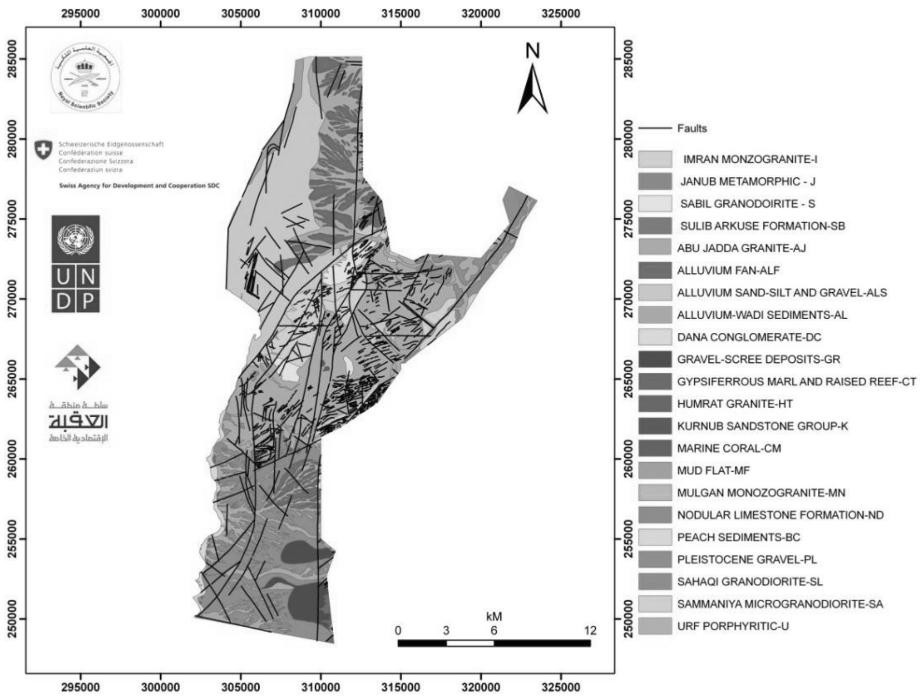
Historical Earthquakes

Archaeological and historical evidences together with field studies clearly revealed the damaging earthquakes that have hit this region that are mainly related to the DST region (Sieberg, 1932; El-Isa and Mustafa, 1986). These studies have indicated that the largest reported magnitudes of the DST region are of the order of 6.5 to 7.5. The occurrences of large earthquakes and their associated damage in the DST region are frequently reported during the Greek, Assyrian, Roman, Byzantine and Islamic times. In particular, Arab chronicles describe with details main shocks, aftershocks, surface breaks and related damage distribution in the region as early as 7th - 8th centuries (Abou Karaki, 1987; Ambraseyes et al., 1994).

Recent Seismic Activity

Prior to 1964, local instrumental seismicity monitoring was never conducted in the DST and djacent areas (except Ksara station in Lebanon which was operating since the year 1910). In the western part of the Dead Sea region,

Instrumental monitoring started in 1964 when two seismograph stations were installed in Jerusalem and Eilat (Arieh et al., 1985). Later, more than 33 stations were installed. In Jordan (east of the Dead Sea), a three component short-period seismograph station was installed in the University of Jordan in May 1981. In 1983, the Jordan Seismological Observatory (JSO) of Natural Resources Authority (NRA) started a national program through which eight telemetry seismic stations were installed in northern-central Jordan.



Geological Setting

The geology of the study area is quite complex due to the pronounced lithological variability taking place within a very small region. Figure 3 showing an updated geological map of ASEZ as part of a detailed geological mapping project that was carried out by the RSS. The geological mapping project was a major component of a seismic microzonation study of ASEZ (RSS, 2009).

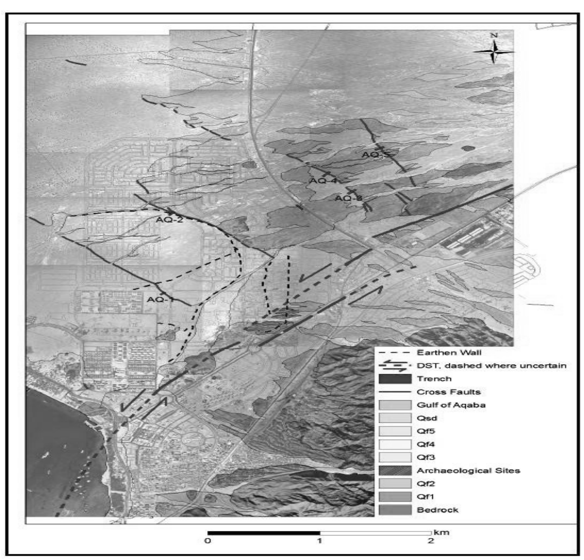


Figure 3: Geological Map of the Study Area (after RSS, 2009).

Active Faults in Aqaba City

The major active fault in Aqaba City is called Aqaba Fault which emerges from the Gulf of Aqaba. It is strike-slip major motion and originates in the gulf and dies out under the city. The exact location of the Aqaba fault is unclear because of erosion along the trend by a recent wadi and the human activities in the city. The fault appears to trend northeast with increasing curvature as it dies out toward the northeast. The location of the Aqaba fault is constrained to lie to the east of at least four distinct, NW-trending cross-fault (Niemi, 2009).

Distinct fault scarps mark these cross faults (Figure 4). Structurally, the normal to oblique slip on the cross faults indicates active NE-direction extension that produce subsidence at the head of the Gulf of Aqaba. The reliability of earthquake hazard assessment depends largely on co-seismic displacement and slip rate data gathered from geologic evidence of past earthquakes along active faults. Aqaba fault is the main concerned for potential earthquake activity in Aqaba City.

Earthquake Hazard Assessment

Earthquake hazard can be defined as the probability of the occurrence of a potential ground motion in relation to an expected earthquake taking place within a specified period of time and within a given area. This hazard is spatially distributed in relation to earthquake sources (zones, linear faults or points), local geological and soil conditions.

The analysis of earthquake hazard incorporates the quantitative evaluation of ground motion at a site or region of interest based on the characteristics of surrounding earthquake sources. According to FEMA (1989), the responsibility of this task falls primarily within the disciplines of geology and seismology with ample input from civil engineering.

It should be clear enough that earthquake hazard is very technically restricted to the behavior of the ground, apart from any effects on the built environment. The basic methodology of hazard analysis is comprised of source modeling, wave attenuation, and local ground amplification.

Soil Classification and Shear Wave Analysis

Accurate assessment of local site conditions is essential in determining the ground motion parameters as well as the potential of liquefaction and ground failure. Consideration of the local site condition results in the development of a site-specific response spectrum to be used in the structural analysis and design.

Previous RSS projects in ASEZ had led to the classification of surface soil materials into 5 different soil classes based on field geological mapping and limited geophysical surveying using Spectral Analysis of Surface Waves (SASW) across 4 selected sites.

Since soil shear wave velocities obtained from those 4 sites are not truly representative for the whole region, and there was a need to carry out further geophysical surveys to come out with a more representative soil shear wave map of the study area. Accordingly, 11 new sites were selected for further investigation. These new sites are located within both the northern and southern alluvium parts of the study area.

The 11 site were subjected to (1D) Multichannel Analysis of Surface waves (MASW) by employing passive and active field surveying procedures. Data gathered using the 2 procedures were combined finally, to give an average estimate for the shear wave velocity for the upper 30m of the soil column. Figure 5 shows the final shear wave map was produced based on these results, plus the results of the 4 sites that were previously investigated by RSS.

Attenuation Relationship Model and Earthquake Data Base

Empirical attenuation relationships are generally employed in the quantification of seismic hazard in either deterministic or probabilistic approaches. These relations describe the change of ground motion severity with source mechanism, distance, and local geology. Due to the limited strong motion data in Jordan published empirical ground motion relationships specifically developed for the DST region are not available. However, Ambraseyes et al. (1996) relationships for both peak ground acceleration (PGA) and spectral acceleration (SA) in terms of surfacemagnitude (Ms) were found to be appropriate to be used within the DST region.

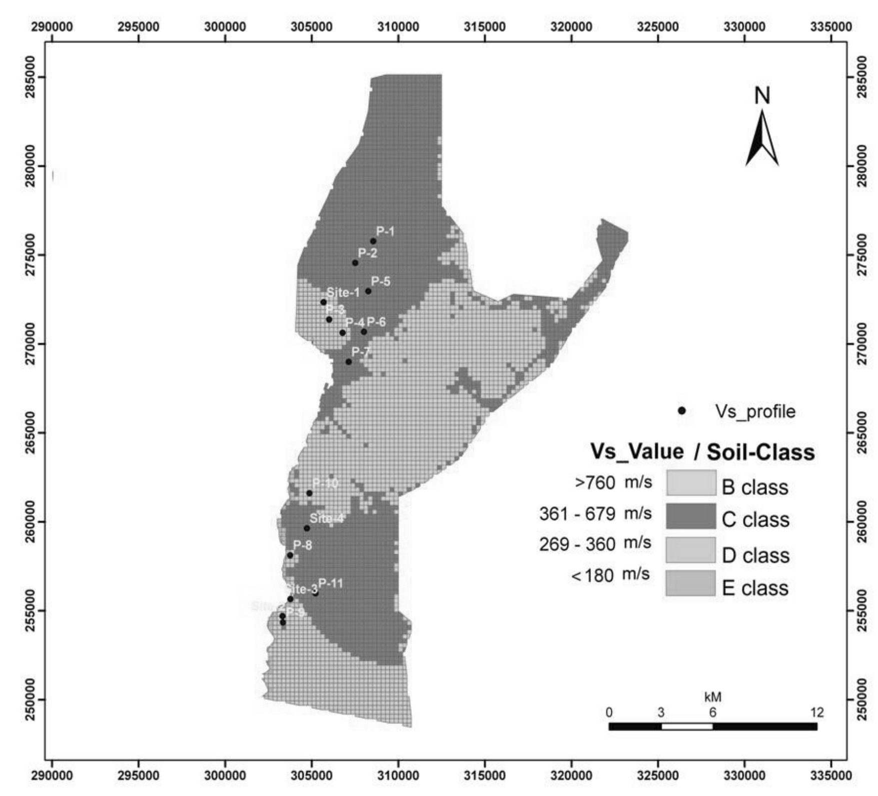


Figure 5: Final shear wave velocity and soil classification map of the study area.

However, leonov (2007) conducted a comparison of a number of attenuation relations based on the strong motion records of the 22-th November 1995 Gulf of Aqaba earthquake of a moment magnitude of 7.3 that occurred on the Aragonese fault (i.e. Aqaba II in this study), 93 km south of the towns of Eilat and Aqaba. He stated that among the all tested equations, with regards to the long distant PGA values and the correspondent magnitudes, four representative equations from the selected collection appear to be more appropriate than the rest. Moreover, he recognized that most fitting equation for the DST region is that of Boore, Joyner and Fumal (BJF) equation (1994).

Following the investigation carried out for the Near East countries (Lebanon, Cyprus, Syria, Jordan, Israel and Palestinian Authority), RELEMR project assumed the Boore et al. (1997) relationship to be predicate ground motions for the region. Meanwhile, Jiménez et al. (2007)proposed the application of Ambraseyes et al. (1996). On the other hand, Malkawi and Fahmi (1996) developed a ocally derived historically and instrumentally based PGA attenuation equation.

In order to validate the fitness of these models to the seismicity of the region, it was crucial to investigate the behavior of these relationships against available strong motion data. Al-Qaryouti (2008) developed a local attenuation relationship using recorded strong ground motion data. Table 2.6 lists a portion of his reported data that has an Ms Value of greater or equal to 5. The original data were reported in local (M_L) and moment (M_w) magnitude values. The catalogue was made available by the Jordan Seismological Observatory (JSO) which shows events less or equal than 6 with M_L and above 6 as M_w till end of 2009, check Figure 6.

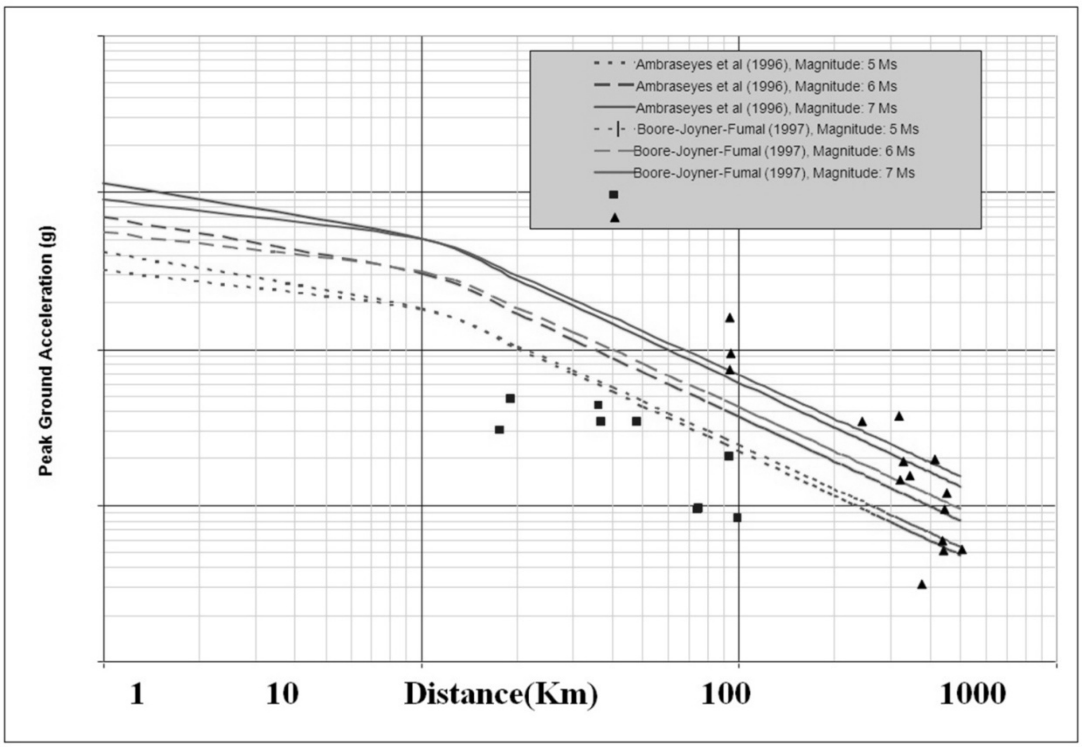


Figure 6: Ground motion prediction equation plot of Boore-Joyner-Fumal (1997) and Ambraseyes (1996). Strong motion data were taken from Al-Qaryouti (2008).

The earthquake catalogue of the DST region and adjacent regions is divided into two main categories: historical and instrumental. This study took into account the more distance seismic source regions which affected the study area especially those sources with high seismic activity and where major earthquakes have occurred. Therefore, the extent of the earthquake catalog and seismic sources are bounded by the latitudes of 26°-32.8°N and the longitudes of 32°-39°E for the purpose of implementing this study for Aqaba City.

Figure 7 Table 2.7 summarizes the historical earthquakes that occurred in the DST region within the coordinates of 26°-32.8° N and 32°-40° E up to 1896 A.D.

It is important to mention that the criteria used in revising the historical events catalogue includes:

- Any considered earthquake must be cited by one of the following references:
  - Ben-Menahem (1991).
  - Abou-Karaki (1987).
- Any considered earthquake in A.D. must be at least cited in three references.

The instrumental database used in this study was compiled from the records of the Jordan eismological Observatory (JSO), the International Seismological Center (ISC), the International Seismological Summary (ISS), the National Earthquake Information Services (NEIS), and the Institute for Petroleum Research and Geophysics in Holon (IPRG), Ben-Menahem (1979), Abou-Karaki (1987) and Al-Tarazi (1992).

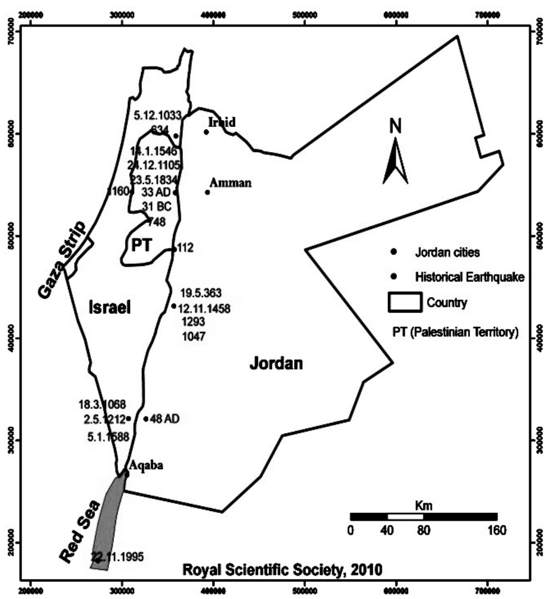


Figure 7: Historical earthquake activity within the DST region.

Earthquake Scenario Definition

The earthquake scenarios were defined based on the nature of the seismotectonics as well as the characteristics of the macroseismicity of the region. The DST is rich with many historical and paleo-earthquakes that give clear and real image about most probable earthquake scenarios. Accordingly, the following earthquake scenarios are proposed (Figure 8):

- Scenario 1 (Sc 1), represents the Aqaba Fault Earthquake Scenario.
- Scenario 2 (Sc 2), represents the Wadi Araba Earthquake Scenario
- Scenario 3 (Sc 3), represents the Gulf of Aqaba Earthquake Scenario.

These scenarios reflect the major active faults that may affect the Aqaba City with maximum moment magnitude of 7.5 for all scenarios. The motions of the faults of these scenarios are strike-slip in major component and normal or reverse in minor component. Scenario 2 reflects all historical earthquakes within 200 km away from Aqaba if they occur again and may affect the Aqaba City as it is today. Of course, there are other scenarios may affect the Aqaba City, but the considered scenarios are the most probable to occur. Additionally, the 1995 Gulf of Aqaba earthquake scenario was investigated using 7.5 and 7.2 magnitudes. The 7.2 magnitude of the Gulf of Aqaba is intended to provide calibration for subsequent risk assessments.

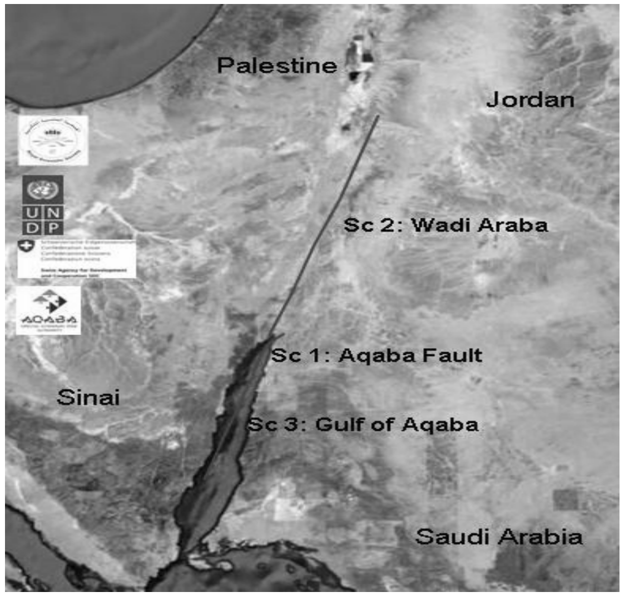


Figure 8: Google map shows the earthquake scenarios that considered in this study.

Deterministic Hazard Assessment

Deterministic seismic hazard assessment method tries to characterize the spatial distribution of the earthquake ground motion that would result from a given earthquake (scenario earthquake). The geological and seismological information including active faulting and seismotectonics forms the basis to predict the appropriate scenario earthquake, which is usually given in broad terms, involving rupture length, location and magnitude. The deterministic methodology involves: the determination of the scenario earthquake, identification of proper attenuation relationships and appropriate site-response quantification. For this study, the deterministic hazard was evaluated using both intensity and ground motion parameters (PGA and SA) based on appropriate attenuation relationships. For both cases the median (50-percentile) value obtained from the used attenuation relationships was adopted.

For this part of the deterministic seismic hazard method, the selected ground motion parameters of analysis are the Peak Ground Acceleration (PGA) and the Spectral Acceleration (SA) at periods of 0.2, 0.3 sec and 1.0 sec using StrucLoss 1.5. A comparison of the attenuation relationships of Ambraseys et al. (1996) and Boore et al. (1997) with New Generation Attenuations (Abrahamson and Silva, 2008, Boore and Atkinson, 2008, Campbell and Bozorgnia, 2008, Chiou and Youngs,(2008) are plotted in Figure 2.38. For near source conditions, Ambraseys et al.(1996) attenuation highly overestimates the peak ground acceleration. In this study, for earthquake scenario I and II, Boore et al. (1997) is utilized for the calculation of the PGA and SA for the periods: 0.2, 0.3 and T = 1.0 sec. For earthquake scenario III, average of Boore et al. (1997) and Ambraseys et al.(1996) is utilized for the calculation of the PGA and SA for the periods: 0.2, 0.3 and T = 1.0 sec.

Elements at Risk

Introduction

In urban areas buildings, population, lifeline systems and socio-economic activities constitute the —elements at risk‖. Buildings and lifeline systems are generally termed —Built Environment‖. The physical losses to elements at risk that would result from a specified earthquake scenario necessitate an extensive and comprehensive collection of their inventories. The inventories of the built environment were studied broadly in the following categories: buildings, transportation systems, water system, and sanitary system.

Building Data Aqaba is divided into 74 zones but not yet completely named. However, to make our tasks easier we assigned names for those unnamed zones

The Department of Statistics (DOS) divides each zone into blocks (Figure 10) for the purpose of their census work. The block is defined as a group of buildings forming a locality or part of it, with clear man-made boundaries such as paved or unpaved streets, lanes, passages, electricity posts, telephone posts, railways, etc,or natural boundaries as mountains, rivers, and valleys and are easily identified on ground. A GIS map of 318 statistical blocks (Figure 10) in an ArcGIS shapefile format was provided by the DOS, and then edited for accuracy of boundaries between blocks.

Classification of Aqaba City buildings were based on the expertise of engineers from ASEZA and RSS. Additionally, field survey was conducted for verification. Because of the fact that the construction year, the construction type, and the storey number of the building are the most important parameters affecting the earthquake performance, the DOS database was queried and classified according to these parameters, whenever available.

Figure 9: Aqaba City zones.

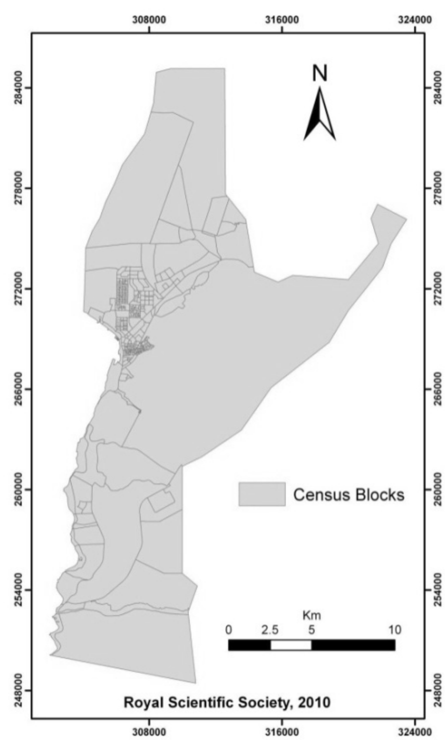


Figure 10: Aqaba City census data blocks (edited after the DOS).

Raw data of buildings and population were provided by DOS in excel sheets. They were aggregated into a block scale and linked to the spatial map since each bock has a unique geocode.

Buildings of Aqaba City were classified into the following types:

I-Building type:

Type 1- Skeleton-stone cladding
Type 2- Skeleton-standard
Type 3- Skeleton- EQ resistant
Type 4- Skeleton- soft story
Type 5- Skeleton-tunnel
Type 6- Masonry
Type 7- Reinforced Masonry

J- Number of Stories

1- 1-3
2- 4-6
3- >6

K- Date of construction

1- Post-1990 (included) 2- Pre-1990

The main reason for taking the year 1990 as a cutoff year is that the commitment of using building codes in the construction practice, as agreed by the majority of contractors and engineers, in Aqaba City has begun after 1990.

Table 1: Count of building classes indexed with B_{IJK} identifier.

Class	Building Type (I)	Number of Stories (J)	Age (K)	Number of buildings
B111	1	1-3 floors	Post-1990	218
B112	1	1-3 floors	Pre-1990	3
B121	1	4-6 floors	Post-1990	2
B211	2	1-3 floors	Post-1990	4440
B212	2	1-3 floors	Pre-1990	4391
B221	2	4-6 floors	Post-1990	34
B222	2	4-6 floors	Pre-1990	7
B311	3	1-3 floors	Post-1990	483
B321	3	4-6 floors	Post-1990	3
B411	4	1-3 floors	Post-1990	11
B421	4	4-6 floors	Post-1990	37
B422	4	4-6 floors	Pre-1990	7
B512	5	1-3 floors	Pre-1990	33
B612	6	1-3 floors	Pre-1990	2239
B711	7	1-3 floors	Post-1990	176
B712	7	1-3 floors	Pre-1990	41
	Total number of buildings			12125

Demographic Data

In this section night time population of Aqaba (DOS, 2007) was determined on the block level, and then assigned to 250x250 m cells in order to calculate the human losses due to a major earthquake. The population data of Aqaba have been obtained from the Department of Statistics. There is no available statistics showing the daytime population. Therefore, it was decided to limit our study to nighttime population only. Table 2 lists the 16 building classes with their population.

Table 2: Total Population for Each Building Class in ASEZ.

Class	Building Type (I)	Number of Stories (J)	Age (K)	Number of buildings
B111	1	1-3 floors	Post-1990	2379
B112	1	1-3 floors	Pre-1990	9
B121	1	4-6 floors	Post-1990	6
B211	2	1-3 floors	Post-1990	43065
B212	2	1-3 floors	Pre-1990	39555
B221	2	4-6 floors	Post-1990	205
B222	2	4-6 floors	Pre-1990	88
B311	3	1-3 floors	Post-1990	131
B321	3	4-6 floors	Post-1990	6
B411	4	1-3 floors	Post-1990	14
B421	4	4-6 floors	Post-1990	87
B422	4	4-6 floors	Pre-1990	23
B512	5	1-3 floors	Pre-1990	290
B612	6	1-3 floors	Pre-1990	12896
B711	7	1-3 floors	Post-1990	191
B712	7	1-3 floors	Pre-1990	50
	Total number of Population			98995

Risk Assessment

Urban Earthquake Risk

The analysis results of building damage losses and their ratios to the total number of building for the three proposed earthquake scenarios are summarized in Table .The total numbers of damaged buildings are considered to be the sum of damaged buildings in moderate, extensive and complete damage status. The analyses results estimated the numbers damaged buildings and the ratio to the total number of buildings to be 6,015 (49.6%), 4.272 (35.2%) and 194 (1.6%) for scenarios I, II and III respectively.

Table 3: Statistics of Building Damages Losses for all Earthquake Scenarios.

SCENARIO	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Damaged Buildings	Total Number of Buildings in the district
I	2,469 (%20.4)	3,641 (%30.0)	2,283 (%18.8)	2,545 (%21.0)	1,187 (%9.8)	6,015 (%49.6)	12,125
II	3,975 (%32.8)	3,878 (%32.0)	1,908 (%15.7)	1,763 (%14.5)	601 (%5.0)	4,272 (%35.2)	12,125
III	11,098 (%91.5)	833 (%6.9)	126 (%1.0)	60 (%0.5)	8 (%0.1)	194 (%1.6)	12,125

Figures 11,12, and 13 show the distribution for all building classes that will be damaged according to scenario I, II, and III respectively.

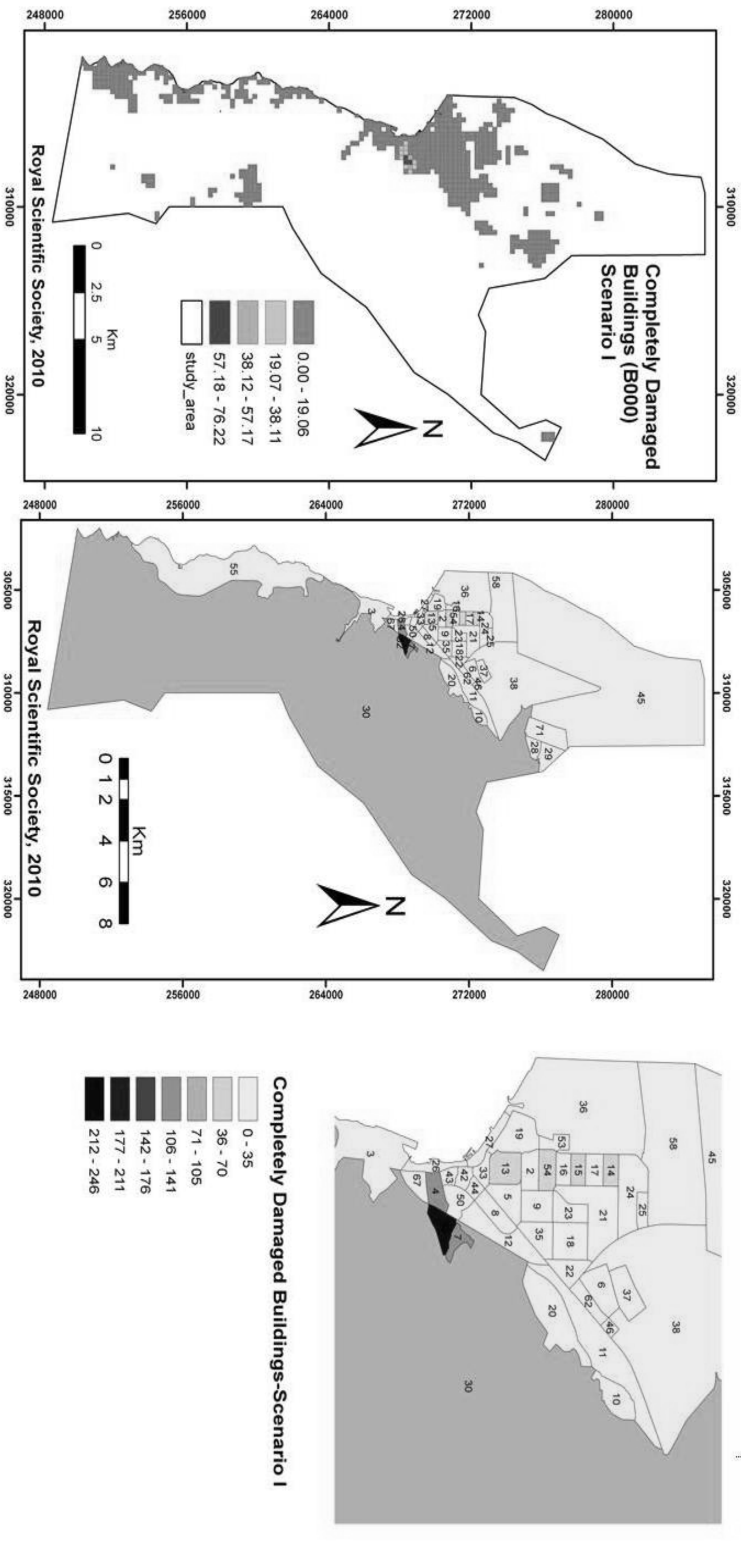


Figure 11: Completely Damaged Buildings Distribution for all Building Classes- Scenario I.

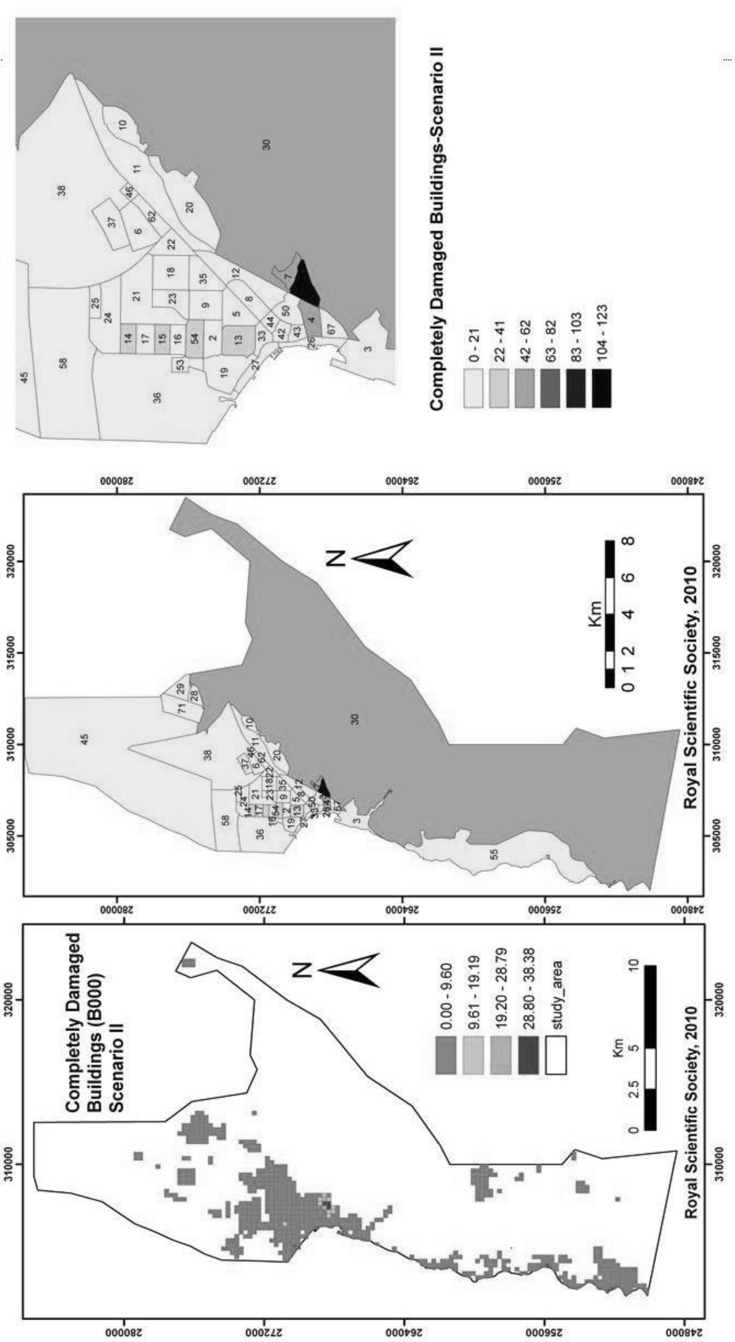


Figure 12: Completely damaged buildings distribution for all building classes- scenario II.

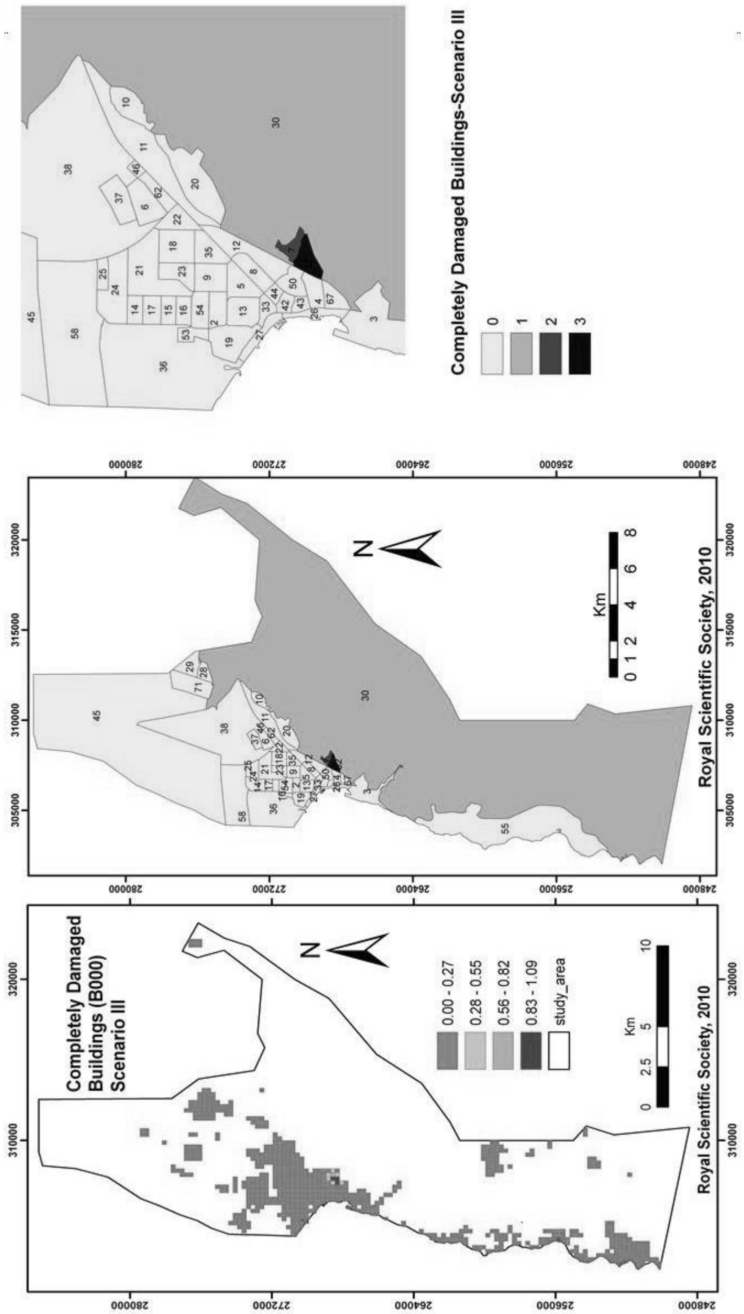


Figure 13: Completely Damaged Buildings Distribution for all Building Classes - Scenario III.

Casualties

The total numbers of casualties for the four levels of casualty severities based on the three proposed earthquake scenarios are given in Table . The casualties are computed for four injury severity levels as defined in HAZUS99; severity-1, severity-2, severity-3 and severity-4. The casualties are computed based on nighttime population for ASEZ area. The total number of causalities and ratios to the total population are estimated as 4,719 (4.8%), 2,656 (2.7%) and 44 (0.04%) for scenario I, II and III, respectively.

Table 4: Casualty estimates for all Earthquake Scenarios.

SCENARIO	Total Population	Severity-1	Severity-2	Severity-3	Severity-4	Total Casualties
I	99020	2,362 (%2.4)	1,159 (%1.2)	599 (%0.6)	599 (%0.6)	4,719 (%4.8)
II	99020	1,356 (%1.4)	654 (%0.7)	323 (%0.3)	323 (%0.3)	2,656 (%2.7)
III	99020	27 (%0.0)	9 (%0.0)	4 (%0.0)	4 (%0.0)	44 (%0.0)

Shelter Needs

The expected shelter needs were calculated using the approach explained in Chapter 4. The results showed that a total population of 48,991(49.5%) needs shelter according to scenario I, 36,368(36.7%) according to scenario II, and 1,504 (1.5%) according to scenario III as given in Table 5.

Table Error! No text of specified style in document. Number of people needs shelter for all Earthquake Scenarios.

SCENARIO	Total Population	Moderate Damage	# of people in Extensive Damage	#of people in Complete Damage	# of people need shelter
I	99,020	19,003 (%19.2)	20,991 (%21.2)	8,998 (%9.1)	48,991 (%49.5)
II	99,020	16,299 (%16.5)	15,185 (%15.3)	4,883 (%4.9)	36,368 (%36.7)
III	99,020	1,016 (%1.0)	435 (%0.4)	52 (%0.1)	1,504 (%1.5)

Other Damages

In addition, for each scenario, Physical Lifeline damages were computed for the following:

- Transportation System,
- Water and Wastewater Transmission Systems,
- Health Centers, and Emergency Services,
- Electrical Transformers.

Conclusion

Seismic hazard is technically restricted to the behavior of the ground, apart from any effects on the built environment. The basic methodology of hazard analysis is comprised of source modeling, wave attenuation, and local ground amplification. This is commonly evaluated in terms of probabilistic and deterministic assessment approaches. Probabilistic seismic analysis provided estimates of the severity of ground shaking on bedrock throughout the investigated ASEZ area with a 10% probability of exceedance in 50 years. The results of seismic hazard analysis showed that the Aqaba Fault system is recognize as the main seismic source within the region, which runs through the offshore-onshore boundary of the northern gulf region across the city of Aqaba. Revision of historical and recent instrumental earthquake catalogues, tectonics of the region has led to the identification of the various seismogenic zones that can potentially cause seismic damage to the region. Accordingly, three earthquake scenarios were proposed; the Aqaba Fault Scenario (scenario I), the Wadi Araba Scenario (scenario II) and the Gulf of Aqaba Scenario (scenario III), with a maximum magnitude of 7.5. In order to provide means of calibration for risk estimations, the Gulf of Aqaba Scenario was proposed to have a magnitude of 7.3, which is equal to the event known as the 1995 Aqaba Earthquake located about 80 km south of the City of Aqaba. These scenarios were suggested based on active seismicity and the deaggregation of probabilistic seismic hazard analysis for the investigated area.

Seismic risk assessment involves the investigation of urban exposure to existing seismic hazards. Accordingly, detailed data in relation to existing elements at risk of ASEZ were collected and populated on a grid of 250x250 m cell size.

According to scenario I, the ratio of district total damaged buildings to the total damaged buildings of ASEZ for scenario I, indicated that the districts of Old city (11.7%) and Al-Shalaleh (11.4%) have the highest level of damage, while the districts of Al-Kazan, East region-Industrial South, Al-Radwan, and Al-Naser have ratios ranging between 5% and 5.7%; Al-Rawdah Middle, Al-Remal, and Al-Zahra' have damage ratios between 3.7% and 4.5%. All other districts in ASEZ have damage ratios less than 3%.

Considering scenario II, the ratio of district total damaged buildings to the total damaged buildings of ASEZ for scenario II, indicated that the districts of Al-Shalaleh (11%) and Old city (10.3%) have the highest level of damage. while the districts of Al-Naser, AlRadwan, Al-Rawdah Middle, Al-Kazan, Al-Remal and East region-Industrial South have ratios ranging between 5% and 6.1%; Al-Zahra', Residential 10th, Al-Dawha and AlRawdah South have damage ratios in the range 3.0% - 3.3%. All other districts in ASEZ have damage ratios less than 3%.

Scenario III analysis indicated that the districts of Al-Shalaleh (21.8%), Old city and Al-Kazan (10.8%) have the highest level of damage, while the districts of Old City, Al-Radwan, Al-Naser and Qaboos-Tala Bay have damage ratios ranging between 5.8% and 7.6%; Al-Rawdah Middle, Al-Remal and Al-Dawha have damage ratios between 3.1% and 3.9%. All other districts have damage ratios less than 2.1%.

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STUDY OF DIFFERENT STAGGERED SHEAR WALL CONFIGURATIONS ON SEISMIC PERFORMANCE OF RCC FRAMED BUILDINGS

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Abstract

Shear walls are one of the excellent means of providing earthquake resistance to multi-storeyed reinforced concrete building. When RCC Multi-Storey building is designed without shear walls then column sizes are quite heavy and steel required is large. So there is lot of congestion at these joint and it is difficult to place and vibrate concrete at these place and displacement is quite heavy which induces heavy forces in member. Shear wall may become essential from the point of view of economy and control of horizontal displacement. There are lots of literatures available to design and analyze the shear wall. However, the decision about the location of shear wall in multi-storey building is not much discussed in any literatures. It is very necessary to determine effective, efficient and ideal location of shear wall. When shear walls are situated in advantageous positions in a building, they can be very efficient in resisting lateral loads originating from wind or earthquakes.

It is well-established fact that shear walls are quite effective in lateral load resistance, but it is limited to low-rise to medium-rise reinforced concrete buildings. It is believed that shear walls would be effective in high-rise construction as well, but its performance would be different from low- rise buildings. Restriction in the architectural design by the presence of the shear walls may contribute to discourage the engineers from adopting the shear walls. Due to this a new concept of providing storey deep and bay wide discrete staggered shear wall panels has been introduced.

In this paper non-linear static analysis (considering P-Δ effect) of a 30-storeyed reinforced concrete frame building in zone V provided with conventional shear wall (non-staggered) and a new kind of arrangement i.e. frame with staggered shear wall panels has been done for determining parameters like lateral displacement and storey drift. The various arrangements of staggered shear wall panels have been investigated and critically assessed for their feasibility and advantages as compared to the conventional shear wall system. The non-linear static analysis of frame with shear wall/shear wall panels gives better understanding and more accurate lateral load evaluation of buildings, as the progression of damage can be determined.

The seismic analysis of all the frame models for various load combinations according to IS: 1893 (Part 1)-2002 has been done by using software ETABS. The primary objective is to achieve a configuration where the lateral displacement and storey drift are minimum.

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Introduction

Recently spatial flexibility has become more and more important in planning of residential buildings, not only for special planning but also for ease of remodeling. New structural systems are required to meet growing demands for spatial flexibility, and one good alternative is the staggered-wall system. The system consists of a series of storey-high walls spanning the total width between two rows of exterior columns and arranged in a staggered pattern on adjacent column lines. The staggered-wall system has the advantage that large clear span open areas are possible at the first floor level, because columns are located only on the exterior faces of the building. Other benefits include minimum deflection and greater stiffness in the structure while reducing seismic loads and foundation costs.

Non-linear static analysis of frame shear wall (non-staggered) and staggered shear wall panel emphasizes on stiffness, ductility, strength and drift control to prevent possible damages followed by complete collapse. We typically use the linear static (first order) analysis to determine design forces and moments resulting from loads acting on a structure. First order analysis assumes small deflection behavior; the resulting forces and moments take no account of the additional effects due to additional deformations of the structure under load. On the other hand second order static analysis combines two effects to reach a solution; large displacement theory: the resulting forces and account of the effects due to the deformed shape of both the structure and its members, stress stiffening: the effect of element axial loads on structure stiffness, tensile loads stiffening an element and compressive loads softening an element. As structures become ever more slender and less resistant to deformation, the need to consider second order analysis and to be more specific P-Δ effects arises. As a result, codes of practice of various countries are referring engineers more and more, to use the second order analysis in order that P-Δ and stress stiffening effects are accounted for when appropriate in design.

P-Δ is a non-linear (second order) effect that occurs in every structure where elements are subject to axial load. It is a genuine effect that is associated with the magnitude of the applied axial load and the displacement. The magnitude of the P-Δ effect is related to the (i) magnitude of axial load P, (ii) stiffness/slenderness of the structure as a whole and (iii) slenderness of individual elements. In linear analysis of structures, the equations of equilibrium are based on the undeformed geometry existing before load application. This is sufficiently accurate for many practical cases. However, the frames with slender members may have large deformations, so that it is necessary to consider equilibrium in the real deformed configurations. This requires non-linear analysis involving iteration, which can be done using Newton-Raphson's technique. The equilibrium equations are based on trial displacement values, whose accuracy is improved by iterations, so as to satisfy the equilibrium of the nodes or the members in their displaced positions or their deformed shapes. Non-linearity caused by large deformations is referred to as geometric non-linearity. A member subjected to large axial force combined with transverse loads or to transverse end translation or rotation represents a geometric non-linear problem, often referred to as a beam-column problem or casually, a P-Δ problem.

Building Description

- Number of storey: 30
- Type of frame: Special RC moment resisting frame fixed at base.
- No of grids in X direction: 9
- No of grids in Y direction: 7
- Spacing between frames: 5 m along X and 4 m along Y- direction
- Floor height: 3.0 m
- Ground floor height: 4.0m
- Depth of Slab: 175 mm
- Size of beam: (300 × 450) mm
- Size of column:
- 1 to 10 storey (700× 700) mm
- 11 to 20 storey (600× 600) mm
- 21 to 30 storey (500× 500) mm
- Thickness of masonry wall: 230 mm
- Thickness of shear wall: 230 mm
- Materials: M 30 concrete, Fe 415 steel Material
- Density of concrete: 25 KN/m^3

- Density of infill: 20 KN/m^3
- Live load on each floor: 4.0 KN/m^2
- Floor finish load: 1.0 KN/m^2
- Wall load: 11.04 KN/m
- Seismic zone: V
- Type of soil: Medium
- Importance factor: 1
- Response reduction factor: 5
- Damping of structure: 5 percent

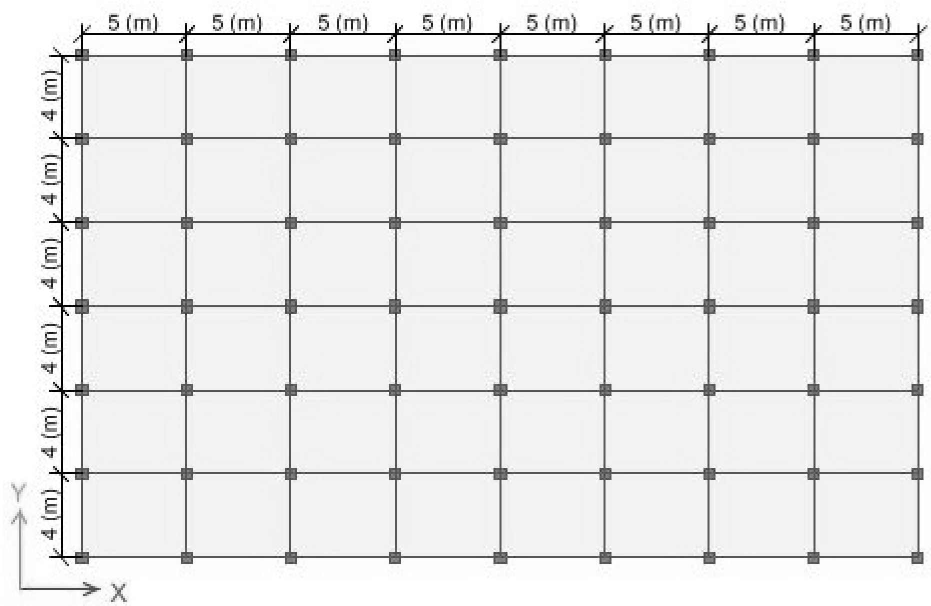

Fig. 1: Floor plan of the building

Modeling and Analysis

The 30-storeyed building frames consist of beams, columns, slabs and shear wall/ staggered wall panels are modeled for analysis usimg software ETABS. In first case a frame without shear wall is analyzed. In second case a frame with conventonal shear wall is analyzed. In third and subsequent cases the frames with staggered arrangement of shear wall panels are analyzed. Nonlinear static analysis (with P-Δ effect) has been done for all the models.

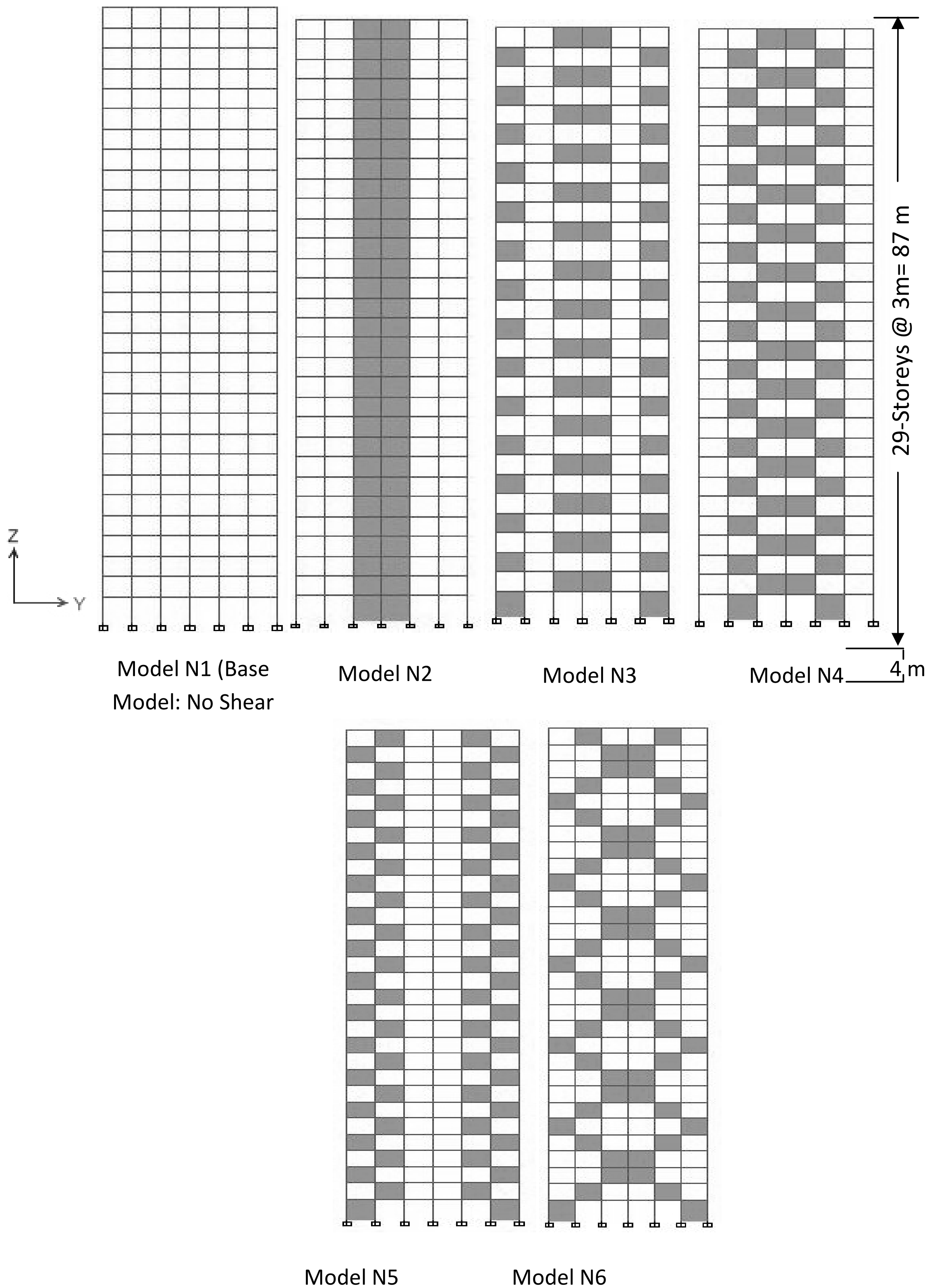

Fig. 2: Elevation of all the Models

Results

Among all the load combination, the load combination of 1.5DL+1.5EQ is found to be the most critical combination in both X and Y directions for all the models. So all the results are for load combination of 1.5DL+1.5EQ, where DL= Dead load including floor finish load and wall load, and EQ= Earthquake load in corresponding direction.

Obtained results have been presented in form of graphs, indicating the trends and pattern of variables such as lateral displacement, storey drift.

Lateral Displacement

As the storey level of building increases the lateral displacement of the building increases, since with the increase in the storey level of the building the lateral stiffness of the building decreases.

Lateral Displacement in X Direction

The maximum lateral displacement was obtained on the top floor level in each model which was reduced by 44.98% in model N2, 53.46% in model N3, 71.42% in model N4, 55.86% in model N5 and 89.22% in model N6 as compared to the model N1 (base model).

Numerical values and trend of lateral displacement for all the models can be observed from table 1 and figure 3 respectively.

Lateral Displacement in Y Direction

The maximum lateral displacement was obtained on the top floor level in each model which was reduced by 34.52% in model N2, 40.66% in model N3, 58.34% in model N4, 46.35% in model N5 and 77.40% in model N6 as compared to the model N1 (base model).

Numerical values and trend of lateral displacement for all the models can be observed from table 2 and figure 4 respectively.

Storey Drift

In case of drift, as the storey level of the building increases, the drift also increases up to a certain storey level and after that it decreases.

Storey Drift in X Direction

The maximum storey drift was reduced by 46.52% in model N2, 53.70% in model N3, 72.05% in model N4, 57.95% in model N5 and 88.75% in model N6 as compared to the model N1 (base model).

Numerical values and trend of storey drift for all the models can be observed from table 3 and figure 5 respectively.

Storey Drift in Y Direction

The maximum storey drift reduced by 37.25% in model N2, 42.08% in model N3, 61.10% in model N4, 50.63% in model N5 and 79.68% in model N6 as compared to the model N1 (base model).

Numerical values and trend of storey drift for all the models can be observed from table 4 and figure 6 respectively.

Table 1 Lateral Displacement along X-Direction

Storey No	Lateral Displacement (mm)					
	N1	N2	N3	N4	N5	N6
1	10.1	2.1	1.9	1.3	1.6	1
2	23.4	5	4.7	2.8	3.9	1.9
3	38.5	8.9	8.4	4.8	6.7	3
4	54.2	13.7	12.7	7	10.2	4.1
5	70.3	19.2	17.8	9.5	14.1	5.2
6	86.3	25.4	23.2	12.5	18.6	6.6
7	102.4	32.1	29.3	15.7	23.4	8.2
8	118.4	39.3	35.5	19	28.6	9.5
9	134.2	46.9	42.4	22.7	34.1	11
10	149.9	54.7	49.1	26.4	39.9	12.5
11	166.6	63	56.5	30.5	45.9	13.9
12	183	71.5	63.7	34.4	52.3	15.3
13	199.1	80.1	71.4	38.8	58.8	17
14	214.9	88.9	78.7	43	65.5	18.9
15	230.2	97.7	86.5	47.6	72.3	20.2
16	245.2	106.5	93.9	51.9	79.3	22.1
17	259.6	115.3	101.6	56.6	86.3	23.7
18	273.5	124	108.9	61	93.3	25.2
19	286.8	132.6	116.3	65.6	100.3	26.6
20	299.5	141	123.2	70	107.3	28.2
21	313.2	149.4	130.4	74.6	114.3	30.1
22	325.9	157.5	137	78.9	121.1	31.3
23	337.7	165.4	143.6	83.3	128	33
24	348.5	173	149.6	87.5	134.6	34.5
25	358.1	180.3	155.5	91.7	141.1	35.7
26	366.5	187.3	160.9	95.7	147.4	36.9
27	373.7	194.1	166.1	99.7	153.7	38.2
28	379.5	200.6	171	103.5	159.5	39.5
29	383.9	206.9	175.7	107.2	165.5	40.5
30	387	212.9	180.1	110.6	170.8	41.7

Table 2 Lateral Displacement along Y-Direction

Storey No	Lateral Displacement (mm)					
	N1	N2	N3	N4	N5	N6
1	9.2	2.5	2.4	1.7	2	1.1
2	21	6.2	5.9	3.6	4.7	2.5
3	34.2	11.1	10.6	6.4	8.3	4.2
4	48.1	16.9	15.9	9.4	12.6	6.2
5	62.2	23.6	22.3	13.1	17.5	8.5
6	76.5	31.1	29	17	23	10.6
7	90.9	39.1	36.6	21.5	29	13.1
8	105.3	47.7	44.2	26	35.4	15.7
9	119.8	56.6	52.6	31.1	42.1	18.5
10	134.2	65.9	60.9	36.2	49.1	21.5
11	149.7	75.6	69.9	41.8	56.5	24.2
12	165.1	85.5	78.7	47.4	64.2	27.3
13	180.3	95.5	88.2	53.5	72	30.6
14	195.4	105.7	97.2	59.5	80.1	33.9
15	210.2	115.9	106.7	65.8	88.2	37.3
16	224.6	126	115.7	72	96.4	40
17	238.8	136.1	125.1	78.4	104.7	43.3
18	252.5	146.1	134	84.7	112.9	46.8
19	265.7	155.9	143.1	91.2	121.2	50.4
20	278.5	165.5	151.6	97.4	129.2	53.8
21	292.3	175	160.6	104	137.5	56.5
22	305.4	184.3	168.6	110.2	145.3	59.8
23	317.7	193.1	176.9	116.5	153.2	63.3
24	329.1	201.7	184.3	122.5	160.6	66.8
25	339.5	209.8	191.7	128.5	168.1	70
26	348.8	217.6	198.4	134.3	175.1	72.5
27	357.1	225	204.9	140	182.1	75.6
28	364.1	232	210.9	145.5	188.5	78.7
29	369.9	238.8	216.8	150.8	195.2	81.8
30	374.5	245.2	222.2	156	200.9	84.6

Table 3 Storey Drifts along X-Direction

Storey No	Storey Drift (mm)					
	N1	N2	N3	N4	N5	N6
1	10.644	2.14	2.016	1.348	1.656	0.996
2	14.091	3.075	2.835	1.518	2.34	0.972
3	15.909	4.083	3.897	2.094	2.907	1.083

4	16.644	4.971	4.404	2.238	3.606	1.155
5	16.917	5.745	5.358	2.613	4.026	1.209
6	16.98	6.414	5.58	3.096	4.602	1.413
7	16.947	6.99	6.39	3.366	4.914	1.593
8	16.854	7.482	6.429	3.42	5.379	1.293
9	16.734	7.896	7.107	3.843	5.619	1.611
10	16.702	8.202	6.972	3.768	5.946	1.518
11	17.211	8.604	7.698	4.254	6.222	1.395
12	17.103	8.826	7.449	4.11	6.552	1.428
13	17.031	9.015	8.001	4.557	6.693	1.74
14	16.668	9.135	7.674	4.359	6.939	1.935
15	16.251	9.195	8.079	4.734	7.011	1.395
16	15.777	9.204	7.692	4.509	7.152	1.869
17	15.252	9.168	7.968	4.809	7.179	1.698
18	14.673	9.087	7.542	4.569	7.221	1.464
19	14.052	8.976	7.725	4.806	7.227	1.458
20	13.542	8.79	7.233	4.527	7.14	1.671
21	13.401	8.736	7.455	4.794	7.236	1.851
22	13.324	8.469	6.834	4.488	7.047	1.227
23	12.465	8.211	6.813	4.593	7.035	1.752
24	11.358	7.929	6.273	4.353	6.771	1.506
25	10.17	7.632	6.102	4.335	6.774	1.245
26	8.904	7.335	5.667	4.17	6.402	1.2
27	7.56	7.044	5.394	4.047	6.483	1.311
28	6.141	6.777	5.088	3.963	5.979	1.326
29	4.665	6.552	4.824	3.804	6.246	1.038
30	3.27	6.294	4.584	3.642	5.463	1.191

Table 4 Storey Drifts along Y-Direction

Storey No	Storey Drift (mm)					
	N1	N2	N3	N4	N5	N6
1	10.808	2.764	2.648	1.8	2.096	1.232
2	13.902	4.002	3.702	2.103	2.985	1.404
3	15.567	5.292	5.121	2.952	3.765	1.848
4	16.284	6.402	5.766	3.222	4.623	2.118

5	16.62	7.344	6.975	3.963	5.202	2.385
6	16.788	8.145	7.26	4.2	5.868	2.172
7	16.869	8.817	8.253	4.836	6.306	2.586
8	16.896	9.378	8.31	4.866	6.81	2.727
9	16.89	9.843	9.135	5.457	7.152	2.91
10	17.312	10.176	8.964	5.424	7.467	3.102
11	17.902	10.662	9.906	6.042	7.881	2.727
12	17.8	10.893	9.561	5.979	8.163	3.213
13	17.799	11.085	10.278	6.48	8.394	3.39
14	17.541	11.193	9.822	6.372	8.568	3.483
15	17.22	11.232	10.368	6.759	8.709	3.438
16	16.839	11.211	9.834	6.615	8.757	2.73
17	16.392	11.133	10.239	6.897	8.838	3.429
18	15.888	11.01	9.642	6.723	8.766	3.621
19	15.33	10.848	9.96	6.927	8.82	3.636
20	14.915	10.602	9.249	6.678	8.595	3.474
21	15.001	10.545	9.717	6.963	8.784	2.73
22	14.726	10.191	8.769	6.654	8.412	3.417
23	14.169	9.837	8.937	6.711	8.43	3.57
24	13.089	9.45	8.058	6.468	7.992	3.534
25	11.928	9.039	8.037	6.384	8.001	3.258
26	10.68	8.622	7.272	6.207	7.458	2.58
27	9.348	8.217	7.119	6.012	7.542	3.114
28	7.938	7.839	6.513	5.91	6.873	3.171
29	6.465	7.521	6.375	5.694	7.173	3.087
30	5.061	7.194	5.85	5.529	6.18	2.826

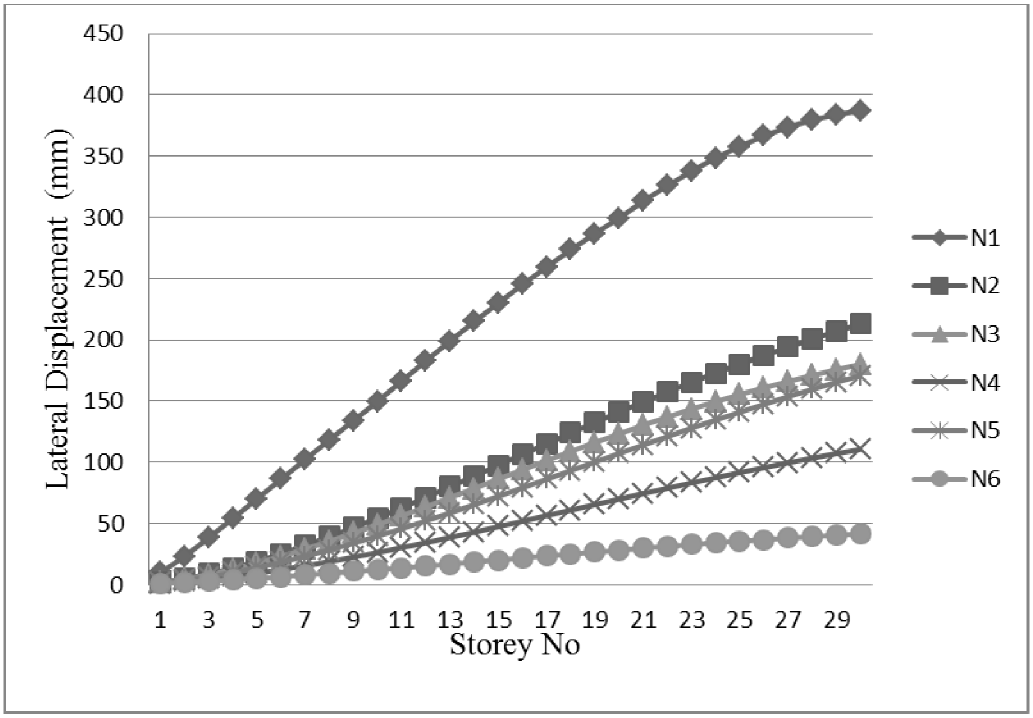

Fig. 3: Lateral Displacement along X-Direction

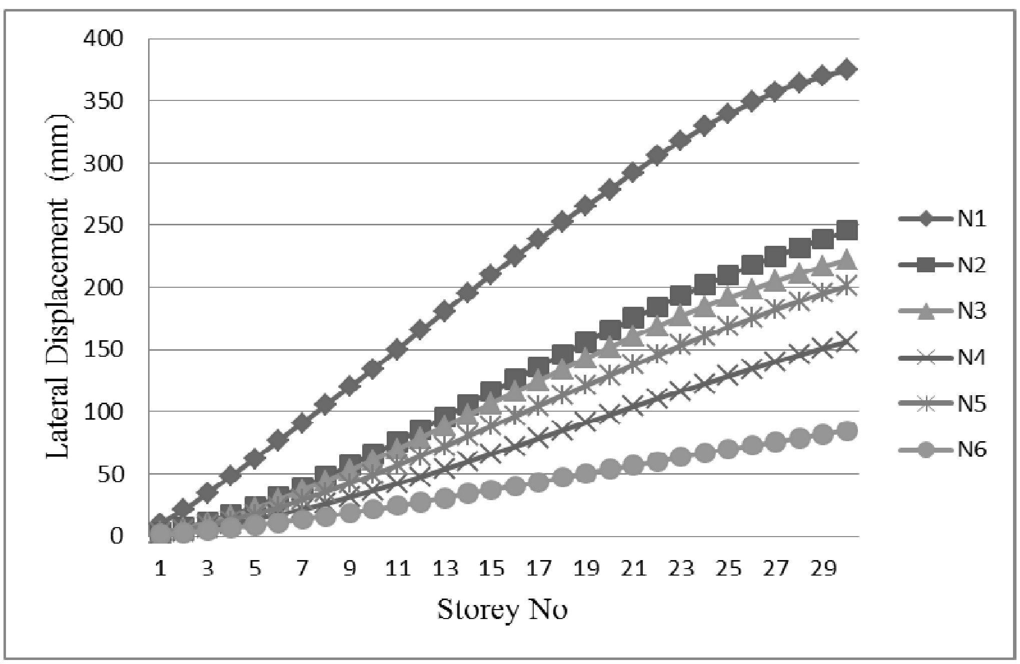

Fig. 4: Lateral Displacement along Y-Direction

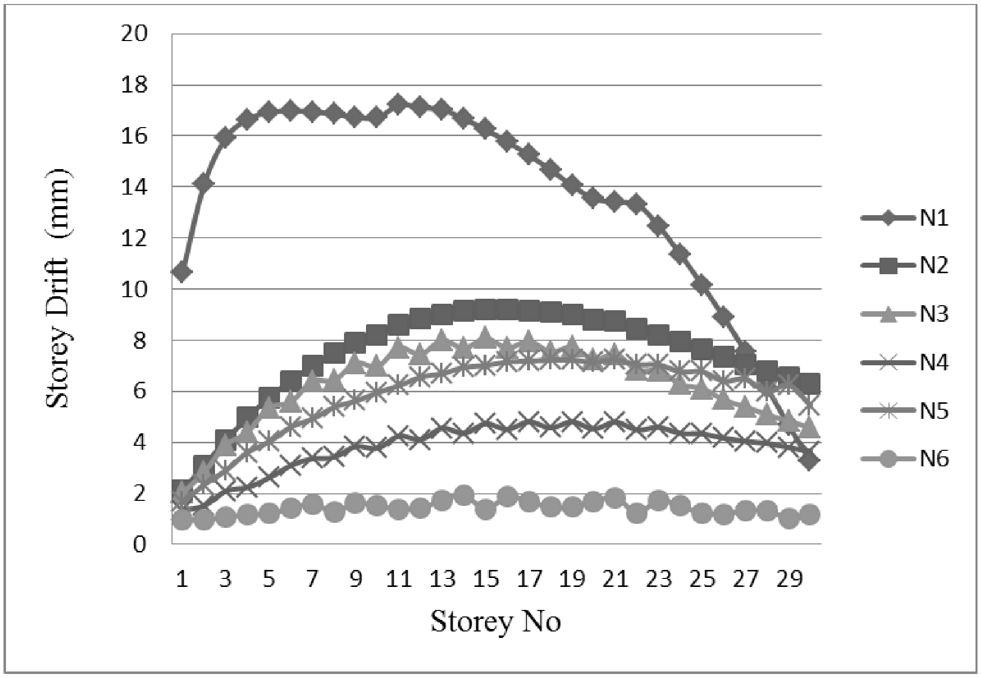

Fig. 5: Storey Drifts along X-Direction

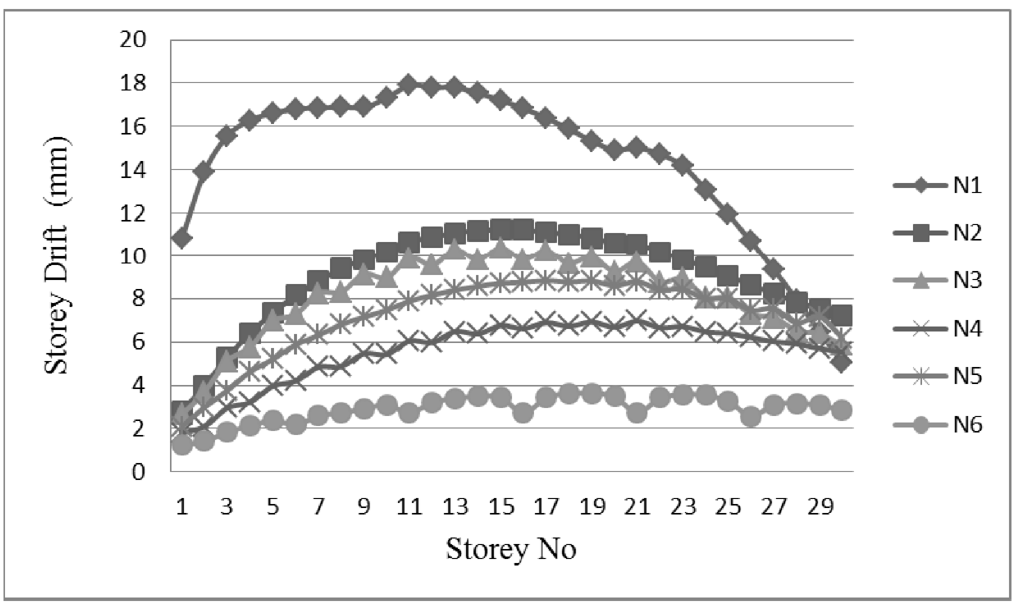

Fig. 6: Storey Drifts along Y-Direction

Conclusion

The analytical study on various staggered shear wall configurations is done and the lateral displacements and storey drifts for various staggered shear wall configurations are obtained. From the study, the following conclusions can be drawn out:

- Among all the load combination, the load combination of 1.5DL+1.5EQ is found to be the most critical combination in both X and Y directions for all the models.
- Model having shear walls scattered in X shape throughout the width in the elevation of the building (Model M6) is most effective for the structures in the earthquake prone areas.
- Model having shear walls scattered in X shape but not throughout the width in the elevation of the building (Model M4) is also found to be effective for structures in the earthquake prone areas.
- Presence of Staggered shear walls enhances the strength and lateral stiffness of the structure by reducing the lateral displacement and storey drift more than conventional types of shear walls.

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A STUDY ON SEQUENCE OF PLASTIC HINGE FORMATION IN RC FRAME BY NONLINEAR STATIC ANALYSIS

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Abstract

Push over analysis is popularized in recent days as a tool to evaluate the performance of structures underground motions. The three concepts of push over analysis, such as capacity, demand and performance are symbolized by capacity curve and target displacement similar to the maximum displacement expected to be experienced by the structure during a considered earthquake. The evaluation considers the factors such as global drift, interstorey drift, inelastic element deformations, deformation between elements etc. The first and most important step of this procedure, modeling of the structure demands the determination of the nonlinear properties of each component that are quantified by strength and deformation capacities. Notwithstanding the development made in the static inelastic push over analysis, the results obtained from analytical methods are failing to match the actual displacement characteristics of the structure. A thorough investigation needs to be carried out to address this issue which may be the cause of order of sequence of hinges formation. An attempt has been made in this paper to investigate the sequence of hinge formation by analyzing an RC frame by using a software package SAP 2000.

Key words: *Push over analysis, ground motions, target displacement, hinge formation, SAP2000.*

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EARLY WARNING SYSTEM

- Early Warning System At The Community Level –Technological Advancements - *Dr. Sourabh Bhattacharya, Divya Nagilla*

EARLY WARNING SYSTEM AT THE COMMUNITY LEVEL – TECHNOLOGICAL ADVANCEMENTS

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Abstract

India with a coastline of 7516 km is vulnerable to cyclones of varying intensities. The major lesson learnt from cyclones Phailin and Hudhud is that there is a need for development and implementation of Early Warning Systems at the local community level. There is also need for advanced observational systems, data communication, management and delivery systems. The India Meteorological Department(IMD) also needs to predict the actual wind velocity of the cyclone prior to its arrival. In this paper through literature review we try to understand the existing Early Warning Systems at the community level, the technologies which are being used for communication to remote areas and the technologies used for measuring wind velocity during cyclones in other countries.

Keywords: *Cyclone, Early Warning system, technology, communication, wind velocity measurement.*

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Introduction

The loss of life due to extreme hydro meteorological eventshas decreased significantly by factor of 10, saving millions of lives.This has been attributed to emergency warning systems which helped in improved forecasting, monitoring and emergency preparedness. But, the economic losses linked to these disasters have increased nearly 50 times over the past five decades (World Meteorological Organisation, 2015).

Some of the poorest and the most vulnerable communities in coastal states of India live in the zone up to 1,000 meters from the high tideline and immediate vicinity of the sea.These communities consist of fisherman, farmers and other allied professions.The coastal areas are vulnerable to cyclones and other disasters which can turn back the development by many years(Press Information Bureau, 2013). The death of family's livestock or the loss of capital or tools of trade can also lead to complete devastation of their earning capacity (Metri, 2006).

Early warning systems help in the protection of natural resource base and productive assets (infrastructure and private property or investments) .Large amount of economic losses and damages can be avoided with small fraction of investment in improving the existing early warning systems .The amount spent on in recovering avoidable damages due to disasters can be saved and spent on other development activities (Subbiah et al., 2008).Which will in turn ensure economic growth. By reducing the impact of disasters the rehabilitation costs are also reduced.

The current early warning system with India Meteorological Department (IMD)helped in timely evacuation of the people from the vulnerable areas but reduction in the economic losses and livelihood is very low (Babu et al., 2014).There is little or no attention paid to potential disasters faced by the vulnerable communities and what can be done to mitigate their impact (Metri, 2006). IMD's current cyclone early warning system does not possess the ability to measure the actual wind velocity prior to the landfall of the cyclone (National Disaster Management Authority, 2015).The correct measure of the velocity will help in making accurate decisions at the local community level for evacuation (National Institute of Disaster Management, 2014). The early warning dissemination system to send communication directly to the last mile is not in place (National Disaster Management Authority, 2015).Currently, aweb based system with multiple options of sending messages with the help of satellite phones directly to the people vulnerable to the disaster is not present (National Institute of Disaster Management, 2014).

Low income countries are more disaster resilient whereas the developed countries are more disaster resistant (Zapata & Madrigal, 2010). In this paper through literature review we try to the existing Early Warning Systems at the community level, the technologies which are being used for communication to remote areas and the technologies used for measuring wind velocity during cyclones in other countries.

Literature Review

Different types of systems like the decision support, early warning, resource management, communications and inter agency systems play a vital role during emergency and disaster events. The composite system composed of all the above systems helps in delivering support functions in chaotic operational environment. The frequent occurrence of disasters and their negative impact on the communities has made us to further look into the early warning and communication systems (Martin & Rice, 2012).

The advanced monitoring systems and the sophisticated technology are of no use if it is unable to reach people who need it the most during disasters (Davis & Izadkhah, 2008) .Emergency communication and warning systems are those systems which collect, process, store, analyze and distribute information in case of emergency during disasters. They include hardware, software's, networks, business processes and human interactions (Martin & Rice, 2012).

An early warning system is the crucial element of disaster risk reduction. It helps in reducing the number of deaths caused and the economic loss incurred due to disasters (Davis & Izadkhah, 2008). The four components of an early warning system are as follows.

- Risk awareness: prior knowledge of the likely risk scenarios that communities face.
- Monitoring and Warning service: monitoring of capacities for these risks and rapid and reliable decision-making processes for early warning.
- Communication: dissemination of understandable warnings and preparedness information to those at risk.
- Response capability: knowledge and preparedness capacity to act by all partners of the information chain.

Failure in any part of the chain can mean breakdown of the whole system. Efficient early warning systems have strong linkages between these four elements (Davis & Izadhah, 2008).The members in the early warning system can be grouped into three categories. Thescientific bodies originate the. The media and the government officials act as intermediaries for dissemination of the warning information. This information is finally received by the local community leaders (Davis & Izadhah, 2008). The processes which are involved in the early warning systempresent in Indiaare explained in the flow chart(India Meteorological Department, 2013).

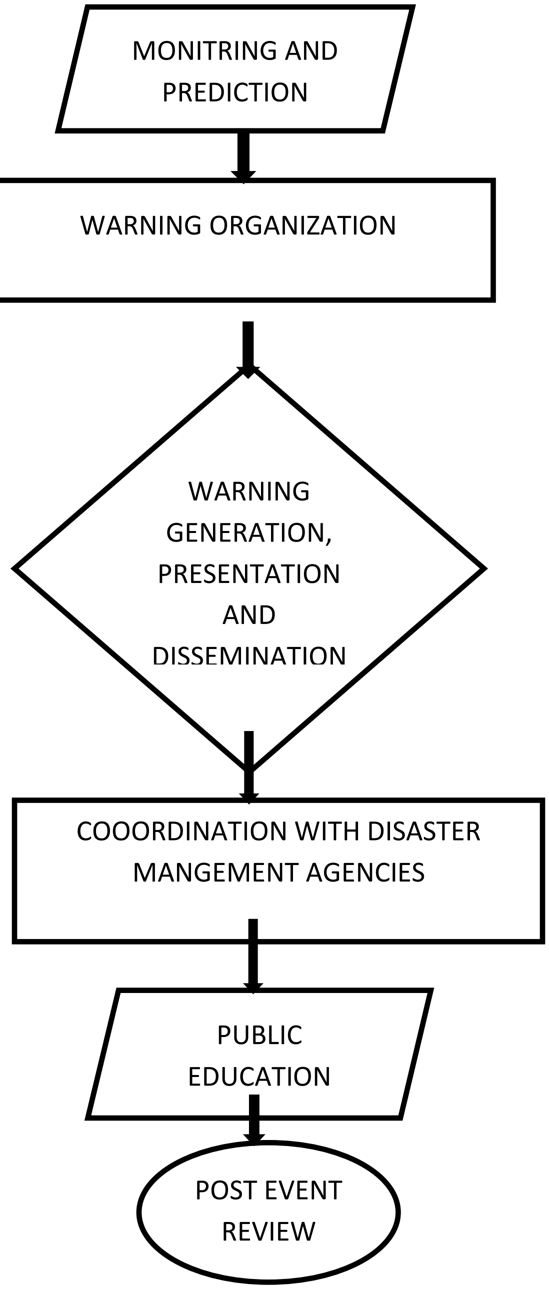

Figure 1 Early Warning System in India

Due to the absence of effective early warning system in India, cyclones HudHud and Phailin caused huge destruction. Cyclone HudHud damaged about 1, 12,850 houses. The livelihood of more than 7, 52,540 people belonging to agriculture, horticulture, livestock, fisheries and handlooms was severely affected due to the cyclone. The total economic loss which was incurred was estimated to be Rs. 13,263 crores (National Disaster Management Authority, 2015). The previous year on 12th of October 2013 cyclone Phailin hit the coastal district Ganjam of Odisha.Thousands of houses were washed away, power supply and communication was disrupted (Yadav & Barve, 2014).

Methodology

The web based technologies which are used for communication and the wind velocity measurement systemsused during cyclones are explained through literature review. In web based technologies, Sentinel alert system in Australia andCell Broadcast Technologyin Lithuaniaare discussed. In this paper the role of Hurricane Hunters in giving accurate weather information is also explicated. As a result of the literature review we identify the technologies which need to be implemented in India in order to reduce the economic losses and make it disaster resistant.

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Communication

"Communications save lives" stated Dr Zavazava in his presentation on disaster risk reduction held in Kobe(United Nations, 2005) .There is a need for development of many internet based information systems so that accurate information is accessible to the people in poor countries(Davis & Izadkhah, 2008). Extensive communication can play a vital role in overall disaster management (Kashem, 2006). The communication systems help in informing the potentially adverse parties and react to adverse situations (Martin& Rice, 2012).

The various modes through which cyclone warning information is disseminated in India is through telephone, tele fax, Very High Frequency(VHF)/High Frequency Radio Tele communication(HFRT), satellite based Cyclone Warning Dissemination System(CWDS), police wireless, Aeronautical Fixed Telecommunication Network(AFTN), internet(e-mail), websites, radio/TV network, mobile phones, Interactive Voice Response Systems (IVRS), Short Messaging Services(SMS).IVRS has been installed at 26 MeteorologicalCentre's (MC)/ Regional Meteorological Centre's (RMC) to give automatic response to the queries of the caller. A person needs to dial "18001801717 "toll free number from anywhere in the country to get information about the cyclones. High speed data terminals are also installed at all MCs and RMCs to send SMS and emails(India Meteorological Department, 2013).

The communication regarding the cyclone is given to the common people through All India Radio (AIR) and CWDS (India Meteorological Department, 2013). IMD has installed the receivers of CWDS systems in coastal areas at [1]Block Development, [2]Taluk offices and police stations, state and district level government headquarters, vulnerable to cyclones (Sahni et al., 2001). There are 352 Cyclone Warning Dissemination system. Telefax and email are sent to the concerned authorities and people using the capacity of INSAT satellite through the CWDS. CWDS receivers receive warning messages in local languages in the areas likely to be affected by the cyclone(India Meteorological Department, 2013). INSAT satellite sends cyclone warnings to designated isolated places in local languages (Sahni et al., 2001).Local AIR broadcasts hourly bulletins in local language, English and Hindi. The bulletins give the location of the cyclonic storm, its direction of movement, place and time of landfall. The details of the adverse weather conditions in the areas likely to be affected by the storm are also given. The local population is informed through police wireless by the state government for their evacuation (India Meteorological Department, 2015).

In Australia Sentinel alert system has been developed which provides emergency early warning system that delivers instant audible, visual and text warnings to houses, people and property in danger. The Sentinel Alert Infrastructure consists of the satellite system, the radio transmitters and the computer network. The warning messages are sent by the competent authority who has adopted sentinel alert system in that particular

[1]Block Development: Planning and development units in an area of a city or country.

[2]Taluk office: An entity of local government which exercises fiscal and administrative power over villages and municipalities under its jurisdiction.

area. The danger zone is drawn by the control officer on computer mapping interface. The Global Positioning System (GPS) co-ordinates and Identification (ID) of covering transmission towers are calculated by the computer. The control officer types and sends the warning messages. The satellite units controlling the radio transmitters receive the message. The GPS co-ordinates and Text warning is broad casted by the Radio Transmitters. The home receivers calculate if GPS co-ordinates place them in danger zone if yes then alarm is sounded and text message is displayed. The self-installed home unit receives danger zone, danger levels and specific text information and uses the GPS to calculate which properties are in danger and should be alerted. It can also be attached to sprinkler system, external siren (Sentinel Alert, 2015)

In Lithuania, Cell Broadcast Technology allows delivering informational messages within a specified territory of the public mobile phone communication network coverage area. Unlike with sending SMS, cell broadcast messaging does not require search and identification of a subscriber, i.e., messages are simultaneously delivered to all citizens within a specified area who have the cell broadcasting messaging function activated on their mobile phone.The messages can be delivered not only to Lithuanian residents, but also to foreign citizens in the territory of Lithuania. This technology avoids congestion on public mobile communication networks (Pitrenaite-Zilenieneet al., 2014).

Wind Velocity Measurement

IMD forecasts the intensity of the cyclone with the help of Numerical Weather Prediction(NWP), synoptic and statistical methods, satellite and radar observations. The NWP method is used for predicting 24-72 hours forecast. The synoptic, statistical, satellite and radar observations are used for 12/24 hours forecast. In the synoptic method prevailing wind conditions like wind shear, sea surface temperature, Ocean thermal energy, lower level inflow and upper level inflow are taken into consideration for forecasting. In the NWP along with the above mentioned fields the satellite and radar observations are also taken into consideration (India Meteorological Department, 2013)

Hurricane hunters fly into tropical cyclones in the North Atlantic Ocean and Northeastern Pacific Ocean to gather weather data. They are aircrews (consisting of pilot, co-pilot, Navigator, Aerial Reconnaissance Weather officer). Satellites can give information regarding the formation of cyclone but they cannot provide the interior barometric pressure of a hurricane nor provide accurate wind speed information. They enter into the eye of the hurricane at the altitude of 1,500 to 10,000 feet to measure the wind temperature and pressure. Instruments called dropsondes are used by the forecasters for prediction (Martin & Rice, 2012).

The weather data collected during the flight is sent by the Reconnaissance weather officer to the National Hurricane Centre through satellite communication. The weather officer sends the messages that include exact latitude and longitude of the center of the hurricane maximum wind velocity, maximum temperature and minimum pressure. The GPS enabled dropsondes are used to predict strength, speed and direction of storms. The dropsondes combine GPS receivers with pressure, temperature and humidity (PTH) sensors to capture atmospheric profiles and thermodynamic data in hurricanes. Dropsondes while descending on a parachute transmit data to the scientists on board throughradio frequency transmitters (Pitrenaite-Zilenieneet al., 2014).

As the dropsondes are very expensive ($ 750 each) the distortion in GPS signal over the ocean wavesmethod has been suggested by the scientists to measure the wind speed. But this method cannot be used on land and over calm seas (Pitrenaite-Zilenieneet al., 2014). CLIPER model is also used for intensity measurement in Atlantic and Pacific basins (Sahni et al., 2001).

Conclusion

The economic losses can be reduced to a great extent by investing in web based systems which help in disseminating disaster warning information directlyto the people (Hallegate, 2012).Hurricane hunters must be used to measure the exact wind velocity in order toreduce the unnecessary evacuation cost.It has been estimated that an investment of 1 billion USD per year in early warning systems in developing countries will reduce the asset losses between 300 and 2 billion dollars USD per year (Hallegate, 2012). There are no cyclone monitoring systems at the community level. The establishment of cyclone wind monitoring stations at the coastal level is required (National Institute of Disaster Management, 2014). For the early warning systems to be effective the governments, federal and local officials, scientists and policy makers, legislators, teachers and community leaders should work together. Along with the scientific advancements in the community level there is also a need for increasing the awareness at the community level (Davis & Izadkhah, 2008).

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ENVIRONMENT – ECO SYSTEMS & CLIMATE CHANGE ADAPTATION

- The Role Of Coastal Vegetation In Protecting Shorelines: A Case Study In Bhitarkanika Conservation Area, Odhisa, India - *Dhruv Verma & Sonali Ghosh*
- Study on Ecosystem based Disaster Risk Reduction in Sunderbans, UNESCO World Heritage Site.- *Rupa and Sonali Ghosh*
- Strategic Environmental Assessment as a tool in Disaster Management - *Md. Shafiqul Baria and Uttam Kumar Majumderb*
- Mangroves play an important role in natural disaster reduction and resilience - *Akhil Singh.*
- Government Strategy In Dealing With Climate Change : A Case Study Of Food Security Crisis In Malaysi - *Dr. Ahmad Martadha Mohamed and Zahrul Akmal Damin*
- Impact And Role Of Mangrove Forests And Biodiversity Conservation In Disaster Management In East Godavari Riverine Estuarine Ecosystem (Egree) Region - *Dr. Thulsi Rao Kundhi, M. Ravikumar, Dr. Kalyani Bai Kunte*
- Some Anthropogenic Factors of Landslide In *Aizawl, Mizoram. - Lalrokima Chenkual*
- Impact Of Drought On Community, Vulnerability And Coping Methods Used In Villages Of Northern Rajasthan, India - *Dr. Rajiv Gupta , Dr. Amrita Agrawal*

THE ROLE OF COASTAL VEGETATION IN PROTECTING SHORELINES:
A CASE STUDY IN BHITARKANIKA CONSERVATION AREA, ODHISA, INDIA

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Abstract

Increasing climatic variations is heavily effecting the earth's environment. It is a known fact that differential warming of land and sea is disrupting the atmospheric circulations and hydrological regime of earth. Since India is not an exception to this phenomenon, it is also facing the risk of hydro meteorological disasters like Cyclones, Sea storms and so. Indian coast line is a very critical biogeogrphic zone as one side it is home to mankind, animals and plants & on other side it is an important economic zone. The present study will focus on the role of mangrove forest in mitigation of cyclones and subsequent effects especially in Bhitarkanika Conservation Area comprising Bhitarkanika National Park and Wildlife Sanctuary. It is a comparative study to show vulnerability of stakeholder villages with and without forest. The study will help in future nomination of the property on UNESCO World Heritage Site list and further management. Previous studies across the globe have shown that mangroves and coastal plantations reduce impacts of cyclone but in India an extensive study in this regard is yet to be undertaken. It is predicted that areas with mangrove forest reduce the physical impacts of cyclones and simultaneously provide social equity.

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STUDY ON ECOSYSTEM BASED DISASTER RISK REDUCTION IN SUNDERBANS, UNESCO WORLD HERITAGE SITE

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Abstract

Disaster Risk Reduction (DRR) aims to reduce the damage caused by natural hazards like earthquakes, floods, droughts and cyclones, through an ethic of prevention. Ecosystem-based approaches address the crucial links amongst environmental conditions, ecosystem services, livelihoods, disaster risks and climate risks. But in the context of DRR and development planning the role of ecosystems in providing hazard protection, livelihood recovery and sustainability, and resilient development is often ignored. The present study represents the role of healthy and well managed ecosystems as natural infrastructures to prevent hazards, reducing the exposure of people and their productive assets to hazards, reducing the vulnerabilities to disasters by supporting livelihoods that are sustainable and resilient to disasters and the ability to support the post-disaster recovery needs of the communities. The present study will be carried out in Sunderbans region of West Bengal in India. The Sunderbans region is taken for study since this region is highly populated and disaster like cyclones, floods, oil spills etc is the regular phenomena. Moreover, this region is also recognised by UNESCO as World Natural Heritage Site.

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STRATEGIC ENVIRONMENTAL ASSESSMENT AS A TOOL IN DISASTER MANAGEMENT

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Abstract

Approximately one-quarter of the world's population currently lives at risk from natural hazards and economic losses from natural disaster. Every decade an estimated one million people are killed by natural disasters. Here we follow the definition of natural disasters as event that results in mortality and damage which exceed the response and recovery capabilities of the affected area, creating the need for outside assistance. But proper policy, planning and program (PPP) in the development process of an area can give better opportunity to manage natural disaster. Strategic Environmental Assessment (SEA) may be an important tool in natural disaster management process. SEA is a systemic decision support system, aiming to ensure that environmental and possibly other sustainability aspects are considered effectively in policy, plan and program making. Now a day, SEA has become an important instrument to help to achieve sustainable development in public planning and policy making. The importance of SEA in disaster management is widely recognized. A well planned developmental works or projects in an area can give better access to manage disaster. Moreover, it can help to mitigate the disaster in an area. Again, disasters significantly disrupt the built and social environment. Recovery from a disaster can place considerable demands on the environment, ranging from increased resource extraction to uses of natural resources. The post-disaster period often present an opportunity to reshape pre-disaster environment leading to new settlements and re-designing pre-disaster land uses. In non-disaster times, almost all of the actions undertaken following a disaster would be subject to environmental reviews and take place in a context set by SEA. But a failure of proper SEA can lead to avoidable environmental damage and increased hardship for the disaster survivors. This paper explores how the SEA can work in the disaster management context. Some case studies will be also examined in this paper.

Key words: *Strategic, Environmental, Assessment, Disaster and Management*

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MANGROVES PLAY AN IMPORTANT ROLE IN NATURAL DISASTER REDUCTION AND RESILIENCE

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Abstract

Environment degradation, settlement patterns, livelihood choices and human behavior are all factors contributing to disaster risks, which in turn results in even more harmful effects on human development and environmental assets. Environment degradation tends to multiply the actual impacts of hazards and limits an area's ability to absorb those impacts, and this often decreases the overall resilience to hazard impacts and recovery from disasters.

Natural hazards are ongoing part of human history, especially the coastal dwellers face different kinds of hazards (hurricane, storm) currently around 1.2 billion people (23% of world population) live within 100 km of coast (Small et al. 2003). A tropical typhoon that ravaged Bangladesh in 1991 resulted in over 100,000 deaths and the displacement of millions of individuals (W.Neil Adger, et al. 2005). Coral reefs and mangroves play a crucial role in decreasing the impact of coastal natural disturbances. Ancestral mangroves can be traced back 65 million years (Duke, 1992) and vast tracts of deforestation have occurred in recent past. Mangrove forest offers a significant defense against the full impact of tsunami as it did in Indian Ocean tsunami 2004 (Vermaat & Thanpanya, 2006). Protection and conservation of environment is essential for disaster reduction and resilience.

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GOVERNMENT STRATEGY IN DEALING WITH CLIMATE CHANGE
A CASE STUDY OF FOOD SECURITY CRISIS IN MALAYSIA

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Abstract

Food security has received urgent attention by the government, especially in the context of unpredictable climate change in the world. High dependency on import for food as well as natural disasters caused by flooding and land slides are a cause for concern to the government. As a result, initiatives are being taken to formulate disaster management strategies to better prepare against extreme climate changes that severely affect food production. Accordingly, the framework of this study is to identify disaster management strategies implemented by the government in the face of climate change. Based on a qualitative approach, an in-depth semi- structured elite interviews were adopted. Data were analyzed using content analysis to explore the establishment of government's strategy in relation to food sustainability. The results of the data analysis found that there are six main themes in regards to government's disaster management strategy in the face of climate change, namely (i) research and security; 23:15 percent, (ii) risk management; 22:22 percent, (iii) preparation of work plans; 21:29 percent, (iv) the preservation and conservation; equivalent to 12.4 percent, (v) crop management; equivalent to 12.4 per cent, and (vi) potential development; equivalent to 9.26 percent. It is hoped that the results of this study can help policy makers to formulate and improve strategies for addressing climate change and at the same time protect the country from any unforeseen circumstances related to the issue of food security.

Keywords: *Disaster management, food security, climate change*

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IMPACT AND ROLE OF MANGROVE FORESTS AND BIODIVERSITY CONSERVATION IN DISASTER MANAGEMENT IN EAST GODAVARI RIVERINE ESTUARINE ECOSYSTEM (EGREE) REGION

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Abstract

Extreme natural hazards are emerging as a cause of major concern in the coastal regions. India has been traditionally vulnerable to natural disasters on account of its position and unique geo-climatic conditions. Disaster events can be natural or anthropogenic in origin, or be triggered by a combination of these factors. Human-induced disasters can include complex emergencies/conflicts, famine, displaced populations, industrial accidents and transport accidents, while natural disasters may be geophysical (earthquakes, landslides, avalanches, volcanic eruptions), climatic (hurricane, tsunami, flooding, drought, storm surge) or biological (epidemics, pest infestations). In India, 57% land is vulnerable to earthquakes; 12% land is vulnerable to floods; 8% land is vulnerable to cyclones. Owing to its geo-climatic, geological and physical features, the east coast of Andhra Pradesh is also vulnerable to all major natural hazards. But to protect the shoreline areas of EGREE operational area, this region is blessed with Godavari mangrove forests (322.22 Km^2) as ecological bio-shields, of which 235.70 Km^2 area come under coringa wildlife sanctuary. Under Coringa Management plan 2013-2023, about an area of 1185.64 ha have already been regenerated within the sanctuary area. Currently the main production sectors operating in the landscape/seascape are fisheries, aquaculture, saltpans, manufacturing activities such as oil and gas exploration, fertilizers, edible oil, rice products, tourism and ports. These activities are impacting the overall ecological integrity of the mangrove ecosystems in CWLS and adjoining areas, with associated impacts on the livelihoods of local people. A balance needs to be struck between meeting increasing present-day needs, on one hand, and conserving the environmental support system provided by the mangrove forests, on the other. EGREE foundation under the initiatives of UNDP-GEF-GoI-GoAP project laid a deep foundation for sustainable management of this fragile ecosystem of the area with the involvement and participation of local community, Industries and related stakeholders.

Keywords: *Ecosystem services, Coringa Wildlife sanctuary, Natural disasters, Disasters management, Godavari Mangroves.*

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Introduction

Coastal and marine ecosystems are among the most productive ecosystems in the world that provide many services to human society and are of great economic value [1]. Indian coastal ecosystems comprising of mudflats, sandy beaches, estuaries, creeks, mangroves, coral reefs, marshes, lagoon, sea grass beds, and sandy & rocky beaches extend to 42,808 sq km. Extreme natural hazards are emerging as a cause of major concern in the coastal regions. India is no exception to such natural disasters on account of its position and unique geo-climatic conditions. Disaster events can be natural or anthropogenic in origin, or be triggered by a combination of these factors. Human-induced disasters can include complex emergencies/conflicts, famine, displaced populations, industrial accidents and transport accidents, while natural disasters may be geophysical (earthquakes, landslides, avalanches, volcanic eruptions), climatic (hurricane, tsunami, flooding, drought, storm surge) or biological (epidemics, pest infestations). Indian sub-continent is amongst the world's most disaster prone areas with 57% area is vulnerable to Earthquake; 28% area is vulnerable to Droughts; 8% area is vulnerable to Cyclones and 12% area is vulnerable to Floods (while 37% area was affected in 1998); 50 % forest cover area is vulnerable to forest fire; 18% area is vulnerable to landslides [2]. One million houses damaged annually including human social & other losses. In the Year 2014 although there were no extreme catastrophes, Asia and Pacific witnessed 119 disaster events. Economic losses from natural disasters remained high. For instance, 2014 was an atypical year in terms of storms, transboundary floods and landslides [3], which collectively contributed to the region's total economic losses of US$59.6 billion. Tropical cyclones such as Hudhud in India cause 11 billion US$ Economic loss besides Riverine floods cause loss of 16 billion US$ [4]. A natural hazard pertains, "to a natural phenomenon which occurs in proximity and poses a threat to people structure and economic assets caused by biological, geological, seismic, hydrological and meteorological conditions or processes in the natural environment".

Disasters can have adverse consequences on the environment and on ecosystems in particular, which could have immediate to long-term effects on the populations whose life, health, livelihoods and well-being depend on a given environment or ecosystem. Environmental impacts may include: (i) direct damage to natural resources and infrastructure, affecting ecosystem functions, (ii) acute emergencies from the uncontrolled, unplanned or accidental release of hazardous substances especially from industries, and (iii) indirect damage as a result of post-disaster relief and recovery operations that fail to take ecosystems and ecosystems services into account. As a result, pre-existing vulnerabilities may be exacerbated, or worse, new vulnerabilities and risk patterns may emerge especially in circumstances where there are cumulative impacts due to recurring natural hazards [5]

On the other hand, environmental conditions themselves can be a major driver of disaster risk. Degraded ecosystems can aggravate the impact of natural hazards, for instance by altering physical processes that affect the magnitude, frequency and timing of these hazards.
Environmental degradation also contributes to risk by increasing socio-economic vulnerability to hazard impacts, as the capacity of damaged ecosystems to meet people's needs for food and other products is reduced [6].

The poor often occupy fragile and marginal spaces, possess limited rights and entitlements over natural resources and are less capable of applying more sustainable resource use strategies. Similarly, the connections between poverty, development and increasing disaster risk are also now better understood; the poor suffer high casualties and generally have the least capacity to recover from disasters [7]. Poor communities tend to be more vulnerable, as their livelihoods often depend heavily on natural resources and ecosystem services [8].

Ecosystems provide valuable services for hazard protection and regulation, which until now have been under-utilized by disaster risk reduction programmes and strategies. Ecosystems serve as natural infrastructure that can reduce physical exposure and buffer the effects from natural hazards. However, it is equally important to recognize ecosystems' contributions towards overall vulnerability reduction by sustaining livelihoods and economies and strengthening their resilience against hazard impacts. Healthy and well-managed ecosystems provide critical goods and services that enable communities to cope with and recover from disasters. The functions of coastal ecosystem for Disaster Risk Reduction are mentioned in the table:

Ecosystems	Hazard Mitigation
Wetlands and floodplains	Wetlands and floodplains control floods in coastal areas, inland river basins, and mountain areas subject to glacial melt [9].
	Peat lands, wet grasslands and other wetlands store water and release it slowly, reducing the speed and volume of runoff after heavy rainfall or snowmelt in springtime.

	Coastal wetlands, tidal flats, deltas and estuaries reduce the height and speed of storm surges and tidal waves[10].
	Marshes, lakes and floodplains release wet season flows slowly during drought periods.
Coastal ecosystems, such as mangroves, saltmarshes, coral reefs, barrier islands, and sand dunes	Coastal ecosystems function as a continuum of natural buffer systems protecting against hurricanes, storm surges, flooding and other coastal hazards – a combined protection from coral reefs, seagrass beds, and sand dunes/coastal wetlands/coastal forests is particularly effective [11]. Research has highlighted several cases where coastal areas protected by healthy ecosystems have suffered less from extreme weather events than more exposed communities [12].
	Coral reefs and coastal wetlands such as mangroves and salt marshes absorb (low-magnitude) wave energy, reduce wave heights and reduce erosion from storms and high tides [13].
	Coastal wetlands buffer against saltwater intrusion and adapt to (slow) sea-level rise by trapping sediment and organic matter [14].
	Non-porous natural barriers such as sand dunes (with associated plant communities) and barrier islands dissipate wave energy and act as barriers against waves, currents, storm surges and tsunami [15].

Disaster Risk in Andhra Pradesh

Owing to its geo-climatic, geological and physical features, the east coast of Andhra Pradesh (A.P.) is also vulnerable to all major natural hazards. Due to existence of Eastern Ghats in A.P., the area between Pentakota (East Godavari) and Baruva (Srikakulam Dt.) are less prone to cyclone tracks. But, the delta areas of the rivers - Pennar, Krishna, Godavari are cyclone track prone areas.

About Study Area

Protected Mangrove Areas mitigate against coastal hazards, such as tropical storms and cyclones and their associated hazards (e.g. storm surges, flooding). The Coringa wildlife sanctuary – a Protected Areas in in East Godavari District of Andhra Pradesh protecting the mangrove forests, which reduces the cyclones/tsunami damage to Kakinada city. Coringa Wildlife Sanctuary, a paradise for the nature lovers is situated amidst mangrove forests of the Godavari region in Andhra Pradesh, India. EGREE (East Godavari Riverine Estuarine Ecosystem) region is blessed with Godavari mangrove forests (322.22 Km^2) as ecological bio-shields, of which 235.70 Km^2 area come under Coringa wildlife Sanctuary. They serve as barriers to coastal storms, conservers of soil, supporters of sustainable fisheries, providers of medical products and fuel wood and fodder, habitats of wide range of flora and fauna, sources of genes for sea water tolerance and above all as the **'flagship'** of nature's ecological security system in coastal estuaries. The dynamic mangroves ecosystem of the Coringa Wildlife Sanctuary supports biodiversities such as Fishing Cat, Otter, Jackal, Estuarine Crocodile, Sea Turtle, Sea Gull, Pelican, Stork, Heron, Snipes, Flamingos, to name only a few. Over 264 species of birds are found within and outside the wildlife sanctuary. Numerous species of salt tolerant plant species constitutes its flora, which include tropical and subtropical floral species such as Rhizophora, Avincennia, Sonneratia, Aegiceros, and others.

Mangroves are the most important "ecological bio-shields" for the coasts. It has been widely recognized that they protect our shoreline, harbour a unique biodiversity, help fisheries and protect coastal population against storms, cyclones, tsunamis etc. Mangroves are estimated to absorb up to 80 percent of the wave energy during storms and typhoons, in addition to other benefits such as coastal protection and water filtration. Besides these, Mangroves have tremendous social and ecological, economic value. Ecological services of mangroves are Flood control, Groundwater refill, Shoreline stabilization & Storm protection, Sediment & nutrient retention and export, Water purification, Reservoirs of biodiversity, Cultural values, Recreation & tourism, Climate change mitigation and adaptation. If the millions of coastal residents who benefit from the services provided by mangroves are to survive and continue to enjoy the enormous benefits provided by healthy mangroves, then we need to quickly and proactively develop climate change-oriented mangrove management programs. The annual economic value of mangroves, by the cost of products and services they provide, has been estimated to be anything $200,000 - $900,000 per hectare [16]**.** The Economic benefits from mangroves are Flood control, Industrial wastewater treatment, Agriculture production, Support for downstream fisheries, Firewood, Fishing, Recreation, Domestic sewage treatment, Freshwater supply for local people, Carbon sequestration etc.

In EGREE region, currently the main production sectors operating in the landscape/seascape are fisheries, aquaculture, saltpans, manufacturing activities such as oil and gas exploration, fertilizers, edible oil, rice products, tourism and ports. These activities are impacting the overall ecological integrity of the mangrove ecosystems in Coringa Wildlife Sanctuary (CWLS) and adjoining areas, with associated impacts on the livelihoods of local people. EGREE foundation under the initiatives of UNDP-GEF-GoI-GoAP project laid a deep foundation for sustainable management of this fragile ecosystem of the area with the involvement and participation of local community, Industries and related stakeholders.

Under the implementation activities of Coringa Management plan 2013-2023, UNDP project (EGREE Foundation) in collaboration with A.P. Forest Department, about an area of 1185.64 ha have already been regenerated within the sanctuary area. Still small pockets of unplanted areas are available for regeneration and they may be taken up during 2014 & 2015 planting season. A total of 60% area is
damaged and needs for rechanneling. The areas outside the sanctuary adjacent to the western border wherever possible should also be taken up for plantation to maintain the cushioning effect for the sanctuary. All the encroached abandoned aquaculture farms shall be brought under the mangrove plantations.

Fishbone Method

The standard method of Fishbone channeling shall be adopted for regeneration. It has been observed in all the planted areas earlier, many of the natural fish nursery ponds have disappeared as they have not been given due importance at the time of designing itself. Simulation or restoration of mangrove ecology shall be based on nature’s design. It is recommended to explore possibilities of restore all disappeared natural breeding ponds of the fish and other invertebrates. Care should be taken while regenerating the areas such that all natural aquatic ponds are protected and the courses of water inflows into them shall be maintained.

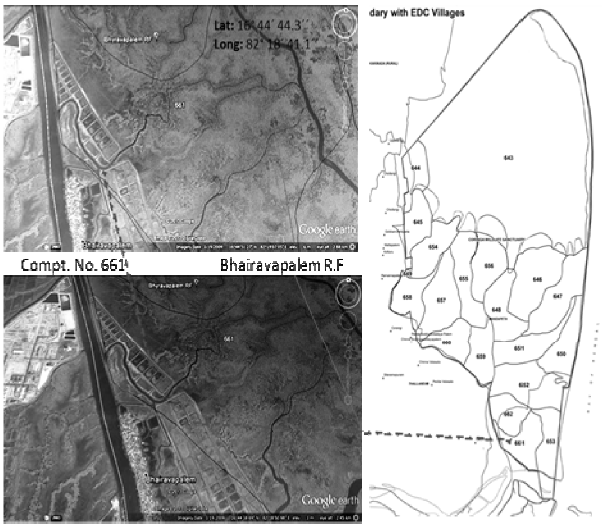
The following are the areas recommended for plantation in and around Coringa wildlife sanctuary.

Table-1: Areas recommended for plantation

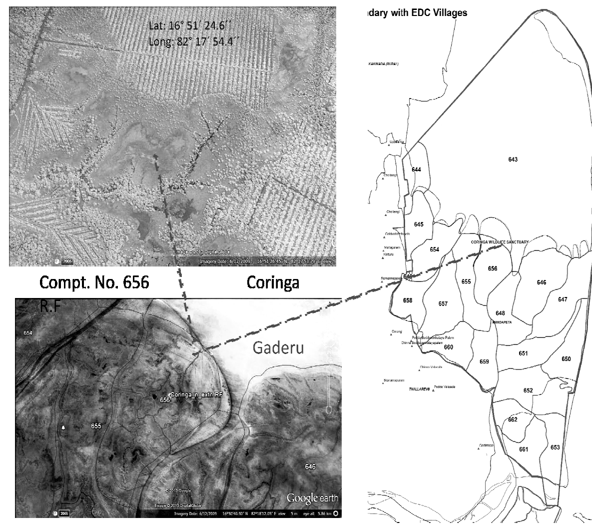
S. No	RF/Range	Beat	Compt. No	Area of Compt. (ha)	Area Available for plantation (ha)	Nature of the Area	Latitudes and Longitudes (around)	Ref-erence
1	Coringa Kakinada WLM	Coringa	656	700.85	50	Degraded	16° 51′ 24.6′′ 82° 17′ 54.4′′ Elevation 5m	Map 1
2	Bhairavapalem Kakinada WLM	Bhaira-vapalem	661	603.29	50	Encroached, Abandoned aquaculture farm land area inside the Sanctuary Boundary	16° 44′ 44.3′′ 82° 18′ 41.1′′ Elevation 3m	Map 2
3	**Buffer** Rathikalava;	Rathikalava	670	615.37	100	Degraded land and Encroached,	16° 41′ 41.8′′ 82° 17′ 56.9′′	Map 3

Kakinada (T) (Adjacent Bhairavalanka Village)		Abandoned aquaculture farm land area within and outside the RF	Elevation 4m
Total Area to be planted	**200**		

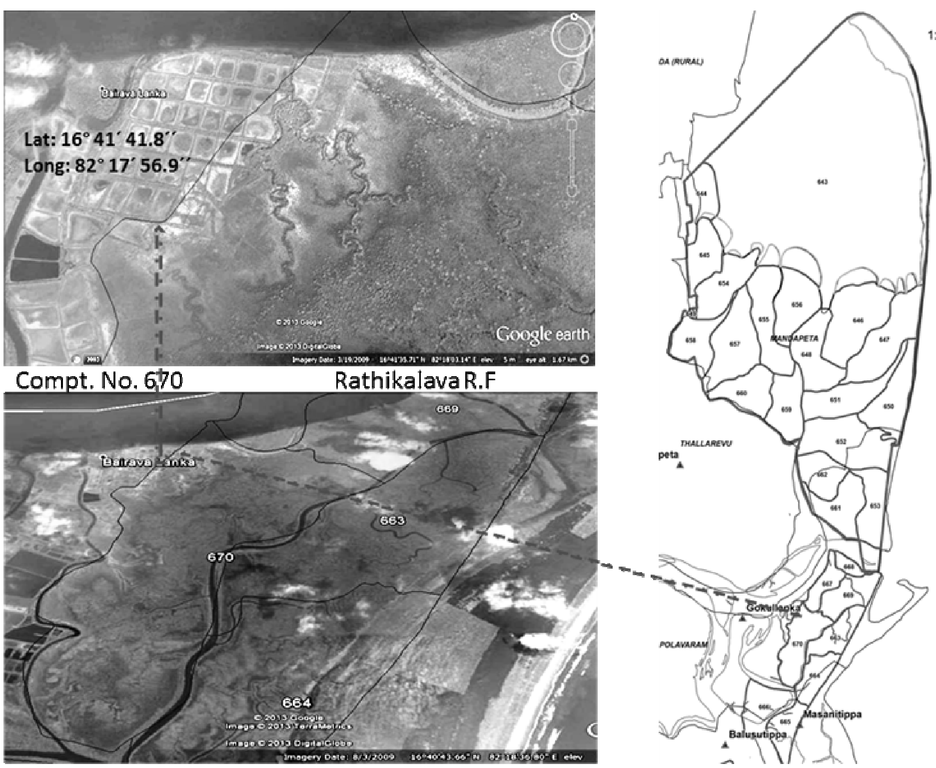
Map: 1



Map: 2



Map: 3



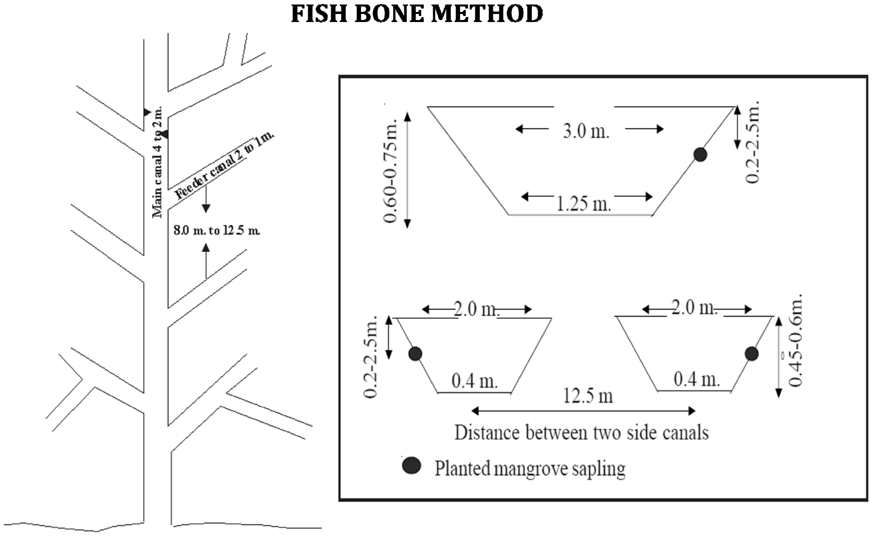
Methodology and Techniques

Restoration of mangroves shall be done only when the salinity of the degraded area is brought down. In order to reduce the salinity, fishbone type canals are to be dug and tidal flushing and draining of stagnant water is facilitated. This results in brining the salinity levels to 60 ppt in summer to fresh water level during monsoon seasons. After a buffer period of three months, the nursery shall be raised, mangrove saplings are planted along the trapezoid shaped canals in the degraded areas

Canals are designed like fishbone in order to facilitate easy inflow and outflow of tidal water. The main canals shall be dug at an angle of 45° to the natural creek, while the side canals can be dug at an angle of 30° to the main canal. This needs a preplanning, by marking canals using pegs and chalk powder. The canals are to be dug in a trapezoidal shape in order to plant the saplings at the mid level of the canal. Geomorphology and hydrology in mangrove restoration based on the contour survey and hydrology study, the canal depths and dimensions shall be fixed, corresponding to the topography and tidal amplitude of the selected restoration site. As a result, tidal water entering during the highest of high tides stagnates in the saucer shaped area due to the elevation of edges, temperature and salinity of the stagnant water increases and shoots up to 114 ppt during summer.

The levees salinity variation in the Saveru creek and Rathikalava RF, varies from 6 ppt during the south-west monsoon to 31 ppt during fair weather season. In the Coringa Wildlife Sanctuary area, at Matlapalem canal, salinity showed a variation from 4.6 ppt during the south-west monsoon to 30 ppt during fair weather season. Based on the hydrological studies, the depth of canals for restoration was decided to be 0.65 m with reference to mean sea level so as to have adequate tidal flushing.

FISH BONE METHOD



The depth of the main canal varied from 0.45 to 1.0m and the side canals from 0.6 to 0.45 m as per the contour. The top width of the main canal can be between 2 m and 3.5 m and the respective bottom width could be between 1.0 m and 0.4 m The dimensions of the side canals shall be 2 m top width, 0.4 m bottom width and 0.45 m depth. In case, the canals are dug closely to the dimension of the side canals shall be reduced accordingly to 1.25 m top-width, 0.2 m bottom width and 0.4 m deep.

Based on the salinity levels of soil, mangrove species shall be selected for planting in the degraded areas. Species like *Avicennia marina, Avicennia officinalis and Excoecaria agallocha* could tolerate wide range of salinity. Mangroves namely *Aegiceras cornicularum, Bruguiera gymnorrhiza, Rhizophora apiculata, Rhizophora mucronata* and *Xylocarpus moluccensis* shall also planted to ensure genetic diversity. Eight month old mangrove saplings raised in the nursery may be used for planting. The mangrove saplings shall be planted along the slopes (20-25cm from the top) of the canals with a spacement of 2 m.

De-silting

The bunds formed by the deposition of the excavated soil during canal digging will silt the canals during the monsoon seasons. The silted canals have to be de-silted before the onset of summer, because during summer the tidal amplitude is generally low. Tidal flushing is very important during summer because the soil salinity will shoot up due to high temperature and cause damage to the roots of the seedlings. Such seedlings will be replanted in the following monsoon season. The survival percentage is measured in the initial period for better monitoring. Initially the growth rate was slow and after 2 to 3 years the seedling growth rate was faster. The natural regeneration of the seedlings also occurs simultaneously. After four years, the planted saplings start bearing fruits, which will regenerate, and the density of the area will increase.

Technical Failures

Over the years, as seen in the field, there are many failed restoration plantations, invariably wasting both time and money as the seedlings were planted without considering its ecological requirements (substrate height, water flow, and appropriate species selection) and resulted in failure within a year after planting. There are many such areas available for re-planting, especially in the buffer zone. In order to minimize the failures and to make the field staff to understand the reasons for the failure, the life cycle of various mangrove species preferred for plantation, is given in the following table-2:

Table-2: Showing the Life Cycle of Species Preferred for Plantation:

Species	Type of Seed	Months	Indicator of Maturity	Size at Maturity
Avicennia marina	Propagule	December, January, February	Yellow fruit skin	Weight of seed > 30 g
Brugeira gymnorrhiza	Propagule	May, June, July, August, September, October, November, December	Reddish brown body	length > 20 cm
Ceriops tagal	Propagule	August, September	Yellow collar, brown/ green body	length > 20 cm
Rhizophora apiculata	Propagule	December, January, March, April	Reddish collar	length > 20 cm, diameter > 14 mm
Rhizophora mucronata	Propagule	September, October, November, December	Yellow collar, green Body	length > 50 cm
Sonneratia alba	Fruit	April, May, June, September, October	Float in water	fruit > 4 cm
Xylocarpus granatum	Fruit	September, October, November	Yellow/brown fruit Floats in Water	Weight of seeds inside fruit 30 g each.

The Potential Available to Restore Wetlands

Due consideration shall be given to recover the lost wetland area in the region in order to resume back the lost ecosystem services. While in implementation the following assumptions may make sense:

- Restoration can reverse some degradation but many damages are not reversible;
- Wetland restoration approaches and techniques shall be near natural; and
- Restoration policies can improve with time and experience.

Still, every project has unique features, making it difficult to develop templates for restoration. Therefore, we argue that adaptive restoration offers great potential to learn how to restore specific sites.

Wetlands contribute more too annually renewable ecosystem services than their small area implies. Biodiversity support, water quality improvement, flood abatement, and carbon sequestration are key functions that are impaired when wetlands are lost or degraded. Restoration techniques are improving, although the recovery of lost biodiversity is challenged by invasive species, which thrive under disturbance and displace natives. Not all damages to wetlands are reversible, but it is not always clear how much can be retained through restoration. Hence, we recommend adaptive approaches in which alternative techniques are tested at large scales in actual restoration sites.

Conclusion

- Coastal forests (Mangroves) and trees can, under certain conditions, act as bio-shields to protect lives and valuable assets against coastal hazards, including: tsunamis, cyclones, wind and salt spray and coastal erosion.
- The degree of protection offered by coastal bio-shields depends on a number of variables, including: (i) the characteristics of the hazard itself (e.g. type, force, frequency); (ii) the features of the site (e.g. bathymetry, coastal geomorphology); and (iii) the characteristics of the bio-shield (e.g. type of forest/tree, width, height and density of the forest).
- Care must be taken to avoid making generalizations about the protective role of forests and trees based on evidence from one or a few areas; the many factors that influence the protective role of the forests/trees must be understood and taken into consideration before lessons can be learned and applied elsewhere.
- Coastal forests and trees are not able to provide effective protection against all hazards (e.g. extremely large tsunami waves, flooding from cyclones and certain types of coastal erosion); provisions for other forms of protection and (in extreme events) for evacuation must be relied upon. Care must be taken not to create a false sense of protection against coastal hazards.
- Importance of incorporating coastal protection as an integral part of coastal area planning and management is recognized.
- Options for protection include: soft and hard solutions and a hybrid of the two. If none of these is appropriate and viable, it may be necessary to zone coastal land use to prevent (further) settlement and construction of valuable assets in the vulnerable zone.
- It is important to match the species with the site in order to avoid high mortality and low performance of the planted trees. Some forest types and tree species cannot survive or thrive in areas exposed to specific coastal hazards; therefore, they are not candidates for protective measures.
- Development of bio-shields is not possible in all situations owing to, *inter alia*, biological limitations, space constraints, incompatibility with priority land uses and prohibitive costs.

- The level of knowledge and understanding of the functions of forests and trees in coastal protection is still insufficient and there is a lack of multidisciplinary research and cooperation in this field. Specific areas needing further attention include research in non-mangrove coastal forests and collection of data and development of models on interaction between the physical and ecological parameters.
- There is a need to recognize that many years are required to establish and grow bio-shields to a size and density that could offer protection against coastal hazards.
- Considerable research and field initiatives related to forests and coastal protection have been carried out over the past several years; they provide a useful foundation for further work to improve understanding of the protective role that forests can offer.

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SOME ANTHROPOGENIC FACTORS OF LANDSLIDE IN AIZAWL, MIZORAM

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Abstract

Mizoram is one of the North Eastern States of India and located in the 21°56' and 24°31' N latitude and 92°16' and 93°26' E longitude. The geographical area is 21,081 sq. km with a width of 115 km approx. from east to west and a length of 285 km approx. from north to south. It is bounded by Bangladesh and Tripura state in the West and Myanmar in the East and South; Manipur state and Assam in the North.

The unique geo-climatic conditions of Mizoram make the state vulnerable to various natural disasters of recurrent nature. Mizoram, being a hilly terrain is prone to landslides. Every year a number of landslides have been reported from various places. These cause a lot of miseries to public resulting in loss of life and property, disruption of communication network, and also cause economic burden on the society. This is primarily attributed to high slope and relief, immature geology, neo-tectonic activity, heavy rainfall and unplanned and improper land use practice in the state.

Landslide, a natural phenomenon, becomes complex because of interplay of various natural (both inherent and external factors) and anthropogenic factors. Landslide incidents are more prominent during the rainy/ monsoon season as the soil structure gets soften by heavy and continuous downpour, especially of high degree of slope. This paper looks at various anthropogenic activities such as improper land use, interference of infrastructure developmental activities etc. that ultimately leads to landslide in Mizoram. And also suggest various ways to mitigate landslide incidences.

Key words : *Landslide, inherent, external, anthropogenic*

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Introduction

Mizoram is one of the North Eastern States of India and located in the 21°56' and 24°31' N latitude and 92°16' and 93°26' E longitude. The geographical area is 21,081 sq. km with a width of 115 km approx. from east to west and a length of 285 km approx. from north to south. It is bounded by Bangladesh and Tripura state in the West and Myanmar in the East and South; Manipur state and Assam in the North. The mountainous terrain of the area is characterized by steep slopes, high relief, weathered, fractured and folded rocks with adverse hydrogeological condition.

The unique geo-climatic conditions of Mizoram make the state vulnerable to various natural disasters of recurrent nature. Mizoram, due to its geographical location, bad land topographic features, susceptible geological structure of the state, nature of rock formations, climatic condition, land use pattern and land cover etc., the state has witnessed massive landslides every year besides cyclone, floods, cloudburst, hailstorms, drought etc.

Every year landslide phenomenon particularly during monsoon months accounts for considerable loss of life loss of life and property, damages to human settlement and infrastructure, disruption of communication routes, agricultural and forest reserve and adversely affect development of the area and the community as well. Aizawl lies approximately in between 92° 60' E longitude and 21° 58' N latitude and the altitude of the city varies from 950 to 1155 metres above mean sea level. In 2015 – 16 (upto September), Aizawl, covering an area of about 700 sq.km suffered numerous landslide causing around 80 totally damaged and 50 severely and partially damaged houses.

The State has increasing trends of people migrating from rural areas to towns and cities in search of employment and livelihood. There are 23 urban areas in the State including the capital town - Aizawl. Urban population constitutes 51.51%. as per 2011 census where Aizawl alone has 2,91,822 i.e 26.75 % of the state total population of 10,91,01 and 51.92% of all Urban population. The majority of the immigrants usually belong to the lower income strata of population. The increasing influx of poor immigrants to an area adds pressure on the existing infrastructure and land resources. Lack of spatial urban planning has led to unplanned growth of towns and cities resulting in extremely inadequate congested drainage, waste management and sanitation facilities making these settlements vulnerable during disaster. As the city is located in a hilly terrain and most of the houses are constructed in fragile areas of steep, soft, porous and permeable silty sandstone and shale of Middle Bhuban Formation of Surma Group, this leads to more landslides during rainy season.

Common Factors Responsible for Landslide.

Some slope are susceptible to landslide whereas others are not so. There can be several factors for the occurrence of landslides which may work individually or collectively to cause a landslide. Landslide in Mizoram is primarily attributed to high slope and relief, immature geology, neo-tectonic activity, heavy rainfall, drainage, vegetation and unplanned and improper land use practice in the state. The factors governing landslides can be classified broadly as inherent and external factors. In most cases, a number of factors exist simultaneously and any attempt to decide which ones finally cause failure is extremely difficult.

Landslide, a natural phenomenon, becomes complex because of interplay of various natural (both inherent and external factors) and anthropogenic factors. Landslide incidents are more prominent during the rainy/ monsoon season as the soil structure gets soften by heavy and continuous downpour, especially of high degree of slope. Tropic of Cancer passes through the middle of the State. Thus there always is an abundant rainfall during monsoon season, starting from April till October. Monsoon is normally preceded by cyclonic storms and hailstorms. This excessive, prolonged rainfall together with various human interventions with the nature is one of the most important causal factors for landslides in the city.

Various Anthropogenic Activities that Cause Landslide

Various anthropogenic activities such as interference of infrastructure developmental activities, improper land use, unplanned growth of settlements, unauthorized structures in the unsafe zones, absence of an adequate drainage system, negligence and ignorance of the people, absence of laws and regulations etc. have accelerated the process of ecological imbalance that ultimately leads to landslide in the city.

Excavation of Slope

Excavation, toe cutting for developmental works like Communication network, building construction results in steepening of sides, removing lateral support to the slope which altered the strength of the rock or soil and overburden of slope, reduces the stability of slopes causing an increase in driving force thereby resulting in Landslide. Large scale earth cutting in the hill slopes is going on unabated due to paucity of living accommodation in the city without considering the geotechnical aspects which has threatened the stability of the slopes and landslides have become a common hazards in the city.

Unauthorized Construction in Vulnerable area

Due to an urge to stay in the urban area, some people are constructing residential building in vulnerable area which makes them exposed to hazards as they hold valid House pass/permit in the form of LSC from Land Revenue & Settlement even at high degree of slopes. Some high rise buildings are precariously perching on the high degree of slopes which make them prone to disaster.

Unplanned Growth of Settlements

Aizawl city came into being a little more than 100 years ago, its growth was not checked and there is no town planning and regulations. This might be evident from the Census data.
This rapid haphazard urbanization bring in its wake the problem faced by most of the urban, unplanned city as mentioned earlier.

There is no proper Town/City Plan and no proper Hazards zonation and regulation in land use. There was no proper Building Regulation and Bye law for a long time, Aizawl Development Authority start enforcing Building Regulation 2008 only but it was found that strict **execution and** proper **monitoring** of Building Regulation and Bye laws at a very later stage was very difficult task.

Improper Drainage System

Due to urbanization etc, drainage network is very insufficient which leads to overflow; defective maintenance of drain like laying water supply pipe, throwing of waste material in the drain leading to blockage or choking of drain resulting in over flowing. In some localities, absences of drainage channel are noticed. As such rain water flows and percolates here and there causing flashflood and landslide.

Effects of Vegetation or Deforestation

All vegetation types have an effect on slope stability but woody vegetation (trees) is the main type affecting the landslide. It either affects hydrology or mechanical properties of the slope. Also some areas on forested hill slopes are cleared off for gardening giving rise to gully erosion during/after high rainfall. Deforestation exposes barren soil to erosion and destabilization. Plan roots have the tendency to bind soil and thus they are helpful to retard slope instability unless the failure plane is very deep i.e beyond the root zone. This factor contributes for many Himalayan landslides, as intensive deforestation is reported in many parts of the Himalaya.

On the contrary, sometimes the growth of plants and other vegetation in the pre existing planes of landslides or joints of the rock or retaining wall may also cause excess tress on joint walls due to the growth of the roots. This phenomenon pushes the slope/materials out and cause landslide.

Dumping of Earthen or Waste Materials/Creation of Dumps of Very Loose Waste

While earthen materials from slope cutting are to be disposed to the dumping sites; many people just dump it near their settlement without any precautionary measure or support. Disposal of excavated debris and waste material in open slope is also common. During rainy season, these loose, un-compacted earthen material when left unattended for quite some time were made more saturated and heavier, thus tends to flow downwards resulting in slope failure.

Absence of Rain Gutter

Many houses do not have rain water harvesting system in the form of Rain gutter. Rain water fall from the roof top or walls directly to the ground which are not properly channelized in the drain thereby flowing in any direction and percolating to the soil around the building resulting in weakening the area as a whole that ultimately results in slope failure around the building. Thus The Aizawl Municipal Council Building Regulations, 2012 section 26, 2b provides that 'The roofs shall be so constructed to permit effective drainage of the rain water thereof by means of rain gutters and closed conduits of suitable material and adequate capacity, joined and fixed so as to ensure that rain water is properly discharged at ground level by pipe and dampness does not occur in any part of the walls or foundations of the buildings or those of adjacent buildings, and no spout should be allowed to drain into the road or public area or within the adjacent compound or building'

Improper Domestic Waste Water Disposal

Domestic waste water from every building (residential, commercial and government building) are generally dispose to the nearby natural drain channel by a pipe; but in some building, the drain pipe are too short or the connection are loose or broken thereby leaking or disposing the water in a slope which ultimately result in slope failure.

Water Leakage from Services like Water Supply Pipe, Sewage etc

Leakage of huge quantity of water exert pressure to the nearby lands or drainage channel, when the water over flow, it ultimately leads to landslide.

Conclusion

An unplanned development and construction activities creates a probable danger for the slope failure in and around the city. As Aizawl is the most important urban centre in the state of Mizoram, the man-made processes will only get more intensified with time which is a worrying prospect for increased landslide occurrences in the area.

Developmental activities like construction of buildings, road cutting, embankments, cut and fill structures disturbs the natural slopes and blocks surface drainage, loading of critical slopes and withdrawal to toe support promote vulnerability of critical slopes.
Water is commonly the primary factor triggering a landslide. Slides can occur following intense rainfall, when storm water runoff saturates soils on steep slopes.

Landslide can lead to massive disaster in terms of loss of human lives, land and other resources. It can be avoided if proper susceptibility/hazard zonation techniques are followed. The Aizawl Municipal Council put forward a Draft Site Development And Slope Modification Regulations, 2014 which shall apply for the purpose of stringent control of all aspects of site development, slope modification and clearing operations and to establish procedures for issuance, administration and enforcement of a site development permit.

Awareness level has to be upgrades, capacity building of elected representatives, various governmental official, stakeholder, community, NGO/CBO/CSO is the needs of the hour to reduce the occurrences of landslides in Aizawl. Lastly it must be bear in mind that to prevent and mitigate the incidence of landslide, it would be logical to take steps which would counter the effects of the factors responsible for landslide occurrence.

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IMPACT OF DROUGHT ON COMMUNITY, VULNERABILITY AND COPING METHODS USED IN VILLAGES OF NORTHERN RAJASTHAN, INDIA

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Abstract

The work presents facet of drought and its impact in rural community of Northern Rajasthan, India. The study was intended to obtain detailed insights into community responses of a type that cannot be determined through secondary study or desk research alone. Drought is neither a one day problem nor it guarantees that it will not repeat, it is recurrent problem. it needs promising management and mitigation techniques. Study area selected was drought struck 4 villages named as Kakdeu-kalan, Raila, Moruwa, and Hanumatpura located in Northern Rajasthan in District of Jhunjunu and Churu, where community is heterogeneous with people of different caste. Multi Stage Random Sampling was the technique to collect data. Primary data was collected through pretested structured questionnaire; it was utilized to collect data of 100 households. 25 houses selected randomly from each village. Field work done for this case study has collected drought experiences, which ever communities have faced now or before. 52 % people are involved in agriculture work. According to Present Research, in normal year 44% of people of this region falls below poverty line, whereas in drought year 79% of population get pushed below poverty line, and paradoxically 52% of families are involved in agriculture, which is grieve concern. This situation is disappointing and forcing agriculture workers to quit agriculture as occupation and leaving us with several questions popping up in our mind regarding food security in later years.

Keywords: *Drought vulnerability, Impact of drought, coping methods, drought and food insecurity.*

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Introduction

In terms of drought, Rajasthan is one of the most severely affected states in India. However, its impact largely depends upon vulnerability. Underprivileged are more disposed to drought impacts resulting food crisis and health problems. In coming decades, the drought risk and vulnerability is expected to increase rapidly (IDSR, 2002)[1]. Drought is a natural hazard with slow onset, evolves over months or even years, affects a large spatial area, and cause little structural damage. Its onset, end &severity are often difficult to determine. Like other hazards, the impacts of drought span economic, environmental, and social sectors[2].Drought is a repeated feature of climate that affects virtually all countries to some degree[3].However, severity depends upon different geographic locations and the preparedness of the society.

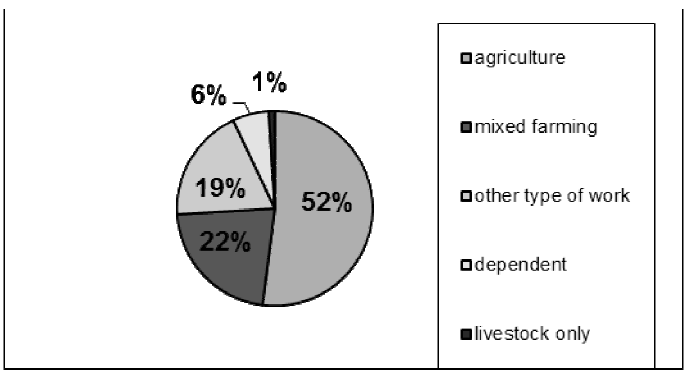
Lack of proper mitigation and management techniques are more severe now days. On the contrary, techniques that are available are also not well executed. Due to that, number of people are leaving agriculture as their profession and adopting other works. In later years this will result in food insecurity not only at micro but also at macro level. It alarms us that it's time to wake up and avoid such dis-stressful results as in no time today's micro level problem can change into macro level problem either directly or indirectly tomorrow. Hence, it is necessary to take steps to counteract this problem now.

In Rajasthan overstocking is not found in larger extent that remained a mitigation way of agriculture people from long back. According to survey,average crop production of a farmer's land in normal years iseleven quintals of Karif crops like Guar, Bajra, etc. This figure itself depicts low socio economic status of farmers and on an average a family of five consumes one-quintal crop monthly and by generating eleven quintal they manage food for eleven months only. If number of members of a family is more than five, this stock gets exhausted more quickly. In drought year situation gets worse. According to Wilhemi et al. (2002), one of the main aspects of any drought mitigation and planning strategy is the 'vulnerability assessment[4], which identifies who are most affected and what are the reasons behind their vulnerability.Vulnerability could be defined as a combination of a system's exposure to threats, its sensitivity and capacity to adapt to threats(IPCC). Drought in arid and semi-arid regions is not a calamity, like an earthquake or a cyclone, but a regular climatic feature. Instead of resorting to calamity relief, governments should consider drought mitigation as the principle strategy of agricultural and rural development[5].

Rationale of Study

Fig. 1 Drought affects on household of study

This study representsaspects of drought and its impact on study population. The study was intended to obtain detailed insights into community responses of a type that cannot be determined through secondary study or desk research alone. Drought is neither a one day problem nor it guarantees that it will not repeat; it is a recurrent problem. It needs large and genuine survey about people sufferings and requires effective management and mitigation techniques.



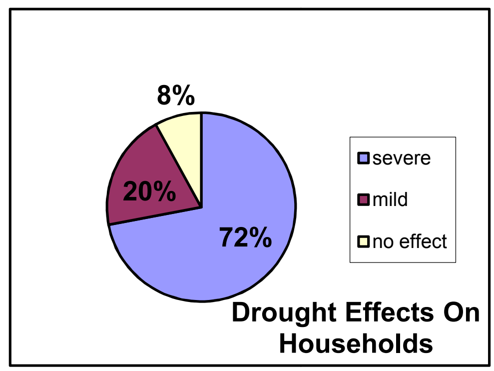


Fig 1 shows drought affects in study area.

Fig.2. Occupation-wise distribution of population.

Data Collection and Methodology

Study area selected was drought struck 4 villages namelyKakdeu-kalan,Raila,Moruwa,and Hanumatpura located in northern Rajasthan in districts of Jhunjunu and Churu, where community is heterogeneous with people of different caste. Multi Stage Random Sampling was adopted to collect data. Primary data was collected through structured questionnaire from 100 households. Twenty-five houses were selected randomly from each village. Fig. 2 shows occupation wise distribution of population. 52% people are involved in agriculture work.

Impacts of Drought

The impacts of drought vary from person to person depending upon their socio economic status. It is complex to assess drought impacts in various sectors because impact can be regional or local[6].Impacts also depend upon severity, duration, and frequency of drought in that region. Broadly, Impacts of Drought are divided into three major categories, i.e. socio-economic, health, and environmental. It includes drinking water

&food scarcity, irrigation water scarcity, reduction in ground water level, changes in quality of water, fodder scarcity, conflicts in society, etc. More specifically impacts are given below in Table 1.

Table 1: Impacts of drought according to perception of local community in study area

Impacts	**Respondents**	
	No.	**Percentage**
Socio-economic Impact		
Unemployment	66	66
Lack of drinking water	63	63
Family and communal clashes	59	59
Lack of food	40	40
Selling of assets and animals	27	27
Migration	20	20
Discontinued education of their children	11	11
Postponed ceremony or marriage	8	8
No socio economical impact	11	11
Health Impact		
Cholera	35	35
Malnutrition	32	32
Depression	25	25
Respiratory problems	08	08
Fever	06	06
Environmental Impact		
Ground Water level Reduced (well, boring etc.)	60	60
Increase in environmental temperature	55	55
Difference in water quality(salt, fluoride)	37	37
Effects on plants, trees	28	28
Migration Birds / animals	18	18
Soil depletion	12	12
Base Total	100	100

Drought could be meteorological drought, agricultural drought, hydrological drought and socio-economic drought[7], but eventually Impacts on the livelihoods of people in terms of reduced food availability, forced migration, depletion of fixed and movable assets, social marginalization, and health and nutrition.[8]

Drinking Water Scarcity

People travel 2-3 km on an average for fetching water at the times of drought. In this region almost all water sources went dry due to drought resulting severe drinking water shortage. Government intermittently provided water supplies using hired tanks sometimes on payment. Drought across Rajasthan and aridity has already enhanced a rapid reduction in ground water levels, as in most of the areas there is decline in water table. As a result, effort to deepen existing wells generally proved to be ineffective. People used to bring and stored water and due to improper handling and storing it became cause of contamination, resulting severe infections. There are five mechanisms in which climate change can affect population health:(i) thermal extremes, (ii) extreme weather events, (iii) pollution, (iv) exposure to water, food, and (v) vector borne pathogens.[9]

Food and Fodder Scarcity

In villages of northern Rajasthan drought had a major impact on cropped area causing food and fodder shortage. Here Rabi or winter cropthat requires irrigation from outer source are declined to least levels. However, for those who had irrigation facility, there was decline in winter cropping primarily due to gradual decline in ground water level. Because villagers are economically week, majority of people can't manage to have water pump to irrigate fields results in decline of crop production in non monsoon season, and entire agricultural area are planted during Kharif season during monsoon, causing economic losses. In addition, if drought occurs during Kharif season it leads to worsening economic loss along with invested resources in sown land, engaged labor, seeds, fertilizers, etc. Other than agricultural production Rabi crops have another importance being significant source of animal fodder in summer. Crop failure or unsown land during Rabi season causes adverse impact on livestock and cause income loss. This makes their economic status weaker and pushing them to sell assets, earnings, and animals in minimum prices for their survival. Facilitation of water irrigation during Rabi season could be a way to reinforce their income streams. Crop cultivated in study area is given in Table 2

Table 2: Crops Cultivated in Study Area

Crops Cultivated	**Respondents**	
	No.	Percentage
Kharif Crops (Monsoon Crops)		
Guar	80	80
(Minor millet)Bajra	45	45
Moong	15	15
Groundnut	No Cultivation	0%
Rabi Crops (Winter crops)		
Wheat	No cultivation	0%
Mustard	No cultivation	0%
Base Total	100	100%

Socio-Economic Impacts during Drought

Drought causes selling, mortgaging, pawning of assets to local moneylenders, who charges 3-6% interest on loan per month, which further deteriorates conditions of farmers because of inability to pay loan. But to combat it, many farmers opts for mixed farming, which includes land and animal farming. Conversely, fodder requires irrigation it could not be produced locally due to unsown Rabi crops and fodder insufficiency manifests itself largely in summers. With decrease in fodder there is decrease in milk production, which rather used to become source of nutrition for farmers and their family along with income as well. In study area decline in agriculture as occupation has been observed.

Decline of Crop Production in Drought:

In drought year, crop production drastically decreases according to study in sample area. In normal years average production of crop is 10.92 quintal and in drought year it goes down to 1.80 quintal. Agricultural workers consider untimely rainfall harmful as drought, causing destruction of crops and therefore loss of money.

Change in Income Distribution during Drought and Normal Years

Figure below depicts changes in income during drought year and normal year and comparison of BPL (below poverty level) strata. In 2012, planning commission reports that rural BPL income per capita per month was INR 672.8 at national level and in Rajasthan it was INR 755. If we consider two earning members excluding children and old in family of 5 or 6.Income of BPL family calculated as INR 18120, and this shows maximum families are below poverty level in this area. Nearly 50% of agricultural laborers and 40% of other laborers are below the poverty line in rural areas, (according to planning commission 2012 report) [10]. In drought year conditions gets most deteriorated, when people earn only 5000 or less.

Fig 3 clearly shows that during drought year, around 79 % families in study area comes in the poverty level where income remains below INR 18120, whereas in normal year population below poverty level is 44%. This means 35% families get pushed below poverty level in drought year.

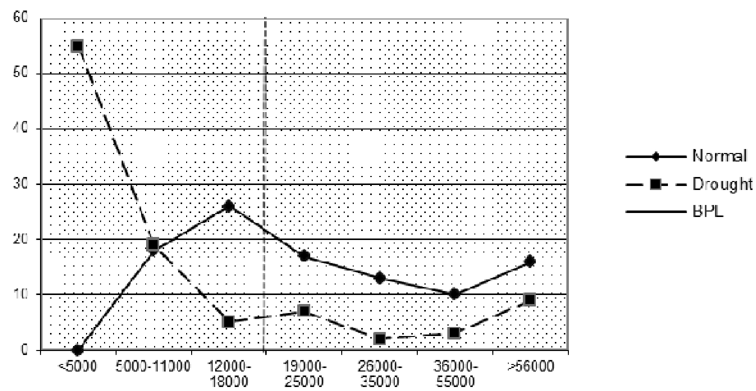


Fig. 3 Change in Income distribution during Drought and Normal Years (x axis =household, y axis= annual income)

Vulnerability Assessment According to Perception of Local Population

Vulnerable groups in study sample clearly depict farmers, livestock and labors as most susceptible groups in drought (table 3). Resilience to come out of drought also decides the impact of drought if drought occurs frequently; coping power decreases and victims remain vulnerable. Community in study area told us frequency of drought in their area given below in table explains that drought comes alternate year in this region in varying intensity, be it severe , moderate, mild based on vulnerability or economic status, but coping decreases with time . Coping strategies performed by local community is depicted in table 3, in study area vulnerable groups in study sample represent farmers, livestock and labors as most susceptible people towards drought. Resilience to come out of drought too decides the impact of drought. If drought occurs frequently; coping power decreases and victims remain vulnerable. Frequency of drought recorded in present study according drought struck community is presented in table 4

Table 3: Vulnerability Assessment according to perception of Local Population

Vulnerable groups	Respondents	
	No.	Percentage
Farmers	88	88
Livestock	65	65
Labors	35	35

Old- age	15	15
Children	14	14
Women	7	7
Handicapped	3	3
Landless	2	2
Base Total	100	100%

Table 4 Drought Frequency According to Study Area

Drought Frequency	Respondents	
	No.	Percentage
Drought comes alternate years	50	50
Every two years	32	32
Every three years	9	9
Not effected/not known	9	9
Total	14	14

Coping Method used by Local Community of Northern Rajasthan Villages

Along with diversifying source of income, households opt to various other coping strategies. Primary coping method used by study population is given in table 5. Dependence on daily wage labor is the coping way, used maximum by rural drought struck people. This coping method can be put under diversification of work which helps out people to combat drought, but on the contrary slowly encourages agricultural workers to leave agriculture as occupation. Other methods they opt are selling assets and livestock, exhausting their future savings. They believe that government is not helping them in fighting drought, survey shows that 94% people have disagreed with any usefulness of help provided by government.

Table 5 Coping Method used by Local Community of Northern Rajasthan Villages

Coping Methods	Respondents	
	No.	Percentage
Non agricultural labor	55	55
Exhausted all their future savings	39	39
Sold livestock	17	17
Selling assets	10	10
Migration	8	8
Stored grain selling	6	6
Humanitarian help	2	2
No coping	7	7
Base Total	100	100 %

Maximum people in community have expressed that they need employments from government side to cope up in the times of drought. Other things they need as assistance from government is given below in Table 6.Residents of rural northern Rajasthan have combated from drought several times and adapted to live in such a way, but they have certain expectation from government to have assistance, shown in Table 6.

Table 6 Assistance Population Asked from Government or Self Help Group or NGOs

Demands	Responses (No.)	Percentage
Employments	69	69
Money for employment generation	31	31
Water /food/shelter	21	21
Water harvesting	21	21
Infrastructure	20	20
Information technology	13	13
Investments in livestock rearing	13	13
Humanitarian aid	12	12
Education and agricultural training	09	09
Base total	100	100

Conclusion

After survey and statistical analysis on observations and perceptions recorded by 100 study samples, vulnerability wise, farmers and animals are more susceptible to drought. Hence, government should work upon drought risk reduction, mitigation and management methods continuously. Further and continuous research should be encouraged so that ways to effective management could be explored and be implemented. Plans should be more centered towards vulnerable groups, while formulating schemes, better execution, implementation, monitoring and evaluation should also be prioritized in work frame. As our country has more of agriculture based economy, so care of farmers and animals should be of main concern. Primary health care for villagers and veterinary care for animals should be provided and time-to-time IEC (information, education, communication) should be arranged in villages regarding agricultural and health advisory.

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FIRE

- Rocky Forest Fire in California - *Dr. Mukta Girdhar*
- An Eye on the Most Prevalent Threat of the Disaster FIRE - *Pankaj Tiwari ,Abhay Gupta & Prince Anurag*

ROCKY FOREST FIRE IN CALIFORNIA

Dr. Mukta Girdhar

Asstt. Professor Guru Gobindsingh Indraprasth University Dwarka, New Dehi.

Abstract

Forest fire in United States is a common occurrence. There are typically between 60,000 to 80,000 forest fires that occur each year, burning 3 million to 10 million acres (12,000 to 40,000 sq. km) of land depending on the year. They pose a great risk to life and infrastructure during all times of the year, though mostly throughout the hotter months of summer and spring.

California state is located on the West Coast of the United States. It is the most populous U.S. state, with a population of 38 million people. This year 2015 Fire in densely populated California draws the most attention, throughout the world. At present California has many active forest fires. ***Rocky fire*** *is one of them. It was burning at unprecedented rates. Fire had spread 69636 square miles area. California fire deptt has to face many challenges, during battling with blaze, evacuation, protecting infrastructure and forest. This paper deals challenges and effective use of Geospatial technology in every face of Forest fire management.*

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AN EYE ON THE MOST PREVALENT THREAT OF THE DISASTER-FIRE

Pankaj Tiwari, Abhay Gupta & Prince Anurag

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Abstract

Any kind of disaster has a potential to shatter the economic development of that country. In the present scenario no organization is perfectly untouched to the most prevalent threat that is - FIRE. Man-made hazards and natural hazards have a history of economic and social losses worldwide and for effective fire management we have to consider both for creating a safe environment.

We know that property damaged by floods can often be dried out and restored. Structural damage from an earthquake might be repaired. Stolen property always has a chance of being recovered. Damage from fire, however, is usually permanent and irreparable.

Several fire incidents or major accidents, such as LPG tank explosion at SanJuanico (Mexico City, 1984), Bhopal gas tragedy (1984) and the Piper Alpha fire (UK, 1988) in the oil and gas industry have highlighted the need to improve radically the safety performance of the oil and gas organizations' operations. Fire safety which is also a part of disaster management for any industry has become a subject of increasing importance in recent years.

It is a well-known fact that disaster management main goal is to minimize the effect of disaster by making proper mitigation plans. The objective of this paper is to look into various aspects of fire prevention techniques and its mitigation in different industries by using state of the art software, national/international standards and guidelines.

Fire and explosion analysis is being carried out to find out find thermal radiation intensity of radiation (4.5KW/m2, 12.5KW/m2., 37.5KW/m2), ISO-Risk Contour, societal risk and explosion overpressure and to identify and analyze the main risk contributing factors of fire /explosion risks and devise actions to reduce or to prevent them. Worldwide accepted risk assessment software PHAST-RISK - 6.7developed by M/s DNV, U.K. has been used to carry out the fire and explosion analysis.

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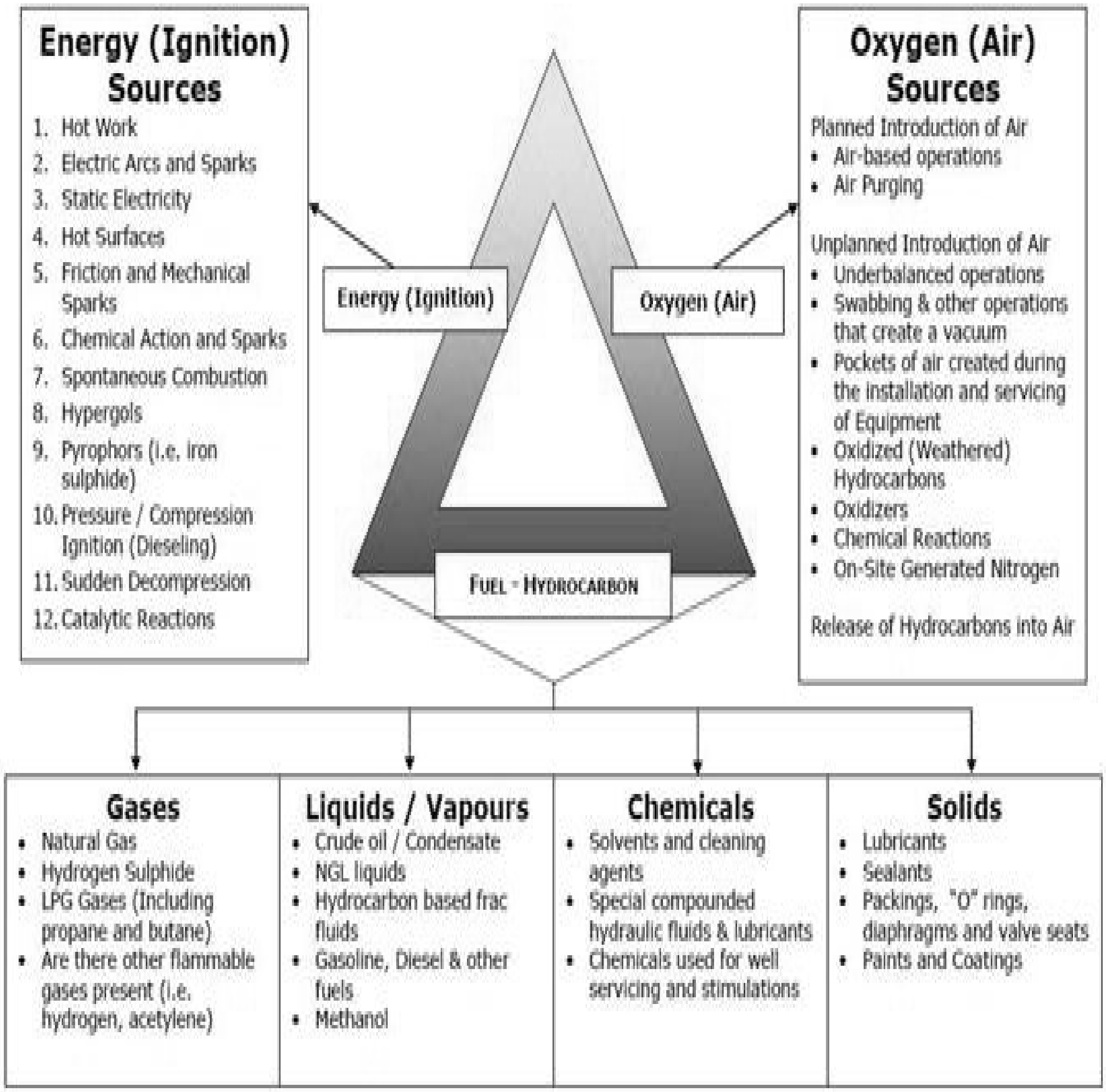
Introduction

A wide variety of measures may be employed to prevent, control and mitigate the effects of fire and explosions. Whilst the emphasis should always be on explosion prevention (e.g. through prevention of leaks or elimination of ignition sources), the possibility of accumulation and subsequent ignition of a flammable hydrocarbon-air mixture cannot always be eliminated. Therefore control and mitigation measures may additionally be required. The fire triangle shows the three critical components required for combustion. It is widely understood that to remove the potential for a fire or explosion, one of the three sides of this triangle must be eliminated. Given the nature of upstream oil and gas operations, this is not as simple as it seems:



The ability to develop effective solutions for improving industry safety depends on training which results in a better understanding of these elements. A fire triangle with expanded parameter lists is therefore provided. The fire triangle should be used to guide the identification of potential fuel, oxygen, and energy sources.

It is important to remember that even though all sides of the fire triangle co-exist, there is not 100 per cent certainty that a flammable mixture will ignite; the "ingredients" need to be present in the right amounts and in the vicinity of each other. Conducting an operation on the basis that is has been completed safely numerous times previously without incident can provide a false sense of security.

Risk Analysis Methodology

QRA (Quantitative Risk Analysis) is a way of making a systematic analysis of the risk from hazardous activities, forming a reasonable evaluation of their significance in order to provide information of a decision-making process (CCPS, 1989). There are many reasons for performing a QRA and equally as many benefits to be had.

QRA can be used as a way of maximizing safety at minimum cost, it can be used as part of developing safety cases, or it may be a requirement of the particular legislative regime within which a plant operates. There may also be risk exposure criteria which are acceptable for insurance purposes which have to be satisfied or it may be useful purely from a decision making standpoint. QRA combined with an effective safety management system can act to both improve safety and reduce costs. It is of particular benefit when identifying the most effective risk reduction measures. By clearly identifying the areas of highest risk, it allows effort to be focused on them. When a risk reduction measure is proposed, its effect can be clearly illustrated by modifying the QRA model and recalculating the risk levels to assess how effective this measure has been. Using this methodology the benefits of a variety of risk reduction measures can be compared and the most effective combination can be implemented.
QRA process is summarized in Figure 1.

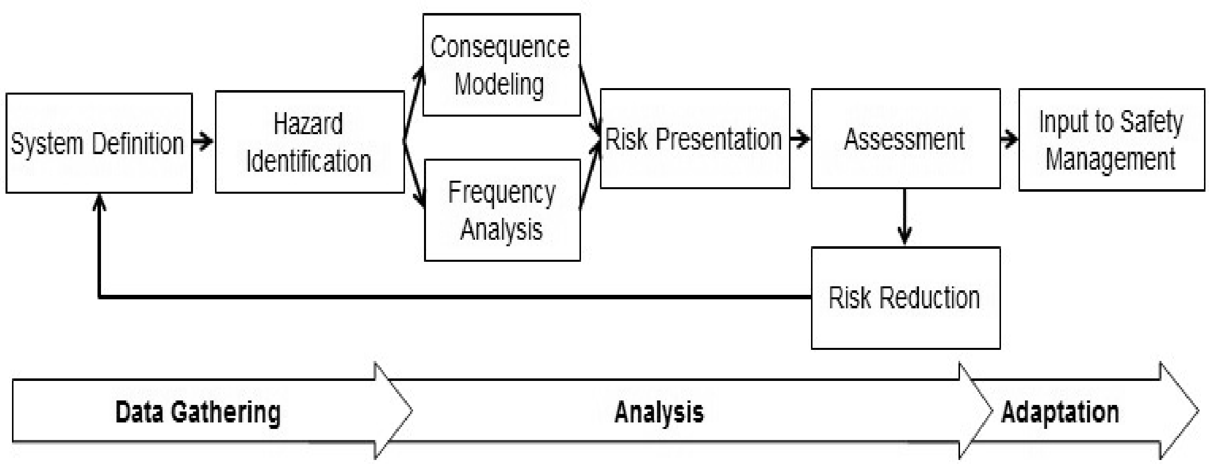


Fig-1

SAFETI (Software for the Assessment of Flammable, Explosive and Toxic Impacts) Risk Analysis software is core tool for risk studies. This was developed in partnership with the Dutch Government in the early 1980s and, since then, it has been expanded and enhanced to a very high degree. It is now regarded as by far the most comprehensive quantitative tool for assessing process plant risks. SAFETI incorporates PHAST (Process Hazard Analysis Software Tools) for consequence modelling. SAFETI is designed to perform the analytical, data processing and results presentation elements of a QRA within the frame work described in Figure 1.

The main inputs to risk assessment are:

- Define loss-of-containment failure cases in terms of size of leak (hole size or rupture), process fluid, temperature and pressure and inventory.
- Likelihood of event.
- Environmental information (meteorology, ignition data, population data).

Meteorology covers wind speed and direction, topology and atmospheric temperature, pressure and stability. The latter has a major effect on cloud dispersion. Some stability classes are "unstable", particularly those associated with strong sunlight and atmospheric turbulence, which aids rapid dilution. Others are classed as stable, often corresponding to early morning with light wind, and associated with poor atmospheric dilution; these usually cause the most serious consequences. In dispersion analysis, the pairing of atmospheric stability and wind speed is an important factor and worst case scenarios will generally be associated with low wind speed and stable conditions which result in a relatively highly concentrated static cloud.

Measures of Risk

The two most common risk measures are societal and individual risk. Both should be considered when performing a QRA. The UK Institution of Chemical Engineers (1992) defines risk as „the frequency at which an individual may be expected to sustain a level of harm from the realisation of specified hazards". It is usually taken to be the risk for death and expressed as a risk per year. The most common example of individual risk is the iso-risk contour. This allows for major hazard areas to be easily identified and the effects on specific vulnerable locations to be more easily observed.

Societal risk provides an indication of the likely severity of an accident. A more formal statement is again provided by the UK Institute of Chemical Engineers (1992), which defines Societal Risk as "the relationship between the frequency and the number of people suffering a given level of harm from the realisation of specified hazards". It is normally taken to refer to the risk of death and expressed as a risk per year. This is normally displayed as a FN curve, which is one of the most complex quantitative measures developed for regulatory control purposes. It is based on a log-log plot of frequency against number of fatalities. The frequency axis is cumulative, and is expressed in terms of "N or more" rather than the more intuitive "N or less". Although the F-N plot is not as easily understood as individual risk contours, it does present a form of risk that is very important to regulators. Government agencies are particularly concerned about large fatality infrequent events as these cause major disruption to the community. Individual risk does not convey this information and thus decisions based only on individual risk do not address potential disaster scenarios where many may be killed by a single event like, for example, Bhopal.

Risk Criteria

Risk analysis provides a measure of the risk resulting from a particular facility or activity. However, the assessment of the acceptability or otherwise of that risk is left to the judgement and experience of the people undertaking and/or using the risk analysis.

The normal approach adopted is to relate the risk measures obtained to acceptable risk criteria .A quantitative risk analysis produces only numbers but it is the assessment of those numbers that allows conclusions to be drawn and recommendations to be developed. The assessment phase of a study is therefore of prime importance. The simplest framework for risk criteria is a single risk level that divides tolerable risks from intolerable ones. Such criteria give attractively simple results, but they must be used judiciously since they do not reflect the uncertainties both in estimating risks and in assessing what is tolerable.

A more flexible framework for risk criteria is used by the UK HSE. It specifies a level, usually known as the maximum tolerable criterion, above which the risk is regarded as intolerable and must be reduced. Below this level, the risks should be made as low as reasonably practicable (ALARP). This means that when deciding whether or not to implement risk reduction measures, their implementation costs may be taken into account. In this region, the higher the risks, the more it is worth spending to reduce them.

Table No. 1: Individual Risk Criteria (Suggested by Health & Safety Executive, U.K)

RISK LEVELS	PUBLIC (per year)	PLANT PERSONNEL (per year)
Maximum Tolerable	$1x\ 10^{-4}$	$1x\ 10^{-3}$
Negligible	$1x\ 10^{-6}$	$1x\ 10^{-6}$

Table No. 2: Societal Risk Criteria (Suggested by Health & Safety Commission, UK)

RISK LEVELS	N	F
Maximum Tolerable	1	$1x10^{-1}$
	10	$1x10^{-2}$
	100	$1x10^{-3}$
	1000	$1X10^{-4}$
Negligible	1	$1X10^{-4}$
	10	$1X10^{-5}$
	100	$1X10^{-6}$
	1000	$1X10^{-7}$

Note: 1. N is the Number of Fatalities

2. F is the frequency of N or more fatalities per year

Scenario-A Case study

In this paper we are going to take one particular type of GGS (Group gathering station) for better understanding of the QRA study with the help of our state of art software SAFETI-6.7. We will try to find out different thermal radiation intensity graph, societal risk contour and F-N curve so that we can get idea about how a fire and explosion study help us to prevent or mitigate from disaster. For this study we have assumed some data that is given below.

The details of major inventory holding facilities are listed below:

S. No.	Equipment	Size L(m)*D(m/inch)	Pressure (kg/cm^2)	Temperature (^0C)	Inventory (kg)

1.	L.P. header (gas phase)	10*8 (inch)	6	40	650
2.	L.P. Separator	4.4*1.4(m)	5.5	30	3000
3.	Storage Tank 400 M^3	400 m^3	atm	30	221000

Consequence Analysis of the Case Study

Consequence analysis involves the application of mathematical, analytical and computer models for calculation of effects and damages subsequent to a hydrocarbon release accident. Consequence models are used to predict the physical behaviour of hazardous incidents. Only flammable materials are present in GGS, only fire and explosion effects (Pool fire/Jet fire/Flash fire/overpressure) are relevant to the present Risk Analysis Study.

Further, it also helps in identification of Maximum Credible Accident (MCA) Scenario which is considered as the worst accident. In other words an accident in an activity , resulting in the maximum consequence distance and is still believed that it can happen. The MCA scenario is suitable for emergency planning.

Fire and Explosion Modelling

Jet Fire

Jet fires are burning jets of gas or atomized liquid whose shape is dominated by the momentum of the release. The jet flame stabilizes on or close to the point of release and continues until the release is stopped. The effect of jet flame impingement is severe as it may cut through equipment, pipeline or structure.

Pool Fire

Pool fires are burning pools of liquid, which has collected on a horizontal surface. The size and spread of the pool will gradually increase with time but will reach an equilibrium size shortly after ignition; the pool size is then determined from the burning rate and the release rate. Thermal radiation levels are estimated for this equilibrium size pool fire. If the liquid release is stopped, the size of the burning pool will gradually diminish. Heat flux at the flame surface of a pool fire is normally 100-150 $KW/m^{2.}$

Flash Fire

A flash fire occurs when a cloud of gas burns without generating any significant overpressure. The cloud is typically ignited on its edge; remote from the leak source the combustion zone moves through the cloud away from the ignition point. The duration of the flash fire is relatively short but it may stabilize as a continuous jet fire from the leak source.

Explosion

A vapour cloud explosion (VCE) occurs if a cloud of flammable gas burns sufficiently quickly to generate high overpressures (i.e. pressures in excess of ambient).

Damage Criteria

Different accident scenarios result into different damaging effects. To assess the damage level caused by the various accidental events, it is essential to firm up the damage criteria with respect to different types of accidents e.g. thermal radiation, toxicity, explosion overpressure, etc.

The damage criteria considered for this analysis are as follows:

Table No. 3 - Thermal Radiation Damage due to Incident Radiation Intensity (Source: World Bank Technical Paper no. 55 "Techniques for Assessing Industrial Hazards")

Incident Radiation Intensity (KW/m^2)	Damage to Equipment	Damage to people
37.5	Damage to process equipment	100% lethality in 1 minute 1% lethality in 10 seconds
25	Minimum energy required to ignite wood at indefinitely long exposures without a flame	100% lethality in 1 minute Significant injury in 10 seconds.
12.5	Minimum energy required to ignite wood with a flame, melting of plastic tubing	1% lethality in 1 minute 1^{st} degree burns in 10 seconds.
4.0		Causes pain if exposure duration, is longer than 20 seconds but blistering is unlikely
1.6		Causes no discomfort for long exposure

The level of damage caused is a function of duration of exposure, as well as of heat flux. This is true both for the effect on buildings and plant equipment and for the effect on personnel. However, the variation of likely exposure times is much more marked with personnel, due to the possibility of finding shelter.

Explosion

In the event of an explosion-taking place within the Installation, due to hydrocarbon and air mixing and catching fire, the resultant blast wave may have damaging effect. The tanks, buildings, structures etc., can only tolerate low level of overpressure. The positive pressure phase of the blast wave can last from 10 to 100 mille seconds for typical UVCE (Unconfined Vapour Cloud Explosion). The same overpressure level can have different effects depending on the duration.

The following damage criteria are suggested for equipment and people due to explosion overpressure:

Table No. 4 Damage Effect of Blast Overpressure (Source: World Bank Technical Paper no. 55 "Techniques for Assessing Industrial Hazards")

C(s)	**Limit Value ($mJ^{-1/3}$)**	**Overpressure (psi)**	**Characteristic Damage**	
			To Equipment	To People
C(1)	0.03	5	Heavy damage to 1% death from lung buildings and to damage process equipment	>50% eardrum rupture >50% serious wounds from flying objects
C(2)	0.06	1.5	Repairable damage tobuildings and damage To facades ofdwellings	>1% eardrum rupture >1% serious wounds from flying objects
C(3)	0.15	0.75	Glass damage	Slight injury from flying glass
C(4)	0.4	0.3	Glass damage to about 10 % of Panes	

Consequence Analysis Results

Jet Fire

Jet fire impingement of high thermal intensity may be critical for equipment/ facilities. Effect distances for 37.5Kw/m^2 radiation intensity for credible scenarios are listed below:

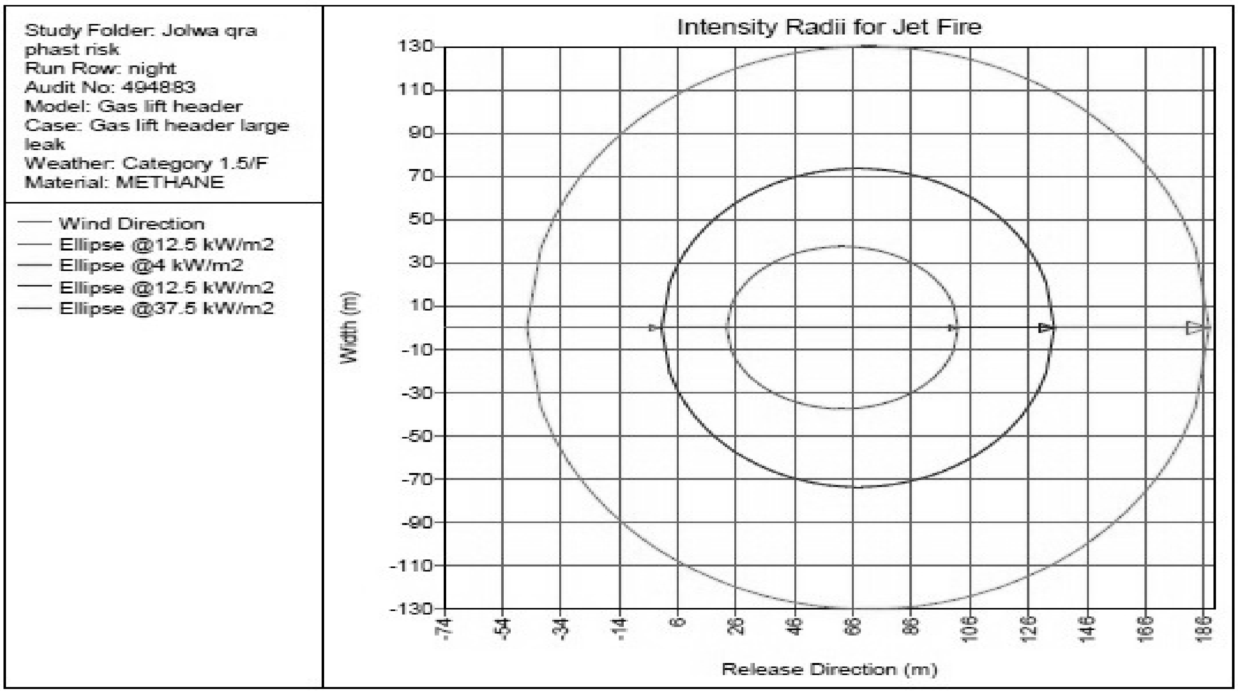
Table: Jet Fire

S.No	**Equipment**	**Distance (m)**		
		Small leak	**Medium leak**	**Large leak**

1	L.P. Header	NR	NR	30
2	Gas Lift Header	12	31	101
3	L.P.Separator Gas NR	NR	NR	30

NR - not reached

It can be seen from the above table that thermal radiation of 37.5 kw/m^2 due to jet fire in the event of large leak in gas lift header is extending upto 101 meters as depicted in the graph given below:



Late pool fire:

Thermal radiation due to pool fire in major inventory holders like storage tanks or separators can be disastrous, if firefighting equipment is subjected to thermal radiation of more than 4 kw/m^2. A person can withstand radiation level of 4kw/m^2 for 20 seconds (refer table 3 on Thermal radiation effects). Hence it is important that facilities like fire water pump are located in safe zone.

Late pool fire effect distances for major inventory holders of GGS for 4 Kw/m^2 and 12.5 kw/m^2 radiation level are tabulated below

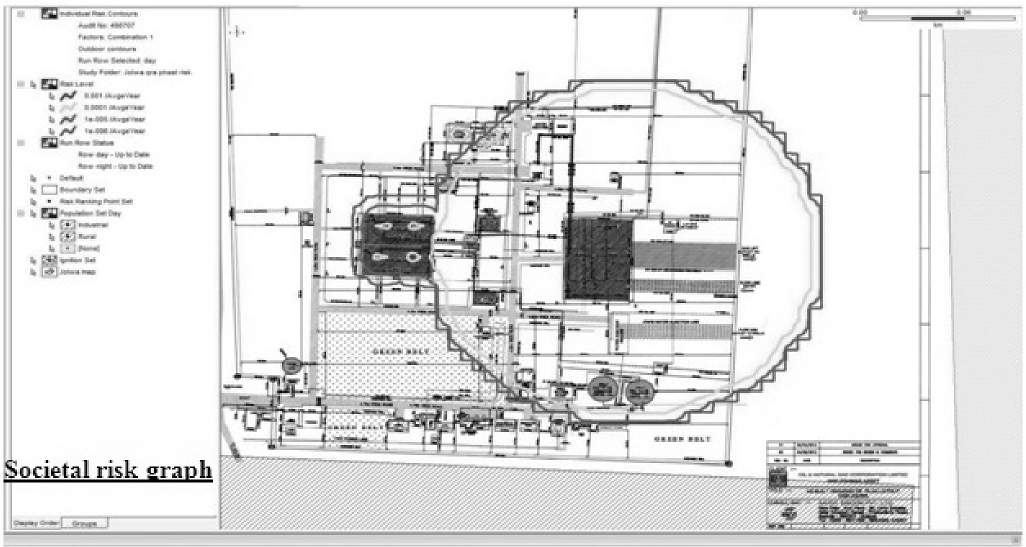
Table: 5 Late Pool Fire Results

S.No	Equipment	Distance(m)							
		Small Leak		Medium Leak		Large Leak		Catastrophic Rupture	
		4 kw/m^2	12.5 kw/m^2	4 kw/m^2	12.5kw/m^2	4kw/ m^2	12.5kw/m^2	4kw/ m^2	12.5 kw/m^2
1	LP Separator Liquid.	57	25	63	26	65	27	61	23
2	Test Separator Liquid	51	26	54	26	52	25	51	21
3	Storage Tank m^3	61	21	61	21	38	21	39	8.6

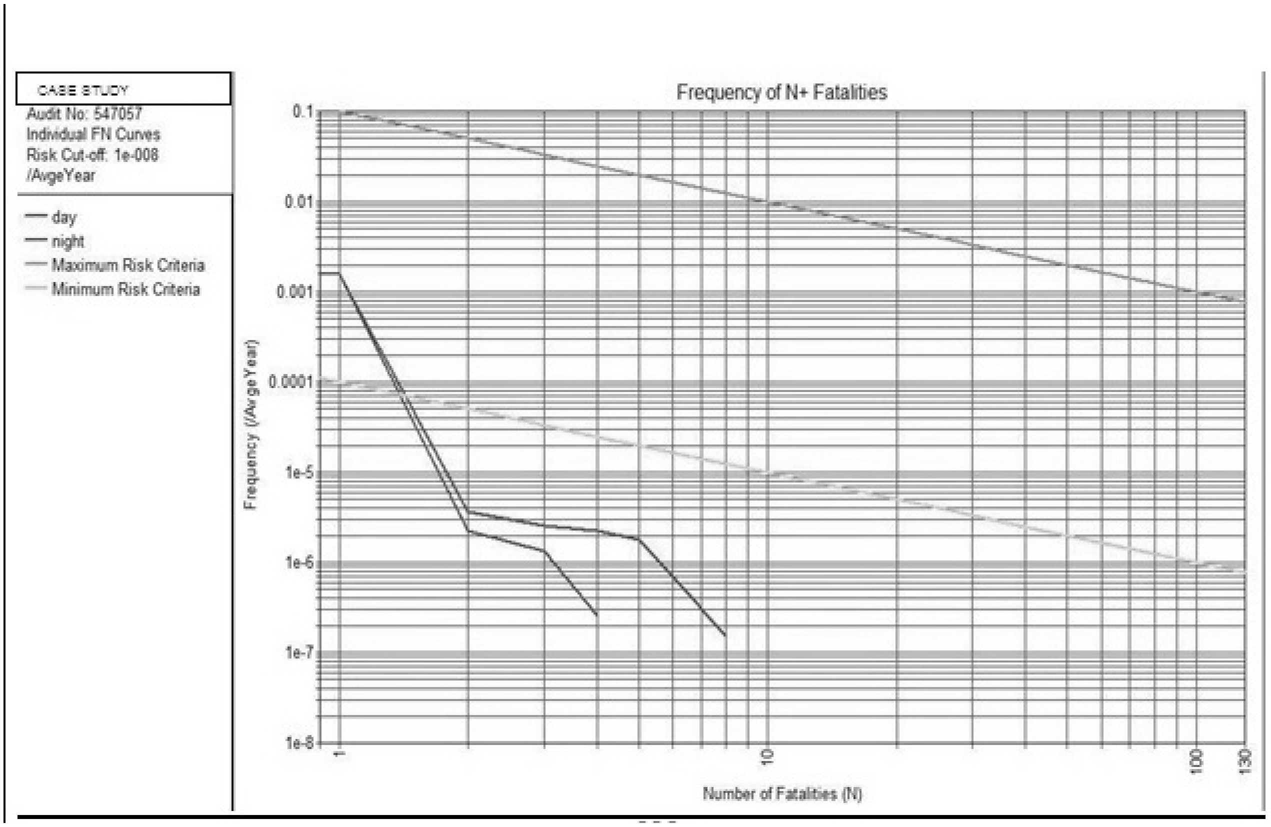
Explosion Overpressure

Explosion overpressure effects were analysed for using DNV-GL software "Phast -6.7". It is observed that for the given operating conditions, explosion overpressure generated is not more than 1 Psi.

Individual Risk Contour



Societal risk graph



Major Findings

- Maximum Credible Accident (MCA) Scenario:
  - ➢ In the event of large leak in Gas Lift Header, Jet fire of 37.5 KW/m2 radiations is extending up to 101 meters towards east side of the plant boundary and is affecting population within 50 meters residing in east side of the plant.
  - ➢ In the event of large leak in L P Separator, Pool fire of 12.5 KW/m2 radiations is extending up to 63 meters towards east side and is restricted within plant boundary.
- Major risk contributors in our case study are Gas lift header and LP separator contributing almost 70% risk.
- Individual Risk to Plant personnel is generally within ALARP (As Low As Reasonably Practicable) risk region and Societal Risk is generally within Negligible Risk Region.

Conclusion

1. QRA helps in Identification of potential hazards, very useful in site selection, equipment & facilities layout
2. Identification of major risk contributors
3. Evaluating risk reduction measures

4. Demonstrating risk acceptability to regulatory body and the workforce
5. Formulation of Emergency Response Plan (Disaster Management Plan)
6. The three major findings needs to be taken into account while formulating Emergency Response Plan (Disaster Management Plan) for the plant
7. Gas Lift-Header is the major risk contributor and hence, process area should be adequately covered with gas detectors with provision of alarm in control room.

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5. API RP2A (21st Ed) Section 18.

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FLOODS

- The Challenges of Flood Disaster Management in Nigeria
  - *Professor A. M Jinadu,*
- Rapid Assessment and Training of Resilient Communities to floods in Karari and Eastern Nile localities of Khartoum state, *Sudan.-Magzoub Toar*
- September 2014 Floods in Jammu & Kashmir: The way forward to build a sustainable & flood resilient Jammu & Kashmir- *S.K.Bukari, Saqib Gulzar, Ovais Gulzar*
- Identification and Prediction of Extreme Rainfall events over India during the monsoon of 2014. - *G. Ch. Satyanarayana, D. V. Bhaskar Rao, D. Srinivas and C. V. Naidu*

THE CHALLENGES OF FLOOD DISASTER MANAGEMENT IN NIGERIA

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Abstract

Flooding is a major disaster as well as an annual event in Nigeria. The incidence of flooding is becoming more severe in the resent times due to the effect of climate change and other related factors. The flood disasters witnessed in Nigeria in year 2010, 2011 and 2012 were highly devastating. In particular, the flooding disasters that occurred between August and October, 2012 in the county had significant negative impacts on human lives and properties and disrupted the normal functioning of several communities. The study examined the challenges of flood disaster management in Nigeria, using the 2012 flooding as a reference point. The paper utilizes secondary information collected from documented research works and other reference materials. The findings show that Nigeria has a long history of major flooding disaster beginning from the 1940s. Series of devastating flooding disasters experienced in the country have huge negative impact such as loss of lives, injuries, destruction of houses and public utilities as well displacement of millions of people. Some of the flood disaster management efforts such as flood early warning services, fund disbursement for rehabilitation and recovery, preparation of action plans, disaster relief operations were found not to have yielded expected outcomes. The management efforts were constrained by continuous occupation of flood prone areas, poor community attitudes to early warning information, low institutional capacity, mismanagement of relief funds and non-implementation of disaster plans. Amongst others, effective decentralization of disaster management functions, inter-agency collaboration and coordination, investment in flood management infrastructure, effective early warning services, relocation of vulnerable communities and the implementation of existing disaster management plans were recommended for effective flood disaster management in Nigeria.

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Introduction

The rapid rate of urbanization with the attendant problems of urban sprawl, poor unguided physical developments in marginal areas, increasing poverty and infrastructure deficiency in the developing countries has resulted in disaster risk accumulation in our towns and cities (Jinadu, 2013). As a consequence, natural and human induced disasters of different magnitudes have become part of daily life experience in human settlements across the globe. In the recent time, the frequency of hydro disasters has been on the increase as a result of climate change and related problems. Thus, extreme temperatures, global warming and the resultant climate change are the major trigger events responsible for a large proportion of disasters in all parts of the world.

There is a general increase in the trend of climate-related disasters since year 2000 (UNISDR, 2013). Between 2002 and 2011 the average annual disaster frequency observed was 394 events while in 2012, a total of 357 natural triggered disasters were registered (Centre for Research on the Epidemiology of Disasters, 2013). These disasters have resulted in huge physical damages and economic loss worldwide. According to the UNISDR (2013), disaster impact between 2000 and 2012 affected 2.9 billion people, killed 1.2 million people and resulted in 1.7 trillion US dollar. Also, the NatCatSERVICE's statistics of disaster loss events worldwide in 2014 show that there were 980 loss events, 7,700 fatalities and USD 110 billion overall loses.

Amongst all forms of disasters, flooding is a major disaster with highest frequency of occurrence, wider area coverage and highest impact in all countries of the world. In Nigeria, flooding is a major annual disaster. The country has a long history of seasonal flooding, the situation is becoming more severe in the resent times due to the effect of climate change and other related factors. The flood disasters witnessed in Nigeria in year 2010, 2011 and 2012 were phenomenal and highly devastating. In particular, the flooding disasters that occurred between August and October, 2012 in the county had high negative impacts on human lives and properties and disrupted the normal functioning of several communities. Apart from these, other isolated flood disasters recorded in Nigeria between 2013 and 2015 have wreaked havoc on communities and have brought about economic loses.

Over the years, the Nigerian Government and her international development partners have committed a lot of resources to flood disaster management. However, much progress has not been made in the areas of flood disaster risk reduction, recovery and community resilience. This paper therefore examines the challenges of flood disaster management in Nigeria. It considers issues of flooding problem in Nigeria, the management efforts instituted, the challenges faced by the government and proffers some recommendations for effective flood disaster management in Nigeria.

Nigeria: Location and Basic Facts

The Federal Republic of Nigeria is situated in the Western part of Africa within latitudes 4° to 14°N of the Equator and longitudes 3° to 15°E of the Greenwich Meridian. It shared boundary with Cameroon and Chad in the east, Niger in the north, Benin Republic in the west and the Gulf of Guinea in the Atlantic Ocean in the south (Figure 1). Nigeria is made up of 36 federating States and the Federal Capital Territory (FCT) with Abuja as the capital city. The landmass of Nigeria covers a total area of 923,768 sq. km which is inhabited by over 500 ethnic groups. Nigeria has an estimated population of 174, 507,539 in 2013. It is the most populous country in Africa and tenth in the World. As of 2015, Nigeria is the world's 20th largest economy with a nominal GDP of over \$500 billion. Table 1 shows some basic facts about Nigeria.

Figure 1: Location of Nigeria in Africa

Source: Department of Urban and Regional Planning, FUT Minna, 2015

Flooding Disasters in Nigeria

Nigeria as a country has a long history of seasonal flooding associated with the rainy season, which normally last between June and October. Urban and rural flooding is a common occurrence in settlements located in low lying terrains, on river flood plains and in coastal environment. The country traversed by two major rivers - Niger and Benue on which the Kainji, Jebba and Shiroro dams are built. Other important rivers include rivers Kaduna, Ogun, Sokoto, Hadejia, Gongola and Cross River. The flood plains of these rivers have become permanent abode for several communities that live in small settlements. These communities have historic flooding experience and have been affected by series of seasonal flooding arising river bank overflow. The situation became worse after the construction of dams at Jebba, Kainji and Shiroro and the occasional opening of dam sluice gates which normally results in devastating floods and the submergence of hundreds of villages downstream (Jinadu, 2014).

The history of major flooding disasters dates back to the 1940s. The first flood hit Ibadan, the headquarters of old western region of Nigeria (now the capital of Oyo State) in 1948 and subsequently the city witnessed devastating flood disasters in 1963, 1978, April 30, 1980, 1985, 1987 and 1990 (Adedeji, Odufuwa & Adebayo, 2010). In particular, the famous Ogunpa floods in Ibadan in the 1980s that killed several people, destroyed many houses and completely grounded socio-economic activities, provided the watershed of devastating flooding experience in Nigeria.

Severe incidences of flooding disaster in Nigeria are many. Communities living in the downstream of major dams, on the flood plains of major rivers and the coastal areas have recorded series of flooding disasters too numerous to mention. Some of the recent flooding disasters include those of 2010, 2011 and 2012 that were highly devastating. The floods of these years affected Sokoto, Kano, Katsina, Jigawa, Niger, Kebbi, Benue, Oyo, Ogun, Ondo, Bayelsa, Delta, Akwa Ibom, Anambra, Cross River and many other States of Nigeria. The various flooding disasters resulted in loss of lives, injuries, destruction of houses and public utilities as well displacement of millions of people. In year 2010 alone flood disaster affected 1,500,200 and resulted in 30,000, 000 US Dollar loss (Jinadu, 2013).

There no year that is free of flooding disaster in Nigeria. Several other flooding events have been recorded after the 2012 disaster. Table 2 shows the summary of few incidences of flooding disasters between 2010 and 2015 and their impact in Nigeria.

Table 2: Flood Disaster Incidences and Impact, 2010 – 2015

Year	Months of Occurrence	No. of Events	Number of States affected	Impacts\Damages
2010	August - September	5	Sokoto, Taraba, Jigawa, Kebbi, Niger and Oyo	40 people killed, 2,350 people, buildings, properties, farmlands and animals were affected worth millions of naira were destroyed
2011	June - September	9	Lagos, Kano, Anambra, Kwara, Bauchi, Oyo Ebonyi and Ogun	56 people killed, 8,056 people displaced, 77 houses, vehicles and properties were affected
2012	May - September	40	28 out of 36 States and FCT affected.	363 people killed, 5,851 injured, 3,891,314 affected, 3,871,53 displaced, 82 schools, 20 markets, 3 million hectares of farmlands affected; properties worth millions of Naira destroyed.
2013	May – October	21	Nasarawa, Osun, Katsina, Bauchi, Kano, Jigawa, Sokoto,Kebbi, Plateau, Kaduna, Edo, Oyo, Ondo, Imo and Akwa Ibom	28 people killed, 17 injured, 3,927 houses affected, 33 villages sacked, 217 farms destroyed; infrastructure and properties destroyed.
2014	June - August	9	Sokoto, Taraba, Plateau, Oyo, Edo, Delta, Akwa Ibom and Anambra	24 people killed, 90 households, 62 communities sacked, 786 houses 165 farms affected, infrastructure and properties destroyed.
2015	July – October	11	Sokoto, FCT, Benue, Kwara, Kaduna, Gombe ,Jigawa, Delta, Yobe and Imo	21 people killed, 3 injured, 50, 000 households, 1400 houses, 863 farms; infrastructure and properties destroyed.

Notes: The data on the table is limited to available information and is not exhaustive

Source: Compiled from National Daily Newspapers in Nigeria, 2010 - 2015

The flooding disaster of 2012 is regarded as the worst since Nigeria became independent in 1960. The findings of the rapid assessment conducted immediately after the floods indicated that the floods affected 28 states, 254 LGAs and 3870 communities (Figure 2). It was also estimated that over 82 schools and 20 markets were damaged while over 3 million hectares of farmlands were destroyed. According to the 2012 PDNA report, 'the impact of the 2012 flooding was very high in terms of human, material, and production loss, with 363 people killed, 5,851 injured, 3,891,314 affected, and 3,871,53 displaced' (Federal Government of Nigeria, 2013). Plates I and II show some images from the 2012 floods in Nigeria.

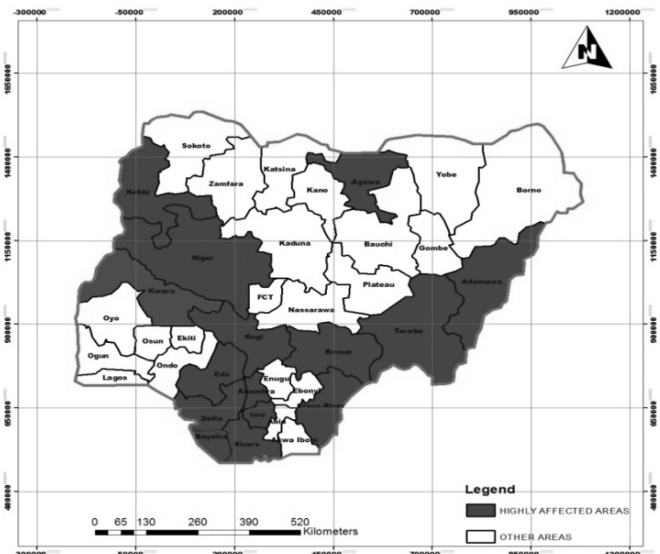

Figure 2: States Affected by 2012 Floods in Nigeria
Source: National Emergency management Agency, 2012


Plate I Plate II

Plates I & II: Images of the Impact of 2012 Flooding Disaster in Nigeria
Sources: Compiled from This Day Live, 2012 and Punch Newspaper, August 15, 2013

The PDNA report estimated the total value of destroyed physical and durable assets caused by the 2012 floods in the most affected states of Nigeria as ₦1.48 trillion (US$9.5 billion) and the total value of losses across all sectors of economic activity was estimated at N1.1 trillion
(US$7.3 billion). The overall impact of the flood on real GDP growth in 2012 is estimated at 1.4 percent (₦570 billion, in nominal terms).

The serious physical and socio-economic impacts of the 2012 floods were a major concern in the aftermath of the disaster. The Government, Development Partners, NGOs and many other stakeholders instituted actions to rehabilitate the victims, recover from the disaster and reduce the risk to prevent or mitigate future flooding. Some of the management actions are considered in the next section of the paper.

Flood Disaster Management Efforts in Nigeria

Nigeria as a country has shown a long time commitment to issues of the environment and disaster management. The country has either acceded to or ratified a number of international treaties, conventions and disaster management frameworks including Rio Declaration (1992), Climate Change Convention(1992), Rotterdam Convention (1998), Kyoto Protocol (2001) Hyogo Framework for Action (2005 -2015), Rio+20 Declaration (2013) and the Sendai Framework (2015). In all of these treaties and conventions, Nigeria has strived to implement programmes of environmental management and disaster risk reduction. Specific flood disaster management activities of Nigeria, most especially in the aftermath of the 2012 event are enumerated below.

Flood Warning Services

Flood Early Warning Services are Provided by the Nigerian Meteorological Agency (NIMET) in collaboration with National emergency management Agency (NEMA), National Orientation Agency (NOA) and the Dam Authorities in Nigeria. NIMET produces annual Seasonal Rainfall Prediction (SRP) and issues out warnings on excess rainfall and possible flooding every year. An agreement was signed between the Nigerian and Cameroonian Government on sharing early warning information with respect to the release of water from Lagdo Dam in Cameroon, which was the major cause of the 2012 flooding. For instance, the early warning messages issued between March and October, 2015 were disseminated through stakeholder workshops, radio, television as well as traditional and religious institutions.

Preparation of Reports and Disaster Management Plans

In the aftermath of the 2012 flooding, Nigeria, with the support of the United Nations Systems, European Union (EU) and other Development Partners conducted the Post Disaster Needs Assessment (PDNA) of 2012 flood disaster. The PDNA provided information on the effects and impacts of the 2012 floods, the financial requirements for rehabilitation of victims as well as the framework for recovery and reconstruction. The country was also supported by the UNDP and the World Bank/Global Facility for Disaster Reduction and Reconstruction (GFDRR), to prepare the National Disaster Recovery Strategy/Framework and 2012 Flood Recovery Action Plan for emergency recovery and mitigation. The Flood Recovery Action Plan is modeled on that of the US, the UK, New Zealand and it is regarded as the first of its kind in Africa (This day Live, 2013).

Fund Disbursement for Flood Rehabilitation and Recovery

In the aftermath of the 2012 flood disaster, the Federal Government established a Presidential Committee on Flood Relief and Rehabilitation and released the sum of ₦17.6 billion for disbursement to the affected States and relevant Federal Agencies. The affected states received ₦ 13.3 billion while the agencies received ₦ 4.3 billion (Odogwu, 2013). The Economic Community of West African States also gave Nigeria $382,000. The affected States were categorized into four groups – A to D. States in category A got ₦ 500 million each; category B got ₦ 400 million each; B got ₦300 million while category D got ₦ 250 million each. The funds were meant for rehabilitation, recovery and preparedness for disaster risk reduction in the affected States.

Flood Vulnerability Mapping

In order to prepare for and reduce the risk of future floods, NEMA in collaboration with Office of the Surveyor-General of the Federation (OSGOF) and National Space Research and Development Agency(NASRDA) conducted flood vulnerability mapping exercise in 17 States to identify communities at risk and safe relocation sites. The mapping was done based on the 2012 flood extent and elevation of the areas mapped (NEMA, 2014). The maps were made available to responsible authorities in the State for the purpose planning and flood disaster preparedness.

Construction of Relocation Shelters in States Affected by Flood

The Presidential Committee on Flood Relief and Rehabilitation **initiated flood shelter projects in the aftermath of the 2012 floods and awarded contracts worth ₦5 billion. For instance, Bauchi, Benue, Niger,** Kogi and Delta States commenced the building of 2 blocks hostel accommodation for people that might be displaced by future flooding disasters. The concept of flood temporary shelter was based on providing wet season homes for peoples who depend and live in flood prone areas for livelihoods. Such people are to be temporary housed in upland during the peak of wet\flooding season.

In addition to the above Efforts, other Contingency Activities of NEMA in Disaster Management include **w**arehousing\stockpiling of relief supplies, acquisition of rescue equipment such as Mobile Intensive Care Units (ambulances) and multi-purpose emergency vehicles as well as multi-agency sensitization programmes.

The Challenges of Flood Disaster Management

An assessment of the various flood management programmes in Nigeria reveals that the level of success in flood disaster preparedness, rehabilitation and recovery is still very low. The outcomes of flood disaster management activities are not commensurate with the level of resources committed by the Government. Some of the challenges faced in the management of flooding disasters include, but not limited to, the following.

Occupation of Flood Plains and Poor Response to Early Warning.

The flood plains of the major rivers in Nigeria have become permanent abode for several fishing and farming communities who depend on the areas for their economic livelihoods. There are over 350 of such communities that live in small settlements in Niger State alone. The Government has not been able to relocate vulnerable communities in Nigeria despite all warnings and sensitization efforts. The majority of the people living in flood-prone areas have refused to relocate due to social and economic attachment to their place of abode while the Government could not provide alternative abode and livelihoods for few of the communities that are ready to relocate. The situation is made worse by limited access to warning information by rural communities and poor attitudes of some communities that received but often ignore early warning messages.

Emergency Response Delay due to Poor Accessibility

Many rural communities in Nigeria face the problem of difficult terrain and poor accessibility in times of emergency. Coastal communities in Anambra, Rivers, Bayelsa, Cross River and Akwa-Ibom and Delta States as well as those living on the flood plains River Niger and Benue in Sokoto, Kebbi, Niger, Kwara and Kogi States are often cut off in time of flooding disasters. As a result, emergency response and relief assistance are often delayed. In Niger State for instance, findings from the post 2012 need assessment in Niger state revealed that 64.8% of the victims received assistance from various sources. However, a high proportion of the victims (68. 5%) confirmed that there was no quick response from the government (Jinadu, 2012). Also, situation report from the 2012 emergency response indicated that some areas were difficult to access and the humanitarian situation in some remote camps was unclear (OCHA, 2012). The problem of poor accessibility is further demonstrated in the case of Patani town of Delta State where NEMA and State officials found it impossible to send relief materials to over 3, 000 flood victims in temporary camp in October, 2015 (Arisenigeria, 2015).

Mismanagement of the Ecological and Flood Relief and Rehabilitation Funds

Mismanagement of the ecological fund for addressing environmental problems has been a major challenge in Nigeria. In year 2012, the Senate Committee on Public Accounts uncovered an abuse of the fund to the tune of N154.9 billion (Odogwu, 2013). There were several cases of diversion of the ecological funds to non-environmental projects in many States. Also, there are many reports of gross mismanagement of the ₦17.6 billion released to the Presidential Committee on Flood Relief and Rehabilitation in the aftermath of the 2012 flooding disaster. The relief funds did not reach the targeted flood victims as the State Governments in Nigeria diverted the funds for various political purposes (Box 1). Also, the flood shelter projects initiated in many of the States in 2012 were abandoned soon after commencement. The findings of the Presidential Committee on Flood Relief and Rehabilitation in 2015 show that many of the buildings are below 20% completion rate while the building projects did not take off in many of the States.

Box 1: Case of Relief Fund Mismanagement in Kogi State, Nigeria

> Seven months after flood devastated some communities in Kogi State; most of the flood victims are still lamenting the neglect from the State Government in addressing their plight…… A visit round some of the affected communities scattered around the nine affected Local Government area showed the victims are still grappling to return to normal life. Pains, anguish, stress, anger are on their faces…… Like Government's poor attitude to management, the State government after sharing the monies to the nine local Governments failed to monitor the disbursement of the money to affected persons which gave the committee the free hands to usurp the money for their personal and some political purposes….. Flood victims in Gadumo, Ajaokuta LG and victims of Bassa in Bassa LG who received N3, 000 rejected the money which sparked off protest.
>
> Source: Obahopo Boluwaji (2013).

Low Institutional Capacity and Inadequate Coordination.

There is the challenge of low institutional capacity for disaster management in the country. As a federation, the NEMA Act 50 of 1999 established the National Emergency Management Agency (NEMA), State Emergency Management Agency (SEMA) and Local Emergency Management Committee (LEMC) for emergency management at the federal, state and the local levels respectively. These institutions, most especially the SEMAs and LEMCs, lack adequate capacity in terms of manpower, skills and equipment. As a result, little or no emergency management activities are happening at the state and local level, leaving the main business of emergency response to NEMA, which has limited operational capacity to cover the entire country. Some of the States have no functional SEMAs while LEMC have not been established in most States of Nigeria. Also, effective coordination of disaster management activities of line ministries and stakeholder agencies remain a problem as the National Platform for Disaster Risk Reduction established in Nigeria is not functional.

Non-Implementation of Disaster Management Plans

One major challenge of flood disaster management is the non-implementation of existing reports and plans. Today, the country parades numerous reports and disaster plan such as the National Disaster Response Plan (NDRP), Search and Rescue (SAR) & Epidemic Evacuation Plan, National Pandemic Response Plan, etc. Most of these plans are not being implemented. More importantly, the PDNA report of 2012, the National Disaster Recovery Strategy/Framework and 2012 Flood Recovery Action Plan, which provide comprehensive strategies and programmes for flood disaster preparedness, mitigation and recovery have not been implemented since 2012.

Poor Enforcement of Land use Regulation Laws.

The nature of physical development in many towns and cities in Nigeria bears testimony to weak urban planning and poor implementation of existing development control laws. Incidences of illegal development and river bank encroachments in many settlements increase the risk of urban flooding. The poor implementation of the land use planning and development control provisions of the Urban and Regional Planning Law of 1992 and inadequate drainage systems have made most settlements vulnerable to flooding disaster. The problems of political influence, inadequate funding and illegal planning approvals have combined to weaken effectiveness of urban planning institutions in Nigeria.

Conclusion and Recommendation

There is no doubt that flooding is a common disaster in all nations of the world and that Nigeria shares in the bitter experience of flood disaster. As discussed in this paper, the efforts of the Government in flood disaster management are overwhelmed with challenges that reduce the expected outcomes and make flooding a major source of future concern in Nigeria. The world has come to realize the there is no permanent, once and for all solutions to some natural disasters like flooding. However, it is also agreed that the impact of unavoidable disasters can be avoided or mitigated through effective management actions.

Therefore, Nigeria as a nation needs to needs to take actions to overcome the existing challenges in order to reduce the risk and the vulnerability of communities to flood disasters. In achieving this, the following recommendations are made.

There is the need for more effective decentralization of disaster management functions in Nigeria. The current six zonal offices and seven operational offices of NEMA should be increased for more national coverage and effective response. Also, the State Governments should as a matter of priority, empower the SEMAs through legal backing, funding, personnel recruitment and training, equipment procurement, etc., to make them functional. LEMCs should be mandatorily set up in all the 774 Local Governments Areas in Nigeria and be empowered to carry out disaster risk reduction activities at the local level. In addition to this, NEMA should establish inter-sectoral committees involving all stakeholders to assist in strategic areas of disaster management.

The decentralization of disaster management functions requires effective coordination in order to achieve the desired results. Therefore, NEMA should ensure proper coordination of the activities of the line ministries, departments and agencies (MDAs) who are involved in disaster operations and management. The

National Platform for Disaster Risk Reduction should be made functional for effective coordination of disaster management activities in Nigeria.

The country should embark on capacity building and massive investment in flood control infrastructure and equipment (flood drainages, shelters, and rescue infrastructure). Adequate manpower training is required to build the capacity of the emergency management agencies in Nigeria. Although the Government has taken a good initiative by establishing six Centre of Disaster Management and Development Studies in six Universities in Nigeria, the training efforts of the Centres should be complemented with regular specialized practical trainings in search and rescue, relief operations, camp and victim management.

The Nigerian Government needs to invest more on flood management infrastructure. The flood shelter programmes initiated in the affected States should be completed. The federal Government should provide more funds for the flood shelter project in order to provide alternative accommodation for communities living in flood prone areas. The Presidential Monitoring Committee of project should be re-constituted into a task force for proper monitoring and to ensure the completion the projects in all States. Also, provision of more standard flood water drainages in cities, search and rescue and transportation equipment are required for effective mitigation and response.

The National Emergency Management Agency and the Nigeria Meteorological Agency need to step up and sustain the current level of flood early warning services to the nation. Early warning information not well disseminated or not heeded is useless. More efforts should be directed to ensuring wider dissemination, use and compliance with early warnings by communities at risk. Above all, the early warning services should culminate into massive community sensitization and persuasion (through incentives), with a view to eventually relocating vulnerable communities to safer areas.

A better and more sustainable approach to effective flood disaster management in Nigeria lies in the implementation of the existing reports and disaster management plans. The PDNA report, the National Disaster Recovery Strategy/Framework and the 2012 Flood Recovery Action Plan contain well thought-out and useful strategies for managing flood disasters in Nigeria. The Government should show commitment and good political will to implement the provisions of the documents. If this is done, Nigeria will certainly be on the path of effective flood disaster management, which will mitigate the impact of unavoidable flooding and build community resilience.

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RAPID ASSESSMENT AND TRAINING OF RESILIENT COMMUNITIES TO FLOODS IN KARARI AND EASTERN NILE LOCALITIES OF KHARTOUM STATE, SUDAN

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Background and Justifications

Khartoum state was reported to have witnessed heavy rains & floods during 2013 autumn where Eastern Nile & Karari localities were heavily impacted with resultant loss of lives , human injuries & thousands of mud houses were totally or partially swept by heavy unexpected down pouring & sweeping strong flow of water from the high lands on both localities.

At karari locality; the people mostly hit were vulnerable displaced poor, they built their mud houses hurriedly with limited resources which couldn't resist the amount of water they were engulfed in.

While the affected area of the Eastern Nile locality, was more or less impacted by Soba valley; known as a route for the Butana high lands water to the Blue Nile. The area was inhabited informally as a squatter area which was later regularized by the authorities under social and political pressure. The relatively long drought gave the authorities and the population a false feeling of security from the floods hazard, this was augmented with lack of institutional memory .Not enough drains & water passages were made across the relatively high constructed road extending parallel to the affected area & beyond, constituting a high embankment for the formed flood lake, where boats were the only means of accessibility for rescue, this resulted in human losses and heavy material damages including some concrete buildings.

There has been loss of livestock, and small businesses have been closed in these areas. The socio-economic impact for these already vulnerable populations has been devastating. The high number of affected houses and public facilities in Khartoum as reported by the Humanitarian Aid Commission (HAC) in their report from 28th of August of 2013 as shown below reflects the need to promote and disseminate a more sustainable urban development and resilient to floods building construction materials and practices in order to break the annual cycle of emergency.

N. of affected household	Peoples		Houses Destroyed		Schools	Affected Service Utilities			
	Deaths	Injuries	Totally Destroyed	Partially Destroyed		Home latrines	Public Latrines	Health Centers	Water Stations
25,676	31	44	15,089	12,965	222	17,048	80	20	18

The above facts necessitated the intervention of the UN- HABITAT as a mandated UN agency to support the community of the two localities and Khartoum state through a project titled " 'Emergency Flood Response in Khartoum for Vulnerable Communities" funded by the Government of Japan and in collaboration with the United Nations Office for Projects Services (UNOPS). The overall goal is to strengthen the capacities of the intervention related to government and communities to enable them to conduct emergency construction of public facilities and necessary infrastructure through adaptation and implementation of resilient to floods urban planning and building techniques. For this purpose, there is a need to support the Ministry of Planning and Urban Development (MPUD) and Local Governments to provide technical solutions to manage resilient to floods urban settlements, basic services and infrastructure reconstruction and drainage systems.

In terms of the quarter of century academic and field applied experience; the Institute of Disaster Management and Refugee Studies (DIMARSI) of the International University of Africa (I.U.A) presented itself to the UN HABITAT and was envisaged and valued by UN HABITAT Sudan as able local academic institution. Jointly agreed TOR reached, based on which an agreement with UNHABITAT was signed shouldering DIMARSI the responsibility of a consultancy to perform Rapid Assessment and Training of Resilient Communities to floods in Karari and Eastern Nile localities of Khartoum state. Salient features of the said agreement were translated in the following:-

General Objective

To draw effective, acceptable and affordable interventions to build capacity for a flood resilient community through rapid assessment, training communities and local authorities.

Specific Objectives:

- Identify the gaps of human and institutional capacities at locality and community levels in regard to disaster management
- Recommend the flood resilient strategies, approaches and tools that can be applied to track incidents and manage actions
- Improve the technical and operational capacities at the state, locality and community levels to better plan and manage resilient to floods urban settlements including early warning system.

Tasks

DIMARSI formed the core team for the rapid assessment for the areas affected by floods in Khartoum state in 2013, namely, Eastern Nile and Karari localities. UN-Habitat recruited specialized individuals in the fields of Urban Planning, GIS/survey Engineering and Hydrology, who undertook tasks in their respective fields of specialization as part of the team in this project.

The specific tasks of this consultancy were:-

- Desk review including the previous assessments
- Organize and lead participatory rapid assessment exercise for the two localities in collaboration with the project team already recruited by UN HABITAT (GIS survey Eng., Urban planner, Hydrologist and Community mobilizes)
    - Assess the technical, managerial and operational capacities related to floods response and management at different levels in the two localities
    - Assess existing practices, indigenous knowledge, and early warning system and communication strategies if any and recommend appropriate mechanisms
    - Design training modules of resilient communities to flood based on assessment results and capacity gaps identified
    - Conduct training based on training modules developed
    - Elaborate on the Rapid Assessment to Flood Vulnerable location maps and report
    - Produce risks maps for the two areas based on the rapid assessments and GIS information

Deliverables

- Rapid assessment report on the two localities

- Training modules (training to be delivered on flood resilience to target beneficiaries at locality and community levels in the two locations)

- Risk map developed showing vulnerable and risky areas based on the rapid assessment results with recommended solutions
- Standard operation procedure on how to respond to flood, building on best practices and indigenous knowledge at community level, and identify roles and responsibilities of different stake holders during crises and draw tools for flood resilience

Methodology

DIMARSI assigned a specialized team for the consultancy project implementation according to the TOR agreed upon. In order to catch the rapid nature of the assessment and the short period of time ahead; two separate sub teams of faculty staff members and other specialized part time staff made responsible for the assessment and training for either locality based on the institute previous exposure and field work in each community, focus group discussion based on prepared check list, and other recognized reliable rapid assessment tools adopted to identify the gaps and indigenous experiences, both teams performed the same tasks in parallel to each other, within the same time frame using the same tools. Minor differences between the two communities considered on the module's development & applied training, as these; were realized in reference to the previous DIMASI field studies in both localities. Local community role was central in participation in assessment. All stake holders participated. Gender sensitivity highly observed.

Assessment tools developed, qualitative data collected, analysis, monitoring & final reports formulations compiled by a central team where both sub teams were represented.

The advice of an epidemiologist and public health expert from the faculty was sought as an additional health assessment tool.

Trained master degree students recruited and oriented on the subject study, including among others general idea on field work, the nature of the work, the contents of data collection tools, how to review the data reports, how to extract data from different sources as well as some practical exercise trained for data collection under supervision of locality team leaders.

Part time GIS specialist was incorporated to procure base, contour maps and develop different layers maps in collaboration with DIMARSI team as per expected deliverables.

The training was based on pre, intra and post floods activities.

Each Local authority made responsible for selecting 50 eligible community representatives and locality staff candidates according to the specified and agreed criteria.

Major resilient community training areas tuned according to the assessment findings, covered the following:-

- Pre floods needed capacities
- Intra floods activities
- Post flood activities

Project Activities

On the Desk Review

DIMARSI was acquainted with both localities calamities during 2013 floods; The applied nature of the institute deemed necessary participation in field relief ,helping people ,training students and undergoing field research, yet the involvement in this project; reinforced the institute wealth of knowledge by further access to more than 60 local and international flood related experiences. These experiences were studied, digested and reproduced in the form of guide lines embodying best practices and experiences to fit all the project activities shown below, in the form of ways and means of rapid assessment, contents and methods of delivering communities resilient to floods training modules relevant to both localities needs, capacity gaps as stated in the agreement with UNHABITAT.

Logistics and Project Implementation Structure

DIMARSI deployed its entire faculty to achieve best results of this exercise. Based on specialty and experiences; four teams were formed according to the following:-

- literature review team undertook on the desk academic review .Some of the local references were inaccessible and had to be fetched from the relevant institutions .References were diversified covering floods impact on affected communities, assessment tools ,best mitigation . Prevention practices and post flood plain benefits.
- Assessment team made of three sub groups; i) assessment tools design and data collectors training group, who were entrusted to share with the literature review team and advice the most suitable tools that fits the situation and agreement terms .They could successfully pick the focus group discussion (FGD) and meeting key local authority and community informants in addition to observation as best tools meeting the rapid nature and fulfilling participatory approach. They prepared and conducted a two days training for the data collectors. Training was equally attended by the locality assessment team leaders. They also held a brain storming exercise to develop a check list for the FGD, identify thematic groups and selection criteria which were minimum basic education; key informants were exempted from this condition. All the assessment team members including the data collectors participated. The urban planning engineer and the hydrologist members of the UN HABITAT technical support team equally attended. ii) Locality assessment team leaders, assigned to two energetic faculty members each responsible for a locality to liaise with the local authorities and community for a convenient assessment and training venues, accessible, satisfying training and meeting needs. They were to oversee the conduction of the assessment FGD, proper data collection, iii) data collectors group were selected to meet the gender sensitive composition of the thematic groups; with emphasis on their good communication, data analysis and report generation skills .Four were assigned to each locality.
- GIS team made of two faculty member specialists, supported by the UNHABITAT technical support team; they were to identify geographical particulars of affected areas, generate risk reports and map it.
- Training team, almost all the faculty members participated in the training modules design guided by the literature review findings further improved by the assessment reports pointing gaps and needs. Two non DIMARSI experts, the urban planner and the hydrologist of the UN HABITAT technical support team were included in the training team. A senior colleague
- shouldered the training coordination in both localities; he prepared a three days unified training time table for both localities with one day gap to ensure uniformity of subject delivery by the same trainers to both localities. The coordinator worked out a check list for training venue criteria and handed it to the assessment team leaders to check in the field, it was reasonably adhered to.

Deliverable 1

Rapid Assessment Application and Findings

Numbers of methods have been used, utilizing both primary and secondary sources, whether qualitative or quantitative. Primary data was generated from focus group discussions, interviews with key informants and administrators, direct observation, and official reports. Secondary data was collected from articles, books, and reports relevant to the issues discussed in this paper.

The focus group method was employed by requesting local administrators and community leaders in both localities of Karari and Eastern Nile to name about 18 persons per group for six groups representing the main stakeholders in each locality. They were told to ensure that each group was to be constituted of males and females of varied ages. The six groups to represent the stakeholders were as follows; women, youth, teachers and parents' councils, popular committees, administrators and engineers, farmers, and small producers (in Eastern Nile) and craftsmen and casual labor (in Karari). The reason for the difference in the last group between Karari and Eastern Nile is because the mode of livelihood is not the same in the two- the first being agro-pastoral.

During the focus group discussions checklists were administered by trained graduate students under the supervision of a team leader. The questions contained in checklists cover areas of ownership of land, important and effective social groups in pre-, during and post- disaster stages, as well as methods of communication, types of material and immaterial damages, preparation for the disaster, handling of the crisis situation, rehabilitation of the damaged buildings and services, and finally, the participants' views and proposals of how to benefit from their crisis experience for future disasters.

The checklists of administrators and engineers were meant to generate technical responses and views regarding the above mentioned issues. While the checklists addressed to the small producers and craftsmen and casual labors were intended to give a general picture of how the two communities can depend on their own resources to sustain their livelihood after the disaster

Karari Locality

Geographical and Social Considerations

Alfateh area (the affected area in Karari locality) lies in the northwestern part of Khartoum State. The area is predisposed to rainfall disasters. It is a densely populated area whose inhabitants are of mixed tribal origin, the majority of them are low-income groups, who were originally internally displaced persons (IDPs) in Khartoum prior to their transfer to the present location. The causes of their original displacement vary between drought, wars, and desertification.

Eastern Nile locality

Geographical and Social Considerations

Sharg Al Neel (The affected area in Eastern Nile Locality) is located in the northeastern part of the Khartoum State. The locality is characterized by the presence of a hill in the center of the area resulted in divide water line which distributes the water in two directions, east and west. This made most of the locality located in valleys and watercourses, consequently vulnerable to floods.

The majority of the buildings were made of mud which made the locality susceptible to destruction by the 2013 floods. The low level areas were more impacted. Moreover, the elimination of vegetation for urban expansion had increased the exposure to the floods.

The original inhabitants of the Locality are of related tribal kinship but being close to Khartoum with chances for manual work attracted many others. The locality is characterized by a unique social tissue, this homogeneity made them help each other during disasters.

Findings of the Focus Groups Discussion

The following summarizes the views generated from focus groups discussion with representatives of Karari and East Nile residents regarding their living conditions and the impact of 2013 floods disaster on their livelihood:

All Alfateh people owned their land plots through the government's residential plan after the government moved them from non planned places in the last few years without well planning and infra structures to new site. Almost all houses built with adobe (mud materials), while building materials in Sharg Al Neel were; traditional mud-blocks, red-breaks and concrete cement. Almost all Alfath area used pit-hole latrine compared to 80% in Sharg Al Neel used the same.

In both Alfateh and Sharg Alneel the neighborhood, popular committees played important role pre, intra, and post disaster, while local authorities and NGOs, their role appeared during and after the disaster.

The existing infra structures in Alfateh not been affected much (schools, health centers, mosques), but as we know there were neither electricity nor piped drinking water even before the disaster. In Sharg Al Neel the entire groups agreed that all the infra-structures were affected during the disaster. The asphalt roads were purposely broken in a number of sites to drain the accumulated flood water. The drinking water supply system was severely affected due to mixture with flood water and sanitation drainage system.

All the respondents in Alfateh groups established that despite the presence of the watercourses and rainwater drainage system, they were nevertheless ineffective due, in their opinion, to bad execution. Compare to Sharg Al Neel the ineffectiveness due to; residents threw waste and garbage materials in them and to bad execution.

In Alfateh, most of the respondents mentioned that the reasons behind the causes of damages that the houses were built in the middle of historically known runoff watercourses while in Sharg Al Neel put first that the level of streets was higher than that of the houses.

Livelihood; the dominant type of works in Alfateh area was self-employment and casual labor, while in Sharg Al Neel was governmental employment and small businesses, followed by farming and animal breeding.
70% of group members in Alfateh had no previous experiences with the floods compared to 100% in Sharg Al Neel had experiences.

All the focus groups in both Alfateh and Sharg Al Neel stressed that communication in the pre/ during disaster period was through different means of mass media (radio, and TV) and few through modern means of communication such as cell phones. One to one communication prevailed. As for the post-disaster period in Alfateh, mass media ranked highest with 90%; verbal communication70%; and modern means of communication30%, while in Sharg Al Neel, the verbal communication door to door was the commonest followed by modern means and mosques.

Pre disaster preparedness in both Alfateh and Sharg Al Neel groups, it was clear that the majority were not prepared for facing the coming disaster. Regarding prior ideas of how to confront the disaster, some individuals in Sharg Al Neel related that they thought of doing fill ups in front of their houses, open the watercourses, while in Alfateh, they thought of seeking refuge in higher places, moving to other areas, using tents as an alternative, evacuating their rooms, and doing fill ups.

The majority of the groups in Alfateh maintained that most of the needs and equipment used in mitigating the negative effects of the disaster were supplied by voluntary organizations, followed by local groups and governmental bodies, while in Sharg Al Neel, governmental authorities came first then voluntary organizations, followed by the local groups.

All the groups admitted that dealing with vulnerable groups including those with special needs was carried out reasonably; and they were rescued to safe places. For the small businesses group in Alfateh, total damage was 53.3% and the partial damage 35% ; while in Sharg Al Neel, total damage was 12.5% and the partial damage 87.5%.

Causes of aggravating the disaster effects: in Alfateh both engineers and administrators agreed that the reason behind aggravating the disaster lay in: technical and engineering mistakes at 70%, non-anticipating the looming crisis (58%), lack of support of governmental bodies, citizens, and NGOs, plus unpreparedness (46%), while in Sharg Al Neel; lack of coordination between the governmental bodies and others followed by lack of preparedness then technical and engineering mistakes.

Some Notes on the Focus Groups Discussion FGD

- There was a problem of transparency with regard to the relationships between the community members and government officials. This could be explained by the fact that most of the representatives of the community organizations more or less their selection have been influenced by government local authorities. As a result of that some important points might have not been brought up or discussed in depth.
- It is apparent that communal cohesion supersedes all other forms of collectivity. There for we can propose here that future programs can be design and build on the formal fact to empower the local communities and maximize their benefits.
- It worth noting that introduction of the compressed mud blocks by UNHABITAT is perceived as one of the important preventive measure pointed by all the participants in Alfateh locality.
- The assessment revealed that UN agencies and other bodies are advised to emphasize the preventive measures further rather than focusing on maintenance and rehabilitation.
- Bridges construction, drainage systems and mapping area contours and risk maps are highly weighed preventive measure for both localities.
- Coordination between different governmental levels, especially with federal level seems to be rather weak and need to be more strengthened.

Deliverable 2

Training of Resilient Communities to Floods in Karari and Eastern Nile Localities of Khartoum State

DIMARSI team in collaboration with other non DIMARSI experts successfully designed and completed training of trainers for a selected group of Karari & Eastern Nile localities communities in flood resilience carried in simultaneous parallel two stages composed of introductory theory and an applied practical interactive second stage for both localities.

To achieve the designated objectives of the project; the following was performed by DIMARSI assigned team:

Training Tasks

- Design theoretical training modules for resilient communities to flood, based on assessment results, capacity gaps identified and past knowledge and experience of DIMARSI, acquired during 2013 flood impacts on the two specified localities.
- Conduct interactive training through lectures group assignments and discussions. Simulation, problem solving was used for applied training.
- Cultural and societal differences pointed by the FGD observed during training.
- A final trainees evaluation for the different aspects of the course including venue convenience, catering, training contents and staff competence was carried.

Theoretical Introductory Course

As planned & agreed with the relevant local government authorities and Public Committees a group of 50 trainees were targeted in each locality based on the criteria developed by DIMARSI. There was over attendance at Eastern Nile locality compared to the Alfateh locality. The training program started immediately after the rapid assessment exercise was completed, following a time table of three consecutive days each day assigned a specific theme to be covered in 5 lectures; 1.5 hours each. One day gap was observed between the two localities. Training started ahead at AlFateh locality to enable the same group of lecturers to deliver the same theme of training following the same time table at Eastern Nile locality the next morning and so forth as a measure to maintain uniformity of the training program at both localities. The themes addressed the three phases of flood disaster as follows:

- **Pre Floods Needed Capacities**
  - Weaknesses, strengths and indigenous experiences identification.
  - Early warning means and application at local level.
  - Voluntary work as a value and practice
  - Planning and early preparedness
  - Community role in water drainage, preparedness and maintenance
  - Community role in physical planning and land use

- **Intra Floods Activities**
  - Rapid assessment during the flood (Identifying victims, assessing damage and needs)
  - Communications skills and means at local level. (Channels of communication and dissemination)
  - Community mobilization, liaison and organization
  - Relief management,
  - Status of lifelines (evacuation/access roads, electricity grid, communication, water and food supply), hospitals and shelters
  - Care for vulnerable groups
  - Coordination and Team work
  - Psychological first aid- Human and Social security
  - Environmental health, Disposal of human excreta, solid waste & corpses.

- **Post Flood Activities**
  - Community participation in flood loss assessment (impact on business and services)
  - Rehabilitation and Recovery
  - International and local flood resilient best practices (Disaster to development)
  - Flood plain benefits

Applied Training

Problem solving approach modules were developed by DIMARSI to address community response to flood hazards. Each module is a set of questions related to a practical problem targeting a specific phase of flood intervention .Each team leader acted as a facilitator for the training supported by the lecturer who delivered the relevant theoretical lecture.

A Scenario of an X village with high flood vulnerability in terms of location and limited infra structure capabilities to face the disaster impact, but known to have good community cohesiveness; is placed simulating pre – intra- and post flood activities in form of community and authorities responses to the different situations posed by the questions.

Trainees were divided into 3 to 4 groups, each was assigned one intervention, to review, discuss and reach joint solutions and set of practices to be implemented. Each group is to deliver a presentation of their findings, open for discussion by the plenary. Recommendations and advices noted and edited.

Pre Flood Phase

Questions for the pre- flood phase included:

- How to make use of the voluntary work values, traditions and concepts of the Sudanese communities culture of disaster mitigation?
- List and document strengths, weaknesses and subsequently recommend solutions and remedial measures to attain success in disaster management.
- Show the role of the community in planning their village pre flood.
- How to make use of the Early Warning Systems and their application, modern or traditional ones, during the preparedness phase?

Intra Flood Phase

Questions for the intra - flood phase included:

- How to assess the needs with respect to, search and rescue operations, Evacuation, shelter, feeding, serving vulnerable groups… etc?
- How to make a vision of effective communication, coordination with the officials and NGO's…etc.?
- How to prepare a future plan for relief operations, mainly, food deliveries, medical needs, clean water, shelter and housing needs …etc?
- How to solve problems related to physical planning mistakes:
  - Water Drainage
  - Bridges and canals.

Post Flood Phase

Questions for the post- flood phase included:

- How to deal with the psychological trauma resulting from the disaster shock?
- List and document best practices for future expected floods and ways for sustainability?
- How to institute risk reduction modalities to shape the disaster mitigation into a developmental act?
- How to build resilience; making use of the scarce resources to meet the basic needs? And experience to prevent dependency.

Applied Training Evaluation

The applied program was a good opportunity for local communities to understand the complexities of flood- disasters interventions, and discover their need for joint action, during planning and response to flood nightmares; resulting in disaster risk reduction

Participants from both localities were highly motivated and actively participated in the discussions and expressed their appreciation for the knowledge and experience they gained. The trainees full responses to the evaluation document distributed to them were analyzed and report generated a number of recommendations.

Deliverable 3

GIS - Risk identification and Mapping

The demarcation of the disaster-prone areas has been based on the information contained in the rapid assessment reports of the targeted areas and the executive officials' reports of the different administrative units of the two localities. Moreover, field survey taking waypoints (GPS points) had been carried out to determine the coordinates of vulnerable areas.

Comparing the information gathered in the rapid assessment reports with the information obtained from the executive officials and the field work, it is evident that there is a good conformity between most of them.

Risk areas have been classified according to the following:

Location

Most of the areas in Eastern Nile Locality are located in low level areas and within valleys (watercourses). The areas that were exposed to the floods in 2013 were affected by the valley which comes from Albutana area and divided into two branches; Soba Valley and the other is Sayyal Alhawwab Valley. The extent of the damage varied according to the proximity of the area to the valley.

Most villages of the locality were located inside low level areas and the asphalt road level was higher than the surrounding areas, consequently the flood water course was blocked which led to a great damage of most of the buildings. Also, the presence of Al-Silait irrigation Canal near to some villages had increased the degree of exposure to risk.

Alfath area is not very low but its elevation varies between its different blocks. Alfath 1 and 2 are relatively higher than Alfath 3 and 4. It was noted that the damage which occurred in Alfath 1, was because it was surrounded by two asphalt roads with higher level than houses.

The Volume of Rain Waters

Eastern Nile Locality had been affected by the rains that were concomitant with the flash floods but there were some areas which were more affected than others due to a number of factors other than rains; such as type of building materials, inefficient drainage systems, unplanned settlements and low level areas. Some of these areas were inundated by water that came from the nearby neighborhoods, and because these areas were low and surrounded by the asphalt road from all directions, a number of buildings had collapsed.

All Alftah area had been seriously affected with flash floods which came from western side and Almarkhiyyat Mountains rather than by the rains.

Drainage Systems and their Efficiency

Eastern Nile Locality suffers from the lack of effective drainage systems and the existing ones are either small streams which can't drain all the water or large but are no longer effective due to the accumulation of refuse and litter. Moreover, these drainage systems had not been maintained before the rainy season, and with the absence of culverts the residents were forced to make openings in the asphalt roads to discharge the water. Indeed drainage systems represent a real problem for Eastern Nile Locality.

The factors which had mostly contributed to the damage in Alfath area were drainage systems, which were either no longer functioning or were not routinely maintained or in effective due to limited capacity.

Treatments and Recommended Solutions

- Because the Eastern Nile Locality suffers from a serious problem in the discharge of rain waters, some culverts with large capacities and bridges have been made in different areas.
- Evacuation of buildings blocking the watercourses was suggested.
- Rehabilitation of the drainage systems.
- Embankment to protect some areas from the flash floods.
- Cleaning the drainage system from mud and debris before rainy season**.**
- Construction of buildings inside watercourses should strictly be forbidden.

Deliverable 4

Standard Operational Procedures

Based on the project design, assessment feedback and training implementation; steps followed to realize the project goals reinforced by the evaluators critique were noted, chronologically arranged and compiled in form of specific actions proved effective to deliver the project goods to form standard operational procedures.

Identified Gaps and Challenges

- **Rapid assessment**
  - Getting the cooperation and necessary permission of the concerned authorities.
  - Logistics and communication obstacles.
  - Difficulty of accessing the needed information.
  - Selection of focus groups was primarily done by local authorities and popular committees In spite of
  - DIMARSI criteria.
  - Unclear division of roles between the community and the Locality Authorities.

- **Training Flood resilient communities**
  - Number of people to be trained in the two localities was not as targeted. In Alfateh area numbers were below the target, while in Eastern Nile the number by far exceeded the target.
  - Recommendations by the FGD as how to benefit from the floods plains was weak and lacking orientation almost identical at both localities as both were not exposed to such an experience before.The issue was first introduced in the training course as international experience later.

- **GIS risk identification and mapping**
    - Inaccessibility to GIS professional base maps due to very high cost and lack of cooperation of those who own.
    - Lack of high resolution data which led to utilize open sources data such as; Google Earth images.

Lessons learned

- The traditional experience of reinventing the wheel repeating the same responses to the same disaster every time ,mourning losses and reinstituting the same pre flood targeted infra structure, implies that both communities , local and central authorities share lack of vision of long term benefits of post flood plains. This constitutes an important food for thought for planners and community educators.
- Factors that led to the high degree of risk were; geographical location and topography (land level), quality of buildings, rain water quantity, efficiency of drainage systems and type of ownership (land tenure).
- By comparing the two localities it has been realized that most of the Eastern Nile Locality is a low area and the majority of settlements are located within watercourses. Settlers didn't abide by the law regulating villages physical planning whereas; Alfateh is planned and relatively elevated.
- One of the most important strengths of both communities was the volunteering value of local community through their effective role as first line rescue and relief providers they have a good potential if well organized.
- Evidence based disparity between communities income shaped their response to the disaster i.e. poor type of building materials increased the damages at Alfateh, while Eastern Nile Locality with relatively better standards of living suffered less damages apart from the poor pockets within.
- There is a dire need for training and follow up of proper documentation of health records for future planning Sphere guide lines are advised for conformity and comparison with international figures.
- Climate change and long periods of drought encouraged living under the risk of flood and relaxed communities preparations for protection and prevention.
- Squatters who live in flood prone areas share the responsibility not weighing the hazards of traditional water courses.
- Preparations made by local governments to mitigate flood risks in rural areas usually start late in the rainy season, and complicate intervention at the time of flooding.
- Limited livelihood strategies tend to reduce community resistance and delay recovery.
- In spite of the high social connectedness; local and indigenous knowledge only can't mitigate flood disasters. There is genuine need among rural communities for more training and capacity building.
- Communities at both localities appreciate the initiative of both DIMARSI and UN HABITAT Office to arrange and conduct the training program.
- Local governments' capacities are limited and need to be enhanced to develop stand by systems to mitigate flood disasters.

Recommendations

Buildings Material

- Firmly execute laws prohibiting building in watercourses
- Compensate and demolish buildings that block the watercourse.
- Use affordable strong and durable locally accepted building materials.

GIS and Urban Planning

- Adopt the Remote sensing (RS) and Geographic Information System (GIS) techniques in urban planning.
- Use the GIS as effective tool to determine the most suitable location for new constructions (suitability modeling).
- Identify and map risky sites for both localities and share with the community.
- Thorough re-planning of the affected areas.
- Re assessment of the valleys, water courses and rain water drainage systems according to present estimates and future projected volume of rain water and flash floods.
- Involve local community in the planning process to ensure joint owner ship and commitment.

Locality Authorities and Community

- Develop strategies, action plans and allocate necessary funds towards disaster risk reduction in order to save lives and avoid damage of properties including houses and public utilities caused by recurrent floods.
- Issue and ensure strict adherence to land use laws embodying prohibition of building in valleys and watercourses.
- Design and execute constructing bridges and crossings on high level roads based on water courses and the level of the roads.
- Strengthen the community participation
- Early preparedness and readiness by:-
    - Rehabilitate, Clean, maintain and expand bridges, crossings, drainage network capacity in size and numbers.
    - Securing strategic stock of food, shelter , medicines, boats, manual water drainage tools, generators and stand by earth moving heavy equipments, before the rainy season
    - Organize local community bodies and net works
    - Sensitize civil society and charity organizations (Zakat fund)
    - Rehabilitate and ensure alternative evacuation centers e.g. schools
    - Institute community awareness campaigns. Activate local early warning systems, Mosques, community radios are advised and advocate voluntary work.
    - Raise the level of health institution preparedness; material needs and staff.
    - Refresher training for concerned stake holders and activists groups.
    - Update and develop effective methods of early warning.
    - Ensure effective coordination between the community and the governmental authorities.

Dimarsi

- Conduct annual refresher workshops, before the rainy season, to raise awareness, disseminate information, coordinate with stakeholders, and mobilize and organize community participation and contribution towards disaster prevention and preparedness
- Establish a network for the TOTs. Follow and supervise TOTs to conduct community training workshops in the residential areas.
- Trainees to undertake patrols in the two Localities to pin-point potential risk generating incidents.
- Closely work with the two Localities towards the implementation of the recommendations of the rapid assessment and training workshops.
- Distribute paper copies of the training handouts.

General

- Invest on the lines of Disaster risk reduction as a development tool through
    - Strategize building a culture of re inventing disasters into development processes targeting both the community and the authorities
    - Introduce Disaster management and voluntary work as extracurricular activities at schools.
    - Take the advantage of flash flood in water harvesting projects for vegetables and fruits orchards irrigation and dispersing seeds for a green belt, grazing land and initiating community forests.

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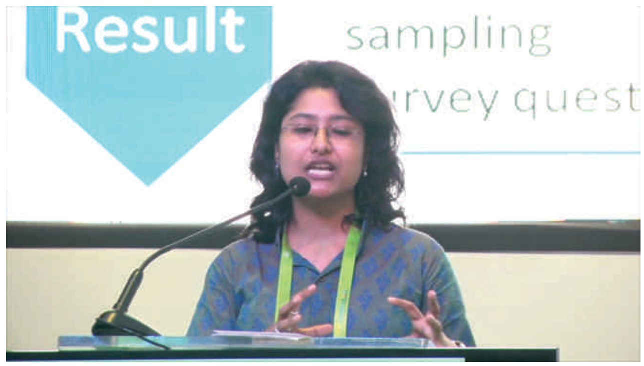

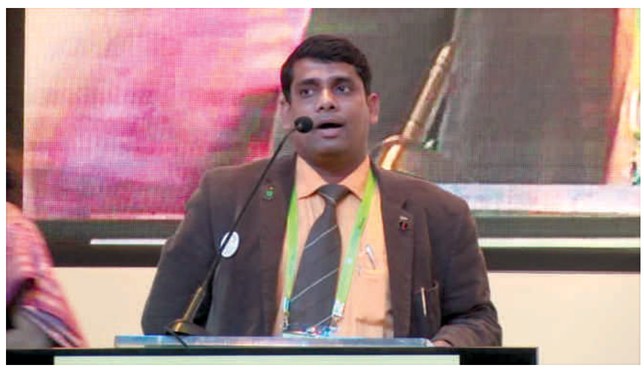

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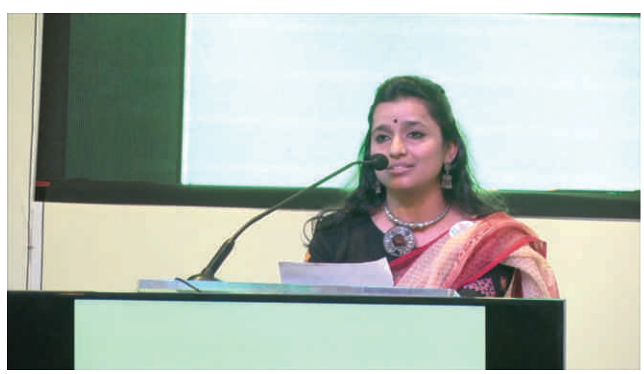

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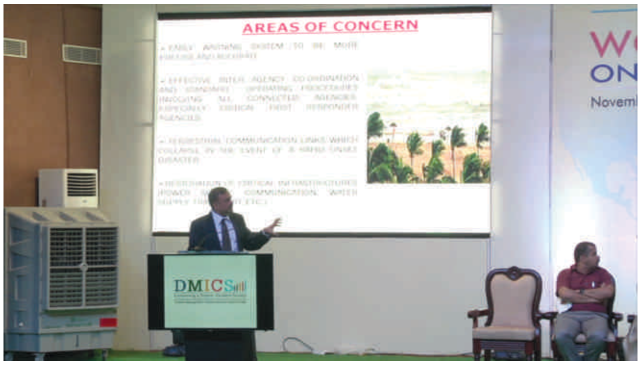

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SEPTEMBER 2014 FLOODS IN JAMMU & KASHMIR: THE WAY FORWARD TO BUILD A SUSTAINABLE & FLOOD RESILIENT JAMMU & KASHMIR

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Abstract

Natural phenomena like floods become disasters because of lack of awareness on how to construct affordable disaster resistant houses by using viable technologies. It has been observed that this ignorance results in the violation of the basic rules of good construction and hazard resistant technology leading to deaths, injury and unwarranted hardship to the people along with huge losses in terms of houses and infrastructure. The recent floods in Jammu & Kashmir have been an eye-opener to all the stakeholders such as designers, developers, engineers, government and the public where in the need to plan, design and build our infrastructure following not only the earthquake resistant guidelines but also the flood resistant housing guidelines has been greatly reinstated and deliberated and effectively proved owing to the colossal damages, death & destruction caused by September 2014 floods. This paper provides useful Information on the performance of various types of building materials when subject to flood conditions (i.e. water immersion), the performance of different types of residential building construction subject to flooding, likely physical damage, use of more appropriate materials and designs for house construction to reduce damage, and post-flood reinstatement of dwellings. Further, preliminary guidelines for repair, restoration, retrofitting & rebuilding of building structures in flood affected areas of Jammu & Kashmir have also been proposed based on the actual field survey of the flood affected areas, exhaustive literature survey, current available research and global documents written for the same purpose. It is hoped that this work if implemented properly will help in mitigating the devastating losses, both life & property and help in reducing the hardships of people of Jammu & Kashmir struck by September-2014 flood in particular and to all those who may be struck by a flood in general and that it becomes an important tool in making Jammu & Kashmir less vulnerable to disasters like floods.

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IDENTIFICATION AND PREDICTION OF EXTREME RAINFALL EVENTS OVER INDIA DURING THE MONSOON OF 2014.

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Abstract

Extreme rainfall events are likely to be causation for flash floods, crop damage, landslides etc that may be leading to loss of life and damage to property. Some studies indicated an increase in the frequency of these extreme events in recent years attributed to global warming. In this study, Rank method has been used to identify the extreme rainfall events based on the percentiles as thresholds of rainfall amounts based on the past observations. An extreme event in rainfall is considered to have occurred, if the rainfall amount is more than the threshold, at a grid point. In 2014, four extreme rainfall events were reported that have caused enormous damage; and they are (i) heavy rainfall of >16cm on 23 July over Madhya Pradesh; (ii) Orissa heavy rainfall event with more than 20 cm on 5 August 2014; (iii) heavy rainfall of ~18cm on 6 September 2014 over Jammu and Kashmir, and (iv) rainfall of ~13cm on 9 September 2014. These rainfall events will be analysed for understanding the associated meteorological factors and to assess the predictability using a high resolution mesospheric atmospheric model.

Weather Research and Forecasting (WRF) Model, designed to have nested domains and with 1 km innermost domain covering the study region, is used to simulate these heavy rainfall events. WRF model driven by global model inputs for the initial and lateral boundary conditions is integrated for 72 hours continuously. Model predictions at day1, day2 and day3 for these events are assessed with different model skill parameters. The results show good predictability of these heavy rainfall events with high skill scores. This study emphasizes the uses of high resolution models to predict heavy rainfall at different lead times, especially with 24-hour lead time that may help disaster management.

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GENDER

- Gendering Disasters: Rethinking disasters using a feminist lens - *Dr. Shubhda Arora & Dr. Santosh Kumar*
- Genderscope: defying societal rules for him and her - *Eilia Jafar*
- Gendered vulnerabilities in times of disaster: Case of Bangladesh -*Dr. Shahnaz Huda*
- Women and Disaster - *Priyaanka Jha*
- Roles of Women and Disaster Planning in Rural Mindanao, Philippines - *Mr. Mervin Gascon*

GENDERING DISASTERS RETHINKING DISASTERS USING A FEMINIST LENS

Dr. Shubhda Arora & Dr. Santosh Kumar

Abstract

The gendered overtones have long been absent from the traditional mainstream disaster research. With the social vulnerability paradigm gaining importance, a lot of interest has been generated in examining how the same disaster affects men and women differently. The dominant discourse is that of disaster management; which is believed to be an exclusive domain of the practitioners. The practioners and field workers who are majorly involved in disaster operations, rescue and relief are the army and the paramilitary forces which are also male dominated organizations. The management discourse offers a reductionist understanding of disasters and tends to restrict it to a rather linear and simplistic 5R model (Readiness, Rescue, Relief, Reconstruction and rehabilitation). Such a conceptualizing invizibilizes the different complex layers of caste, religion, gender, class and is based on the presumption that disasters affect everyone equally.

Major works in disaster have been devoid of critical feminist frameworks and questions have not been raised on the dominant power structures that exist in society. The framework does not restrict itself to the men and women alone but the different experiences of disasters that the other gender categories of LGBTQIA have. The need to include and privilege individual experiences of disasters and be gender sensitive is where disaster research should be headed.

Being a 50 year old tradition, disaster research is a relatively young and an evolving discipline. It provides an interstitial space where infusion of feminist ideology is imperative for meeting the challenges that disasters offer. The traditional roles of caregiver and the home-maker that women are conditioned to assume get ossified and patriarchal authority gets reified during disasters. This makes women and the 5 other gender categories more vulnerable and in need for special care and protection. Disasters tend to accentuate the vulnerability for the already vulnerable groups. On the contrary, research in this field of inquiry also suggests that women tend to shun their inhibitions and challenge prevalent norms to assume a more prominent role in the public sphere in times of disasters. Documented works of women forming coalitions and self-help groups are a case in point.

Feminist tradition gives prerogative to these negotiations and the dialectical relationship that women share with their socio-cultural environment in a disaster situation. The idea of the reminiscence of the past, the trauma and the bereavement brings us to the post modernist question of whose disaster is it anyway? How much loss is loss; and how much pain is & pain? Is loss and pain of disasters different for different gender categories?

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GENDERSCOPE: DEFYING SOCIETAL RULES FOR HIM AND HER

Eilia Jafar

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Abstract

It is a well-established fact that gender inequalities existing in communities exacerbate during disasters leading to differential impact on men, women, boys and girls. This is often due to the societal norms and the different roles assigned to men and women. The paper presents a systematic review of literature and analysis of case studies and field updates covering previous research in the field of gender in emergencies and resilience frameworks. While most of the literature focuses on the need for equal rights, access and entitlements of women and girls, research also indicates that men and boys are significant partners in resilience efforts and sustainable development cannot be achieved without engaging with men and boys. The paper concludes with recommendations on how gender equity and equality can be achieved in the aftermath of a disaster.

Key words: *gender, equality, humanitarian, resilience, stereotypes*

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Introduction

Disasters and conflicts around the world have been increasing over the past few decades. Due to climate change the frequency of natural hazards has been increasing and as a result of interacting with different vulnerabilities disasters are becoming more and more complex.

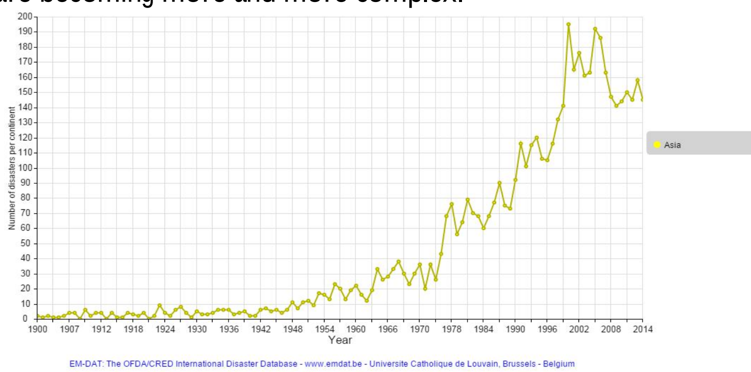

Fig1. Number of disasters in Asia 1900-2014 (Source: Emdat)

Emdat database shows the increasing trend of natural disasters being reported for Asia. While this can also be partly attributed to better reporting of disaster events with improved technology and development there is clearly an increasing trend.

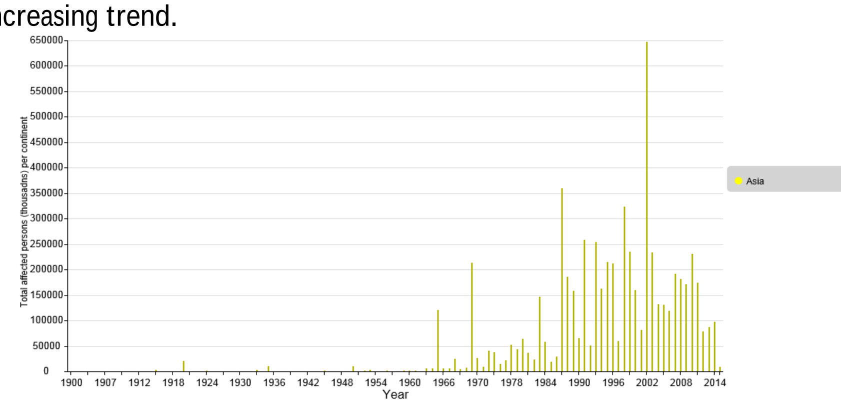

Fig2. Total affected population in Asia 1900-2014 (Source: Emdat)

The number of people affected by disasters in Asia has also been increasing. With the numbers being exceptionally higher for some years due to mega disasters, the trend is an increasing trend.

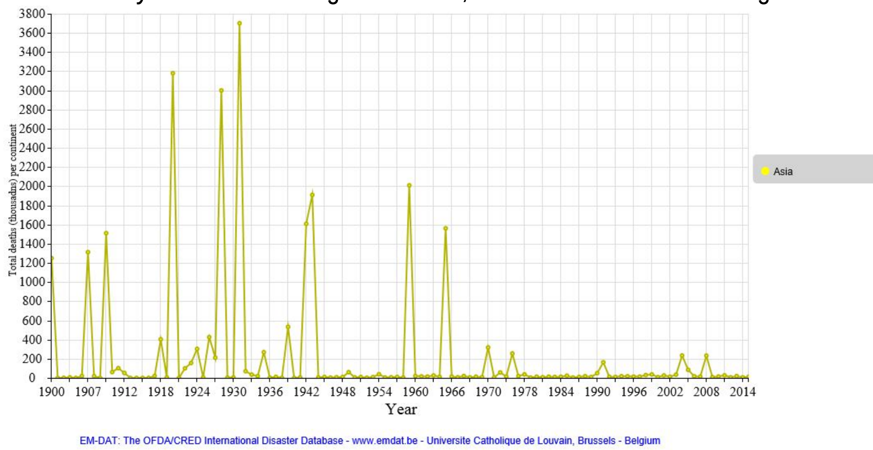

Fig3. Total number of deaths due to natural disasters in Asia 1900-2014 (Source: Emdat)

The good news is that number of deaths due to natural disasters in Asia has been decreasing. This indicates an increase in awareness on Dos and Don'ts of disasters and improved communication systems for early warning.

It is important to understand that disasters do not affect women, men, boys and girls equally. "More than 74 per cent of the 84 million in need for humanitarian assistance in 2014 were women and children; generally-speaking, 95 per cent of disaster fatalities occur in low and middle income countries. Evidence affirm that 60 per cent of preventable maternal deaths, and 53 per cent of preventable deaths of under 5 deaths occur in conflict settings and during natural disasters" (UN Population Fund, 2015). Disasters don't affect everyone equally. There are vulnerable groups who have low coping capacity and hold fewer resources and less social capital. Some individuals have increased vulnerability after disaster due to many underlying causes and is a manifestation of various factors like gender, ethnicity, socio economic status, age and disability (Banford, 2015).

Methodology

Extensive literature review of journals, publications, research papers and conference proceedings was done by searching on the Internet, research database and libraries.

Search Strategy: using the key words as well as disaster terms a broad group of disaster, public health and social science electronic database and online information sources were searched. This includes Emdat, EBSCO, relief web, prevention web, CARE Gender Wiki, GripWeb, American Centre Library and Sphere India website.

Discussion

Differential Impact of Disasters

Disasters impact women, men, boys and girls differentially. Vulnerabilities are also not similar across women. Among the women who died in Indian Ocean Tsunami, the most vulnerable were widows, single or disabled women, women with low income, and those belonging to marginalised and racial group (Abeysekera, 2006).

The literature on impact of disasters and conflicts on women and girls can be classified into the following categories:

- Safety and security: Due to a number of factors, women and girls in a post disaster situation are at an increased risk of sexual violence. In a displaced setting when women and girls go out to collect water or firewood or for defecation they are exposed to risk of sexual violence. Even the shelters they stay in may be unsafe without any privacy. Since the dependence on external people like aid workers and parties in power is increased they may demand for sexual favours in exchange of the relief assistance. There are also increased instances of spread of HIV transmission as communities are not able to observe standard precautions. Unwanted sex resulting in pregnancies results in crude ways of abortion which often leads to death of women due to sepsis infections. Other causes of death include long term injuries and obstetric fistula (MISP 2011). As reported in IRC's report "Are We Listening?", Syrian refugee women are victims of multiple types of violence: constant harassment, increased levels of intimate partner violence, early and forced marriage (EU round table, 2014).

- Men and boys infected by HIV also experience increased health risk in the absence of health care services and treatment.

- Access to Education: Disasters also affect women and girls disproportionately in terms of access to education. Girls drop out and early marriage may not be uncommon in non-emergency time also, but it has been observed in disasters and especially in conflict situations that your girls are married off in much higher numbers. The causes vary from reduced family income to the fear of girls being exposed to violence in that setting. Research has also shown that when school buildings are damaged and children need to travel longer distances which are not very safe, girls are mostly kept at home. When schools are functioning in temporary shelter spaces with no sanitary facilities girls miss the school during menstruation. Women volunteers to teach are fewer and male dominant teaching environment is not the most preferred environment for girls. Besides the supply issues enumerated, there are also issues of demand. Teenage pregnancy rates are high in IDP camps. Girls with their own babies may not be able to go to schools. Paying fee with limited resources is also a challenge. As a result girls often are made to sacrifice while boys are sent to schools (Kirk, 2006).

- Early marriage: Following the riots in Muzaffarnagar and Shamli in UP state of India in 2013 a rapid needs assessment was conducted by CARE. In the camps in Shamli it was found that within a period of 3 months after settling in camps, 200 adolescent girls got married and there were preparations for more marriages in Suneti camp. On further probing it was found that parents of such girls were worried about the safety of their daughters in camps (CARE India, 2013).

- Protection Needs: We fail to fathom what security issues a humanitarian decision regarding supplies can lead to. According to a report from Refugees International, during July 2000, UNHCR had to stop supply of soap to approximately half a million Congolese and Burundian refugee populations in Tanzania. A direct implication expected was poor hygiene. However there was an increase in drop out of adolescent girls from schools. And the most alarming finding was that there was an increased rate of girls having sex in exchange of soap. Lack of soap was also reported to be a factor leading to high rates of sexually transmitted diseases among women and girls. (Refugees International, 2001).

- Water Sanitation and Hygiene (WASH) and Health: Findings from rapid gender analysis for Sindupaul Chowk, Nepal in May 2015 done by CARE following the Nepal earthquake highlight the following issues: Women's need and dignity is overlooked by men and boys because shelter and food security are the highest priorities. Women were facing serious issues related to privacy for their needs related to menstruation, changing of clothes, breast feeding and sickness. These were however not a priority for men and boys and was therefore not getting adequate attention. A large number of women had the overall responsibility of taking care of their home as well as livelihood responsibilities including agriculture and livestock. (CARE, 2015). According to a report of UNFPA, during Syrian crisis, many women lost their children as they could not afford the cost of neo natal care. It is estimated that around 70,000 pregnant refugee women are in unsafe conditions and may have to give birth in such challenging circumstances (UNFPA, 2015). Women have been more vulnerable to heat waves. The number of women who died during the Indian Ocean Tsunami compared to death of men, made it clear that women and girls are at least three or more times at risk of death due to disasters than men (Women and health care reforms)

- Food security and nutrition: In the aftermath of a disaster when food is availability is less, women and girls are likely to reduce their intake to meet the food requirements of male members of the family. Access to food and other humanitarian assistance may also be a challenge for women due to safety and security issues. Pregnant and lactating women are affected disproportionately because their nutritional and physiological needs are higher. Infants suffer when women stop breastfeeding due to lack of privacy in IDP camps or public shelters. There are four dimensions of mainstreaming gender issues in food security: availability of food, access, utilization and stability. Food security programs are known to have failed due to the assumption that communities are homogenous with similar needs and interest (IASC Gender handbook).

- Increased hardship due to gender norms: Women are usually assigned the role of child care, taking care of old and ill in the house and performing household chores. In places where women and girls are assigned the job of bringing water, collecting firewood and doing all the household chores, the roles remain the same even after a disaster but the level of hardship increases. They often need to go much longer distances for the same roles they were performing earlier and are also subject to increased violence at domestic level (Women and health care reforms).

The literature on impact of disasters and conflicts on men and boys can be classified into the following categories:

- Safety and Security: According to Russel (Forced Migration Review), sexual violence against men and boys is a reality in armed conflicts but highly under reported. The needs of male survivors of sexual violence are also very different from the needs of female survivors. Both men and boys are vulnerable in war zones, in detention and in military operations in civilian areas. In addition the boys are vulnerable in refugee camps.

- WASH and Health: Health risks experienced by men and women following a disaster are different. There is evidence that men have reported much higher number of heart attack and stress than women. Similarly the gender stereotypes and roles expectations have an impact on men and women differently (Women and Health Care Reform).

- Increased hardship due to gender norms: Men have a traditionally assigned role of bread winner. When livelihoods are lost men are under tremendous psychological pressure and stress if they are unable to provide food and meet basic needs of the family. (Women and Health Care Reform). Somali men associate their status with their meeting the expectations of manhood. Men aim to have *Raganimo* (a term that roughly translates to manhood). From childhood they are taught to behave in manly manner i.e. to act fearless and brave when someone attempts to humiliate him, capable, and should never cry. From childhood the boys are judged for manhood starting from judgement by family and different socio-political settings. Men and boys are seen as the protector of family. Women also have a role in supporting men in achieving Raganimo. If the wives eat well and dress well it is considered a good point for men. (Logica, 2015)

- Education: Damage of schools and set of temporary schools far away also impacts boys. Boys are also at risk of abduction if they have to travel long distances alone. When parents are unable to pay school fee, boys start to engage in some work to earn money and to meet their fee requirements (Kirk, 2006).

- Food security and nutrition: Single men and boys separated from families are also at risk of under nutrition because they have traditionally not been involved in food processing, conservation and storage and may not have cooking skills (IASC Gender handbook).

Changing Gender Roles

It is important to understand gender issues in crisis situations:

- Men and women respond differently
- Gender roles change across age and over time
- Power dynamics change

Gender roles change many times after a disaster because of change of situations. When a single male is left in house to take care of children and cooking and cleaning of house, it is a change in traditional role of males. Similarly a single women headed household sees women going out to work and earn, or if the female head of house is unable to go out as she can't leave the kids unattended, she is not able to access services (IASC Gender handbook).

Disasters and conflicts bring a change in family structures, destroy social networks and bring a change in gender roles. As this change is sudden, men, women, boys and girls are caught unaware and seldom prepared for their new roles. When a woman or a child becomes a head of household, he/she is not prepared for this role of head. There is enough evidence that in the times of conflicts and riots women are made slaves or subjected to acts of violence like rape. Traditionally women have been invisible in decision making, framing of policies and influencing service providers. It therefore becomes extremely important to identify the needs and address the issues faced by women and children (IOM).

Men and boys are also vulnerable to disaster and crisis due to the gender norms and expectations which put them at risk. UNFPA emphasises on urgent need to disaggregate all the disaster related data by sex and age. It is also important that such disaggregated data is analysed by people who have skills for gender analysis (Dakkak, et al.).

A large number of health care workers in most of the countries are women. Disasters lead to a work life conflict because when female nurses are required to be in hospitals for longer hours the traditional gender roles assigned to them need to be taken care of by other members, often male members (Amaratunga, 2008)

Men as Partners in Resilience

Findings from a study commissioned by UNFPA in 2007on barriers in promotion and use of reproductive health services in Zinder region identified power and behaviour of men who determine whether medical care should be accessed by women or not, as one of the most significant barrier.

When men migrate to cities leaving behind women and children in villages to survive on small portions of food stocks that are left, women become de facto heads of households with responsibility to meet the needs of family members but without the authority or access to resources. The concept of “Ecole des Maris – (husband schools)” introduced by UNFPA in Niger and adopted by other agencies focuses on educating men on topics such as early marriage, sexual and reproductive health and family planning. Long term sustainable resilience can only be achieved by empowering women and girls while engaging with men and boys (Allison, 2014).

Societal Rules for him and her

In order to build resilience of men and women towards disasters it is important to understand the existing societal norms for males and females. Such rules and norms can either support or act as a barrier in achieving resilience. Such societal norms also constitute the normative framework.
Following are a few examples of societal norms and their linkage with impact of climate change and disasters on women, men, boys and girls

- Women are primarily responsible for collecting water for household.
  Water shortage or contamination of water due to climate change and disasters leads to additional burden on women and spend more time and energy in collecting water from distant sources.
- Women are expected to feed other family members before eating themselves and men are expected to earn and provide for their families. Loss of crops or a drought situation or washing away of stored food due to floods can add additional burden on the women of the house to provide food to other family members. Women in such cases are the first ones to reduce their intake of food Men suffer from psychological issues and mental stress when they are not able to meet the needs of family. (Masson et al., 2015)
- Men are the decision makers in household and community
  The disaster preparedness planning and decisions related to disaster response at community level is dominated by the males and also many times limited to men. This exclusion of women results in lack of awareness of plans and preparedness.
- Household chores are a responsibility of women
  Disasters often lead to many single men headed households. With limited knowledge of household chores men find it extremely difficult to cope with the expectations of their new role.
- Men are the bread winners of family
  Climate change and increase in frequency of disasters striking new geographies catches communities unprepared for the disaster. Livelihoods are lost suddenly and men go through episodes of extreme stress and take extreme steps like committing suicides. E.g during 2014 following crop failure due to drought, more than 1100 farmers committed suicides in Maharashtra, Telangana and Jharkhand in India. (Indian Express, 2015)

Addressing Gender Needs during and Post Disaster:

Humanitarian settings pose an urgency for meeting the overwhelming needs of affected population along with provision of safety and security. Under such pressure many humanitarian workers find it difficult to undertake gender analysis and reach out to women, men, boys and girls effectively. Standard operating procedures can be developed in peace time and it should ensure that action follows a ‘do no harm’ approach (Greenberg, 2009).

UNOCHA recommends ADAPT AND ACT C framework to build gender sensitive resilience. The nine step framework focuses on actions towards gender equality (OCHA Gender Toolkit)

- **A**nalyse gender differences.
- **D**esign services to meet needs of all.
- **A**ccess for women, girls, boys & men.
- **P**articipate equally
- **T**rain women and men equally, and
- **A**ddress GBV in sector programmes.
- **C**ollect, analyse and report sex/age disaggregated data.
- **T**arget actions based on a gender analysis.
- **C**oordinate actions with all partners.

One of the steps towards achieving gender equality in emergency response is by including this in Emergency Preparedness Planning. In CARE, this is done in two steps. Step one is to integrate gender into the disaster scenario developed for potentially high disaster risks. Second step is to integrate into the response plan by preparing a gender action plan. Gender in emergencies strategy of CARE International outlines specific actions to promote gender equality in emergency response. (CARE GiE guidance notes).

Oxfam applies 16 minimum standards for gender in emergencies out of which 4 standards correspond to promoting gender equality through internal practices. These standards are designed to increase participation of women in humanitarian program activities, dignity and empowerment (Rooney, 2015).

Another tool used by CARE is Rapid Gender Analysis (RGA) that begins with secondary data and builds up gradually. It provides information about the different needs, coping capacities and pre-existing societal gender norms.

CARE's Gender marker is an easy tool to assess and grade gender equality in humanitarian response. It draws from the concept of IASC gender marker, but goes a step ahead by applying the marker not just for rating proposals but also to preparedness, planning and response (CARE GiE guidance notes). The CARE Gender Marker is a simple tool that tracks how gender is integrated into the emergency response project cycle on a scale from gender blind (0) to gender sensitive (2a or 2b). The CARE Gender Marker is in a pilot phase (CARE, 2014).

Eco-feminists in their analysis of humanitarian situations focus on linkage between women, ethnicity, socio economic status and the environmental factors like deforestation, pollution, use of chemicals in agriculture and ecology. Most of the theoretical frameworks for disaster analysis focus on social vulnerability and regional distribution of power. An eco-feminist framework on the other hand looks at the pre-existing social oppression in the context of race, class, gender, disability and power and the relationship with environment. This framework also assumes that traditionally women have been much closer to nature due to their roles in society. In the post tsunami days, an increase in partner violence and care giver was observed and reported. A closer review of pre-Tsunami days reveals pre-existing restricted mobility for women, violence and gendered inequality in ethnic groups, thus reinforcing the concept that the impact of disasters and increased vulnerabilities are due to the pre-existing gender roles (Banford, 2015).

Results

There is significant amount of evidence that disasters impact women, men, boys and girls differently and an effective emergency response is only possible if these different impacts are understood well. While both men and women are impacted by disasters in different ways, there is overwhelmingly higher impact on women due to pre-existing societal norms and gender inequality.

Needs of men, women, boys and girls are also different. This includes shelter, food, water, sanitation and hygiene, livelihoods, safety and security and psychosocial support.

Social norms and gender roles assigned to men and women add to their vulnerabilities at the time of an emergency. Traditional roles become harder in disaster and conflict situations and put safety and security at risk. Inability to meet the expectations from society lead to psychosocial issues. Conforming to or defying gender norms should be an informed decision.

Gender roles change in disasters. Women, men, boys and girls are required to take different roles that they are not skilled for. Gender equality and participation of men and women in all tasks will reduce this gap to some extent.

Engaging with men is important to bring gender equality. Even if the issues are around women and girls a change is possible only when men are also engaged in the dialogue and change process.
Gender integration is required in humanitarian response. This can be achieved by integrating from the preparedness phase, developing standard operating procedures and using gender action plan and gender marker.

Recommendations

Gender integration into scenario based emergency preparedness planning by considering the differential impact of disasters on men, women, boys and girls in the disaster scenario.
Collection of sex and age disaggregated data during needs assessment and analysis of such data by skilled persons to understand the impact and needs and plan for a gender integrated response.
Development of standard operating procedures for addressing gender issues and adopting a 'do no harm' approach.

Conducting gender analysis for disaster prone areas using secondary data that can be further built on during emergencies to know the pre-existing gender roles and understand the impact of changing roles on women, men, boys and girls.

Application of Gender Marker (e.g. CARE Gender marker) during proposal development, as implementation phase and outcomes analysis.

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GENDERED VULNERABILITIES IN TIMES OF DISASTER
CASE OF BANGLADESH

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Due to its unique geographical location, Bangladesh has always been highly susceptible to natural disasters such as cyclones, tidal bores, floods, tornados, river bank erosions and droughts. Such disasters impact upon the lives and livelihoods of a large portion of the population who, even in ordinary circumstances and in their day to day lives, continuously battle poverty and suffer from various types of deprivation. Natural disasters cause immense havoc which have long standing affects on the people much beyond the immediate period of the disaster. During such situations of disaster people who are by nature vulnerable due to various factors become even more vulnerable. In Bangladesh women have always been and continue to be particularly at risk due to social, cultural, religious socialization processes which contribute to their being economically and physically insecure. During emergency situations such vulnerabilities are accentuated and deepened so that women and children are more prone to displacement, violence, trafficking and fatalities. For example when in 1991 Bangladesh was devastated by a cyclone 90% of those who died were women.

In the last decades, the State as well as civil society organizations have taken commendable initiatives to reduce the disastrous impacts of natural disasters. Women nevertheless still continue to be amongst the most vulnerable segments of society in times of disaster. Even now, in 2015 it is reported that women and adolescent girls continue to be 'utterly vulnerable' to 'grim health hazards and sexual violation during disaster….' The theme of the World Population Day was thus aptly 'vulnerable populations in emergencies'. This paper will delve into and analyze the impact of natural disasters on women and adolescent girls in Bangladesh during its frequent disasters and discuss the various Governmental initiatives taken to deal with such situations whether through the enactment of laws, policy measures or more practical on the ground measures.

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WOMEN AND DISASTER

Priyaanka Jha, *CPS/JNU*

Disasters either man made or natural goes on to have huge impact on the lives of all species in a manner of similitude. There is loss and destruction of life and property, more than that the kind of emotional toll that it takes on the lives is also of very high magnitude. Over a period of time there has been documentation of all these issues and factors, one can say that the material aspects of the loss has been well accounted and documented for and as a result there have been compensations that the state has provided for. There have been international relief, food aid and supplies of medicines. There have been international and national policies that have been designed specifically for Disaster preparedness and mitigation. So on the surface of it, it looks all fine and perfect. But an essential question that looms large is whether policies and programme, are they sensitive to the differential needs of the women. A significant push needs to be given at all levels especially at the level of policy formulation with the most important step in this direction being to recognise women as active stakeholders in the process and not mere passive victims and recipients.

Community based preparedness for disaster vulnerability reduction - lessons learned from Tutti Island – Sudan

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ROLES OF WOMEN AND DISASTER PLANNING IN RURAL MINDANAO, PHILIPPINES

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Abstract

This paper explores the existing roles of women to transform and emancipate their subordinated roles in disaster planning in the rural communities in Mindanao, Philippines. This paper argues that women's subordinated roles in reproductive, productive and community responsibilities elide their chance to do and become active decision-makers in the disaster planning platforms. As the practice perpetuates patriarchal disaster frameworks, women and their children are left in a state of higher vulnerability than men to disasters. Moser's framework was used as a tool to analyze gender inequality while Kabeer's social relations approach was used as lens to critique the existing gender inequality in various institutions—household, community, state and market level.This study used participatory action researchusing participants observation, key informants interview, and focus group discussions. A total of 30 participants were interviewed through theoretical sampling during the fieldwork in the Province of Davao del Norte in Mindanao. This study finds that women are trapped in their responsibilities concentrated primarily in reproductive roles such as child bearing and rearing and doing household chores. The participants reported that confining men to do reproductive tasks is a taboo and considered unmanly. Productive roles of women are mostly invisible and unpaid responsibilities in clan and community activities. While in terms of community roles, women are refrained if not totally restricted to participate by men and by their reproductive responsibilities.

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HEALTH

- Study of Compliance of Crash Carts to Standards in the Emergency of a Tertiary Care Teaching Hospital - *Makkar N. Madaan N.*

STUDY OF COMPLIANCE OF CRASH CARTS TO STANDARDS IN THE EMERGENCY OF A TERTIARY CARE TEACHING HOSPITAL

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Introduction

Cardiac arrest is defined as the sudden cessation of breathing and the inadequate circulation of blood by the heart [1] and cardio pulmonary resuscitation (CPR) refers the attempts to establish and maintain airway patency by supporting breathing and circulation. The resuscitation trolley is mainly used for the purpose of CPR and management of other emergencies in any health care setting [2]. The response time of a CPR team to a cardiovascular alarm in a hospital setting is one of the critical factors that affect patient survival in cases of cardiac or respiratory arrest or whenever a patient requires immediate resuscitation[3]. Improving response time involves a rigorous organization of the teams and materials used. To respond to emergencies more quickly and effectively, many hospitals rely on mobile stocking systems or carts to centralize all the medications, solutions, medical devices, instruments, and appliances required for performing CPR [4-11].

An organized crash cart contains supplies and equipments necessary to treat life threatening situations. Adequate storage of disposable and non-disposable medical equipment should be available in the crash carts[12]. For Advanced Life Support to be effective, staff should know where cardiac arrest equipment is located, and that the equipment is readily available and in good working order. Broken or missing equipment, or equipment failure, are often the cause of delays in instituting cardiopulmonary resuscitation. A survey of cardiac arrest trolleys in 2002/2003 found that the equipment available varied considerably from recommended standards. Defibrillators do also occasionally fail, but many errors are due to poor defibrillator care and maintenance. Inadequate training and a failure of operators to perform daily checks lead to poor familiarity with the equipment and a failure to identify component failure or damaged devices [13].

The Resuscitation Council of the United Kingdom (2004) requires that the recommended minimum equipment must be available for the successful management of adult cardiopulmonary arrests. The National Patient Safety Agency (2008:8) in the United Kingdom (UK) reported a number of incidents that involved missing or broken equipment during CPR [14].

A separate survey of emergency trolleys conducted in selected UK hospitals found that the availability of necessary equipment varied from hospital to hospital [15].

The Pennsylvania Patient Safety Authority reports the highlighted emergency or rapid response situations in which supplies or equipment were missing or outdated. The locations of these incidents varied as did the types of medical emergencies, but the common theme was lack of the appropriate equipment and supplies to successfully manage the emergency in a timely manner. The reports and corresponding failure modes identified issues such as incorrect size supplies, missing items, empty oxygen tanks, drained batteries of equipment, or under stocked or unlocked crash carts. Review of the literature identifies three factors of clinical emergency preparedness that warrant attention in virtually every clinical point of care area: (1) having rapid access to functioning equipment and up-to-date supplies; (2) having knowledgeable and trained staff to manage the clinical emergency; and (3) once systems are in place, monitoring those systems to ensure that clinical staff maintain a state of readiness to manage clinical emergencies [16].

It has also been stated that human error is one of the major causes for delayed CPR attempts. (inadequate knowledge, checking and maintenance) leading to unfortunate consequences [17].

In a study done by Justin B. Rousek, effective access to medications during arrest is a key component in delivering optimal care and has been found to be a major problem among health care organizations; however, little research has been conducted to improve the efficiency of medication management during an emergency. It was concluded that human factor engineering and usability applied to emergency cart design (consisting of visibility, grouping, and organization) are effective, are customizable, and can affect patient safety by saving valuable time and reducing wasted motions (including errors) during code situations [18].

As per the crash cart readiness process undertaken at the Advocate Trinity Hospital, the root causes of errors identified were mainly the unavailability of the policy to check and maintain the crash carts, insufficient number of crash carts with inappropriate location, lack of training of the staff and continuous sensitization about the upkeep and maintenance of the crash carts. In addition to these, the ACLS algorithms were not readily available, inappropriate management of medication leading to wrong filling of the lookalike and sound alike drugs. The unavailability of the supply list and irregular supply of medications leads to confusion regarding the policy of replacement of the emergency medications [19].

To alleviate this, crash cart should be kept in an accessible place & routinely monitored by staff nurse to ensure that all supplies are replaced & checked weekly by registrar & monthly by hospital inspection team. All the equipment should be in working condition & emergency life saving drugs should be up-to date [20].

The NABH, most popular accreditation body in our country, provides standards and warrants mandatory guidelines for management of emergency medication. The accreditation standard contains objective elements which are measurable components and are equally applicable to government and private hospitals. There are standards and objective elements pertain to the management of emergency medication. The availability of emergency medication is stressed upon. The organisation should have a mechanism to ensure that the emergency medications are standardised throughout the organisation, readily available and replenished in a timely manner. There should be a monitoring mechanism to ensure that the required medications are always stocked and well within expiry dates. In MOM 3 (d), recommendations of sound-alike and look-alike medications are identified and stored separately. They should be documented, segregated and stored separately at all locations. The organisation can follow a method of storing drugs by generic name in an alphabetical order to address this issue. As per MOM 3 (e), the list of emergency medications should be defined and stored in a uniform manner which shall be uniform across the organisation, however the quantity can differ. It recommends that the design of the crash cart would help the organisation to store these medications in a standardised manner, i.e. the rows and drawers to have defined medicines. It warrants that no other drugs shall be kept stored with emergency medications. According to MOM 3(f), emergency medications should be available all the time. In the MOM 3(g), emergency medications should be replenished in a timely manner when used. An inventory check should be done daily to ensure this. The organisation should follow a system of sealing the emergency cart, and a check shall be carried out before re-sealing every time the medicines are used. In case of MOM 5 (c) expiry dates should be checked prior to dispensing. For MOM 13 (c) medical supplies and consumables should be stored in a clean, safe and secure environment. They shall be protected from loss or theft. Overall cleanliness of the storage area shall be maintained [21].

There is emphasis on standardization, as it increases the familiarization of the staff working on these crash carts and reduces chances of errors [22].

The study on the compliance of crash carts based on the requirement of standards was undertaken in a super-specialty tertiary care teaching institute having more than 1100 beds. The four areas of study were Medical, Surgical, Paediatric and Screening area in the emergency department of the hospital. The emergency has been divided into four different ward areas for the purpose of better management of resources and specialized critical care to the patients. In the study area, the clinical management is semi-closed type as the administrative control is with the emergency department by means of chief medical officers who are specialists in their clinical fields of medicine, surgery and paediatrics. In turn, they are supported by the clinicians from other speciality departments. As the management of the cart is an administrative issue, standardization of the carts is expected in all the different areas of the emergency. These areas have separate, independent resources for fixed assets and countable items (except drugs) but in the case of paediatric and screening areas, the consumables are being managed form the surgical emergency. A total of about 600-700 patients/day avail the emergency services of the institute and 20% patients require resuscitation per day. The total capacity of the trolleys/ beds in the emergency area is about 100, wherein the paediatric area has 6 trolleys, surgical area has capacity of 30-40 trolleys, medical emergency is the heaviest, having capacity of 60-70 trolleys. The screening area has trolleys only for triaging and is t best, a transient area for the patients. The approximate number of emergencies handled in the medical, surgical, paediatric emergency is 90, 30, 10 per month respectively. The emergency department is designed in such a way that the areas are different but interconnected for close co-ordination during epidemics and disasters. The area for disaster, with provision of disaster cart is adjunct to the surgical emergency and has access from the patient alighting area.

Aims and objectives

To maintain uniformity in content and proper maintenance of crash carts, three objectives were identified:

- To achieve standardization of crash carts by defining the basic stock.
- To make standard protocols for maintenance of the crash carts.
- To study the effect of standardization and awareness on the maintenance of crash carts.

Methodology

Design

Phase I

A descriptive, quantitative, observational study was conducted at the emergency department of a tertiary care teaching hospital for a period of three months from April 2015 to June 2015 to do a gap analysis of the crash carts. Current medical literature was thoroughly reviewed to identify relevant standards pertaining to the crash carts. As medications are an important part of the crash cart, the relevant objective elements pertaining to the management of medications were also taken into consideration. Based on these parameters, a check-list was devised which was pre-tested through a pilot study. The modified check-list was then used to carry out a gap analysis of the crash carts. The crash carts were mainly evaluated on the following parameters:

- Contents
- Labelling
- Functionality of the equipment
- Documentation

Phase II

Interventional phase: Based on the gaps identified, Standard operating procedures were developed after consultation with the clinical nursing team. The staff was made aware regarding the protocol.

Phase III

Descriptive and observational: After implementation of the protocol, review audits were conducted to know the status of the compliance to the SOP's for the next three months from July 2015 to September 2015 to assess the level of improvement in compliance to standards.

Study Area

The population under the study composed of the emergency area of the super-specialty tertiary care institute. The area was chosen because of the nature and scope of the area to handle patients pertaining to medical/ surgical emergency. Efficient initial resuscitation and management of disaster performed in the area would go a long way in improving the clinical outcome for the patient.

The four divisions of the emergency department of the hospital were selected as the area contains crash carts and the disaster area.

Data Collection Methods

Data was collected through simple random sampling technique. A minimum of 15 random observations per crash cart area and disaster area were made over a period of 3 months each in the pre as well as the post intervention phases.

Analysis

The data was spread into an excel sheet format and the results were tabulated using SPSS 1.7 format.

Results

The results of the study are as follows:

Availability of the Crash Cart

Although all the areas had the facility for handling emergencies, but only 50% had the provision of mobile crash carts, rest 50% had fixed area for maintaining the emergency items. The screening area has an emergency tray instead of the resuscitation cart. The medical emergency had transformed the two shelved Mayo's trolley into a crash cart for convenience as the area is too congested with heavy patient load and with trolleys in the corridors, due to which the mobile cart cannot be moved due to its size. An attempt to use the cart with the mobile cart with drawers can cause significant delays in the resuscitation attempts in this particular area, as the area is too congested. With 8-10 CPR's per day, for effective CPR, the early availability of the cart is very important which is possible only with a small sized cart.

Location of the Cart

The carts (whether fixed or mobile) are located in front of or adjacent to the resuscitation cubicles in all the emergency areas. The disaster cart is located in the surgical emergency area, near the Operation Theatre, which is near to the defined disaster management area.

Content of the Carts

The mobile crash carts have similar designs with a top shelf, a stand for seventeen containers, and at the bottom, five drawers. The content of the carts have been defined by the stakeholders of the emergency department. There is similarity in the number of items pertaining to drugs, equipment and consumable items to be maintained in the mobile carts or fixed emergency area except the disaster area where a few more items including the backup items are placed. Regarding the quantity of each item (drugs or equipment) to be stocked, there is variation as per the past utilization according to patient load. There is the problem of storage of drugs as per the ACLS protocol and look alike and sound alike drugs. The incidence of finding look alike and sound alike drugs together, decreased post intervention to nil except the mayo's trolley as the drugs have to be kept on the shelf in small boxes. The compliance regarding avoiding the mixing of drugs improved considerably to 100% in all areas except, medical emergency where the incidence had reduced from 53% to 14% and from 14% to nil as continuous sensitization of the nurses was done with monitoring from the senior nursing staff. The countable drugs like antibiotics, anti-emetics were found only in paediatric area with the same compliance post intervention due to the paucity of space as no other storage area was available. But the mixing and gap in the status of current stock was considerably reduced to 14%. As far as the equipment is concerned, not much improvement could be made due to the paucity of space except the surgical emergency where the sterile packs were kept near to the crash cart. Due to the design of the trolleys and availability of electrical plug points, the location of the defibrillators also could not be changed. However, staff including technical staff was sensitized regarding the importance of the early institution of the shocks through the defibrillator to improve long term patient outcome. The oxygen cylinders were mostly not kept beside or on the cart due to paucity of space. Regarding the availability of stethoscope, not much change could be made on the cart due to the habit of the doctors to use and take them away. This was done, possibly unknowingly but as the stethoscope was being kept with the nurses, to be used by any staff/ doctor increased the incidence of stethoscope being available to 47%, except on the Mayo's trolley due to its very high frequency of movement.

Security of the Contents of the Emergency Carts

The disaster cart was secured with a lock and key with numbering system of the keys with lock of various cupboards for swift access to the items. For other areas, the compliance to locking increased from nil to 47% only, due to heavy workload. As the open areas could not be secured by lock and key, order was placed for new lockable, mobile crash carts.

Labelling

The drawers of the carts did not contain labelling in any of the trolleys except paediatrics and disaster cart. But post intervention, the compliance increased to 100%. Compliance to labelling with the name of the drug on the containers increased to 93% and the expiry date was now being mentioned in almost 100% of the instances.

Functionality of the Equipment

The responsibility of the functionality of the equipment lies with the technical staff with supervision by the technical supervisor. The frequency of checking of the equipment is once a day. In a few instances, the equipment was found faulty but in the patient care area, post intervention this problem was reduced as the equipment was immediately replaced with the working equipment without waiting for patient requiring emergency to arrive. Also, the stock of the items was increased making the compliance 100%. The oxygen level in the cylinders was found <500 psi in 27% instances which improved post intervention. Also, the availability of the key was a problem, the incidence of which reduced due to continuous sensitization of the staff.

Documentation

Separate registers are being maintained for:

- The emergency drugs: For checking of the expiry date of drugs, incidence has been improved to 93% and the incidence of finding near expiry drugs has reduced to nil.
- Routine medications considered as countable drugs: Stock and expiry date checked and noted

- Equipment: The record for the equipment for the crash cart is being maintained but the status of compliance for the functionality of defibrillator is not proper.

The surgical emergency has been defined as the central stock dispensing area from where the stock is replenished once a day for paediatric and screening areas. The surgical emergency maintains a stock wise register of the drugs, indented from the store. In few instances, the record was not complete and near expiry drugs were found. But post intervention, the compliance improved to 93%. In none of the areas, counter signature by the In-charge/ANS/DNS is being done.

Pre-intervention status:

Area		**Medical Emergency**			**Surgical emergency**		**Paediatric emergency**	**Screening**
Crash carts numbers		**Cart No. 1**	**Cart No. 2**	**Cart No. 3**	**Cart No. 1**	**Cart No. 2**	**Cart No. 1**	**NONE**
PARAMETER								
AVAILABILITY		Present	Present	Present	Present	Present	Present	Absent
TYPE OF CART		Mobile	Mobile	Mobile	Fixed	Fixed	Mobile	Absent
DESIGN		Top shelf having emergency drugs stand with bottom 5 drawers	Two shelved Mayo's trolley	Two shelved Mayo's trolley	Closed, lockable cuoboard embedded in the wall	Open rack rack embedded in the wall	Top shelf having emergency drugs stand with bottom 5 drawers	Absent
LOCATION		In the HDU	In the HDU	In the HDU	Near resuscitation area	Near the Operation theater	In front of the nursing station	Absent
CONTENT								
Drugs:								
Emergency	Arranged as per ACLS protocol	Nil	Nil	Nil	Nil	Nil	Nil	Absent
	Stock defined	Nil	Nil	Nil	Yes	Yes	Yes	Absent
	Gap between the stock defined and current stock	Not predictable	Not predictable	Not predictable	14%	Nil	80%	Absent
	Look alike, sound alike drugs found together	14%	20%	20%	14%	Nil	7%	Absent
	Mixing of drugs	47%	86%	86%	86%	Nil	93%	Absent
Countable	Stock defined	Not available	Not available	Not available	Not available	Not available	Yes	Not availabl

injectables (such as antibiotics, anti-emetics, anti-inflammatory drugs)	Gap between the defined stock and current stock						20%	e
	Mixing of drugs						40%	
Equipment:								
Airway, Breathing		100%	93%	86%	100%	100%	83%	Absent
Availability of stethoscope		33%	Nil	NIl	Nil	100%	13%	Absent
Circulation (Defibrillator):	Availability	100%						Absent
	Location	Near to cart, but not on the cart	Not on the cart	Not on the cart	Near to cart, but not on the cart	Near to cart, but not on the cart	Near to cart, but not on the cart	
	ECG electrodes	100%	93%	86%	100%	100%	86%	
Sterile packs:	Available	80%	Nil	Nil	33%	100%	Nil	Absent
	Location	At the nursing counter	At the nursing counter	At the nursing counter	At the nursing counter	In the cart	At the nursing counter	Absent
Lock:	Availability	Nil	Nil	Nil	Nil	100%	Nil	Absent
	Numbered	Nil	Nil	Nil	Nil	100%	Nil	Absent
Glucose monitor	Availability	100%	47%	86%	86%	100%	93%	100%
	Location	At nursing counter	At nursing counter	At nursing counter	At nursing counter	In the cart	At nursing counter	100%
Oxygen cylinder	Availability	100%	Nil	Nil	100%	Nil (bed-head manifold panels available)	100%	100%
	Location	Near to the cart	Away from the cart	Away from the cart	Near to the cart	Near to the cart	Away from the cart	Near to the nursing station
LABELING								
Drawers		Nil	Nil	Nil	Nil	100%	100%	Absent
For drug containers	Name	80%	93%	93%	93%	100%	86%	Absent
	Expiry date	86%	86%	86%	86%	100%	86%	Absent
FUNCTIONALITY OF THE EQUIPMENT								
Defibrillator	Through defined parameters	100%	86%	80%	100%	100%	73%	Absent

	Frequency of checking (once a day)	100%	100%	100%	100%	100%	100%	Absent
Airway, Breathing	Laryngoscopes	100%	93%	93%	100%	100%	93%	Absent
	Bag mask	100%	93%	86%	100%	100%	93%	Absent
Oxygen cylinder	Functionality (<500 psi)	86%	100%	100%	100%	100%	86%	100%
	Availability of key	86%	100%	100%	86%	100%	100%	100%
DOCUMENTATION								
For emergency drugs	Frequency of checking (every shift)	86%	100%	93%	100%	100% (once every week)	93%	Absent
	Expiry check	86%	80%	93%	93%	100% (once every week)	86%	Absent
	Quantity check	Nil	Nil	Nil	80%	100%	100%	Absent
	Stock register properly maintained	100%	Nil	Nil	80%	100%	86%	Absent
For equipment	Stock register properly maintained	86%	86%	93%	93%	100%	80%	Absent
Defibrillator	Checklist Displayed	Nil	Nil	Nil	86%	100%	Nil	Absent
	Properly maintained in the register	80%	100%	93%	80%	100%	80%	Absent

Post intervention status (the highlighted areas show the change observed in compliance of the measured parameters):

Area	**Medical Emergency**			**Surgical emergency**		**Paediatric emergency**	**Screening**
Crash carts	**Cart No. 1**	**Cart No. 2**	**Cart No. 3**	**Cart No. 1**	**Cart No. 2**	**Cart No. 1**	**NONE**
PARAMETER							
AVAILABILITY	Present	Present	Present	Present	Present	Present	Absent
TYPE OF CART	Mobile	Mobile	Mobile	Fixed	Fixed	Mobile	Absent

DESIGN		Top shelf having emergency drugs stand with bottom 5 drawers	Request for lockable trolley was put	Request for lockable trolley was put	Closed, lockable cuoboard embedded in the wall	Request for lockable trolley was put	Top shelf having emergency drugs stand with bottom 5 drawers	Absent
LOCATION		In the HDU	In the HDU	In the HDU	Near resuscitation area	Near the Operation theater	In front of the nursing station	Absent
CONTENT								
Drugs:								
Emergency	Arranged as per ACLS protocol	Nil	Nil	Nil	Nil	Nil	Nil	Absent
	Stock defined	As per the past utilization status				Yes	As per the past utilization status	Absent
	Gap between the stock defined and current stock	Not predictable	Not predictable	Not predictable	14%	Nil	80%	Absent
	Look alike, sound alike drugs found together	Nil	20%	20%	Nil	Nil	Nil	Absent
	Mixing of drugs	14%	86%	100%	Nil	Nil	100%	Absent
Countable injectables (such as antibiotics, anti-emetics, anti-inflammatory drugs)	Stock defined	Not available	Not available	Not available	Not available	Not available	Yes	Not available
	Gap between the defined stock and current stock						86%	
	Mixing of drugs						14%	
Equipment:								
Airway, Breathing		100%	93%	86%	100%	100%	83%	Absent
Availability of stethoscope		86%	Nil	Nil	53%	100%	47%	Absent
Circulation (Defibrillator):	Availability	100%	100%	100%	100%	93%	100%	Absent
	Location	Near to cart, but not on the cart	Not on the cart	Not on the cart	Near to cart, but not on the cart	Near to cart, but not on the cart	Near to cart, but not on the cart	
	ECG electrodes	100%	93%	86%	100%	100%	86%	

Sterile packs:	Available	80%	Nil	Nil	33%	100%	Nil	Absent
	Location	At the nursing counter	At the nursing counter	At the nursing counter	In the cart	In the cart	At the nursing counter	Absent
Lock:	Availability	47%	Request for lockable trolley was put	Request for lockable trolley was put	Nil	100%	Request for lockable trolley was put	Absent
	Numbered	Nil	Nil	Nil	Nil	100%	Nil	Absent
Glucose monitor	Availaibility	100%	47%	86%	86%	100%	93%	100 %
	Location	At nursing counter	At nursing counter	At nursing counter	At nursing counter	In the cart	At nursing counter	100 %
Oxygen cylinder	Availability	100%	Nil	Nil	100%	Nil (bed head manifold panels available)	100%	100 %
	Location	Near to the cart	Away from the cart	Away from the cart	Near to the cart	Near to the cart	Away from the cart	Near to the nursing station
LABELING								
Drawers		100%	100%	100%	100%	100%	100%	Absent
For drug containers	Name	100%	93%	93%	93%	100%	93%	Absent
	Expiry date	100%	100%	100%	100%	100%	100%	Absent
FUNCTIONALITY OF THE EQUIPMENT								
Defibrillator	Through defined parameters	100%	93%	100%	100%	100%	93%	Absent
	Frequency of checking (once a day)	100%	100%	100%	100%	100%	100%	Absent
Airway, Breathing	Laryngoscopes	100%	100%	100%	100%	100%	100%	Absent
	Bag mask	100%	100%	100%	100%	100%	100%	Absent
Oxygen cylinder	Functionality (<500 psi)	100%	100%	100%	100%	100%	86%	100 %
	Availability	100%	100%	100%	93%	100%	100%	100

	of key							%
DOCUMENTATION								
For emergency drugs	Frequency of checking (every shift)	93%	100%	93%	100%	100% (once every week)	100%	Absent
	Expiry check	100%	100%	100%	100%	100% (once every week)	93%	Absent
	Quantity check	Nil	Nil	Nil	80%	100%	100%	Absent
	Stock register properly maintained	100%	Nil	Nil	80%	100%	86%	Absent
For equipment	Stock register properly maintained	93%	93%	93%	93%	100%	86%	Absent
Defibrillator	Checklist Displayed	Nil	Nil	Nil	86%	100%	Nil	Absent
	Properly maintained in the register	80%	100%	93%	80%	100%	80%	Absent

Discussion

The study conducted in the emergency department of a Super-specialty teaching institute provides us with valuable insight on the maintained and upkeep of the crash carts and the level of standardization with could be made possible in these carts.

Content

The first line and second line drugs are vital elements for providing the effective advance life support (ALS) in case of cardiac arrest. The non-availability of the sufficient amount of necessary resuscitation drugs, simply means that the resuscitation team will be unable to administer effective ALS[23]. The present study showed that adequate number of drugs as defined by the stakeholders was available, but since the quantity of each was not fixed, there are chances of stock out situations. The standard guidelines as per NABH MOM 3(e), which states that no drugs other than emergency drugs should be placed in the crash carts has not been followed as the first drawer contained medications such as anti-biotics, anti-emetics etc., while this space should actually be used for emergency drugs like midazolam etc. Due to this jeopardized space, adequate number of consumables including sterile sets could not be accommodated which has to be then maintained as buffer stock in the storage cupboards. Due to this, there are high chances of inter-mixing of stock of various sizes which can create confusions, gross medical errors in the already stressful situation of conducting a CPR.

The location of the carts was appropriate and in easy reach but in some areas like the medical emergency, all the three carts have been kept in the High dependency unit which can be missed by a new doctor / new staff (including paramedical and support staff). As suggested by Sawson, there are various ways to increase awareness of the presence and location of the trolleys. This includes signs and arrows highlighting their location in the hospital. It is also advised that a greater degree of involvement of the trainees and consultants in updating and restocking the trolleys should be done. Local study days and emergency drills should include the location of the trolleys and not just the clinical aspect of saving the patients [24].

As per the Nursing practice educator, the quantity should depend upon the anticipated work load in terms of nature of work and throughput of patients. Availability of equipment from nearby departments where certain equipment may be shared between areas could include the location of auto -mated external defibrillators (AEDs). Also, the nursing staff should be aware of the location and contents of resuscitation trolley, as they will also be acting in the capacity of the "First responder" during initial stages of the resuscitation [25]. Specialized local requirements such as trauma resuscitation and paediatrics can be in-corporated as per the specific requirement of the area [26].

As recommended by Resuscitation council, UK, Resuscitation equipment should be for single-patient use and latex-free, whenever possible. Where non-disposable equipment is used, a policy for decontamination between use in different patients must be available and followed. A reliable system of equipment checks and replacement must be in place to ensure that equipment and drugs are always available for use in a cardio respiratory arrest. This process should be designated to named individuals, with reliable arrangements for cover in case of absence. The frequency of checks will depend upon local circumstances but should be at least weekly [27].

As recommended by NABH, MOM 13 (c) guidelines, the contents of the cart be locked to ensure prevention of theft. For the disaster cart, the system of numbering the keys with the lock numbers was been undertaken. The other two mobile, lockable carts were not locked probably due to the heavy work load. There can be provision for the so-called 'intelligent trolleys' that could automatically produce reminders or visual signals when equipment is missing which could help nurses remember, to check a piece of equipment prior to CPR. Such automation could increase safety and the nurses' confidence levels during resuscitation. However, the same objective could be reached by sustained effective daily checking and replenishing of all items on each emergency trolley.

Labeling

The protocol for labelling of drawers, containers with the name of the item, expiry date is mandatory, as per the accreditation guidelines, MOM 5 (c). This aids in the reduction of medication errors and timely return of the drugs reaching near expiry. As recommended by signage's defining the signs showing the direction and location of the carts, defibrillators, oxygen cylinders would help create awareness for the users.

Functionality of the Equipment

As per the code blue manual, Royal Brisbane & Women's Hospital Health Service District and New Zealand, Resuscitation Council, the resuscitation equipment must be checked on a daily basis. Also, intubation and IV equipment packs contain disposable (single use) items, except for the laryngoscope handle is being practiced in the department. As recommended by the Standards for Resuscitation, New Zealand resuscitation council, single use equipment, and infection control issues should be considered [28]. The electrical equipment however is checked by the technician staff in all the areas. In the medical emergency, the status is being reported to the nursing in-charge, whereas in other areas, only verbal communication is done, due to which follow up by the nurses can be missed. The protocol followed in medical emergency needs to be followed in other areas also to increase accountability. Adequate number of spare parts needs, batteries and bulbs need to be kept in the cart. This is because, healthcare organizations have an obligation to provide a high-quality resuscitation service, due to which, the concept of the emergency trolleys was developed, to maximize the efficiency in critical situations when seconds could make a difference for the patients survival. Therefore, it is recommended that institutions should adopt common cardiac arrest equipment based on standards and should ensure that regular equipment checks are performed [29]. Although the rational use of drugs and defibrillation in resuscitation has been standardized according to national and international guidelines, there had been no such standardization of resuscitation equipment, until recommendations were given by the Resuscitation Council in 2001 which is considered as the Gold Standard benchmark to describe in detail the availability of relevant resuscitation equipment in cardiac arrest trolleys [30].

Documentation

Attempts have been made to complete the documentation. The documentation for checking must be done in every shift in critical areas and once a day for the electrical equipments. As per Dyson And Smith, A standard checklist with a list of compulsory equipment and drugs must be displayed on the trolley to assist in systematic, visual and functional testing [29]. Jevon recommends that each clinical department should be responsible for checking its own resuscitation equipment – preferably on a daily basis. The functionality and efficiency of the electrical equipment and other hardware on emergency trolleys should also be checked frequently and serviced on a regular basis [30]. Smith et al. found that because basic trolley-checking procedures had not been followed in the UK, these trolleys often lacked essential items, and were therefore of little use for responding to CPR emergencies. They also found that some emergency trolleys were only checked every third day, and some remained unchecked for up to nine day [31].

Conclusion

Emergencies can and do occur, and being prepared for them requires an investment of time, effort and resources. Organization and planning are important for preventing chaotic emergency response. To enhance adherence to checking procedures, Nolan (2000:320) identified five broad categories of tactics: reducing the complexity of the system, optimizing information, wise automation, use of constraints and mitigating the unwanted side-effects of change. These could be applied to resuscitation equipment. In the study undertaken, the availability of the drugs was adequate, however, stock out situations can arise for which the basic stock needs to be defined and implemented. The equipment checking procedures were not followed properly and the role of the nursing, being the first responder was not being highlighted. But the nursing staff should be well aware of the functionality of the equipment. Failure to do so regularly, indicate that delays might be encountered in instituting CPR, in these hospital wards which would negatively impact CPR outcomes. Identifying equipment failures as well as missing equipment may assist facilities in ensuring the development of thorough emergency checklists that address the specific needs of the unit's patient population. Creating checklists and conducting mock codes can go a long way towards monitoring and maintaining a constant state of readiness. To prevent faulty equipment, missing items, or outdated medications whenever needed. Finally, analyzing or conducting a post-review after a real emergency can ensure that all staff provide inputs regarding target areas for improvement. This descriptive study has highlighted that the procedures being followed or recommended should be standardized in all the clinical areas of the hospital except the quantity of items which should be defined according to the workload and past utilization. The fact that attempts have been made by the staff to follow the various guidelines, cannot be refuted. The areas of improvement entitle providing autonomy to the nursing staff with increased responsibility and accountability for improving management model within the department. It has to be accepted that with continuous sensitization and administrative support, maximum compliance can be achieved even with the current workload being handled in the department. The study, conducted in the emergency department of a tertiary teaching institute, one of the apex hospitals of the country. Considering the implications of delays in the emergency, and the impact of such delays on the well being of society and in general, and doctors in particular, a well-equipped, adequately stocked, properly managed crash cart is of vital importance. However more studies need to be conducted in this area considering the time taken for resuscitation along with cost implications of maintaining a standardized crash cart.

Recommendation

Improvements in CPR outcomes might be achieved by the standardization of resuscitation equipment.

Standardized checklists can be used for uniform maintenance standards, ensuring that the emergency trolleys remain well stocked and fully functional. Developing the Standard Operating Procedures with provision of regular audits and in-service education could improve the system of checking, replacing and repairing the equipment of the emergency trolleys. This would help to increase accountability. Stand by manual equipment like portable oxygen, ambu bags should be available in case of electricity failures. Regular audits should be done by nurse administrators of specific emergency trolleys and the outcomes of these audits should be recorded for future comparative purposes.

Departmental managers and senior nursing officials should be held accountable for the maintenance, checking upkeep and recording of all items that should be a part of the emergency trolleys. The equipment that is used for CPR (including defibrillators) and the layout of the equipment and the drugs on resuscitation trolleys should be standardized throughout the institution. The emergency trolley's location should be in identical locations. Bilingual signage's for assisting in location of trolleys, defibrillators, oxygen cylinders, should be placed at strategic locations. Any harm that is experienced by patients – including mortality – because of missing, faulty or expired equipment or the unavailability of necessary CPR medications during an arrest should be described in writing. Such incidents should be reported to the administration. so that remedial actions can be instituted. Minimising the complexity of the emergency trolley, standardizing the equipment, standardizing the checklist, enhancing nurses' knowledge levels, identifying deficits and immediate replacement of emergency equipment would reduce time delays and errors during CPR.

Limitations

- Firstly: The study findings are limited to the emergency area of the hospital. The findings cannot be generalized to the other areas of the hospital considering the process flow and amount of load being catered to by the emergency department.

- Secondly: The post intervention audit needs to be extended over a period of atleast 12 more months so that the actual compliance in this stressful area can be measured.

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Annexure 1: Checklist Used for the Study

1. Are the emergency crash cart available
2. Is the emergency crash cart conveniently located
3. Does the emergency crash cart have a list of medication and equipments
4. Are the medication and IV fluids were labeled properly
5. Are the medication arranged according to their action
6. Are the drawers of the crash cart clearly labeled
7. Are the medication arranged in sequence and in order
8. Are the medication checked periodically and exchanged based on expiry date
9. Are the sterile package checked for package integrity
10. Is the inventoried equipment checked daily on each shift
11. Is the crash cart periodically monitored by ward in charge
12. Is the equipment inventory documentation updated
13. Is the defibrillator checked daily for working condition
14. Does the crash cart contain articles for intubation
15. Is the skilled nursing personal assigned to monitor crash cart
16. Is the oxygen cylinder secured to the crash cart by a portable stand
17. Does the crash cart contain sufficient emergency drugs

Annexure 2: Standard Operating Procedures.

The Standard operating procedures defined for the crash cart is as follows:

Protocol

Definition

Crash cart is cart stocked with emergency medical equipment, supplies, and drugs for use by medical personnel especially during efforts to resuscitate a patient experiencing cardiac arrest

Purposes

- To facilitates coordination of emergency equipment.
- Organized crash cart facilitates staff familiarity with equipment location.
- To ensure a properly stocked emergency equipment and drugs.
- To ensure a properly functioning equipment including defibrillator readily available with easy access.
- A well organized crash cart can serve a lot of time and confusion during an emergency.

Nurses' Responsibility

- Crash cart must be conveniently located.
- All staff should be familiar with the content and location of all medication and equipment in the crash cart.
- Drawers can be organized and arranged from top to bottom in the following order medication, airway, circulation, IV solution and tubing, miscellaneous or as defined by the department.
- Defibrillator must be checked in every shift.
- A licensed staff nurse must be responsible for checking crash cart.
- Each emergency cart should be equipped with a number lock and kept lock unless in use.
- Drawers of crash cart are to be clearly labeled to identify contents by general categories.
- Oxygen cylinder are regularly checked and replaced when tank has < 500 psi.
- Articles for intubation must be readily available.
- Proper drug storage, stock level and documentation must be maintained Crash card checklist.
- The checklist must be monitored by the ward in charge.

INTER AGENCY GROUP PREPAREDNESS

- Evaluating Inter-Organizational Network Preparedness to Respond Tsunami Early Warning System in West Sumatra - *Mizan Bustanul Fuady Bisri1*

EVALUATING INTER-ORGANIZATIONAL NETWORK PREPAREDNESS TO RESPOND TSUNAMI EARLY WARNING SYSTEM IN WEST SUMATRA

Mizan Bustanul Fuady Bisri

Introduction

Indonesia already established end-to-end Tsunami Early Warning System (Ina-TEWS) in 2008 and by 2012 the system was expanded to assume regional mandate as the Regional Tsunami Service Provider in the scheme of Indian-Ocean Tsunami Early Warning and Mitigation System (IO-TEWS). However, there is still a room for improvement exists; i.e. the need to install another tsunami early warning hardware to complement current Ina-TEWS for detecting Near-field induced Tsunamis (NFTs). University of Pittsburgh and Bandung Institute of Technology (ITB) partnership will install a new hardware for improving Ina-TEWS capability on above-mentioned matter, particularly along the coast of West Sumatra Province.

With improvement on the technological side, improvement on the early warning, evacuation order, and emergency/crisis response Standard Operating Procedure (SOP) at local level and education for general public are necessary. As part of the societal improvement, application of network theory using Social Network Analysis (SNA) is being conducted, to analyze the required improvement upon the installment of new tsunami warning system to local early warning, evacuation order, and emergency response policy and real-time information flow among multi-stakeholder in emergency situations. Integral to this concern, empirical analysis on inter-relationsand network among disaster management actors in the study area is required. As initial focus, the study scope of this research is limited to four municipalities in the coast of West Sumatra province;i.e. Agam Regency, Pesisir Selatan Regency, Padang City, and Pariaman City. Therefore, this paper will exhibit the achievement of the first year implementation of this project; i.e. with the following objective: 1) Examine the current network of inter-organizational coordination and information flow in utilizing current tsunami early warning system and emergency response Standard Operating Procedure (SOP), 2) Model the networks of coordination, interaction, and information exchange among disaster-related actors in West Sumatra Province before the new NFT near-field tsunami early warning installed, and 3) Prepared baseline of network for future identification and performance comparison between network on before and after new near-field early warning installment on its timeliness and effectiveness of emergency response. Specifically, the research in its first year aims to answer the following questions: 1) in what ways did multiple disaster-related actors in West Sumatra obtain, utilize, and exchange information regarding tsunami early warning? and 2) what were the characteristics of network of information flow and multiple actors for coordination on current TEWS and what is needed to be adjusted for future near-field tsunami early warning system installment?

Methodology

For this research the network modelling is conducted using Social Network Analysis (SNA); i.e.is the study of structural relationships among interacting network actors, and of how those relationships produce varying effects (Varda et al, 2009). One of the fundamental properties of SNA is the ability to determine, through mathematical algorithms, whether network members are connected one to another, and to what degree, in various relationships.

To serve the purpose of modelling the network for four municipalities in West Sumatra on their tsunami early warning system and emergency response information flows, coordination, and cooperation, there are two data collection methods undertaken; i.e. desk study on secondary data and semi-structured interview for information gathering which commonly known as "network census" in SN work. On the first one, basically the research team reviewed existing development and disaster management plans, reports, Standard Operating Procedure (SOP), and other relevant documents on local government responses to past as well as against future earthquake and tsunami disasters. Information compiled from the desk study will be used for the Baseline Network-Type 1. As for the second data collection activity, the research team conducted semi-structured interview to representative from both governmental and non-governmental organizations via combination of purposive and snow-ball sampling. Information compiled from the network census via semi-interview will be used for producing the Baseline Network-Type 2.

For modelling inter-organizational network of organizations in relation to tsunami early warning system and emergency response preparedness, two network types will be produce as baseline; i.e. Baseline Network type-1 or can be called "Network-based-on paper" and BaselineNetwork type-2 or can be called "Network-based-on actor declaration". Both of the network modelling will be done using SNA software called UCINET Version 6.4 (Wasserman & Faust, 1994).

For the first network, basically all existing development and disaster management plans,reports, Standard Operating Procedure (SOP), and other relevant documents will be reviewed and relational information will be marked and store into Relational Matrix Database 1. From the database, Baseline Network Type-1 will produced i.e. this network basically represent the "ideal" network of organizations in responding to tsunami early warning system and response to the expected tsunami based on the disaster management policy of each municipality. On the other hand, the second type of network (Baseline Network type-2) will use the input from interviewee answers during the interview for network census, as explained in the previous section.[2] Afterwards, similar with the first procedure, Relational Matrix Database 2 will be produce, and later feed in to the SNA software to produce Baseline Network Type-2. By comparing the first and second type of network, structural gaps in the network of disaster management organizations of each municipality can be detected. Furthermore, SNA analyzes the complete network structure (sociometric), i.e. by performing measurements on degree centrality, betweeness centrality, closeness centrality, density, and cliques. For this research, SNA measurements will be conducted for both Baseline Network Type-1 and Baseline Network Type-2, and thus comparison will be made to highlight structural gaps.

Preliminary Result and Way Forward

To this stage, fieldwork to all four municipalities has been done and preliminary Baseline Network Type-1 and Baseline Network Type-2 is ongoing. As an illustration, in Figure 1 it can be seen that the expected network based on Agam Regency Standard Operating Procedure on responding to earthquake and tsunami threat was not materialized in the actual network based on our "network census" via interview to disaster-related actors in Agam Regency. Furthermore, as part of our structural gaps identification, initial figure show that although Badan Penanggulangan Bencana Daerah (BPBD - Local Disaster Management Agency) already identified as key actors, and perceived by other as such, the actual structural gaps lies at the absence of awareness of other municipality agencies on their role as head of task force under the coordination of

BPBD; e.g. in Agam Regency it was the unprepared Public Work Agency

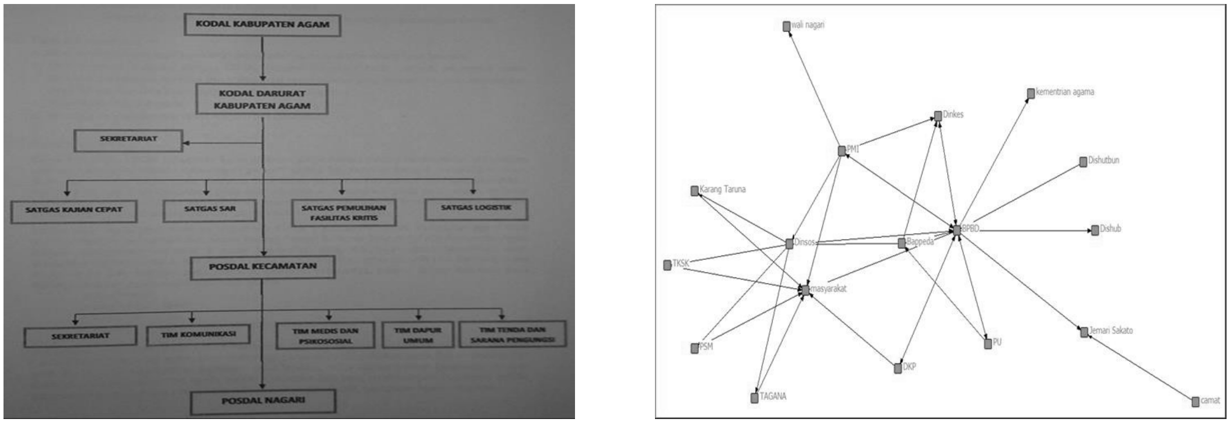


Figure 1 Comparison between Network-based on Tsunami Early Warning and Emergency Documents (left) with Actual Network (right)

as the head of critical infrastructure recovery task force and confusion between Health Agency and Social Agency as to whom in charge more to serve the victims.

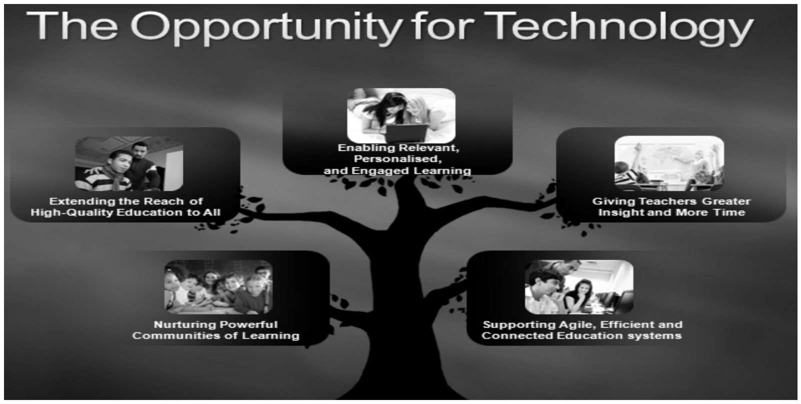
As described above, basically modelling to Baseline Network Type-2 and Type-2 will be produced and comparison will be made. Furthermore, Authors will also analyzed the condition of components of TEWS and emergency response capacity of each municipality, thus search for the correlation and possible explanations on whether the capacity affect the network model. For example, whether or not the quality of TEWS and Emergency Response documents and routine simulation and drill affect the least structural gaps between planned and actual networks. Table 1 exhibit some of the TEWS and ER capacity that being identified on each municipality

Table 1 Overall Baseline Capacity for TEWS and ER in Four Municipalities

TEWS and Emergency Response Capacity	Padang City	Pariaman City	Agam Regency	Pesisir Selatan Regency
Existence of BPBD	o	o	o	o
Existence of EOC	o	o	o	o
24/7 EOC operation	x	x	x	x
TEWS SOP	o	o	x	X
Integrated TEWS and ER SOP	o	o	x	x
General Disaster Emergency Response SOP	o	o	o	o
Tsunami Contingency Plan	o	o	x	x
Experience on TTX, CPX	o	o	x	o

♣

INFORMATION COMMUNICATION TECHNOLOGIES



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- ICT Support Services for National Disaster Management - *M. S. Rao*
- Mapping of Disaster Zones In India - *Prof. BupinderZutshi, PriyaBhakat, Homolata Borah*
- Application of ICT tools in Drought Monitoring and Mitigation - *G S Srinivasa Reddy and C N Prabhu*

ICT SUPPORT SERVICES FOR NATIONAL DISASTER MANAGEMENT

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Introduction

Information and Communication Technology has lanced into all disciplines, thereby rendering decision making more efficient and cost effective. Keeping this in view, in 1990s, to support United Nation's Natural Disaster Reduction Decade Programme, NIC undertook informatics research and development under its national programme, called "Natural Hazards Management Information System(NHMIS)". The main aim of this national programme was initially to provide ICT based solutions for disaster management by utilizing its satellite based computer communication network NICNET, covering all Districts, State capitals and Centre. Under this programme, pilot projects were taken up and several ICT contributions have been made in the area of Disaster Management [1-17]. In the immediate aftermath of December 2004 Tsunami, the Government of India took a far reaching decision with a vision to transform the approach to disaster management (DM) by inducting Science and Technology in all the elements of DM continuum. The DM Bill was introduced and it became an Act in December 2005. As per the new policy frame work, National Disaster Management Authority (NDMA) was established as an apex body for Disaster Management in the country. In tune with the new policy frame work to provide ICT support to National Disaster Management, the NHMIS Division of NIC was renamed as "National Disaster Management Information System (NDMIS)" Division. Since 2005, NDMIS Division of NIC was actively involved in providing ICT support to NDMA.

This paper presents the new government policy frame work and review of the existing ICT set up with specific reference to NIC efforts made so far in developing the ICT systems for disaster management in the country. It highlights the issues/inadequacies of the present system. The on-going and future activities of ICT development and implementation plan of National Disaster Management are also discussed.

Government Policy Framework for National Disaster Management

Keeping in mind, the hazard profile of the country and its impact on the national economy at regular intervals in general and the impact of the last few major disasters in particular viz. i) Orissa, Super cyclone (29th October, 1999), ii) Bhuj Earthquake (26th January, 2001), iii) Tsunami (26th December, 2004) and iv) J&K Earthquake (8th October, 2005) resulting in the loss of about 40,200 lives and Rs 34,400 crores worth property, India decided to switch over from erstwhile reactive and response centric to a proactive and holistic management of DM by inducting science and technology in all the elements of DM continuum on 23rd Dec, 2005, when DM act was passed by the Parliament[18]. Broadly this approach calls for development of the essential scientific and technological infrastructures, establishment of an advanced technology based reliable and dedicated National Disaster Management Information and Communication System (NDMICS) which would play a decisive role.

The Disaster Management Act 2005, clearly spells out the organizational structure withcorresponding functional responsibilities for DM in India. At national level, the Disaster Management Act, 2005, has envisaged the National Disaster Management Authority (NDMA), the apex body headed by the Prime Minister as the Chairperson.In essence, NDMA is to concentrate on prevention, preparedness, mitigation, rehabilitation, reconstruction and recovery phases of disaster besides formulating appropriate policies and guidelines for effective and synergized national disaster response and relief. Furthermore, being the highest policy making body for disaster management in the country, it is also to coordinate the enforcement and implementation of its policies and plans. The Disaster Management Act, 2005 has thus created certain institutional bodies from within the existing administrative structure, with statutory duties in connection with disaster management at all the levels of governance, i.e. National, State and District.

For providing immediate response, National Disaster Response Force (NDRF), which is fully trained and equipped to handle all major natural and some of the man-made disasters like Chemical Biological Radiological and Nuclear (CBRN), has been raised and it works under the general superintendence, direction and control of the NDMA. It is located in 10 different regions of the country as per the vulnerability profile of the region/area and the NDRF (HQ) in Delhi. Each NDRF battalion consists of 1149 personnel.

All the components of the Institutional structure of DM are required to have desired ICT connectivity and support, for effective coordination and management. The early warning and forecasting agencies (NRSC, INCOIS, CWC, IMD, GSI, SAC etc.) require due connectivity with large band width.

Certain specific contents of Disaster Management Act are a clear pointer towards some specific components of disaster management along with related Information and Communication Technology (ICT) infrastructural support measures. Portions of the Act concerning Information & Communication Technology (ICT) Infrastructure are enumerated below.

- Implementation of national, state and district policies.
- Setting up of mechanism for early warning and dissemination of information.
- Establishment of communication links.
- Dissemination of information to the public.
- Providing emergency communication system in vulnerable/affected areas.
- Capacity building in accordance with the guidelines.
- Facilitation of community training and awareness programme.
- Integration of DM in development plans and projects.
- Promoting awareness among stakeholders.
- Organizing conferences and lectures.
- Intentional false alarm or warning - punishable offence.

Review of the Existing ICT setup

National Disaster Management network includes Decision Makers (MHA, NDMA and PMO), Data Providers(NRSC, INCOIS. CWC, IMD, GSI etc.), Data Consumers (SEOCs, DEOCs and Relief and Rescue teams at disaster site) and Emergency Support Functionaries (ESFs). NRSC, INCOIS, IMD, CWC, GSI etc. are the early warning/forecasting agencies identified as large volume data providers for decision making. The State Emergency Operation Centres (SEOCs) at state level, District Emergency Operation Centres (DEOCs) at district level and Mobile Emergency Operation Centres (MEOCs) at the disaster site are designated as user nodes. The Emergency Support Functionaries are the Central Government departments where the response and the Rehabilitation are the major activities.

During the event of the disaster the relief teams (First responders, NDRF teams and NGOs), emergency support functionaries and decision makers at national, state, district and local level at the emergency site should work as team in a coordinated manner.

All the above agencies require robust and fail safe ICT support especially during emergency situation.

Communication Infrastructure

Optical Fiber based Communication (OFC) Network has been extensively installed throughout the country. Using this OFC infrastructure NIC is providing e-Governance/NKN services to various Government organizations. Further, a fairly large Satellite based communication networks also exist in the country viz NICNET, POLNET and ISRO DMS Network provide satellite connectivity. Various major communication networks have already been established in the country. The list of such networks is given below.

- Disaster Management Support (DMS) Network of ISRO.
- Police Telecommunication Network (POLENET) of MHA.
- NICNET/NKN of NIC.
- Network of Department of Atomic Energy.
- Cyclone Forecasting and Warning Network of IMD.
- Seismological Observation Network of IMD.
- Flood Forecasting and Warning Network of CWC.
- Tsunami Warning Network of INCOIS.
- National Emergency Communication Plan (NECP) of MHA for management of Law and order, crisis and disaster situation.

NDRF Battalions are primarily using mobile phones (GSM) for communication. In addition to mobile phones, NDRF Battalions are extensively using VHF/UHF Base Station and VHF/UHF handsets for group voice connectivity in half duplex mode in the operational area. HF sets are being used for communicating long distance from disaster site to battalion headquarters/NDRF Headquarters through ionosphere.

Information Systems

Ministry of Environment & Forest (MOE&F) implemented "GIS Based Emergency Planning and Response System for Major Cluster of Industries" to assist the various agencies for planning emergency situation arising out of the spillage of hazardous chemicals. ISRO developed INSAT based Distress Alert transmitter (DAT) through an Indian industry with technical expertise from Space Application Centre (SAC), Ahmadabad.

Centre for Distributed Computing Jadavpur University in collaboration with IIM, Calcutta initiated a project titled "A Secured Decentralized Disaster Management Information Networking using rapidly deployable wireless network & mobile computing technologies". Indian Disaster Resource Network (IDRN),a web based on-line information system, has been established under the Disaster Risk Management Programme of UNDP. The Network acts as a disaster resource inventory containing comprehensive database of material and human resources available and their locations, to respond to emergencies on an immediate basis. However, it needs to be updated on a regular basis. NIDM is providing the services.

GIS-based National Database for Emergency Management (NDEM) has been established by MHA through NRSC in collaboration with various Ministries/agencies. SAARC Disaster Management Centre (SDMC), New Delhi implemented two very ambitious and socially relevant projects to serve the citizens of the SAARC countries, namely the South Asia Disaster Knowledge Network (SDKN) and South Asia Digital Vulnerability Atlas (DVA) portals. Recently, "InDisData" software has been developed by MHA in consultation with UNISDR. This software helps in compilation of block/district level disaster loss information.Efforts are in progress in implementing the software.

Application Development Methodology and NIC Efforts

Disaster Management is viewed to consist of a number of organizations /departments involved in some aspect or other of the disaster management in its three phases; i.e. pre, during and post disaster phases. For flood and drought management the river basin is the true logical unit for carrying out any meaningful flood or drought management activities. For cyclones, the coastal zones where as for earthquakes the seismic zones are logical units. These logical units do not have any directcorrelation with the existing political or administrative boundaries which are the practical units for disaster administration. Hence, the disaster management model used envisages a scheme where, even though thecomplete logical unit is selected to capture all the relevant data/information, proper in-depth studyabout various practical management aspects are planned based on administrative boundaries for case of implementation. For application development, this logical unit is sub divided in number of physical units which are termed as Work Areas (WAs). The disaster information system model essentially revolves around the selected Work Area (WA) which acts as the domain for undertaking necessary implementational work. The WA may be one or more districts either in-part or in-full. It is also to be noted that the WA even though mostly confined to a particular state to start with, could include portion of other neighboring states.

Based on the above model, initially NIC concentrated its activities on flood hazard management in the state of Orissa, since it happened to be one of the most flood prone states in the country. Cuttack was selected as the pilot district and there after extensive study had been carried out interacting with various State and Central Government user departments for application development for flood management. To understand the requirements and the business logic, various published government reports and documents were collected during the information study phase. Based on the study, various applications for flood management were designed and developed. Applications were designed using the waterfall approach. Most of these applications were demonstrated and some of them were implemented [3, 4].

Subsequently, NIC had also developed applications for Cyclone, drought and tsunami relief management by interacting with NDM Division, Ministry of Agriculture and Ministry of Home Affairs, Government of India at national level. These applications at national level were also developed using the same methodology and design philosophy which was followed in Orissa for flood management. The contributions of NIC in the field of disaster management are documented and presented in various national and international conferences [7, 8, 11, 12, 14, and 16].

Bottlenecks and Challenges

- Several communications and IT related networks are operational both in public and private domain, but they all are operating in 'Stand Alone'mode and need to be integrated appropriately.
- The Early Warning Agencies (IMD, CWC, INCOIS and GSI) and NRSC are having independent ICT infrastructure to meet their own functional requirements. All these organizations use multiple software systems and the services are not integrated. At present the information dissemination is through e-mail, SMS and FAX.
- Heterogeneous software systems developed by these organizations need to exchange data with each other, and a web service is a method of communication that allows
- Software systems to exchange data over the Internet. The present DM system does not have such a system architecture for exchange of data.

Proposed Action Plan and ongoing Activities

To address the above issues and to eliminate the inadequacies of the present system a comprehensive plan for application development was proposed to NDMA [19]. The major applications developed by NIC during the past 10-15 years, can be broadly classified into six major categories as given below.

- Alert Messaging System: Alert Messaging System can be used to send E-mail, & SMS with in a close user group of disaster managers. This system facilitates archiving the messages for future retrieval &reference. The Alert messages may be text, audio or video. The Alert messages may be synchronous or asynchronous mode.
- Incident Reporting System: Incident Reporting System can be used by field reporting teams & district officials to report the data in a standardized format on different disaster events from any part of the country to senior officials in Government Departments.
- Damage/Risk Assessment System: With detailed knowledge of hazard and vulnerability it may be possible to construct models that predict the impact of a given event in a specific time/place. Scenarios can be developed at various levels of sophistication that predicts casualty patterns, scales of damage and the secondary economic impact of the disaster in relation to varying scales of hazard impact. Such predictions have a wide variety of applications in disaster management.
- Resource Analysis and emergent relief: The impact of the event needs to be balanced by resources, including funds, with the ultimate aim of a safe, stable equilibrium. Effective hazard and vulnerability assessment will provide a series of pointers that indicate the type and location of resources that are needed.
- Decision Support Systems for Relief and Rescue Management: Information generated from the above modules in a suitable formats (reports/tables/charts/maps/images) enable to decide on a responsible course of action.
- System Administration and tools: This module provides generic tools for administrating user accounts and databases. Various GIS and Remote Sensing application products are to be integrated as a part of tool library in this module.

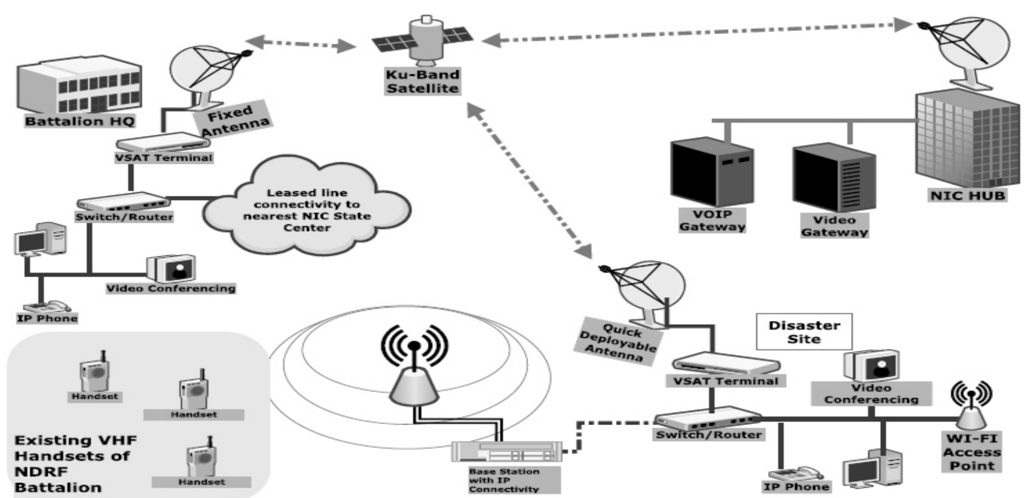
Based on the above technical inputs and extensive consultations with all the other stakeholders, NDMA published the National Guidelines on National Disaster Management Information and Communication System (NDMICS) [20]. The guidelines spell out the ICT requirements and characteristics along with the necessary structure in terms of organizational measures and the operational/functional matrix for achieving NDMA's goal for holistic anagement of disaster. The guidelines broadly relates to two major components. The first one is the guidelines regarding the infrastructure creation namely National Disaster Communication Network (NDCN) and the second one is the guidelines regarding NDM Application Services on GIS platform for DM operations.

NDCN is being hosted on the existing terrestrial backbone with added satellite media as its backup to ensure fail-safe character and the last mile connectivity would be based on satellite and VHF links with evolution towards WiFi/WiMax/micro-cellular systems. NDCN infrastructure comprises of vertical and horizontal connectivity. The vertical connectivity consists of Emergency Operations Centres (EOCs) across national, state, district and incident area levels. The horizontal connectivity consists of connectivity with NDRF battalions, Early Warning Agencies and Emergency Support Functionaries (ESF), who need connectivity to NDCN for effective DM operations. The NDM Application Services would provide assured multi services of audio, video and data augmented with GIS based value added information services in the EOCs. Disaster planning is a continuous process that once started has to be continually developed to relate to a moving target with ever changing patterns of hazards, vulnerability and resources. It is best conceptualized as cyclic process rather than linear process. Hence the ICT development for disaster management is evolutionary in nature. Keeping this in view and based on extensive deliberations with various stakeholders, the implementation of ICT systems for DM operations are in phases/pilot projects as per the broad guiding principles of NDMICS [20].

National Emergency Communication Plan (Phase-II)

NDCN guidelines emphasis the need for strengthening the ICT infrastructure of NDRF Battalions. In the light of NDCN guidelines, the ongoing activities of National Emergency Communication Plan (NECP) of MHA for DM was reviewed during 2010-11 for strengthening the communication infrastructure of NDRF. The following is the structure of NDRF Battalion.

Each NDRF Battalion is having six companies and each company having 3 teams led by an Inspector. Total strength of the team is typically about 45-50 men consisting of six sub-teams of operational and support personnel (Admin/Tech Support/Dog Squad/Medical). During disaster situations, one or more teams/companies may be sent at the site which may be 250 to 500 KMs away from the Battalion Headquarters. A temporary Tactical Headquarters is set up near the incident site and multiple teams may be deployed in an area of 25 to 100 KMs. Teams are then further split into



sub-teams and each sub-team may cover an area of 5 to 10 KMs.

NIC proposed transportable VSATs which can easily be carried by the NDRF teams in the field and mobile emergency operation centre (MEOC) which can be easily set-up in less than one hour at the disaster site. MHA sanctioned Rs. 76.79 Crores in order to strengthen communication infrastructure of NDRF Battalions spread across the country in 10 locations and NDRF HQ in Delhi for providing emergency response as part of NECP (Phase-II) implementation. NECP (Phase-II) project is being implemented with the following communication infrastructure.

- Leased line connectivity at each of the ten Battalion Headquarters and NDRF HQs with nearest NIC state/district center along with Fixed VSAT as a backup.
- 70 transportable VSATs along with IP phones, video phones and Laptops to the ten NDRF battalions for carrying to the disaster sites for setting up Emergency Operation Center.
- VHF base station can also be integrated with IP connectivity by using Radio over IP (ROIP)with transportable VSATs and existing VHF handsets at the disaster site will be able to communicate with VHF handsets in the battalion HQs on a different

VHF frequency.
10 Auto-pointing VSATs to be mounted on vehicles, one for each of the ten NDRF battalions.

The following services can be made operational at the disaster site using transportable VSATs.

- 1. Set-up IP phones at the VSAT location using which field unit will be able to contact the battalion HQs/NDRF HQs.
- Set-up Video Phone at the VSAT location using which field unit will be able to establish video conference with Battalion HQs/NDRF HQs or any district VC studio of NIC.
- Set-up high speed Internet connection at the VSAT location using which field unit will be able to send pictures, videos and regular reports through email/ftp or information can beuploaded on any web portal.

It would also be possible to connect a Wi-Fi Access Point with the VSAT so that voice, video and data services as mentioned above can be easily accessed in wireless mode with in the campus (< 50 M) without need for laying LAN cables. Detailed networkdiagram is given in Figure-1. It is expected that the implementation of the project shall be completed by March, 2016. Figure-1: Communication network diagram of NECP (Phase-II)

NDM Services Pilot Project

A project proposal was under consideration to integrate the NDCN pilot project along with the DM services which are being provided by various Government agencies (CWC, IMD, INCOIS, GSI, NRSC, etc.) [21]. The integrated approach is to provide fail safe communication infrastructure (NDCN) along with the application services to the disaster managers for relief operations in the event of a natural hazard. The integrated approach is part of ICT services of NDMA to assist the local administration in rescue & relief operations based on the inputs from various agencies (forecasting agencies, Emergency Support Functionaries, NRSC and NDRF). This pilot project initiative is titled as "National Disaster Management Services pilot project". As part of the pilot project, it is planned to strengthen the communication infrastructure in 29 locations (2 EOCs at National level, 10 EOCs at State level and 17 EOCs at the District level) to provide the DM services. The broad objectives of the project are as follows.

- Development of ICT infrastructure in EOC at National Disaster Management Authority, MHA, State and District level to facilitate a mechanism to coordinate with various organizations involved in DM activities.
- Receive information/services provided by various forecasting and warning agencies (CWC, IMD, INCOIS, GSI, etc.) in near real time.
- GIS Map services provided by NRSC, NIC and other agencies shall be made available in the EOCs.

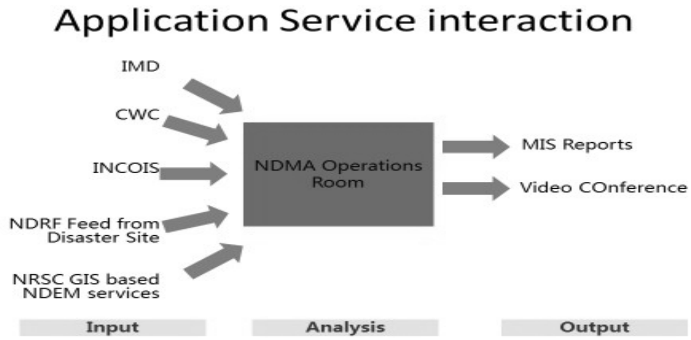


Figure-2: Application Service Interaction in NDMA Operation Room

- Providing a single view of the disaster from the disaster site to all stakeholders, through integration of various information (Video, audio and data).
- A common application development frame work shall be designed to integrate services offered by various Central Government organizations (CWC, IMD, INCOIS, GSI and NRSC).
- Various GIS tools/DSS shall be made available in the EOCs for developing DM applications to cater the local requirements.
- The Early Warning Agencies (IMD, CWC, INCOIS and GSI) and NRSC are having independent ICT infrastructure to meet their own functional requirements. All these organizations use multiple software systems. Heterogeneous software systems developed by these organizations need to exchange data with each other, and a web service is a method of communication that allows software systems to exchange data over the Internet. An application frame work need to be designed to integrate all these services over GIS platform. The proposed application services in NDMA Operations Room are shown in Figure-2.

Conclusions

To improve the responsiveness in functioning of Disaster Managers and to respond quickly to natural disasters, establishment of state of the art Emergency Operation Centres (EOCs) at National, State, and District level are essential. A common application development frame work needs to be developed to integrate services offered by various Central Government organizations (CWC, IMD, INCOIS, GSI, NRSC, Emergency Support Functionaries, and NDRF). This will provide a single view of the disaster to all stakeholders from the disaster site and help in decision making. It should be ensured that the ICT systems are in order and disaster management drills are carried out periodically.

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TOOL FOR DISASTER COMMUNICATION

EXPERIENCES OF MKRISHI DURING HUDHUD CYCLONE

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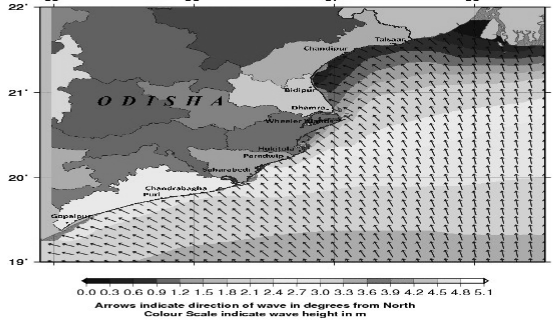
Abstract

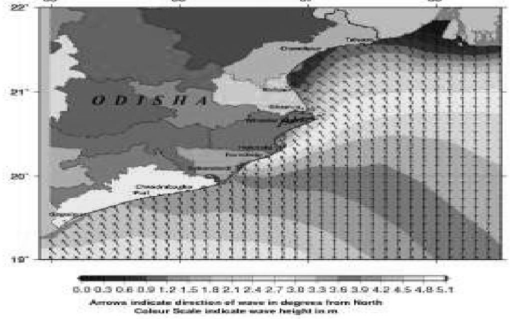
Hudhud was one of the severe cyclonic storms generated in the North Indian Ocean, in 2014. It was the most destructive tropical cyclone in the basin since 2008 after the very severe cyclonic storm Phailin in 2013. Hudhud originated from a low pressure system that formed under the influence of an upper-air cyclonic circulation in the Andaman Sea on October 6 2014. Hudhud intensified into a cyclonic storm on October 8 and as a Severe Cyclonic Storm on October 9. Hudhud underwent rapid deepening in the following days and was classified as a Very Severe Cyclonic Storm by the IMD. On October 11, Hudhud underwent rapid intensification and developed an eye at its centre. In the following hours, the storm reached its peak intensity with a minimum central pressure of 950 mbar (28.05 inHg) and three-minute average wind speeds of 185 km/h (115 mph). Maintaining intensity, it made landfall over Visakhapatnam, Andhra Pradesh at noon of October 12, near 17°42′N 83°18′E 17.7°N 83.3°E. The maximum wind gust recorded by the High Wind Speed Recorder (HWSR) instrument of the Cyclone Warning Centre in Visakhapatnam was 260 km/h (160 mph)) and a minimum central pressure of 960 mbar (28.35 inHg). The strength of the winds disrupted telecommunication lines and damaged the Doppler radar, inhibiting further observations.

There was no direct effect of cyclone in Ganjam (Odisha) district but the wind speed was 60-70 km/hr followed by a little heavy rainfall for few hours. It still impacted 247,558 hectares (ha) of agricultural land in Odisha of which 40,484.5 ha have sustained crop loss of over 50 per cent. A preliminary damage assessment report by the state agriculture department has pegged the crop loss at Rs 23.77crore.Vegetable nurseries were damaged a lot due to heavy rainfall.

Farmers were informed about upcoming cyclone since 6th October using mKRISHI® mobile app and the voice services. Alerts about the path, wind speed, landfall, area to be affected were shared based on IMD and INCOIS information. Though Ganjam was initially in the highly affected area for the upcoming cyclone but later it changed the path. During the cyclonic period the alert were sent to the farmer in a regular interval. As there was no electricity hence mKRISHI® was the only source of news for them. Farmers were advised on apply the last dose of fertilizer for medium duration paddy at the earliest, draining out all the water from the rice field, repairing the drainage channel in the field, etc.

Hence, a coordinated ICT based information delivery in local language helped farmers and fishermen plan their activities towards safety and better crop management.





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ROLE OF HUMAN BIOLOGICAL MONITORING IN DISASTER MANAGEMENT

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Abstract

Human biological monitoring (HBM) is a tool for assessing and understanding the relationship between exposure to pollutants and health implications. We have attempted the use of exposure biomarkers in subjects occupationally exposed to pesticides and aryl amines in field conditions. Our studies pertaining to the workers of industrial settings engaged in formulation of insecticides showed depression of blood cholinesterase activity and identification of DNA and hemoglobin adducts in population exposed to arylamines. Selection of suitable biomarkers and their adequate validation, the biological media to be sampled, statistically approved study design, ethical approval of the study protocol, effectiveness of control measures are the issues to be addressed in use of HBM in management of chemical disasters. The use of relevant biomarkers allows the regulatory decision-making authorities to make prevention strategies for risk reduction. Only with better human data based on validated biomarkers would enable the risk assessment process and initiatives more convenient for formulation of prevention strategies for chemical disasters.

Keywords: *Human Biological Monitoring, Pesticides, Cholinesterase, Aryl-Amines, DNA Adduct, Hemoglobin Adduct*

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Relatively large amounts of synthetic chemicals have been introduced into our environment during the last four decades. Majority of these chemicals come into contact with biological system and thus the complete interaction between them remains an issue of substantial interest. Biological monitoring is a tool for evaluating and understanding the relationship between exposure to pollutants and health implications. The salient objectives of biological monitoring are to prevent (i) to prevent health impairment (ii) to assist in the assessment of risk; (iii) to measure the effectiveness of control measures.

Exposure to a chemical pollutant may be reflected by an increased amount of the pollutant or its breakdown products (metabolites) in the body fluids or tissues of exposed individuals or by measurable characteristics biological changes which may provide a useful index of an individual's exposure. The ideal biomarker is a quantitative measurement reflecting an interaction between a biological system and an environmental agent, which may be physical, chemical and biological (WHO 1993). Biomarkers may be used to evaluate the exposure (internal dose), effects of chemicals and susceptibility of individuals. The ideal exposure biomarkers are chemical specific, detectable in trace quantities, inexpensive to assay and available by non-invasive techniques. Effect biomarkers, on the other end, are measures of function that is affected by the exposure. Biomarkers can provide valuable information in field and semi-field testing and be used to measure a wide range of physiological responses to chemicals at the biochemical, cellular or tissue level. Recent developments in analytical chemistry (Gas Chromatography/Liquid Chromatography – Mass Chromatography) improve our ability to characterize individual exposure to environmental pollutants by measuring their level in accessible biological media, down to the nano-molar level even for organic compounds. The use of more quantitative and sensitive end-points may increase our ability to identify toxic responses to chemicals polluting the workplace and the general environment. Biological monitoring markers are available on several levels for chemical carcinogens, however, these can be used to frequently in occupational health programme by providing estimates of internal and effective dose (Bhatnagar and Talaska 2011). If the concern centers on the question whether exposure has occurred, then a marker of internal dose is appropriate and usually the easiest to obtain. The pollutants like heavy metals (arsenic, cadmium, chromium, lead, inorganic mercury and methyl mercury), volatile organic solvents (benzene, toluene, hexane, xylene and nitro-benzene), organochlorine pesticides, organophosphate and carbamate pesticides, pentachlorophenols, polychlorinated biphenyls, dioxins and furans were considered as the good candidates for biological monitoring. Urine, blood, fat, saliva, hair, faeces, and body tissues are some of the biological samples usually employed for biological monitoring. The choice of the samples usually depends on the ease of collection and metabolic profile of the pollutants.

Biomarkers of Pesticide Exposure

Pesticides comprise a large group of chemical compounds designed especially for the control of pests, weeds, rodents, insects, fungi and plant diseases. There is growing global concern over the toxicological hazards caused by the pesticides to human being and environment especially during last few decades (Jaga and Brosius 1999, Bhatnagar 2001). Biological markers used to assess the exposure to pesticides and persistent organohalogen pollutants have been given in Table 1. The exposure of pesticides may affect a large segment of human population including the workers of industrial settings engaged in production of technical grade pesticides and their formulation products, sprayers, mixers, loaders, pest control agency workers, farmers and a part of general population who may experience exposure through domestic use and consumption of contaminated food and water. Biological markers used to evaluate the exposure to pesticides and persistent organohalogen pollutants have been shown in Table 1.

The measurement of acetylcholinesterase (AChE) depression in plasma and red blood cells provide a suitable index of exposure to organophosphate and carbamate insecticides and may help to identify workers at greater risk (Bhatnagar et al. 2002, Patel et al. 2008). Salivary AChE can be used as exposure biomarker of organophosphate exposure in field conditions (Nq et al. 2009).

Table 1: Biological Markers to Monitor the Exposure to Pesticides and Persistent Organic Pollutants.

S. No	Pollutants	Biomarker	Specimen		Reference
			Blood	Urine	
1	Pesticides				
	i) Organochlorines	Residues	+	+	Dale et al. 1966, Zaidi et al. 1984
	ii) Organophosphates	ChE	+		Voss and Sachsse 1970
		Alkyl Phosphates		+	Hardt and Angerer 2000
	iii) Carbamates	ChE	+		Voss and Sachsse 1970
		alpha-Naphthol		+	Meeker et al 2007
	iv) Pyrethroids				
	Cypermethrin	Cl_2A		+	Eadsforth et al. 1988
	Deltamethrin	Br_2A		+	Zhang et al. 1991, He 1993
	Fenvalerate	Fenvalerate		+	Zhang et al. 1991
2	Polychlorinated Biphenyls	Residues	+		Covaci and Schepens 2001
3	Dioxins and Furans	Residues	+		Lida and Todaka 2003

Cl_2A: 3-(2,2 dichlorovinyl) -2,2-dimethylcyclopropane carboxylic acid; Br_2-A: dibromovinyl-dimethyl-cyclopropane carboxylic acid

Residues of chlorinated pesticides (dichlorodiphenyltrichloroethane and hexachlorocyclohexane) in blood samples of occupationally exposed subjects can be detected by gas chromatography equipped with electron capture detector (Nigam et al 1993, Bhatnagar et al 2003). Urinary alkyl phosphate metabolites of organophosphates are very sensitive indicators of exposure and gas chromatography equipped with flame photometric detector offers a sensitive technique for estimation (Hardt and Angerer 2000). The epidemiological studies on pesticide exposed population should be based on a broad spectrum approach e.g. monitoring of pesticide residues, metabolites and reaction products in biological specimen, assay of ChE and specific organ function tests and delayed neurotoxicity, if any, and health checkup of workers coupled with electrocardiogram monitoring. The biomarkers for the exposure of persistent organohalogens pollutants like polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are their residues in biological samples (Covaci and Schepens 2001, Lida and Todaka 2003).

Biomarkers of Solvent Exposure

The organic solvents like benzene, hexane, toluene, xylene, nitrobenzene and styrene are widely used in the production of petrochemicals, dyes, rubber, plastic and paints, detergents and rayon in the industrial settings. Repeated human exposure to these solvents may result in irreversible structural damage to the nervous system which is manifested by the changes in the behavioural and neurological functions. Analytical tools involving gas chromatography (GC) with specific detectors such as flame ionization detector (FID), photo-ionization detector (PID) and mass detector (MS) and high performance liquid chromatography (HPLC) with UV and fluorescence detectors, can be successfully used for simultaneous determination of the contents of several aromatic solvents and their metabolites in the biological samples. Biological markers used to assess the exposure of various solvents are depicted in Table 2.

Table 2. Biological Markers to monitor the Exposure to Solvents.

S. No.	Solvents	Biomarker	Specimen		Reference
			Blood	Urine	
1	Benzene	Benzene	+		Pikari et al 1989
		Phenol, t,t-muconic acid S-phenylmercapturic acid		+	Astier et al 1992; Raghvan & Besavaiah 2005
	Toluene	Toluene	+		Pikari et al 1989
		Hippuric acid		+	Astier 1992
	Xylene	Methyl-hippuric acid		+	Astier 1992
	Stryene	Mandelic acid			Astier 1992
	Hexane	2,5-Hexanedione		+	Astier 1992
	Acetone	Acetone		+	Brega et al 1991
	Cyclohexane, Cyclohexone	1,4-Cyclohexanadiol		+	Mraz et al 1999
	Furfural	Furfural		+	Tan et al 2003
	Carbon disulphide	2-thiothiazoline-4-carboxylic acid (TTCA)		+	Van Doom et al 1981

Biomarkers of Metals Exposure

The role of biological monitoring in the prevention of exposure to toxic heavy metals has acquired considerable importance. Metal contents in blood, urine, hair, nails or teeth are likely sources for use as surrogate body burden and serve as biological indicators for toxic metal exposure. Recent analytical developments in atomic absorption spectrometry with electro thermal atomization (ETA-AAS) and of inductively coupled plasma mass spectrometry (ICP-MS) allow accurate measurements of all heavy metals with very small sample volume. Biological markers used to assess the exposure of various solvents are shown in Table 3.

Table 3: Biological Markers to Monitor the Exposure to Heavy Metals.

S. No	**Metals**	**Biomarker**	**Specimen**		**Reference**
1			**Blood**	**Urine**	
	Lead	Lead	+	+	Clarkson et al 1988
		d-aminolevulinic acid	+	+	Roels et al 1974; Secchi et al 1974
	Cadmium	Cadmium	+	+	Clarkson et al 1988
	Aluminium	Aluminium	+	+	Clarkson et al 1988
	Chromium	Chromium	+	+	Clarkson et al 1988
	Arsenic	Arsenic	+	+	Clarkson et al 1988

Biomarkers of Bulky Polycyclic Aromatic Hydrocarbons (PAH) and Aryl-amines Exposure

Human are exposed to polycyclic aromatic hydrocarbons (PAHs) from occupational, environmental and dietary sources. PAH metabolites in urine can be sued as biomarkers of internal dose to assess recent exposure to PAHs. The most widely used urinary PAH metabolites are 1-hydroxypyrene (1-PAH) and 1-hydroxypyrene-O-glucuronide (1-OHP-glu) because of their ease of measurement (Li et al 2001).

Many chemical carcinogens (and most human carcinogens) exert their biologic effects through the covalent binding of electrophilic species to cellular DNA to form modified nucleotides known as adducts (Kadluber 1992). In a cross sectional study on the workers exposed to benzidine (BZ) and benzidine based dyes in the industrial settings, the BZ-DNA adducts have been identified in exfoliated urothelial cells (Rothman et al 1996). In the same study population, the hemoglobin adducts in the exposed group subjects have also been identified (Beyerbach et al 2006).

Conclusion

Biomarkers can be used as sensitive and cost effective general indicators and have a major impact on the study of environmental risk factors. There is paucity of data on the health evaluation on high risk population groups and the future vision on biological monitoring should involve an integrated surveillance information system based on comprehensive and periodically updated modules and validated procedures. The sensitivity, specificity and predictive value of individual biomarker must be determined for correct interpretation of results. The populations in the developing countries, however, often have a subsistence lifestyle that depends on the local environment. This should include a quality assurance program to ensure that results are representative, reproducible and reliable. While occupational exposures should be paramount importance, equally vital are environmental studies which document the baseline levels in the general population. Only with better human data based on validated biomarkers would enable the risk assessment process and prevention initiatives more convenient for formulation of prevention strategies in risk reduction and industrial disaster management.

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COMMUNICATION IN DISASTER RESPONSE AND RECOVERY
A CASE STUDY OF UTTARAKHAND, INDIA

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Abstract

While much of the literature on risk communication looks into pre-disaster preparedness and risk reduction, a gap is noted for studies dealing with the role of communication in post-disaster response and recovery. Despite recurrent failure ofcommunication systems during disasters and their subsequent impacts on mounting losses, less emphasis has been paid to the effectiveness of various communication channels and their functional efficiency in dealing with critical situations and needs arising during post-disaster response, recovery and reconstruction. This case study highlights various challenges observed in communications during the 2013 Uttarakhand disaster that killed over 5000 people and affected nearly 2 million population of the state. The findings are based on 101 structured scheduled interviews conducted with the local people from the four affected districts of Uttarakhand along with in-depth interviews conducted with 10 leading response agencies operating at the local, state and national level for a scalar perspective of disaster response. The paper finds that prevailing gaps in communication get worse during disaster and amidst the chaos of incomplete and at times misleading information, delay in recovery results into the loss of trust and faith of the local people in responding agencies. It thus emphasizes that despite situational irregularities, there is a potential to channelize an ongoing communication through local public participation which may not only enhance the speed of recovery and reconstruction, but could also help in building trust towards the government institutions and other humanitarian agencies leading to effective response and generating support for future disaster mitigation.

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ANALYSIS OF GPS TEC FOR PRECURSOR SIGNATURES OF EARTHQUAKESUSING MULTI SIGNAL CLASSIFICATION ALGORITHM (MUSIC)

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Abstract

The variations in GPS VTEC on the earthquake day of the major earthquake occurred in Indonesia wereanalyzed using Multi signal classification algorithm (MUSIC). This technique is used for the estimation of amplitudes, of composite signals at particular frequencies. It performs Eigen value decomposition on covariance matrix of data to detect frequencies. This depends on orthogonality property existing between noise vector and data vectors. This algorithm gives more accurate output for composite signals.

The analysis is done for GPS VTEC data with and without disturbances. The disturbed TEChas a magnitude of around 10dB at dominant frequencies clearly representing the earthquake with that of the undisturbed data.This analysis is useful in predicting the unpredictable natural disasters.

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DIGITAL FLOOD ESTIMATION TECHNIQUE USING GEOSPATIAL TOOLS

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Abstract

The shadow of climate change is looming large on the planet earth. Water is the main medium through which almost all the impacts of climate change will be felt (Stern, 2008). The effects are already visible with the increased frequency of water related disasters like floods. Inflow or flood forecasting has been one of the effective non- structural measures to mitigate the impact of floods with proper reservoir operation including preventive actions downstream.Hydrologic parameters such as rainfall, runoffs etc vary both in space and time. For most of the hydrological models, one of the main components involved is rainfall-runoff process. Determination of more accurate areal rainfall and resulting spatial runoff converted into flow observed at the outlet of the hydrological unit is the technological challenge and is the major cause of hydrological uncertainties. Considering this, an attempt has been made in this study to make innovative use of spatial tools available. Using geospatial technology (SRS,GIS) it is possible to estimate more accurate areal rainfall, spatially varied resultant runoff and route the distributed flows from various segments of the water shed. This paper discusses ***Digital Rainfall Model****- used for estimation of areal rainfall for the storm events.* ***Digital Runoff Model****- for spatial estimation of runoff (effective rainfall) using Arc-CN Runoff tools with land use, soil map and antecedent moisture conditions of the catchment as inputs. Digital flood estimation has been attempted using Clarks approach with the spatially distributed time-area diagram for the watershed. The results of this overall* ***Digital Flood Model*** *are compared with conventional tools using nine observed storm events occurred in Panshet reservoir catchment within Krishna river basin in India, with the conclusion that this simple model having only few parameters to calibrate gives improved results.*

Keywords: *Digital Rainfall, Digital Runoff, Digital Flow, Isochrones, Time Area Histogram*

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USING UAV TECHNOLOGIES FOR FIRE FIGHTING

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Abstract

Fire Fighting and Disaster Management involve a wide range of activities which demand speed and precision on part of the firefighters. Though not common, a fire outbreak can cause severe damage to life and property as it can double in magnitude every 60 seconds. Technological advancements in Unmanned Aerial Vehicles (UAVs) and Internet of Things (IoT) carry with them the potential to minimize the impact of such disasters. This paper addresses the potential of combining these two technologies in assisting fireman respond faster and make critical decisions in the heat of the moment.

There are many possibilities for a fire to start in an open or closed area. The first step in successful firefighting is to detect it at its early stages using UV/IR fire detection systems. These systems are connected centrally to the cloud via a gateway and communicate through M2M communications. In case, fire is detected, the exact location of the incident is transmitted to the onsite UAV. This micro-sized UAV calculates the best and shortest path to reach the location specified based on 3D Structuring of the building. Equipped with a thermal imaging camera, it captures the incident and broadcasts it to the surrounding fire stations. Screening for false alarms, suitable fire engine units are deployed based on factors like cause of fire, intensity, velocity of wind, presence of flammable goods in the premises, civilians trapped all of which are reported by the onsite UAV one after the other. The fireman based on this data can prepare themselves and with the suitable equipment to combat fire like deluge guns, first aid kits for the injured and additional gear for the UAVs before reaching the location.

In cases, where human intervention is dangerous a swarm of UAVs tested and tried to tackle such situations can be used on location to distribute oxygen masks and fire resistant fabrics for trapped civilians. These UAV swarms can also transport heavy-duty robots that can cut down fire from its base enduring heat and blindness due to smoke. This means rescue operations can be carried out at different levels of the affected buildings from all angles with perfect coordination. While these measures are on the one side of the coin, the other side is all about the data. The data collected by these UAVs form a significant asset to develop case studies, to fight future fire accidents better. It also helps speed up the process of damage analysis and thereby fastens relief, recovery measures and the processing of insurance claims.

This ability of UAVs to aggregate all these activities can be explained based on the processes running in the background. Majority of these processes fall under categories like Sensor Fusion, Communication, Motion Planning, Task Scheduling and Cooperative tactics. The other tools for Image Processing, Data Management and Photogrammetry all combine and form the software suite.

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Introduction

"When it comes to the golden hour any tool that can reduce that critical time frame is advantageous" Fire Disaster Management is an area that is continuously challenging human potential for ages. Historical fires like the Chicago fire of 1871 which left more than 90,000 people homeless; the Tokyo fire of 1923 that incinerated approximately 38,000 people with a firestorm are some of the brutal fire accidents that our planet has witnessed. Wiping away thousands of lives from the face of the earth and continuing to cause major destructions globally, this field demands better solutions than ever before. It's the same case even with UAVs. Possessing numerable engineering challenges and holding great potentials

these intelligent aerial vehicles are destined to serve humanity for a long time to come.

Statistics

The World Fire Statistics Centre (WFSC) and the National Crime Records Bureau (NCRB) is renowned for collecting information about fire related accidents. According to the NCRB, in the year 2014 alone, a total of 20,377 cases of fire accidents were reported in India. These fire accidents reported a mortality of 19,513 and morbidity of 1,889 members. The case-wise analysis of all these reports reveals that 18.3% of the 20,377 fire accidents (i.e. 3,728) were reported in residential buildings. In some states, 50% or more fire accident cases were reported in residential buildings. Considering state-wise analysis, maximum cases were reported in Maharashtra (4,805 out of 20,377) which accounts to 23.6% of the total cases. 12 cases of fire accidents were reported in school building that injured 4 persons and caused 8 deaths. In trains, 13 cases of accidental fire were reported which caused injuries to 7 persons and 21 persons died. At this rate nearly 21 men and 40 women are succumbing to fire accident each day in India.

Thousands of people are losing their life and property from almost all parts of the country.The above statistics call for immediate actions to be taken in this sector. Usage of the modern methods and global technologies available should not be an option rather an obligation. Be proactive.

Project

Our project intends to equip firefighters in every possible way. We are determined to solve complex problems that crop up during fire fighting in all the three sectors: INDUSTRIAL, RESIDENTIAL and SOCIAL using state of the art UAV Technologies. Each of these sectors has its own requirements and special strategies to be implemented to combat fire accidents. More or less, the operations involved are similar to each other and discussed together later on. Be it helping fire fighters, reaching to the incident site faster or providing necessary tools for the survivors trapped, our UAV Swarm comprises of 9 different UAVs:

- Micro Fighter
- Transporter
- Survey UAV
- Drone Picker
- The In house UAV
- The Rapid UAV
- Onsite UAV
- Rescue UAV
- Live Feed UAV

These UAVs are named according to their role in any fire fighting operation be it forest fire, building fires or an industrial fire. The basic steps involved in any of these are common and depending upon the severity of the incident at hand, troops of UAVs can be deployed. Throughout this paper we discuss in brief the technologies that help these UAVs co-ordinate perfectly and execute a master fire-fighting plan in all the stages of fire accident.

Scene

There are three elements that are needed in order for a fire to burn. Firefighters refer to these as the fire triangle and they are fuel, oxygen, and heat source. Fuel is any flammable material surrounding a fire, say, trees, grasses, paper, cloths and wood based items and these occupy a lot of space in our homes. The main reason for a fire to break is electrical short circuit. Nearly 65% of the fires caused in homes and industries are particularly due to short circuits. A short circuit in a cable insulated with plastic, fiber or any other non-metal could lead to devastating fires. The other dangerous fact about fire is it can grow in magnitude very fast. Years of research show that a fire can double in magnitude every 60 seconds and with the wind favoring can consume anything in its path. The best example are the wildfires that are more common in the U.S. which wipe away acres of forest land each year causing severe imbalances and climate changes all across the globe.

Firefighters fight wildfires by depriving them of one or more of the fire triangle fundamentals. Traditional methods to extinguish existing fires include water dousing and spraying fire retardants. Clearing vegetation to create firebreaks starves a fire of fuel and can help slow or contain it. Firefighters also fight wildfires by deliberately starting fires in a process called controlled burning. These prescribed fires remove undergrowth, brush, and ground litter from a forest, depriving a wildfire of fuel.

The crux of this discussion is that the earlier we suppress fire, the lesser will be the impact. Hence the primary & the priority measure in preventing any massive destruction is limiting it at its initial stages itself. For this, we employ the on-site UAV in every building, be it an industry or a home. This UAV is connected to the UV/IR sensors centrally through a cloud platform such as the Microsoft Azure. These sensors are placed at distance of 20 ft. from each other depending upon the dimensions and shape of the room.

This onsite UAV continuously listens for messages from the cloud. Just like we get OTPs to our phones automatically, once fire is detected, the sensor transmits its coordinates to the cloud which then forwards this message to the UAV. This message contains the information about the precise location of detector. The UAV then uses indoor navigation technology combined with the prerecorded 3D Mapping of the building to reach the incident coordinates. Now, this onsite UAV starts video recordings of the surroundings and broadcasts this information to the control centers.

This transmission can be done in the conventional TV video and sound transmission channels maintaining necessary measures to minimize interference. Once these signals are received, the control center from their dashboard can screen for any fake alerts. If there is a requirement for a fire operation, this team then can alert the required units providing them access to this real time video. The ground units using a specialized app can view the situation in hand and based on this can prepare all the necessary equipment based on the region of the incident, the cause of fire and the source of heat. The experts present in the control center can monitor the situation on hand and can suggest measures that the people trapped can do to cut down or at least limit fire by the time the ground units reach.

The role of the Inhouse UAV is limited to reporting the situation to the control center. If multiple detections are made at once, priority is established based on the proximities from the UAV. This Inhouse UAV is proprietary in nature and the choice of this UAV is completely in the hands of the owners. After reporting data of all the detected fire incidents to the control center, the UAV waits for any other detections and if there are none goes back and lands in its original safe location. The functioning of the Inhouse UAV is based on several algorithms being processed in synchronism to each other. In the explained scenario, the several challenges faced by this UAV include: Obstacle avoidance, Shortest Path calculation and Geo-fencing. The other important characteristics include a carbon fiber body to resist heat, thermal imagers, video camera and landing gear.

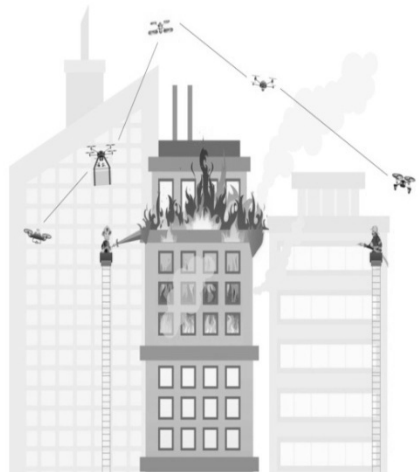

Fig. (a) Firefighters carrying out their operations with help of UAV Swarm

An addition to the ground units is a van carrying a swarm of UAVs each wirelessly connected to the van. This van forms the mini communication center between the control center and the swarm of drones. The specific functioning of the swarm of UAVs is as stated below:

The Microfighter: This UAV is a micro sized machine that follows the firefighters into the building. Equipped with a thermal imager, at each and every step it shows fire fighters what's the condition in the room ahead. As it moves along, the performance of fire fighters can also be analyzed from this feed and help the Fire Department prepare their fire fighters to prepare for the worst situations.

Survey UAV: It is a UAV that is small in size and is assigned the particular task of filming the outer region. This data collected can be used to observe structural stability of the building and identifying any threat for the life of fire fighters within the building. Even after fire is suppressed, the data collected from the

Onsite UAV: The onsite UAV is a UAV especially dedicated to the operator in the van. Unlike all the others, this UAV is completely a remotely piloted aircraft with a controller in the hands of the operator. Based on the situation in hand, the operator can use this UAV to target one specific activity. This UAV is build to carry medium loads, is equipped with a camera and a thermal imaging unit.

Rapid UAV: This UAV rapidly scans the surrounding areas to the affected building to identify any flammable materials or fire outbreak in any adjacent area. This information is vital in alerting the fire fighters from preventing the fire to spread in that direction or in transportation of those flammable materials. It can also alert the neighbors of a potential fire threat to their homes.

Rescue UAV: The primary duty of this UAV is the search and rescue operation. This UAV is equipped with a sensor array that can detect human presence and report it to the dashboard present in the van. It also carries

9 TYPES OF DRONES

1) 

Micro Fighter
- Micro sized machine
- Travels inside along with firefighters
- Carries a Thermal imaging camera
- Mounted with LCD Display
- 360̊ viewing angle camera

2) 

Survey UAV
- Mini sized Quadcopter
- Films the outer building
- Can help analyze fire spread direction
- Cautions the firefighters of structural damages
- Transmits video to the a special dashboard on control center

3) 

Onsite UAV
- Regular sized quadcopter
- Operated by the agent from the vehicle
- Access areas which the operator wants to see
- Transmits the video to the remote controller directly.

4) 

Rapid UAV
- Fixed wing UAV
- Reports first to the area directly over air
- Rapidly scans all the adjoining areas for any flammable goods
- Provides vital information for firefighters about fire outbreak in the surroundings.

5) 

Rescue UAV
- Regular size quadcopter
- Contains a sensor array for human detection
- Equipped with a mic and loudspeaker for real time survivor assist
- Holds a container to carry oxygen masks for survivors.

6) 

Live Feed UAV
- High resolution motion video capture
- Professional photography and film maker
- Broadcasts incident visuals to all the news channels without their interference

7) 

UAV Picker
- Large diameter octacopter
- Carries a mesh to hold other UAVs
- Locates itself at one standard positions and hovers
- Once capacity is full, unloads them and flies Back up

8) 

Transporter
- Medium sized hexacopter
- Designed to carry heavy payloads
- Supplies materials required for firefighters in the fire affected area
- Completely Fire Resistant body

9) 

Inhouse UAV
- Specialized UAV in each mega buildings
- Has 3D Mapping structure of the entire building
- Relies on M2M communications to reach the sensor that detected fire for filming
- Broadcasts this data to nearby fire station control centers

with it a microphone and a mic that can help survivors talk about their situation and also provide them necessary vocal support of things to do and the not to do's even in that peak situation. If required this UAV can also be made to carry with it light weighing stuff like oxygen masks, thermal imaging or night vision glasses.

UAV Picker:This UAV picker is a platform where the swarm of UAVs can return to when their task is completed or when they get deficient of battery. In either cases this heavy duty UAV, carries them back to the van and as per requirement either their batteries are changed or turned off manually.

Transporter: This UAV works together with the fire fighters. In such situation, there is so much at stake and the entire workload is on firefighters. So, to change this scenario and help firefighters operate efficiently, this UAV carries with it tools to crack wall or oxygen cylinders etc. This UAV can either be made to operate by itself or can be remotely piloted from the ground.

Live Feed Drone: This UAV is the centralized source for the entire media operations. It covers the entire scene from all possible angles and live feeds this video directly to all major news platforms. This UAV carries specialized photography equipment to produce high quality video even when it is constantly moving around the incident area.

Implementation in Fire Fighting

All the IoT technologies that are employed in a fire fighting operation can be classified into three main areas:

- Inside the building
- External to the building
- On fire fighters

Inside the building all the fire detection sensors form a mesh network and are connected centrally to the cloud. The location of the sensors, distance between each of them, the specifications required depends completely on the geometry of the building they are used in. The cloud that stores all this data transmits an alert pulse to the In-house UAV when it receives the information about fire detection from any of the detectors. The UAV then responds to the situation as mention earlier.

On the other side, to the exterior of the building is attached the sensors that can detect the direction of heat flow and report the data to the UAV fire truck. They can help firefighters understand the situation and access the probability of fire to spread to the adjoining buildings within the surroundings.

IoT can offer a handful of extra capabilities to firefighters in the scene. The wearable devices like a smart watch can be made to display data collected by the control center. This is to ensure that the data, which really matters, can be sent to the firefighters using smart watches. All this can be done under the guidance of experts from the control center and the data that really matters at that moment can be viewed by firefighters in the scene.

Role of Control Center

This is the centralized data center of all the firefighting operations. This control center can be easily integrated into all the existing fire stations and a standardized procedure of tackling each and every fire accident can be sketched. The control center stores all the video feed from the UAVs with it, thereupon real-time processing of all this information is done to isolate the most significant data. This data can now be used to draw many conclusions and keep all the important delegates informed about all the ongoing operations within a simple mobile app. Every fire officer across the country can be provided the authority to view many aspects of the fire accidents.

(c) A scene of the Control Center in the Fire Station

Research Challenges

To achieve reliable performance from the UAVs there are several aspects to take note of while formulating the design strategy for these UAVs.

Data Quality and Division: In these operations, there is a great need to properly evaluate the reliability of the information reported to the control center. There should be proper mechanism to differentiate data collected from different UAVs. Since this information is of high priority, there must be centralized administration to all this data. The individual units must only be provided data that is important for their operations instead of overwhelming everyone with lots of data.

Battery limitation: One of the most concerning point about UAVs is their flight time. Due to severe deficit in this area most of the functionality is being restricted to shorter spans. This is the primary reason for adding a dedicated vehicle completely dedicated to manage this energy requirement in the midst of operations.

Collision Avoidance: All the UAVs involved in the operationsmust have thecapability toavoid any obstacles be it trees, building walls, humans and even other UAVs. There are existing algorithms for this purpose but their complexity and reliability must be improved two-fold.

Data fusion: During the entire operation, there is lot of data collected. Tons and tons of video footages that is captured during the operation are of no use if it is redundant. These video footages must be primary source of disaster analysis and restoration. Since there are several UAVs employed, each of the data must be fused together and presented as one uniform set of data. This task is quite strenuous as it involves complex software solutions, data storage and network performance.

Network Issues: Almost all of the video captured is to be transmitted to different centers. Real time video transmission has always been a complex task. It needs great efficiency in network resource utilization and connection maintenance.

Precision Sensors: Success in this operation is much reliable on the performance of sensors and the different modules used in synchronism. All these must be in perfect condition both on the hardware side and the software side. This needs tremendous developments both on the hardware front and the software front.

Payload Capacity: Several UAVs at the time of a fire fighting operation have to transfer different materials to the trapped civilians as well as the firefighters within the building. They play a crucial role in reducing the pressure on firefighters during such a situation. But payload carrying capacity of existing UAVs is not much appreciable. There needs to be a transformation in the design to carry heavier payloads with greater efficiency.

Conclusion

Fire Accidents and Wildfires not only lead to loss of life and property in the short term but also have severe long term consequences; of all these the major one is the global climate change. Moreover they also emit greenhouse gases and therefore also contribute to global warming. Increased temperatures mean more fires, which will raise temperatures even further. UAV Applications are on the rise with the development of UAVs in the technical front. The merger of these technologies is required to solve problems that are beyond man's abilities. There is certainly a great need to combine the complexity of developing a fully efficient fire fighting system with the state-of-the-art flying machines.

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APPLICATIONS OF RS AND GIS TECHNIQUES FOR DISASTER STUDIES IN EAST GODAVARI DISTRICT, ANDHRA PRADESH, INDIA

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Abstract

Natural Disasters are inevitable events. The onset of occurrence is generally short period with prior warning and in many cases without. These disasters cause havoc by loss of life and property in a large scale. From time immemorial, man has been facing the wrath of the nature but could not control it. The only possibility is providing mitigation steps. The present study is an area which has a metaphor – "The rice bowl of Andhra Pradesh" – which in itself also known as "The rice bowl of India" named East Godavari District, Andhra Pradesh, India, encapsulates 81°30′, 82°40′ East Longitude and 16°25′, 18°00′ North Latitude. The climatic condition of the study area is semi humid with an annual rainfall of 1200 mm, temperature range between 23.5°C and 45.9°C. The District is flanked on the North by Visakhapatnam District, South by Krishna district, West by West Godavari District with a part of Telangana State and on the East by Bay of Bengal covering an area of 10,807 sq km. Naturally the study area classified by Uplands, Plains & Delta made up of Gondwana sand stones, Basalt, Ash Beds and rich minerals. The Godavari and its distributaries named Gowthami & Vasistha River provide the surface water. Mapping of Land use/land cover, Geology, Geomorphology, Rainfall, DEM were prepared to generate Flood Zonation Map, Shoreline Change Map, etc. using Landsat-8 data processed over ArcGIS &ERDAS software on 1:50,000 scale. Risk Zone map is developed for better mitigation purpose.

Key Words: *ArcGIS, ERDAS, Remote Sensing, GIS, Geology, Geomorphology*

♣

Introduction & literature

East Godavari District is known as rice bowl of Andhra Pradesh with lush paddy fields and coconut groves. It beckons tourists to have a glimpse of its rich cultural heritage The entire East Godavari district broadly classified into 3 natural divisions are Deltas, Upland, and Hill tracts. In East Godavari District there are 5 revenue divisions and consist of 60 revenue mandals with Kakinada being the district head-quarters.

The northern part of the study area covered by 6 mandals, 13 mandals configure the south-east coastline of the district, the western boundary of the district is defined by the river bank of Godavari with 11 mandals along the river. The major river is Godavari along with its distributaries Vainateya and Vasishta. The general elevation of the east Godavari varies from a few meters near to the coast to about 300 meters up hills in the agency. Average annual rain fall 1280 mm. In the past, many Cyclones in the Bay of Bengal have frequently hit the shoreline of the study. A small island named Hope Island is at 5 Km from Kakinada coast in the Bay of Bengal, makes a natural harbor at the shoreline. Hope Island is one of the major protruding deltas on the east coast of India bordering the Bay of Bengal and is a densely populated zone of intense economic activity. As a result, the seaward bulge of the delta overlaps the continental shelf across by about 30–35 km when compared to the general trend of the east coast.

Several studies on the nature of coastal landforms along the delta front also indicated increased sedimentation rates through the river during the nineteenth century and even over a major part of the twentieth century. Padma kumari et al., studied on application of Remote Sensing and GIS techniques on Geomorphology (2012), Land Use/Land Cover studies (2012), Shoreline Morphometrical Analysis (2013), Shoreline Erosion and Deposition(2013) and the respective changes (2015) of East Godavari district, Andhra Pradesh, India. Sarma et al., (2010) and K. Nageswara Rao (2006) studied on Coastal Morphodyanamics and Asymmetric development of the Godavari Delta, Subsidence of Holocene sediments in the Godavari delta, Coastal erosion and habitat loss along the Godavari delta. Nageswara Rao (2010) Impacts of sediment retention by dams on delta shoreline recession: evidence from the Krishna and Godavari deltas India. National Disaster Management Guidelines (2007) prepared by National Disaster Management Authority, Government Authority of India. Tulasi rao (2015) has studied on Coastal and marine nature conservation in EGREE region. Ramasubramanian (2015) examined the Mangrove wetlands conservation and management in Andhra Pradesh. Murthy (2015) presented the recent changes in the coastal environment along the east coast India-impacts of climatic events.

The major advantage of GIS is that it allows identifying the spatial relationship between features and temporal changes within an area over time. Mahadevan and Prasada Rao (1958) based on an analysis of multi-date maps spread over a period of 100 years traced the growth of a 21-km long sand spit at the delta, east of Kakinada that began around AD 1850 and reached more or less the present shape by the 1958 owing to increased sediment supply from the catchment due to deforestation. Sambasiva Rao and Vaidyanadhan (1937) reported overall cumulative accretion of land due to development of several other sand spits at the distributaries mouths of the Godavari during the period between 1937 and 1977 1987, based on the study of toposheets. Babu (1980), Bhanumurthy and Naidu 2003 &2004, Sastry et al (1991), Hong yeoncho, Usha natsan ,Mani Murali (2006) Remote sensing images have been effectively used for monitoring shoreline changes and coastal management in different parts of India. Rao etal.,(1984), Desai etal.,(1991), Naik et al.,(1991), Aggarwal (1991), R.B.Singh and Dilip kumar (2013), Bhat and Subrahamanaya (1993), Bhat (1995), Chen and Rau,(1998), Sreekala etal., (1998), De Solan et al (2001), Navrajan et al., (2005), Sunderasan (1993), Girish Gopinath etal.,(2005), P.S Roy etal., (2010), applied Remote sensing on various features on the surface. Padma kumari et al., (2014) identified change and sea-level rise at the uppada area highly eroded lead to an increase in the cyclone-prone area and loss of life.

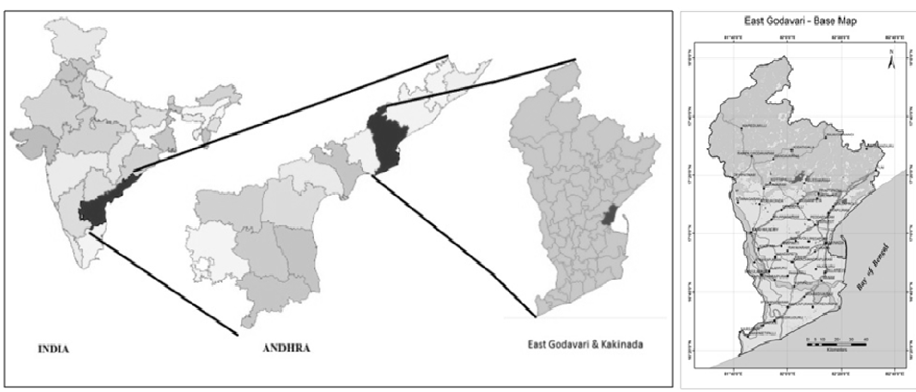


Figure 1: Study area

East Godavari district lies in the North- East coast of Andhra Pradesh, India and bounded on the North by Visakhapatnam district and the state of Orissa. On South East part of the study area, Bay of Bengal covers the coastline. The neighbors on the West are Khammam and West Godavari districts. The district headquarters is Kakinada. With the spatial coordinates 16° 30′, 18°20′ North and 18° 30′, 82° 30′ East, covers 10,807 sq km (Figure-1). The study area is mainly covered by Agriculture land use for Farming, Grassland and other purposes. Annual rainfall is 115 cm. The district flourishes with fertile soils, good rainfall. Climate is mostly hot and humid. The hottest part of the year late May to early June with maximum temp 38°- 42°. Major rivers are Godavari, Pampa, Thandava and Yeluru rivers. The general elevation of the east Godavari varies from a few meters near to the coast to about 300 meters up hills in the agency. Average annual rainfall is 1280 mm. A small island named ‘Hope island’ located at 5 Km from Kakinada coast makes it natural harbor.

History of disasters in Study area (1860-2015)

S.No	Date of Occurrence	Disaster type	Description
1	19.12.1869	Earthquake	Magnitude: 3.7
2	12.06.1893	Cyclone	
3	04.09.1895	Cyclone	
4	28.10.1903	Cyclone	
5	25.05.1904	Cyclone	
6	30.09.1915	Cyclone	
7	21.10.1916	Cyclone	
8	13.10.1933	Cyclone	
9	05.05.1955	Cyclone	
10	04.11.1969	Cyclone	
11	31.03.1980	Earthquake	Magnitude: 3.8
12	02.10.1980	Earthquake	Magnitude: 4
13	15.10.1982	Cyclone	
14	30.07.1990	Earthquake	Magnitude: 3.6
15	04.11.1996	Cyclone	
16	26.12.2004	Tsunami	
17	12.10.2014	Cyclone	

Being in the coastal region, study area is prone to cyclones and depressions. East Godavari district with a coastline of 177 km covering three revenue divisions is vulnerable to cyclones and storms which are frequent in Bay of Bengal. In the East Godavari district 13 coastal Mandals are highly vulnerable to cyclones and storms and have been identified as disaster prone. The villages viz. Chollangi, Chollangipeta, G.Vemavaram, Patavala, Coringa, Polekurru, Neelapalli and P.Mallavaram falling under Tallarevu Mandal and Bhairavapalem and Gokullanka falling under Ipolavaram Mandal are highly cyclone/ storm prone.

Objectives

The main objective is to prepare maps of Land use/Land cover, DEM, Watershed map, etc., and to generate Risk zone map for Flood using Remote Sensing and GIS over the East Godavari district, Andhra Pradesh, India.

Data used & Methodology

Data Used

Toposheets from Survey of India on 1:50,000 scale were procured, scanned and made into softcopies. These Toposheets were used to prepare Base Map of the Study Area.

Satellite Data

- CartoDEM was downloaded from NRSC website (http://bhuvan.nrsc.gov.in). This data was used to generate DEM, Slope, Aspect, etc..
  - Spatial Resolution is 1 arc sec (≅ 30 m)
- Landsat- 7 & 8 scenes were downloaded from http://earthexplorer.usgs.gov website. Four scenes were required to cover the study area of East Godavari District. This data was used to generate Landuse & Landcover Maps, Study the Shoreline changes etc. Pre & Post Disaster data/images are downloaded for the Change Detection Analysis.

Table 1: Satellelite Data Specifications

Feature	LandSat 7 ETM+			LandSat 8 OLI – TIRS		
Spatial Resolution	15 meters – 60 meters			15 meters – 100 meters		
Spectral Resolution	*Bands*	*Wavelength (µm)*	*Resolution (m)*	*Bands*	*Wavelength (µm)*	*Resolution (m)*
	Band1	0.45-0.52	30	Band 1	0.43 - 0.45	30
	Band 2	0.52-0.60	30	Band 2	0.45 - 0.51	30
	Band 3	0.63-0.69	30	Band 3	0.53 - 0.59	30
	Band 4	0.77-0.90	30	Band 4	0.64 - 0.67	30
	Band 5	1.55-1.75	30	Band 5	0.85 - 0.88	30
	Band 6	10.40-12.50	60	Band 6	1.57 - 1.65	30
	Band 7	2.09-2.35	30	Band 7	2.11 - 2.29	30
	Band 8	0.52-0.90	15	Band 8	0.50 - 0.68	15
				Band 9	1.36 - 1.38	30
				Band 10	10.60 - 11.19	100
				Band 11	11.50 - 12.51	100
Date of Acquisition	December 2000			15^{th}& 24^{th} January, 2015		

- **Thematic Maps**:These maps were used to generate themes required to analyse the local conditions.
  - Geology Map: procured from NRSC, Hyderabad
  - Geomorphology Map: procured from NRSC, Hyderabad
  - Soil Map: Procured from National Bureau of Soils Survey & Land use Planning, Nagpur
  - Rainfall Data: Procured from India Meteorological Department(IMD), Kakinada
- **Population & Demographic Data**as per Census-2011 was collected from http://www.censusindia.com web-site
- **Historical Data**was collected from different sources like disaster management websites, IMD, CWC etc., for the occurrences of disaster in the study area Based on the methodology adopted in this study, various maps are generated using Remote sensing and GIS techniques for Disaster studies in East Godavari District, Andhra Pradesh, India.

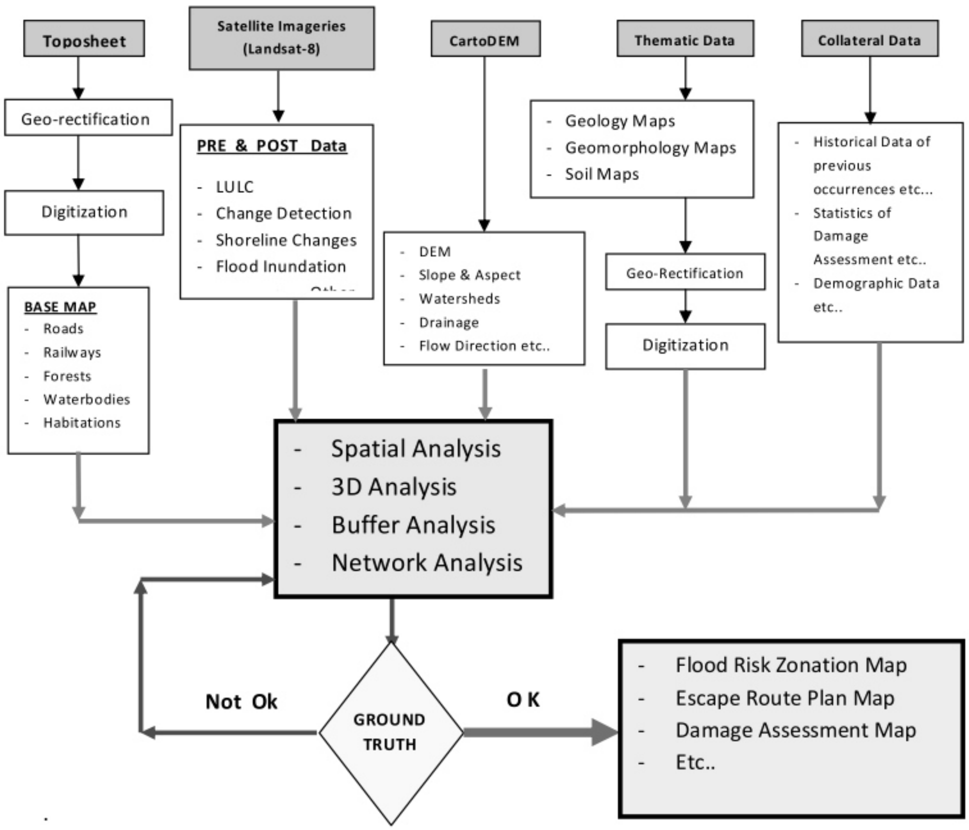


Figure 2: Flowchart of the methodology

Results and discussion

Land Use / Land Cover Classification System

The Land use indicates the usage of land which means man made usage of the earth's surface like built-up lands, agriculture and etc. Land cover is the natural coverage of surface of the earth like forests, water bodies, natural drainage patterns, rivers, oceans, mountains, snow etc. Information on land use/ land cover of the area is very important for planning and development activities of agriculture, horticulture, industries and infrastructure and also damage assessment/monitoring by soil erosion, landslides and floods.

Understanding Land use/ Land cover categories, their spatial distribution and the pattern change is very essential for resource mapping, management and conservation activities (Anderson et al., 1976). This helps in the analysis of environmental conditions and the associated problems. Several thematic classes such as road network, human habitant, drainage, forest and plantation classes can be classified from the satellite imagery. Land use map of the study area (Figure 3) was prepared using application software ArcMap-10.1.

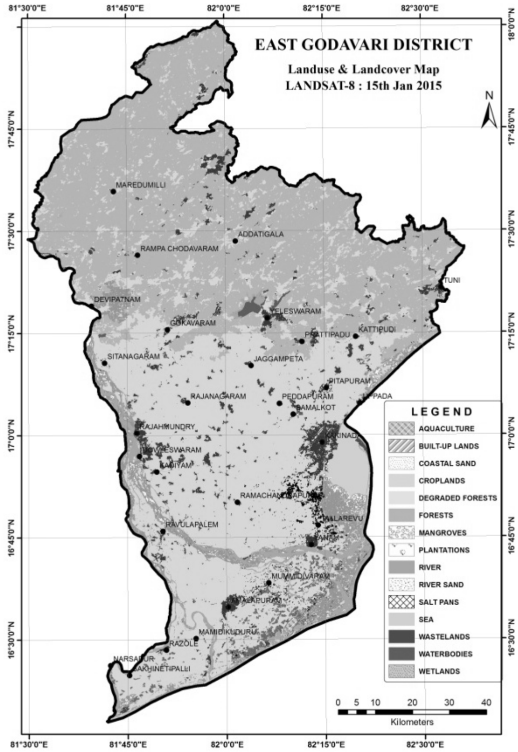


Figure 3: Land Use / Land Cover classification based on satellite image

The total area of land use/land cover of various crops and other infrastructural facilities of Godavari District is 10856.5366 sq km and is given in the table below.

Table 2: Land use\ Land Cover Classification

S.No	Category	Extent
1	Built-Up Lands	2,211,547,323.00
2	Croplands	5,334,253,725.00
3	Degraded Forests	121,228,316.00
4	Forests	1,025,716,272.00
5	Mangroves	1,059,368,143.00
6	River	213,036,041.00
7	Saltpans	789,933,806.00
8	Sand Beds	108,154,048.00
9	Sea	183,261,205.00
10	Waterbodies	2,647.70
	Total	**11,072,974,940.00**

From the current LU/LC studies it is evident that the major land share is owned by CropLands (48.29 %). The next major share is followed by land use category Built-up Lands (20.02 %), Mangrooves (9.49 %), Forests (9.29 %) and Saltpan (7.15 %).

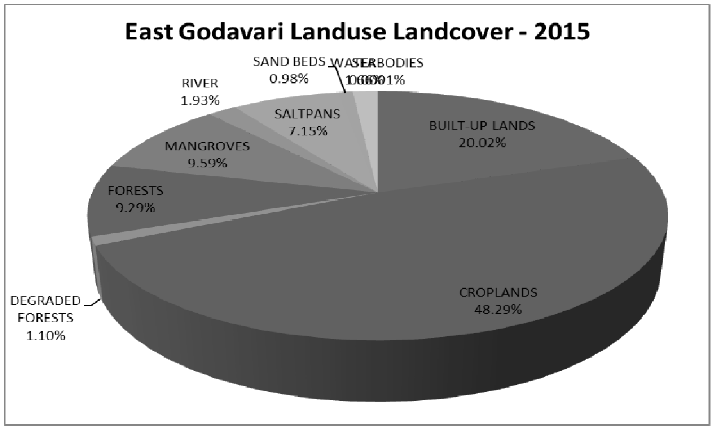


Figure 4: Pie-chart of East Godavari District Land Utilization

Geology and Geomorphology

Geomorphology is one of the significant theme information for all the application projects. Hence, the geomorphic maps proposed to be prepared would furnish to the different resource information needs of the country like geo-environment, geo-engineering, geo-hazards, mineral and ground water exploration and interdisciplinary themes like soil, land use/ land cover and forest, etc. This is useful in identification of some of the sample locations, e.g. in the channel/braided/point bars of stream sediments, channel bars and point bars.

In this study, structural hills (34%) are at northern part belongs to Eastern Ghats Mobile Belt, exposing all the characteristic litho units of the Eastern Ghats Super group viz, made up of Khondalite, Charnockite, and Migmatite groups of rocks and rich minerals. Intermotane valley, buried Pediplain, Denudational and Residual hills are 28%, Deltaic plain (18%) is characterized by fluvial to fluvio marine and marine deposits of Quaternary age, Coastal plain (8%) are majority of the landforms. Abundant existence of Mangroves (6%) present at the coastal ecosystem with rich Fauna & Flora. The Deccan Traps occur 2 km North-East of Rajahmundry and extend in ENE-WSW direction. Limestone Intertrappeans, rich in Gastropod and Lamellibranches fossils, occur near Kotilingala, Korukonda and Kateru. Rajahmundry Formation, named after the type locality, Rajahmundry, is an ensemble of fine-grained, purple to vari coloured Sandstone, Grit and Conglomerate, overlie by current bedded Sandstone with Clay and Shale bands, intermittently exposed between Rajahmundry and Samalkot. It is equivalent to Warkalli Beds of Kerala and Cuddalore Formation Tamil Nadu.

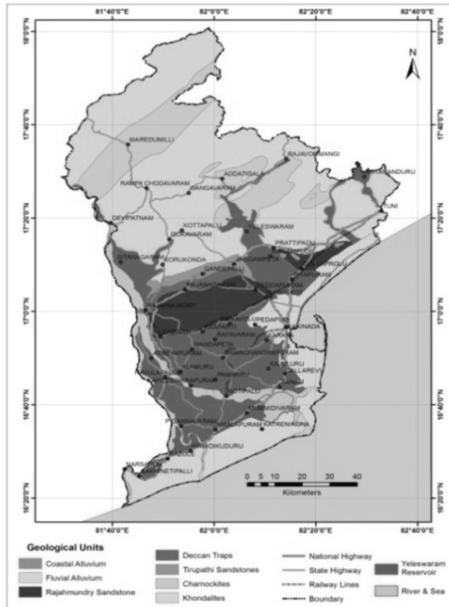


Figure 5: Geology map of the study area

Shoreline Change analysis

Identifying the zones of erosion and deposition based on the convexity and concavity of the shoreline by developing a mathematical model adopted by Li, R., Liu, J-K., and Felus, Y. (2001a) Spatial Modeling and Analysis for Shoreline Change Detection and Coastal Erosion Monitoring, This is also referred as dynamic method of shore line segmentation. Zones of erosion and deposition were derived by extracting the shoreline information from Landsat-7 dated 8th Dec'2000 & Landsat-8 dated 15th Jan 2015 (Table:3 & 4) The overlap or cross over points or intersections on these both lines after conversion to polygons has evolved different areas Table 2&3 and Figure 2&3.

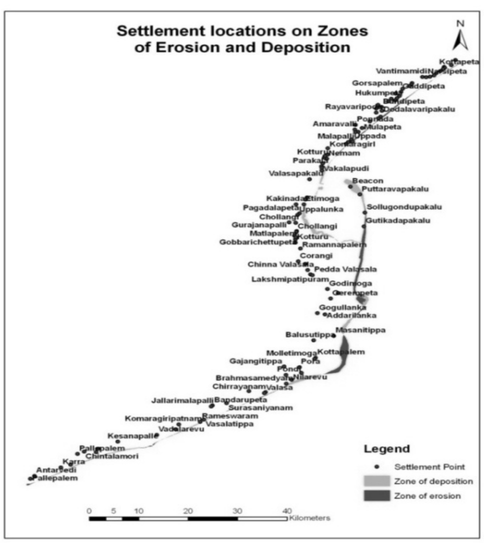


Figure 6 : Zones of Erosion & Deposition with Settlements

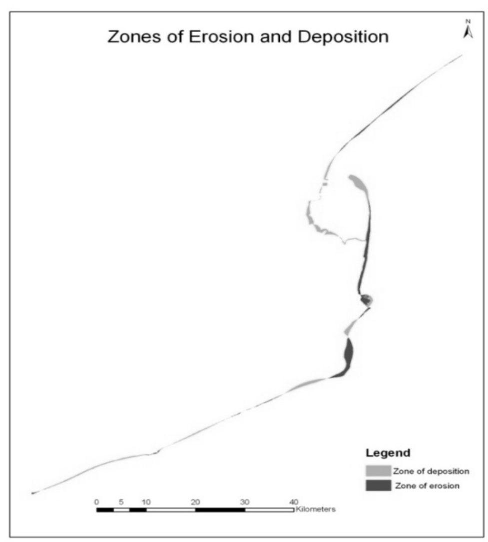


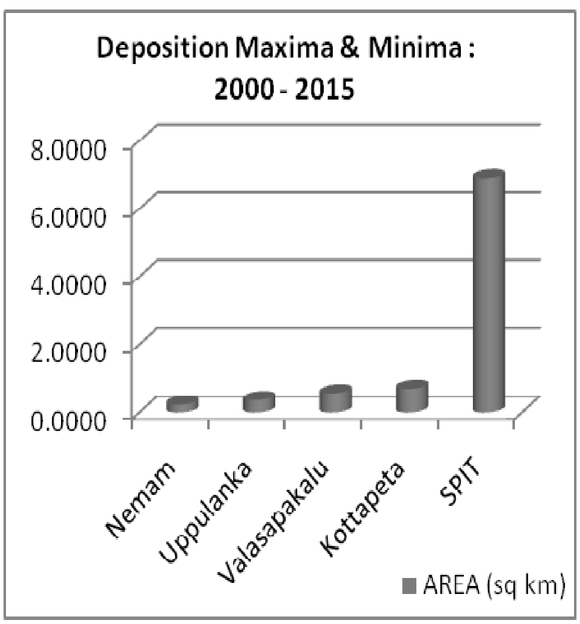
Figure 7 : Zones of Erosion & Deposition with Settlements

Table 3: Erosion Maxima & Minima (2000-15).

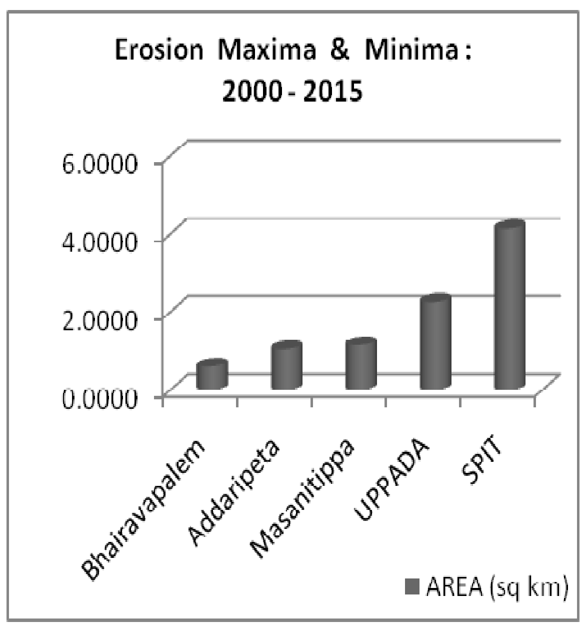
Erosion Maxima & Minima along Godavari Delta Front (2000-2015)		
Zone of Erosion	**Erosion _Max (Sq km)**	**Erosion _Min (Sq km)**
Bhairavapalem		0.6015
Addaripeta	1.0439	
Masanitippa	1.1509	
UPPADA	2.25	
SPIT	4.1361	
Total	8.5809	0.6015

Table 4: Deposition Maxima & Minima (2000-15).

Deposition Maxima & Minima Along Godavari Delta Front(2000-2015)		
Zone of Deposition	**Deposition _Max (Sq km)**	**Deposition _Min (Sq km)**
Nemam		0.2248
Uppulanka		0.3543
Valasapakalu		0.5553
Kottapeta		0.6893
SPIT	6.8977	0.04
Total	6.8977	1.8637



Graph-1 : Graph of Deposition Maxima & Minima (2000-2015)



Graph-2 : Graph of Erosion Maxima & Minima (2000-2015)

Shoreline change results from coastal erosion, the effect of the breaking waves in the near-shore zone, and near-shore currents. The breaking waves in the near-shore zone and the near-shore currents are responsible for the transportation of beach sediments that results in shoreline change.

The morphometric changes that took place during different periods are mapped and geometry of the shore was arrived at and is mapped in the figure 6 given above.

Risk Zone Analysis of Cyclone& Flood

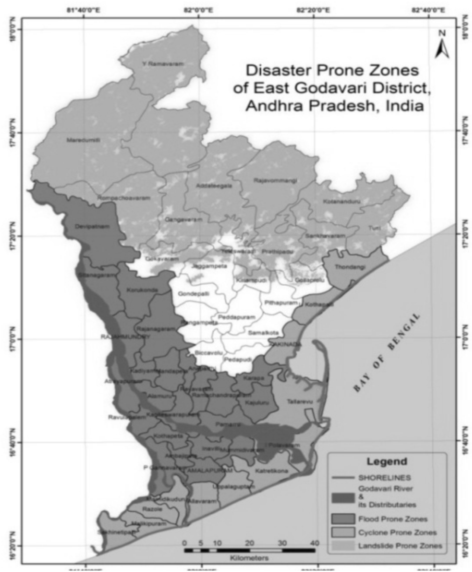


Figure 8: Disaster Prone Zones in East Godavari District

Based upon the selected methodology criteria, the risk zones for the listed disasters is represented in the Figure 8.

5.4. Conclusions

From the LU/LC studies, it is evident that half of the study area is Crop land. In this scenario, even a little hindrance in the natural conditions shall bear a greater loss in socio-economic conditions.

In the study are the mandals prone to the occurrence of various disasters are as tabulated below;

Table 5: List of Disaster Prone Mandals in the Study Area

Flood Prone Mandals (23)	Cyclone Prone Mandals (12)	Landslide Mandals (8)
Devipatnam, Sitanagram, Korukonda, Rajahmundry, Rajanagaram, Kadiyam, Mandapeta, Anaparthi, Alamuru, Rayavaram, Ramachandrapuram, Karapa, Kapileswarapuram, Pamarru, Kajuluru, Atreyapram,	Sakhinetipalli, Malikipuram, Razole, Mamidikuduru, Allavaram, Uppalaguptam, Katretikona,	Y Ramavaram, Maredumilli, Rompachodavaram, Addateegela, Rajavommangi, Kotananduru, Sankhavaram and Gangavaram.

Ravulapalem, Kotapeta, Ambajipeta, Amalapuram, Ainavilli, P Gannavaram and Mummidivaram.	I Polavaram, Tallarevu, Kakinada, Kothapalli and Thondangi.	

With the mitigation of increasing frequency and intensity of disastrous events as a result of climate change, it is more prudent to model these risk zones and low lying areas for both emergency management and development planning.The remote sensing and GIS technology has potential use for not only risk mapping it can also be used in the scientific based damage assessment, monitoring, identification of damaged zones, improvement in forecasting and warning models, updating maps, effective and reliable communication etc.

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ROLE OF INFORMATICS IN EFFECTIVE DISASTER MANAGEMENT: *A CASE STUDY*

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Abstract

The extent of disaster damage containment is dependent on several factors such as disaster prediction, preparedness, damage handling infrastructure and information about the available infrastructure. Lack of understanding of any risk arising out of poor management often leads to unexpected secondary effects/risks making the situation chaotic and complex.

In this paper, various applications of IT in disaster management have been discussed taking cyclone Hudhud as a case study. Also highlighted the various factors in response and recovery operations in case of a fatal accidents. In such cases, two most important aspects commonly influence the efficacy of the disaster management are the emergency medical assistance and communication access to the facility.

Effective exploitation of geo informatics using GIS, GPS, SATCOM and remotesensing technologies will further help to contain damage in terms of life and property. Swift reaction of identified agencies also depends on the information management. Periodic reviews, updating the database and up keeping of the equipment and skills are essential. Also creating awareness through media and making the availability of such information in public domain in the presentable form. Networking with various agencies both in private and public participation strengthen the efforts for effective disaster management.

In the area of health care facility information regarding necessary resources such as, network of hospitals, hospital infrastructure information, communication system are essential. Furthermore information on transport system such as, real time traffic assessment, accessibility, speed limitations, inter-road connectivity, geographical constraints etc can effectively expedite disaster management plans

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Introduction

Disaster strikes countries causing tremendous impact on national economy through loss of life and property. Application of IT can help in minimizing damage extent through disaster prediction, disaster preparedness and post disaster management.

India is considered as the world's one of the most disaster prone country. It has witnessed devastating natural disasters in recent past like droughts, floods, cyclones, earthquakes, landslides etc. Among all the natural disasters that country faces, river floods are the most frequent and often devastating. The shortfall in the rainfall causes droughts or drought like stimuli in various parts of the country. The country has faced some severe earthquakes causing widespread damage to the life and property. India has a coastline of about 8000 km which is prone to very severe cyclone in the Arabian Sea and Bay of Bengal. The recent devastating cyclone that hit eastern coast is Hudhud. Orisha and Vizag in AP bore burnt of destruction. The response at the aftermath of destruction brought out the preparedness of the administration. Many aspects of disaster management was praise worthy and still more could have been achieved with judicious application of information.

As Bangladesh is topping the world ranking of countries most severely hit by cyclones and storm surges in history, the country shows the example of how an appropriate satellite-based early warning system is indispensable for disaster mitigation. The government saw itself in need to develop an early warning system after the killer tropical cyclones of 1971 (300 thousand deaths, 1.3 million people homeless) and 1991 (138 thousand deaths). In 1994, the warning system proved its.

worth as another devastating cyclone of equivalent intensity struck the archipelago. This cyclone, referenced as 02B, claimed over 250 lives and made nearly half a million people homeless. The ultimate impact of this tropical storm was many times less compared to the disastrous 1971 and 1991 events.

The Concepts:

- **Disaster**
  The United Nation defines disaster as 'occurrence of sudden or major misfortune which disrupts the basic fabric and normal functioning of society or community '. A disaster becomes emergency when capability to manage falls short of magnitude of disaster.
- **Disaster Management**
  Disaster management is a range of activities including prevention, mitigation, preparedness, Response, recovery and rehabilitation. It involves all levels of administration, NGOs and local populace as well. Current disaster management starts with disaster prediction, pre-disaster planning, organizational planning, training, information management.

Application of Technology

While we cannot prevent an earthquake or a hurricane from occurring, or a volcano from erupting, we can apply the scientific knowledge and technical know-how that we already have to issue early warnings on cyclones and organize proper response to such warnings. Over the last three decades, scientific knowledge of the intensity and distribution in time and space of natural hazards and the technological means of confronting them have expanded greatly. Major progress has been made in the development of global meteorological models and their application to large scale weather prediction.

The Resolution of the United Nations General Assembly proclaimed the International Decade for Natural Disaster Reduction (1990-1999) which called for a concerted worldwide effort to use the existing scientific and technical knowledge, adding new knowledge as needed, in order to underpin the adoption and implementation of public policy for disaster prevention.

Two major information technologies; 1.GIS and remote sensing and Internet are well exploited in Disaster Management

GIS and Remote Sensing

GIS provides a tool for effective and efficient storage and manipulation of remotely sensed data This can be used to facilitate measurement, mapping, monitoring and modelling of variety of data types related to natural phenomenon. The specific GIS application in the field of Risk Assessment is Hazard Mapping. Theses map could be created for cities, districts or even for the entire country and tropical cyclone Threat Maps are used by meteorological departments to improve the quality of the tropical storm warning services and quickly communicate the risk to the people likely to get affected by the cyclone. Remote sensing comprises Aerial Remote Sensing which is the process of recording information, such as photographs and images from sensor on aircrafts and Satellite Remote Sensing which consists of several satellite remote sensing system which can be used to integrate natural hazard assessments into development planning studies. These are: Land sat, SPOT Satellite, Satellite Radar System, Advanced Very High Resolution Radio.GIS can be used in carrying out search and rescue operations in a more effective manner by identifying areas that are disasters prone and zoning them accordingly to risk magnitudes.

Internet

In the present era of electronic communication, the internet provides a useful platform for disaster mitigation communications. Social networking sites are valuable in sharing information.

Cyclone Hudhud:

Hudhud, a severe cyclonic storm, originating in the Andaman Sea around October 6, crossed the coastline near Visakhapatnam on October 12. After the cyclone, Visakhapatnam bore no resemblance to what it used to be.

Though the United Nations has appreciated the Odisha and Andhra Pradesh government's disaster preparedness during cyclone Hudhud, there are many lessons to be learnt from it. Clearly it is a quantum jump in terms of disaster management preparedness from 1999 super cyclone, which hit odisha, because compared to loss of 10,000 people in that super cyclone it was very low loss of life in hudhud.

- Mangroves and casuarina plantations along the coast and the thick tree cover on the hills used to protect the city in the past from the vagaries of cyclones. Indiscriminate denudation, in defiance of environmental laws in force and the Visakhapatnam Urban Development Authority's mandatory Master Plan, have rendered the city vulnerable to high-velocity cyclones.
  The Coastal Regulation Zone requirements are indispensable for protecting the coastal and marine environment of Visakhapatnam. For example, CRZ prohibits mechanical pumping of water through borewells within 500 metres from the high tide line since it will cause saline sea water to contaminate the ground water aquifers. When Hudhud disrupted municipal water supplies, potable ground water, had it been available, would have provided relief.
  Conserving mangroves, raising casuarina and other durable species of plantations along the coastline and regulating quarrying over the hills should, therefore, form part of the city's future plans. The laws to protect the environment need to be respected rather than held in contempt.

- Following the killer Diviseema cyclone and tidal wave of 1977 in Andhra Pradesh, 146 cyclone shelters were constructed along the Visakhapatnam coast. These shelters need to be maintained in a state of readiness. However, few of them came in handy for providing relief to the people. For a government that makes huge investments on statues and decorative arches, to invest in the upkeep of these cyclone shelters should not be difficult.
  Post-1977, the state had set up a Coastal Zone Management Authority with its counterpart institutions in each coastal district. These institutions have become defunct. They need to be revived and adequately equipped and empowered. The same is the case with the state and district disaster management authorities.

- Hudhud gave the state government more than a week to plan. Knowing that the city's municipality, its police force and the local urban development authority were headless, the government could have quickly responded and posted able officials to give them direction. In times of emergency, nothing can substitute well-managed institutions that can respond on their own.

- No government can ever match the spontaneous effort that could come from local communities. Andhra Pradesh has a law providing for area sabhas/ward committees in towns, but the law has remained on paper. Similarly, gram sabhas in villages can play a crucial role in facing calamities. If fallen trees could be cleared along many lanes in the city within five days after the cyclone, the credit should go to self-help groups and some NGOs. The government should, therefore, involve civil society as a part of any disaster management effort in the future

Management of information of various resources in optimal way is key factor in efficient disaster management either in preparedness, response and recover operations. For example, very often we come across incidents like fire hazards, fatal accidents where the requirement of urgent medical help is essential. In such incidents time is very precious in saving human lives. Though it looks simple to think like, that the victims can be taken to any nearby medical facility, but many times it may or may not be right choice in choosing the particular hospital ill equipped and waste of time involved. Therefore, in the area of health care facility information regarding necessary resources such as, network of hospitals, hospital infrastructure information are essential. Furthermore information on transport system such as, real time traffic assessment, accessibility, speed limitations, inter-road connectivity, geographical constraints etc can effectively expedite disaster management plans.

Conclusion

Preparedness for possible eventualities of post disaster for effective management, it is necessary for government to coordinate with different civic bodies and NGOs. The efforts of many voluntary organisations aftermath of HudHud in restoring the basic amenities in a short time. Off course government also played a major role in restoration. However the response and reaction to HudHud by various organisations are well appreciated. It was observed the restoration efforts were much delayed in some parts of the Vizag City. It could have been still managed much better avoiding gaps in communication and coordination efforts between government, civic bodies and NGOs. It is necessary to educate and bring the awareness to the people periodically over the various phases of disaster management and utilisation of resources. Dissemination of relevant organised information on various aspects of disaster management exploiting the contemporary technology helps to great extent.

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INNOVATIVE USE OF TECHNOLOGY(GIS) FOR DISASTER RISK REDUCTION
- A CASE STUDY

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Introduction

The world is facing an increasing frequency and intensity of disasters - natural and man-made – having devastating impacts.

India has been traditionally vulnerable to natural disasters on account of its unique geo-climatic conditions. Floods, droughts, cyclones, earthquakes and landslides are recurrent phenomena in India. About 60% of the landmass is prone to earthquakes of various intensities; over 40 million hectares is prone to floods; about 8% of the total area is prone to cyclones and 68% of the area is susceptible to drought. The super cyclone of Orissa in October 1999, the Bhuj earthquake in Gujarat in January 2001 and the earthquake in North Kashmir in October 2005, underscores the need to adopt a multi dimensional endeavour involving diverse scientific, engineering, financial and social processes; the need to adopt multi disciplinary and multi sector approach and incorporation of risk reduction in the developmental plans and strategies that help in managing disasters more effectively.

GIS is very effective in disaster management but its use is still very limited in the country like India and is not available even in the highly disaster prone State of J&K. With a view to reduce the impact of disasters on human life and property, it is absolutely necessary to create awareness amongst the public as well as decision makers for allocating resources for appropriate investments in technologies like GIS and Remote Sensing for Disaster Management in India. GIS can improve the quality and power of analysis of natural hazards assessments, guide development activities and assist planners in the selection of mitigation measures and in the implementation of emergency preparedness and response action.

Types of Emergencies

- Human-Caused
  Human-caused emergencies include those unplanned events or accidents that result from human activity or human developments. Examples include chemical spills, nuclear radiation escapes, utility failures, epidemics, crashes, explosions, and urban fires.
- Natural Disasters
  Natural disasters include those unplanned events that occur as a result of natural processes such as earthquakes, tornadoes, tsunami, freezes, blizzards, extreme heat or cold, drought, or insect infestation.
- Internal Disturbances
  Internal disturbances are those events or activities planned by a group or individual to intentionally cause disruption. This includes riots, demonstrations, large-scale prison breaks, and violent strikes. Energy and Material Shortages—Emergencies as a result of shortages include strikes, price wars, and resource scarcity.
- Attack
  This includes acts of large-scale terrorism or war using nuclear, conventional, or biological agents.

Emergency Management Phases

Emergency management activities can be grouped into five phases that are related to time and applies to all types of emergencies and disasters. These phases are also inter-related involving different types of skills.

- Planning
  Planning includes all those activities that are necessary to analyze and document the possibility of an emergency or disaster and the potential consequences or impacts on life, property, and the environment. This includes assessing the hazards, risks, mitigation, preparedness, response, and recovery needs.

- Mitigation
  Mitigation activities eliminate or reduce the probability of a disaster (for example, arms build-up to deter enemy attack, or legislation that requires stringent building codes in earthquake prone areas). It also includes long-term activities designed to reduce the effects of unavoidable disaster.

- Preparedness
  In the preparedness phase, governments, organizations, and individuals develop plans to save lives and minimize disaster damage (for example, compiling state resource inventories, mounting training exercises, installing early warning systems, preparing predetermined emergency response forces etc.). Preparedness measures also seek to enhance disaster response operations (for example, by stockpiling vital food and medical supplies, through training exercises, and by mobilizing emergency response personnel on standby).

- Response
  Response can be termed as the set of activities that follow an emergency or a disaster. These activities are designed to provide emergency assistance for victims (for example, search and rescue, emergency shelter, medical care, and mass feeding). They also seek to stabilize the situation and reduce the probability of secondary damage (for example, shutting off contaminated water supply sources, and securing and patrolling areas prone to looting) and to speed recovery operations.

- Recovery
  Recovery stands for the set of activities necessary to return all systems to normal or better. They include two sets of activities:
  - Short-term recovery activities- return vital life support systems to minimum operating standards (for example, cleanup, temporary housing, and access to food and water)
  - Long-term recovery activities - may continue for a number of years after a disaster. Their purpose is to return to normal life or improved levels (for example, redevelopment loans, legal assistance, community planning etc.).

The Research Problem

The study has been carried out with a view to suggest ways to implement GIS techniques for Disaster Management in India with special focus to the State of J&K.
The main objectives of the study is as follows:

- To understand the working of a typical Geographic Information System
- Benefits of using GIS in Disaster Management
- To analyze the impact of implementing GIS for Managing Disasters with special reference to the State of J&K

Data Source

The impact of the earthquake which occurred on October 8th 2005 in the State of J&K has been dealt thoroughly by survey of affected villages.

Primary Data was collected by conducting focussed group discussions and informal as well as formal interviews with the stake holders. Interactions were also held with the District Administration and also with the head of Disaster Management Cell of the State.
Secondary data was also collected to understand and analyse the impact of the technology and its benefits thereof.

Survey Area

Jammu and Kashmir is the northern-most state of India. Jammu and Kashmir consists of three regions: Jammu, Kashmir Valley, Ladakh.
Srinagar is the summer capital, and Jammu, its winter capital. The State has a total area of 222,236 km^2. The population of Jammu and Kashmir is around 10,143,700. Jammu and Kashmir is divided into 22 districts.
The survey of earthquake affected villages was carried out in two districts of Jammu and Kashmir. These 2 districts, namely, Kupwara and Baramulla were the worst affected areas.

Kupwara District

Kupwara is the North-west frontier District of Kashmir Valley. The District is situated at an average altitude of 5300 feet from the sea level. The geographical area of the District is 2379 km^2. The total population of the district is estimated to be around 640013.

Figure 7: District Kupwara
Source: Wikimedia

Baramulla District

Baramulla District is the largest District in entire valley both with reference to the population and area. The District is spread over an area of 4588 km^2 and its population is around 11.51 Lakhs.

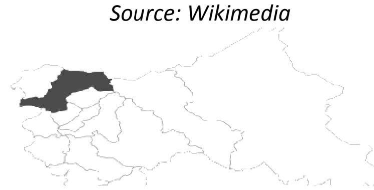


Figure 2: District Baramulla
Source: Wikimedia

Geographic Information System

Making decisions based on geography is basic to human thinking. A geographic information system (GIS) is a technological tool for comprehending geography and making intelligent decisions. A good GIS program is able to process geographic data from a variety of sources and integrate it into a map project. GIS maps are interactive. On the computer screen, map users can scan a GIS map in any direction, zoom in or out, and change the nature of the information contained in the map. They can choose whether to see the roads, how many roads to see, and how roads should be depicted. Some GIS programs are designed to perform sophisticated calculations for tracking storms or predicting erosion patterns.

GIS Functioning and Data Integration

A GIS makes it possible to link, or integrate, information that is difficult to associate through any other means. Thus, a GIS can use combinations of mapped variables to build and analyze new variables.For example, using GIS technology, it is possible to combine agricultural records with hydrograph data to determine which streams will carry certain levels of fertilizer runoff. Agricultural records can indicate how much pesticide has been applied to a parcel of land. By locating these parcels and intersecting them with streams, the GIS can be used to predict the amount of nutrient runoff in each stream. Moreover, as the streams converge, the total loads can be calculated downstream where the stream enters a lake. The following figure depicts the way a GIS integrates data for making it relevant in decision-making.

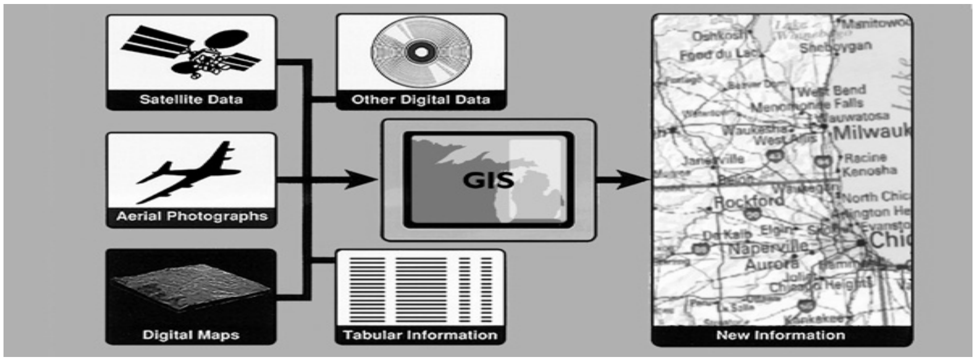


Figure 3: Data integration is the linking of information in different forms through a GIS
Source: US Geological Survey

GIS data represents real world objects (roads, land use, elevation) with digital data. Real world objects can be divided into two abstractions: discrete objects (a house) and continuous fields (rain fall amount or elevation).
There are two broad methods to store data in a GIS for abstractions: Raster, Vector.

A raster data type is, in essence, any type of digital image represented in grids. Anyone who is familiar with digital photography will recognize the pixel as the smallest individual unit of an image.

A simple vector map, using each of the vector elements: points for wells, lines for rivers, and a polygon for the lake.

GIS Tools

GIS software provides the functions and tools needed to store, analyze, and display geographic information. Although there are now several GIS Solutions available off the shelf as well as customised, we shall be restricting our study to two most popular GIS Tools used especially in Disaster Management applications. These are – ArcGIS and ITRIS (Integrated Seismic Research and Information System)

The Kashmir Earthquake of 2005

An earthquake of severe intensity (magnitude 7.6 on the Richter scale) occurred on 8th October 2005 at 8.50.38 AM (local time) with epicentre at 34.432°N, 73.537°E in the Muzaffarabad Region of Pakistan Occupied Kashmir. The tremor, which lasted for 6 minutes, caused widespread death and destruction to property and communication network mostly in the Pakistan administered Kashmir and the North West Frontier Province of Pakistan and the adjoining areas of Indian Administered Kashmir.

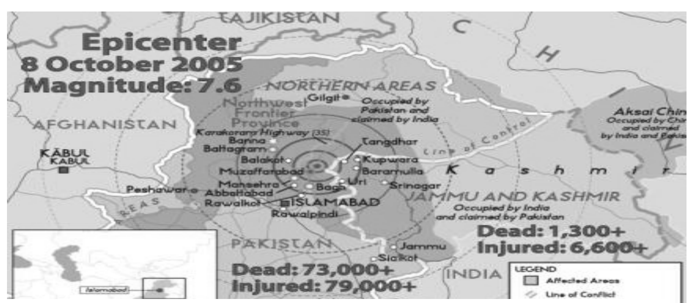


Figure 4: Epicentre of the 2005 Earthquake
Source: Centre for Excellence in Disaster Management and Humanitarian Assistance

Almost all the buildings—mainly stone and block masonry laid in cement sand mortar collapsed in areas close to the epicentre. Up to 25 km from the epicentre, nearly 25% of the buildings collapsed, and 50% of the buildings were severely damaged. The districts of Poonch, Baramulla, Jammu, Udhampur, Ramban Kathua, Srinagar, Budgam, Anantnag, Pulwama and Kupwara were the affected districts in India Administered Kashmir. However, the districts of Baramulla and Kupwara were the worst affected districts, due to their proximity to the epicentre of the earthquake. As per the official reported figures, 1360 persons lost their lives and 6622 were reported to be injured. 33 persons had been reported to be missing in the State.

Survey Observations

Survey was conducted at 6 villages of the worst effected two districts listed below:

S. No	Village	District	Approximate Distance from Epicentre of Earthquake
1	Thandipora	Kupwara	90
2	Chowkibal	Kupwara	70
3	Teetwal	Kupwara	20
4	Tanghdar	Kupwara	40
5	Panzgam	Kupwara	45
6	Uri	Baramulla	25

Table 1: Villages visited during Survey

Casualty Figures

The 2005 Kashmir Earthquake (also known as the South Asian earthquake or the Great Pakistan earthquake) was a major earthquake entered in Pakistan-administered Kashmir and in North West Frontier Province (NWFP) near the city of Muzaffarabad, Pakistan. It occurred at 08:52:37 Pakistan Standard Time on 8th October 2005. It registered a debatable moment magnitude of 7.6 making it similar in size to the 1906 San Francisco earthquake, the 1935 Quetta earthquake, the 2001 Gujarat earthquake, 2009 Sumatra earthquakes, and 7.9 magnitude earthquake of Nepal on 25 April,2015.

The following table displaying the figures of casualties and relief in the Indian side has been obtained from the Disaster Management Cell in the Divisional Commissioner of Kashmir's Office.

S.No	Anantnag	Baramulla	Budgam	Kupwara	Pulwama	Srinagar	Total
Lives Lost	0	674	01	276	0	2	**953**
Amount paid @Rs. 50000	0	336.50	0.5	138	0	1	**476**
Injured	0	399	8	94	0	316	**817**
Amount Paid @Rs. 5000	0	0	0.04	5.9	0	15.8	**21.74**
Fully Damaged Homes	10	14710	44	8994	13	11	**23782**
Amount Paid @Rs. 100000	10	14642	44	8495	11.8	11	**23213.8**
Partial Damaged Homes	112	91334	10560	66887	120	5857	**174870**

Amount paid @Rs 30000	10.38	8346.63	144.29	12305.32	29.15	477.32	**21313.09**
Shelters Constructed	0	11527	0	7995	0	0	**19522**
Amount paid for Shelter Construction @ Rs. 30000	0	3548.10	0	2392.5	0	0	**5940.6**
Incentives Paid for On time Construction @ Rs. 5000	0	448.40	0	266.80	0	0	**715.2**

Table 2: *O/o the Divisional Commissioner of Kashmir (All amounts in Rs. Lakhs)*

The above table depicts the facts and figures of various parameter like: District wise relief amount, lives lost, damage compensation etc. It is evident from the figures that the Districts of Kupwara and Baramulla have been worst affected and thus the maximum relief distribution has taken place in these districts.

Casualty Figures of Surveyed Area

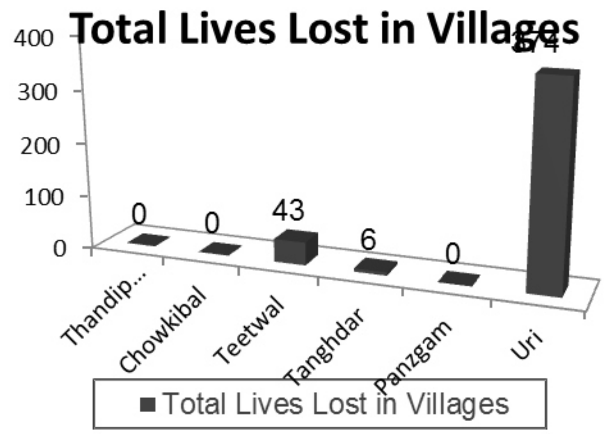
The following table refers to the figures of casualties from among the areas that were surveyed.

S. No	Name of Village	District	Population	Total Lives Lost as per Official Data	Lives Lost among Sample Data Collected	Average No. of Days taken by DMA	Deaths due to Delay	% Deaths due to Delay
1	Thandipora	Kupwara	2122	0	0	0	N/A	N/A
2	Chowkibal	Kupwara	3224	0	0	14	N/A	N/A
3	Teetwal	Kupwara	2986	43	13	6	8	62
4	Tanghdar	Kupwara	2665	6	1	5	1	100

5	Panzgam	Kupwara	2944	0	0	13	N/A	N/A
6	Uri	Baramulla	111712	374	9	66	4	44
	Total		**125653**	**423**	**23**		**13**	**57**

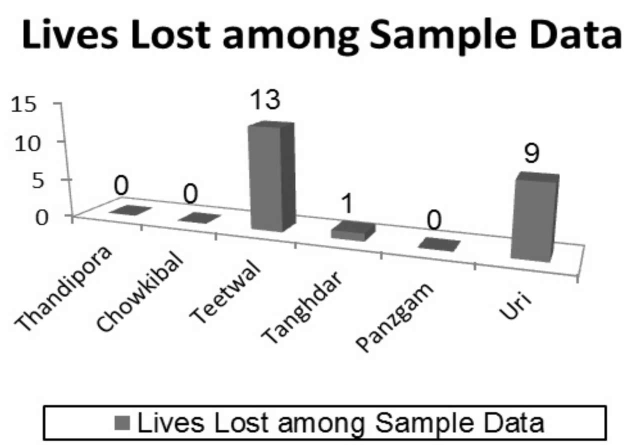
Table 2: Figures of casualties in surveyed villages

The following chart shows the casualty figures related to the six villages that were surveyed.



The casualty figures of Uri and Teetwal are the highest as these were the areas closest to the epicentre of the earthquake. The total deaths that occurred in the area is 423. The total population of the six areas covered is 125653. Hence, the analysis and its outcome is that about **0.33%** of the population died during the disaster.

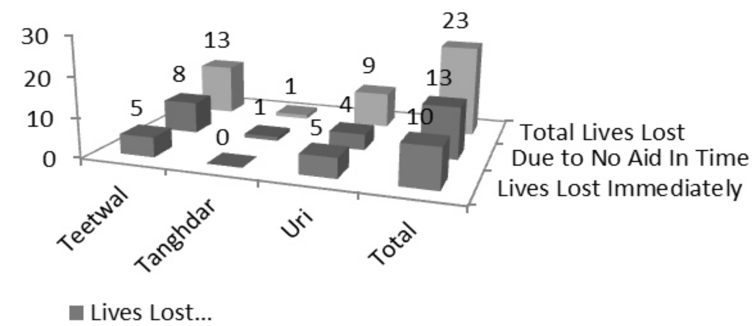
The region is mountainous and hence the approach to some villages was extremely difficult. GIS technology provides a complete assessment of the damage to roads facilitating the Disaster Management agencies in reaching difficult areas.



The above chart shows the casualty among the sample of people that were surveyed. Teetwal, Tanghdar and Uri recorded death figures and the other areas did not. Hence the sample figures collected are in sync with the official figures of casualties.

Casualties Due to Unavailability of Medical Aid in Time

During the survey, people of the effected are were interacted to know the delay in medical aid to them/their family members if any. From the table 2 above, it is observed that 13 deaths occurred in three villages of Teetwal, Tanghdar and Uri due to unavailability of medical aid. The total deaths that occurred in these three areas were 23. The following chart represents the same:



Hence 57% of deaths that occurred in the regions were actually due to non-availability of Medical and other Disaster management related aid.

The GIS System once in place can help in evolving models of the earthquake in the region within fractions of minutes. A good GIS tool can be used to present the information in an intuitive way where the decision maker has a bird's eye view and can drill down to the exact details of the impact in any area of interest.

Described below is a snapshot from a GIS mapping tool where the impact of an earthquake is seen on a road route between two cities. Information on this view would be vital in rushing supplies and relief to the concerned towns as well as planning for the same.

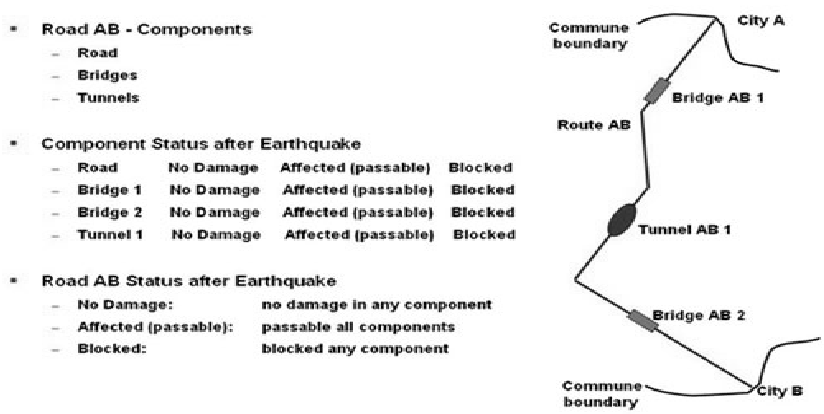


Figure 3: *Reduction in Reaction Time during DisasterSource: gisdevelopment.net*

Effectiveness of GIS in Disaster Management

Reduced Causality

From the above study and analysis, it can be said that had a GIS System in place, there was a high probability of saving many more lives.

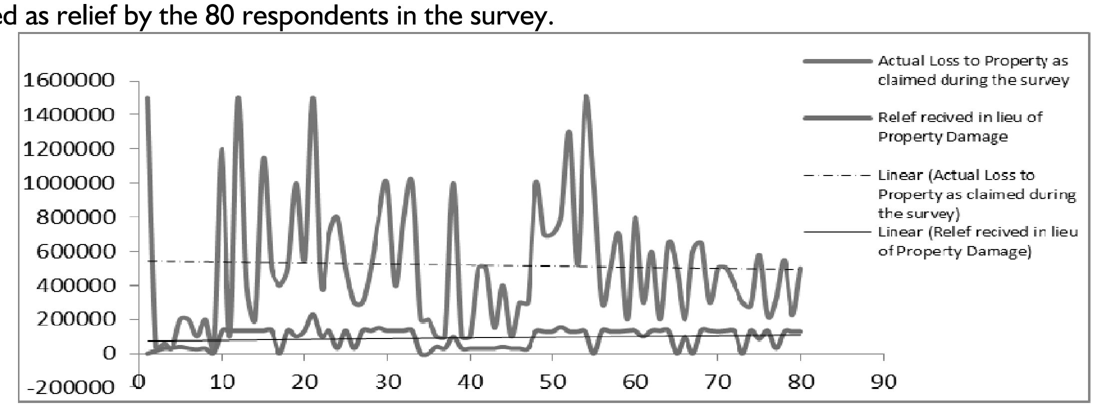
Damage to Property

The respondents were surveyed to estimate the of loss due to damage of their homes and damage relief received by them.

It was observed that the amount of relief was categorised as follows:

- Full Damage to House: Rs 1,00,000
- Partial Damage to House: Rs. 30,000
- Constructing Shelter: Rs. 30,000
- Constructing Shelter within stipulated time (Bonus): Rs.5000

About 100% of the respondents claimed that they had lost much more than they were compensated for. These claims could not be verified resulting this gap. After major earthquakes, the extent of the disaster often needs to be estimated from outside the affected area, because no information flows from the centre of the disaster. For this reason, GIS based systems can issue loss estimates in real-time, based on data sets on building stock and population in its data base and the calculated strong shaking due to an earthquake. If a satellite photograph for the devastated area be available soon after an earthquake, the assessment of damage can be done directly. If, in addition, a satellite photograph of the city in question exists in the image library, a comparison between the two images, before and after, can furnish a quantitative measure of the extent of destruction.By implementing the technique of mapping to 3D GIS the entire area, it would have been possible for the Disaster Management authorities to determine the exact position of the houses and infrastructure that existed before the disaster. Similarly, with 3D GIS it would have been possible to know the extent of damage caused by the earthquake. Using appropriate mapping technique with strong 3D GIS Software, it would have been possible to extract the level of damage to each building within the area, thus eliminating any doubt regarding claims made later on.
The following chart shows the difference between the claimed damage to property and the amount received as relief by the 80 respondents in the survey.



By observing the trend lines of the 2 graphs above, it can be clearly seen that there lies a vast difference in the actual damage to property (claimed) and the relief amount distributed.
The authorities need verification to any claims made and at present there is no way to verify any claims and hence the authorities decided not to compensate the people but only to provide relief in a blanket fashion. However, if with a proper GIS enabled disaster management system, the authorities would have been in a better position to make claim for the victims realistically and perhaps the actual victims would have been given the due rather than fake claimants and influential people of the villages.

Recommendations and Conclusion

Recommendations

The disaster mitigation programmes using Innovative Governance Techniques through ICT implementations must be extensively implemented and practiced. There should be a greater emphasis on development of new technologies in disaster mitigation. The broad recommendations are as follows:

- Disaster Management has to be a multi-disciplinary and pro-active approach. Besides various measures, institutional and policy framework, disaster prevention, mitigation and preparedness taken by the Central and State Governments in India, the community, civil society organisations and media also have to play a key role. We can march towards a safer and sustainable national development only when development projects are sensitive towards reduction of risks to human life.

- Information and Communication Technologies in the form of Internet, GIS, Remote Sensing, Satellite communication etc. are indispensable in planning and successful implementation of most Disaster Risk Reduction initiatives. However, the potential of most advanced technologies is required to be harnessed in early warning, preparedness and response systems along with adequate emphasis on building human capacities to use these tools and technologies.
- GIS as a tool is useful in all spheres of Civil Administration across the globe. The power of decision making provided by these tools cannot be ignored for long. In order to deliver better services to its citizens, India too needs to move fast along the implementation lines of western countries with respect to GIS technologies.

Conclusion

The size of the ICT implementation in Disaster Management in India is expected to be $10 billion in 10 years. This fact was stated in a business conclave during the 58th International Astronautically Congress held in 2007. The annual revenues of the ICT in Disaster Management/ GIS market are expected to grow from an estimated $4 billion to $150 billion in the next decade globally.

With more and more government agencies, private companies and individuals using ICT(GIS) and high-resolution imagery services, the market is growing by leaps and bounds.

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ICT SUPPORT SERVICES FOR NATIONAL DISASTER MANAGEMENT

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Abstract

Information and Communication Technology has lanced into all disciplines, thereby decision making more efficient and cost effective. Keeping this in view, in 1990s, to support United Nation's Natural Disaster Reduction Decade Programme, NIC undertook informatics research and development under its national programme, called "Natural Hazards Management Information System(NHMIS)". Under this programme, pilot projects were taken and several ICT contributions have been made in the area of Disaster Management .In the immediate aftermath of December 2004 Tsunami, the Government of India took a far reaching decision with a vision to transform the approach to disaster management (DM) by inducting Science and Technology in all the elements of DM continuum. As per the new policy frame work, National Disaster Management Authority (NDMA) was established as an apex body for Disaster Management in the country. In tune with the new policy frame work to provide ICT support to National Disaster Management, the NHMIS Division of NIC was renamed as "National Disaster Management Information System (NDMIS)" Division. Since 2005, NDMIS Division of NIC was actively involved in providing ICT support to NDMA.

This paper presents the new government policy frame work and review of the existing ICT set up with specific reference to application development methodology and NIC efforts made so far in developing the ICT systems for disaster management in the country. It highlights the issues/inadequacies of the present ICT system for disaster management. To address the issues and eliminate the inadequacies of the present system a comprehensive plan for application development was proposed. The on-going National Emergency Communication Plan and the proposed application development as part of NDM Services pilot project are summarized.

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MAPPING OF DISASTER ZONES IN INDIA

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Introduction

Disaster is a sudden adverse or unfortunate extreme event which causes great damage to human being as well as plants and animals. Disasters occur rapidly, instantaneously and indiscriminately. These extreme events either natural or man-induced exceed the tolerable magnitude within or beyond certain time limits, make adjustment difficult, result in catastrophic losses of property and income and life is paralyzed. These events which occur aggravate natural environmental processes to cause disasters to human society such as sudden tectonic movements leading to earthquake and volcanic eruptions, continued dry conditions leading to prolonged droughts, floods, atmospheric disturbances, collision of celestial bodies, etc. (Joshi, 2008).

The term disaster owes its origin to the French word "Desastre" which is a combination of two words 'des' meaning bad and 'aster' meaning star. Thus the term refers to 'Bad or Evil star'. The definition of a disaster adopted by the World Health Organization and the United Nations as established by Gunn is: "the result of a vast ecological breakdown in the relationships between man and his environment, a serious and sudden (or slow, as in drought) disruption on such a scale that the stricken community needs extraordinary efforts to cope with it, often with outside help or international aid."

India has been traditionally vulnerable to natural disasters on account of its unique geo-climatic conditions. Floods, droughts, cyclones, earthquakes and landslides have been a recurrent phenomena. About 60% of the landmass is prone to earthquakes of various intensities; over 40 million hectares is prone to floods; about 8% of the total area is prone to cyclones and 68% of the area is susceptible to drought. In the decade 1990-2000, an average of about 4344 people lost their lives and about 30 million people were affected by disasters every year. The loss in terms of private, community and public assets has been astronomical. It was in this background that the United Nations General Assembly, in 1989, declared the decade 1990-2000 as the International Decade for Natural Disaster Reduction with the objective to reduce loss of lives and property and restrict socio-economic damage through concerted international action, especially in developing countries. Disaster management occupies an important place in this country's policy framework as it is the poor and the under-privileged who are worst affected on account of calamities/disasters.

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APPLICATION OF ICT TOOLS IN DROUGHT MONITORING AND MITIGATION

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Abstract

The Drought is the most common natural disaster in Karnataka. Implementing proactive adaptation and mitigation plan at micro level is one of the best practises to withstand the effect of drought in a long term. Karnataka State Natural Disaster Monitoring Centre has taken proactive measure and has built a mechanism with a muliti-disciplinary approach to provide Science and Technology based solution to tackle the situation. Application of ICT tools with State-of –the-art techniques employed by KSNDMC has been of great help for the executive to plan and execute mitigation measures. As the community is directly involved in the process by providing right information at right time, it has been of immense help for them to minimise the loss due to Drought.

Key Words: *Natural Disasters, Drought, ICT Tools, Mitigation*

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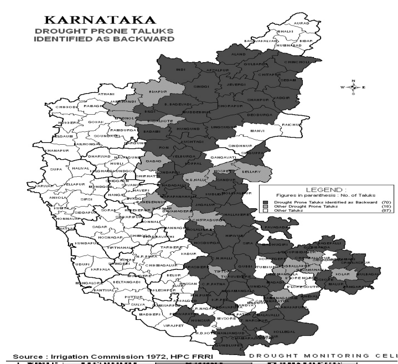
Introduction

Intensity of the monsoon is vital if we are to predict these periods of extreme The effect of global climate change will induce significant change into the tropical climate system, the monsoon. The areas under monsoon shadow will witness the effect of fluctuation in monsoon cycle. These variations in seasonal rainfall are often related to weather in other parts of the world, such as El Niño events in the Pacific Ocean. Understanding the timing, durationweather events such as drought and flood. To capture and analyse the frequency and nature of such extreme weather events requires high resolution data on weather parameters like surface Temperature and Precipitation (Rupakumar *et al* 2006).

For instance, the Drought, being a creeping hazard, can be managed effectively only with reliable weather monitoring and forecasting system. The real time monitoring, data analysis, vulnerability mapping, risk assessment and report generation on drought causing parameters is the only way to effectively tackle the situation and minimise the loss caused by such disasters.

The precession of the information and time are two key factors crucial for dealing with any natural disaster, especially Drought and Flood. Gathering information on drought inducing factors need to be very precise and timely so that the vulnerable areas could be identified and also helps in planning and executing mitigation measures well in advance. In order to achieve this ICT tools plays an important role at all stages of drought monitoring and mitigation, viz. data collection, analysis, identifying vulnerable areas, information and advisory dissemination and implementing mitigation measures.



Year	Drought	Flood	Hailstorms
2001	✓		
2002	✓		✓
2003	✓		
2004	✓		✓
2005		✓	
2006	✓	✓	
2007		✓	
2008	✓	✓	
2009	✓	✓	
2010		✓	
2011	✓		
2012	✓		
2013	✓	✓	
2014	✓	✓	✓
2015	✓	✓	✓

Drought Vulnerability in Karnataka

The historical data about the natural disasters in Karnataka shows that series of various types of disasters have struck the State with devastating effects. In the last 15 years, Karnataka has been witnessing weather related disasters like Drought, Floodand Hailstorm.**Fig 1.**Map showing Drought vulnerable areas in Karnataka and years in which state witnessed various weather related Disasters.

Karnataka stands Second only to Rajasthan in terms of Drought Affected areas. The state is highly vulnerable to drought as compared to its neighbouring states. About 152.1 Lakhs ha (80%) out of 190.238 Lakh ha is affected by drought in Karnataka. Groundwater levels are depleting due to successive droughts and quality of water is getting deteriorated. Although, drought may not pose great danger immediately within a few minutes as could happen in case of a severe earthquake, it has huge impact on the occurrence of loss of livelihoods, migration, poverty etc. Drought is a situation when the actual seasonal rainfall is deficient by more than twice the mean deviation. Drought is defined as period of abnormally dry weather sufficiently prolonged for lack of water to cause a severe hydrological imbalance in the area affected. It is the result of imbalance between soil moisture and Evapo-Transpiration needs of an area over a fairly long period as to cause damage to standing crops and to reduce the yields. Drought may occur due to

- Deficit of rainfall

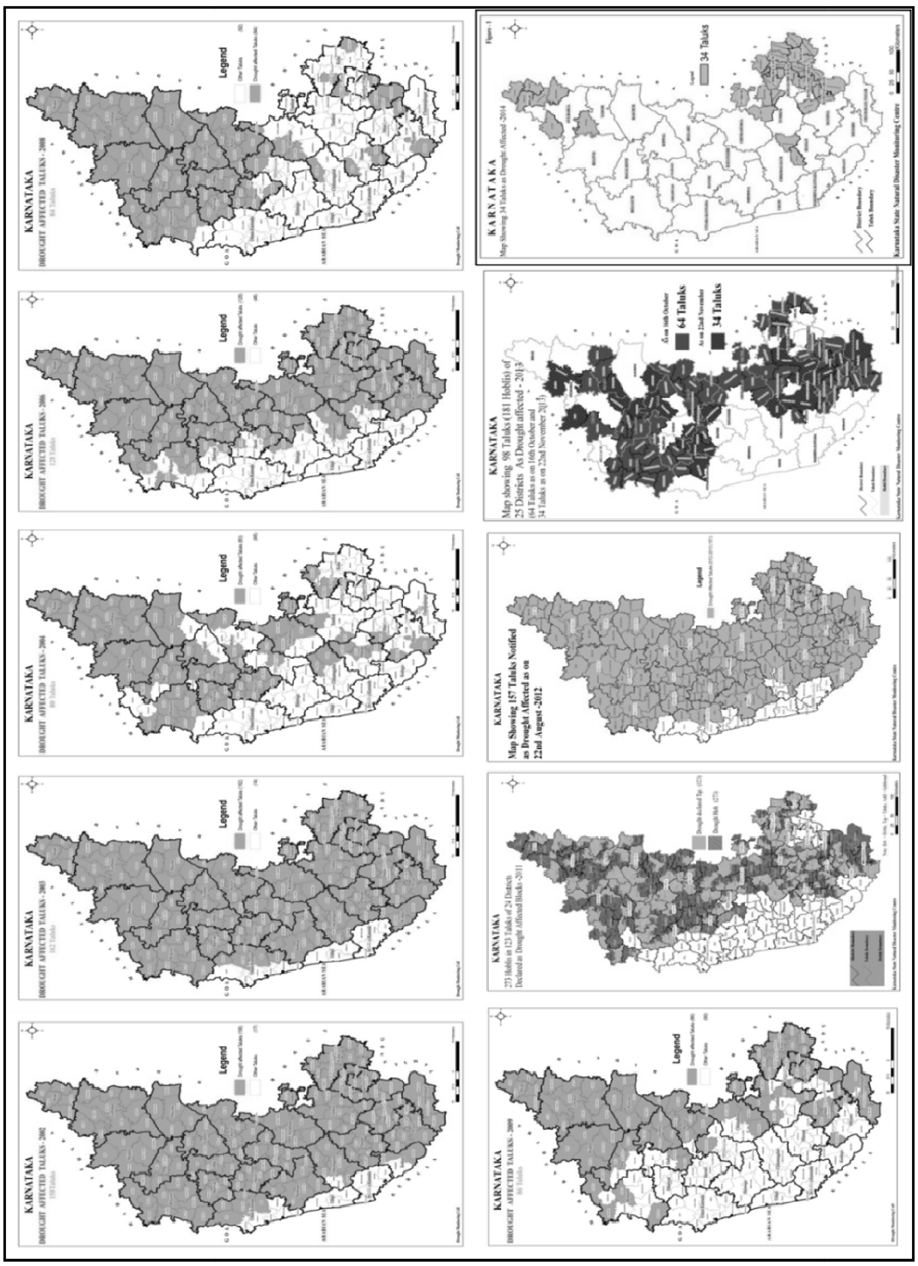


Fig.2. Maps showing drought affected Taluks in Karnataka during since 2012 to 2014.

- Depletion of ground water
- Inadequate supply of water through surface water bodies like rivers, streams, canals, tanks etc.
- Insufficient moisture in the sub surface layer of the soil and
- Increase of demand for water as compared to availability.

The data suggests that 12 out of the last 15 years (2002-2014) Karnataka state was subjected to severe Drought condition. The data also suggests that Drought is a recurring Disaster in the state and some of the Taluks had witnessed Drought more than 5 years consecutively.

Although drought is often attributed to Hydro-Meteorological aberration in a region, the analysis of meteorological data in the state and close look at the events and their affects on the ground, suggests that along with attributing it to Hydro-Meteorological problem, it should also be seen as an issue of water management. Therefore, a multi-dimensional, S & T based approach is necessary to tackle and mitigate the damages caused due Drought.

Rainfall Distribution in Karnataka

The State receives 80% of the annual rainfall in the southwest monsoon period, 12% in the post-monsoon period, 7% in the summer and only 1% in winter (Krishnan, 1984). The Coastal and Malnad regions, which comprises of seven districts, receives > 4000 mm of rainfall during the southwest monsoon. The convergence of the monsoon westerlies and its vicinity to the Ghats brings good showers to the Coastal Districts of Karnataka. The humid malnad region has annual rainfall in the range of 1000-3800 mm. Over the plains, which forms the North and South interior parts of the state, the rainfall drops to as low as 500-600 mm annually.

There are two major rainfall deficit areas in the State with annual rainfall of 500-600mm, both lying in north interior Karnataka, one covering parts of Bijapur, Belgaum, Dharwad and Raichur districts and the other is covering Bellary, Chitradurga and a small portion of Tumkur district. The region with lowest rainfall of less than 500 mm is around Challekere in Chitradurga district. The rainy season is spread over a period of four months (June-September) in the Coastal, Malnad Districts and in Bidar district. Over the interior parts of Karnataka, it is spread over a period of five to seven months. The districts, which have a long spell of rainfall, are Hassan, Mysore, Tumkur and Chitradurga. It is advantageous that the rainy season extends over a period of five to seven months in the comparatively low rainfall areas, as it enables agricultural operations to be carried out over longer period. One of the important aspects of rainfall distribution in the NIK & SIK, which forms the major part of the State, is the pronounced rainfall in September and October, which are the two most rainy months. Rainfall in these months is important for the maturation of Kharif crops and the sowing and early stages of Rabi crop. Over the major part of the State, September-October rainfall forms one-third of the annual rainfall; it is over 40% of the annual rainfall over the region extending from Bijapur, district to eastern half of Raichur and Bellary districts, the north-eastern part of Chitradurga district and the extreme northern parts of Tumkur and Mandya districts.

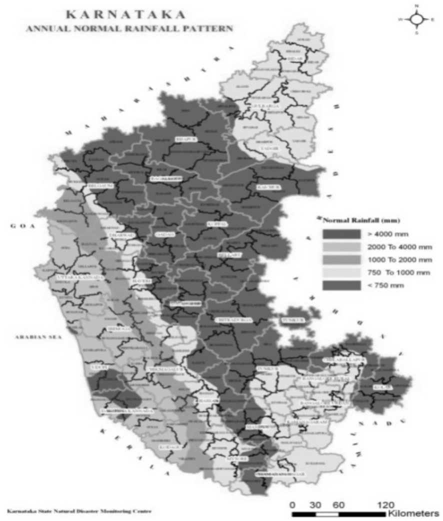


Fig 3: Annual Normal Rainfall Pattern in Karnataka

The spatial and temporal distribution of rainfall in the state varies so much, any change in normal rainfall, the state will be subjected to Drought. For instance in 2015, theStateasawholerecordedanactualamountof653 mmofrainfallas againstthenormalrainfallof839 mm with percentage departure from normal being (-) 22 %. Thusthe State as whole is classified under "DEFICIT"Category. Meteorological sub division-wise rainfall indicates that Percentage departure from Normal was (+) 11% in South Interior Karnataka, (-) 32 % in North Interior Karnataka , (-) 24% in Malnad region and (-) 26% in Coastal Region.

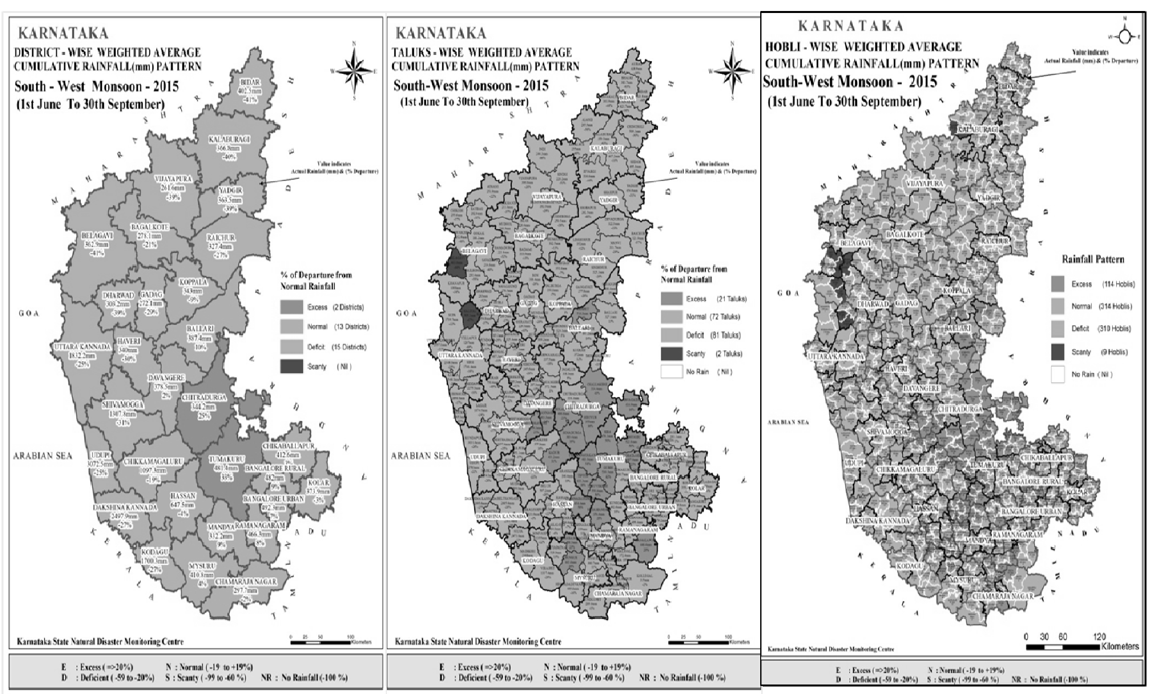


Fig 4: South-West Monsoon – 2015 Rainfall Pattern in Karnataka

As a result 136 Taluks of 27 Districts out of 176 Taluks of 30 Districts were notified as Drought affected.

The impact of Drought on Agriculture in 2015 is immense. In the targeted area for Kharif is 73 lakh hectares, the sowing has taken place only in 47.74 lakh hectares (65%) of which 36.12 lakh hectares are rainfed and 11.62 lakh hectares are under irrigation. Prolonged continuous dry spell has destroyed an area of

1.83 lakh hectares which amounts to 57% of the sown area. 30 lakh hectares is left unsown due to lack of rain. Onion, Potato, Chilli have been severely affected due to moisture stress. An estimated Rs.11,300 crores loss incurred for both agriculture and horticulture crop losss. Even Perennial and plantation crops such as Mango, Banana, Pomegranate, Grapes, Coconut were also affected due to prolonged dry spell.

Weather Monitoring Stations Network

Most important component in mitigation of drought is related to weather system – its monitoring and forecasting. The Drought monitoring mechanism, with a proactive approach, adopted by KSNDMC is unique of its kind in the country which has enabled the Executives earmarking areas affected by Disasters and notifying them in time. This has greatly supported the activation of response system in planning and implementing mitigation measures such as assessment of crop loss, contingency crop planning, mitigating drinking water scarcity, fodder scarcity, providing employment to rural agricultural laborers.

KSNDMC has designed and installed a dense network of Solar Powered and GPRS enabled Telemetric Rain Gages (TRG) stations covering all the 5625 Gram Panchayaths and Telemetric Weather Stations (TWS) at all the 747 Hoblis in the state. The installation of the rainfall / weather monitoring Network program was rolled out in a phased manner in tune with the progress in availability of GPRS connectivity. The dense network of weather monitoring stations is first of its kind in the country and the network utility is very diverse in nature.

Fig 5. The pictures of (a) Solar Powered & GPRS enabled Telemetric Weather Station (TWS) and (b) Telemetric Rain Gauge Station (TRG) installed by KSNDMC in the state.

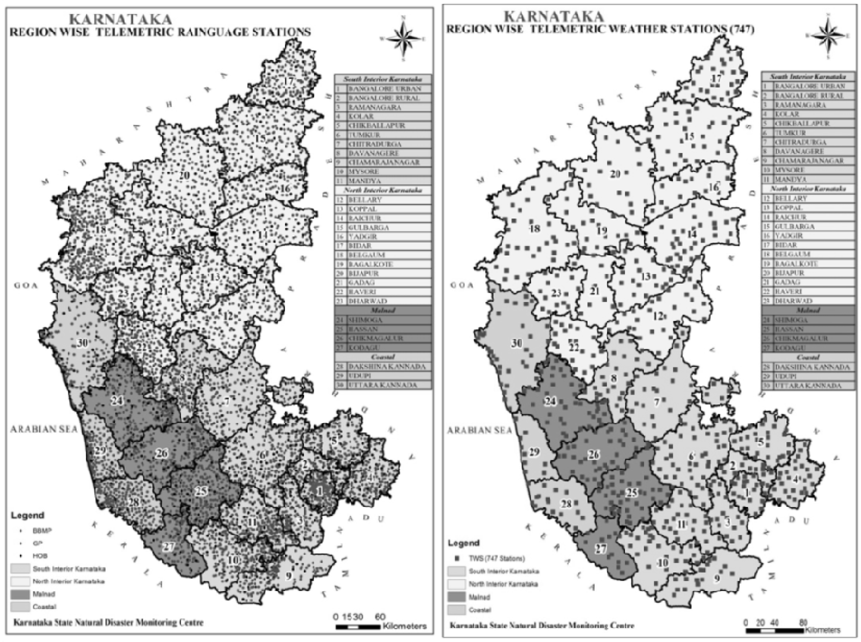


Fig 6. The maps showing the locations of the TRG and TWS installed and maintained by KSNDMC in the state

The key features of the entire network are,

- A Rainfall monitoring station at every ~25 sq. Km
- A Weather monitoring station at every ~ 250 sq. Km
- Data is collected at every 15 minutes without manual intervention.
- All the stations work 24 x 7 and 365 days.
- Rainfall measuring accuracy is 0.5 mm.

The sensors installed in each of these stations are very sensitive enough to capture even small changes in weather parameters with great accuracy. The network has been collecting reliable and uninterrupted data.

KSNDMC is equipped with state of the art facility to receive data from all the TRG and TWS station at every 15 minutes, data processing, data analysis and preparing maps and reports through auto-mode. The necessary software and web-application were developed indigenously and based on the near real time data collected, KSNDMC prepares maps and reports with advisories to the government authorities and to the general public.

Moisture Adequacy Index (MAI)

Moisture Adequacy Index (MAI) provides a good indication of the moisture status of the soil in relation to the water-need, high values of the index signifying good moisture availability and vice versa. MAI is normally obtained from weekly water balance. Drought impact is related to moisture availability at certain crop growth stages. Hence, categories of MAI (severity) at different growth stages are integrated into a single index value to identify drought impact on a particular crop.

KSNDMC has developed Moisture Adequacy Index based on rainfall, Potential Evapo-transpiration, Actual Evapo-transpiration and available water capacity of the soil. Moisture adequacy index are classified into severe Moisture stress (MAI < 25%), Moderate moisture stress (MAI - 25.1 to 50%), Agriculturally favorable (MAI - 50.1 to 75%) and Humid region (MAI >75%). As on 30th September 2015, about 36% of the geographical area in the State was under moderate moisture stress condition.

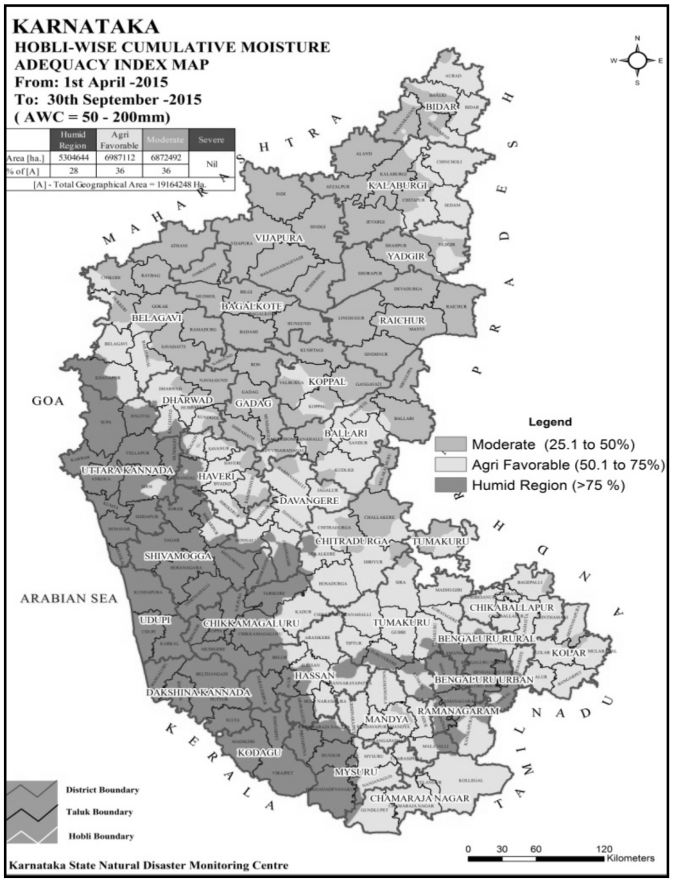


Fig 7. Moisture Adequacy Index map for Karnataka- 1st April to 30th September, 2015

Normalized Difference Vegetation Index (NDVI)

The Normalized Difference Vegetation Index (NDVI) is an index of plant “greenness” or photosynthetic activity, and is one of the most commonly used vegetation indices. Vegetation indices are based on the observation that different surfaces reflect different types of light differently.Thus, NDVI is one of the most successful approach to simply and quickly identify vegetated areas and their condition, and it remains the most well-known and used index to detect live green plant canopies in multispectral remote sensing data. Once the feasibility to detect vegetation had been demonstrated, users tended to also use the NDVI to quantify the photosynthetic capacity of plant canopies.

The maps generated by using Modis Terra Based Normalized difference Vegetation Index (NDVI) and Modis Terra Based Normalized difference Water Index (NDWI) indicates drought condition in parts of interior Karnataka.

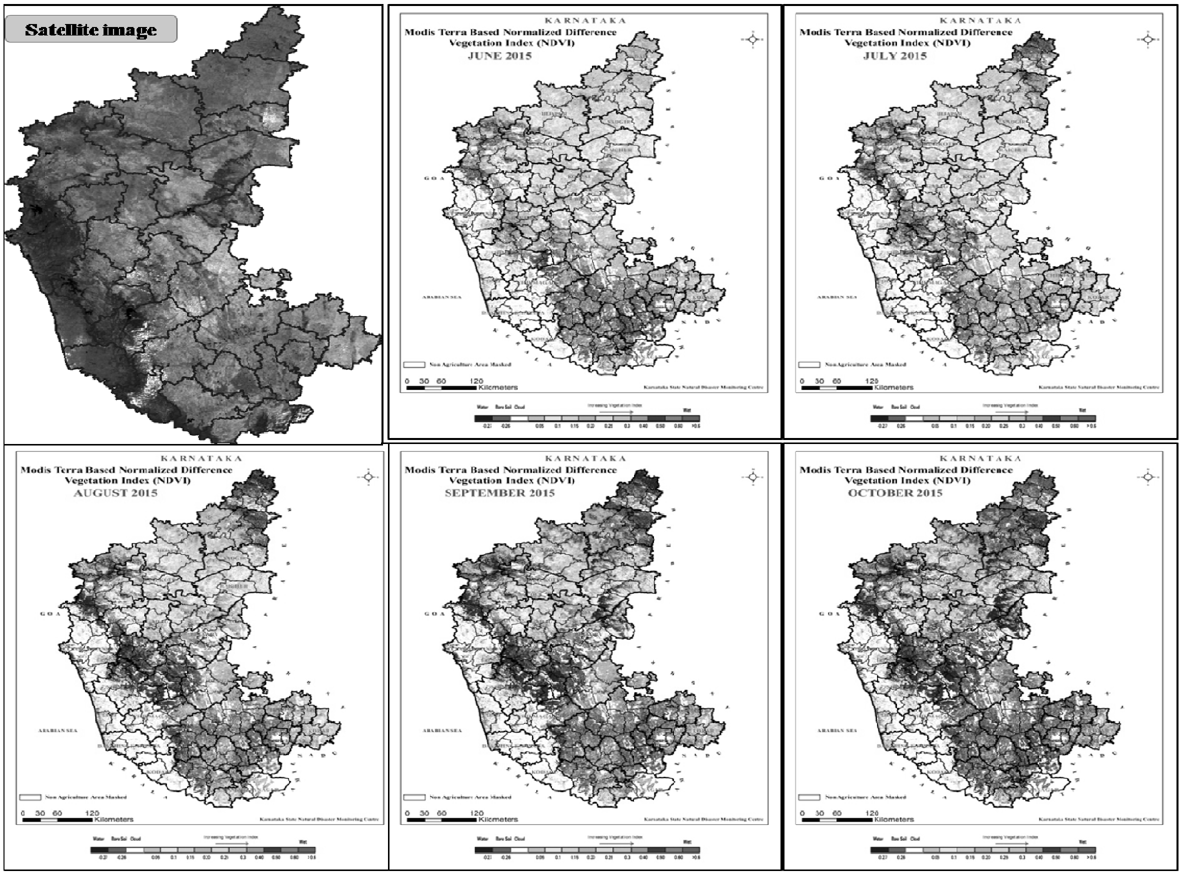


Fig 8. Monthly NDVI maps for Karnataka from June-October, 2015

Weather Forecast:

Generating and disseminating high-resolution weather forecast is yet another important factor in dealing with weather related Natural Disasters like Drought. KSNDMC has been providing Hobli / Grampanchayath level weather forecast at 12, 24, 36, 48, 60 and 72 hrs format for Karnataka. The Meso-scale weather forecast is on Rainfall, Temperature, Relative Humidity, Cloudiness, Wind Speed and Direction.

KSNDMC has been collaborating with Space Application Centre (SAC), Ahmadabad and CSIR-4pi (formerly CMMACS), Bengaluru for generating Grampanchayath level Rainfall / Weather forecast.
The observational 15 minutes data weather parameters collected through weather monitoring stations is also being ingested into the model for improving the weather model output.

Result:

It is common experience that obtaining the information, to integrate and generate information/reports/advisories is to take take very long time. A study reports that 40% of the time is spent on searching for the source for information, 30% of time is spent on waiting for the information to arrive and another 30% of the time is spent in understanding and customizing to the users requirement.

It is evident that that money spent on early warning and preparedness helps in reducing the cost on rescue, relief and rehabilitation, the ratio is 1:7. The investment made on early warning and preparedness has high cost-benefit ratio. It comprises installation of field monitoring sensors – weather and hydrological data collection on real time, transmission of the same to a central computational/analysis centre; data processing; analysis; alert recognition; simulation through appropriate mathematical models, customized report generation ; dissemination of the alerts/reports/advisories to the users. The system developed and operationalised in Karnataka by KSNDMC has addressed all the above mentioned issues and has been providing solutions.

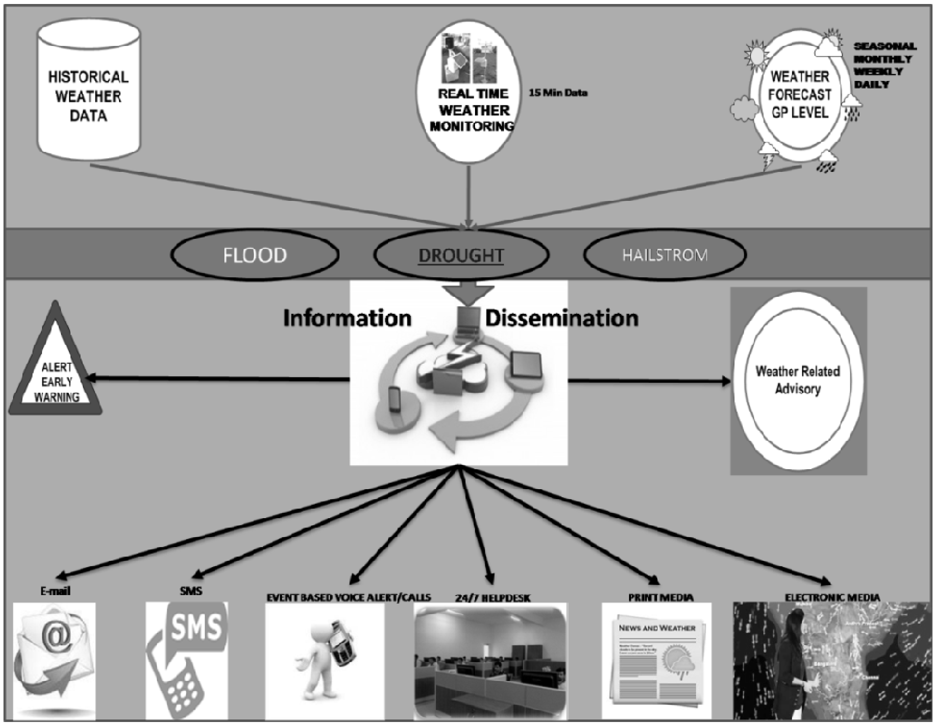


Fig 9: Schematic Diagram of Data collection, information and advisory generation and Dissemination mechanism adopted by KSNDMC.

The drought monitoring mechanism practiced at KSNDMC is unique of its kind in the country which has enabled earmarking areas affected by drought and notifying them in time which has greatly supported the activation of response system in handling drought mitigation measures such as assessment of crop loss, contingency crop planning, mitigating drinking water scarcity, fodder scarcity, providing employment to rural agricultural laborers, preparation of memorandums for seeking central assistance, justifying the severity of the situation at Hobli level.

KSNDMC is providing scientific data on Rainfall, Dry spell, aridity anomaly, agriculture sowing status, crop condition, status of the major reservoir levels and minor irrigation tanks along with meso-scale (hobli level) weather forecast to the Weekly State Level Weather Watch Committee meetings chaired by Additional Chief Secretary and Development commissioner, GOK, Cabinet sub-committees meetings dealing with drought and Cabinet meetings.

Information, reports, weather related forecast and advisories are being made available through mobile phones, e-mail and web portalto DC's, CEO's. HQA's, AC's, Tahsildars, JD's (Agri), AD's (Agri), Agri Officers, SP's, Raitha Samparka Kendras, farmers facilitators under Bhoochethana Program, Krishi Vigyana Kendras (KVKs), Universities, Civil Defense, Home-Guards, Print and Electronic Media.

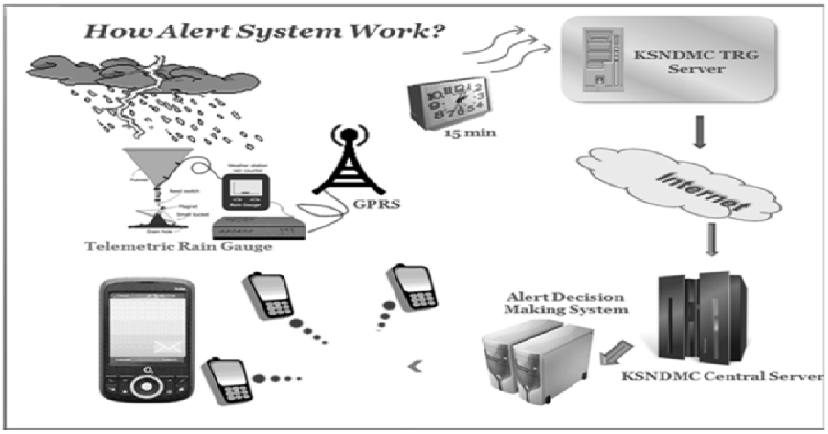


Fig 10 : Schematic diagram of real time alert / early warning dissemination to the Officers of GoK through SMS.

As the information and advisories are reaching the stake holder on near or real time basis, it is helping them immensely for planning and executing mitigating measures, mobilising and organising the resources for tackling any eventualities, executing rescue operations etc.

Community Help-Desk

In order to disseminate the weather data observed and forecast to the general public, KSNDMC has setup an interactive help-desk "VARUNA MITRA" with three Telephone lines (9243345433 and 080-22745232 / 34) which is functioning 24x7x365 basis. The general public, especially the farmers are calling "VARUNA MITRA" and collecting necessary information for their respective Hobli / Grmpanchayath.

The purpose of setting up of this help desk is to reach the scientific information and advisories about the natural disasters to the community so that they can be prepared to act timely to ease the impact of any disasters on their community. As the process is to deal with individual member of the community, the end result is micro-managing the disaster at any point of time.

The interactive nature of the help-desk has been appreciated by the community because

- It has been providing them an opportunity to collect the first hand information from a reliable source which boosts their confidence at the time of distress.
- Know more about any related issues, if necessary.

As a result day by day the number of calls to "VARUNA MITRA" has been increasing substantially.

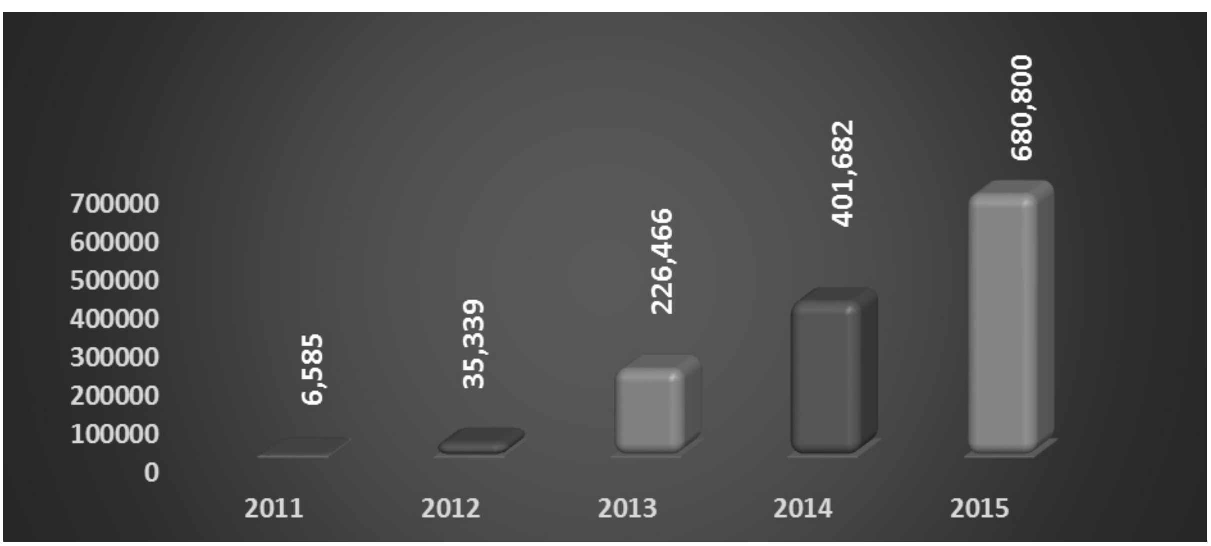


Fig 11. Year-wise number of calls answered by "VARUNA MITRA"

The services and information provided through "VARUNA MITRA" has been helping the farmers either minimise the Crop loss due to weather aberrations and / or increase the yield and the related profit because of timely intervention in their agricultural activities.

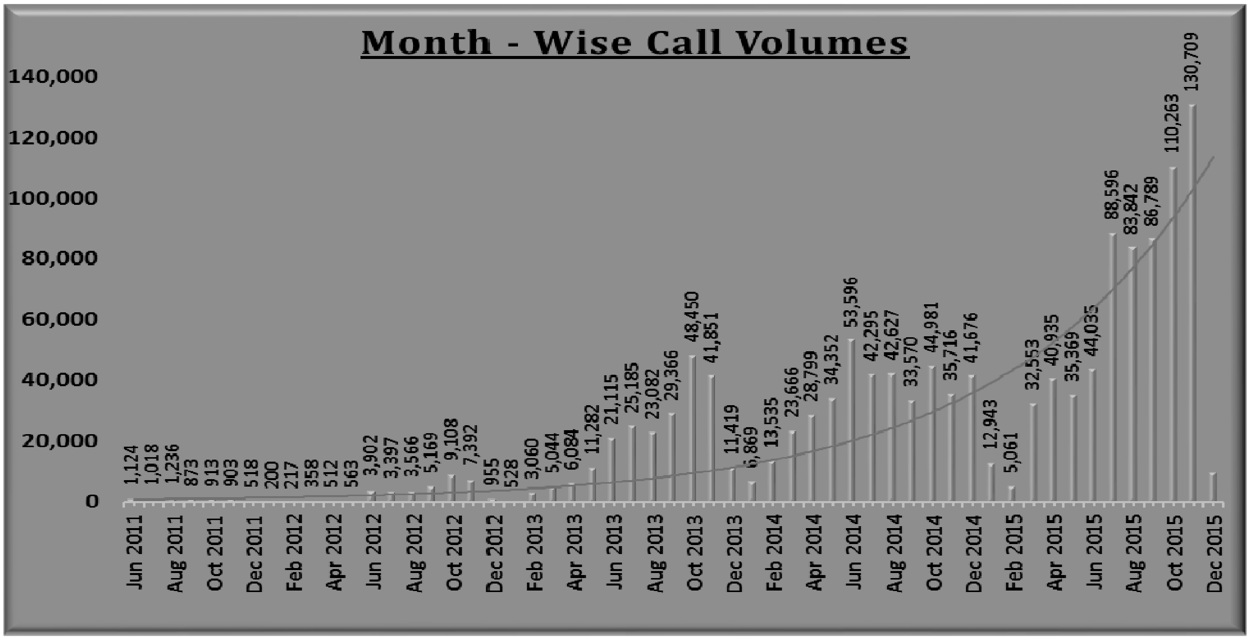


Fig 12. Month-wise call volumes received by "VARUNA MITRA"

Institute for Social and Economic Change conducted a study to evaluate the effect of "VARUNA MITRA" services on the community. The result of the study shows that conducted by, showed that

- As the information is provided through simple terms in regional language it has been very convincing and effective across the community.
- "VARUNA MITRA" has been functioning as a bridge between Scientifc organisation and the end-user.
- Every individual farmer collecting the information from "VARUNA MITRA" is in turn disseminate it to 15-20 people in his area, thereby these services has been reaching lacks of farmers every day.
- More than 80 % of the farmers are satisfied with the resolution, time and accuracy of the *Grampanchayath* weather forecast provided through "VARUNA MITRA"
- The information and advisories helping them in planning and executing agricultural activities like, ploughing, sowing, inter-crop cultivation, spraying pesticides, adding fertiliser and more importantly identifying right time for harvesting.

Conclusion

Planning and implementing adaptation and mitigation plan is the need of the hour to withstand the effect of climate change and related natural disasters on a regional scale. Karnataka State Natural Disaster Monitoring Centre has taken a proactive measure and has built a mechanism with a multi-disciplinary approach to provide Science and Technology based solution to tackle the situation created by any natural disasters in Karnataka at any point of time. Application of ICT tools with State-of –the-art techniques employed by KSNDMC has been of great help for the executive to plan and execute mitigation measures. As the community is directly involved in the process by providing right information at right time, it has been of immense help for them to minimise the loss due to Drought.

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IMPACT

- Socio Economic Impact of Coastal Hazard in Kerala- *Malini Prava Sethi*
- Impacts of Natural Disasters and Its Coping Strategies at Kazircharvillage In Muladi Upazila, Barisal - *Md. Humayain Kabir, Md. Tanvir Hossain*
- Post-Disaster Economic Vulnerability of Female-Headed Households -*Isaias S Sealza*
- Socio Economic Impact of Coastal Hazard in Kerala - *Malini Prava Sethi.*
- Social and Psychological Imprints of Disasters understanding the social and Psychological impact of disasters on the disaster effected people of *Uttarakhand - Dr. Vinay Sharma, Dr. Kapil Joshi,IFS,*

SOCIO ECONOMIC IMPACT OF COASTAL HAZARD IN KERALA

Malini Prava Sethi

PhD Research Scholar, CIAS/SIS,Jawaharlal Nehru University,New Delhi

Abstract

The major activities of livelihood in the coastal areas, such as fishing, agriculture, livestock and non-farm activities have been disrupted by coastal hazards. The local people of fishing communities refers to natural hazards that, impacting the upon fisher-folks' livelihoods as "kolaru". This encompasses the inter-linkages between various natural phenomena such as strong winds and heavy rains, huge waves, turbulent seas, resulting surges often accompanied by thunder and lightning. The Tsunami of 2004 exposed the disadvantages of the coastal fisher population in terms of their resilience and coping capacity. Almost 13 lakhs of people in 187 villages of Kerala were affected by Tsunami with a death toll of 177 persons and 13,735 house damages. The purpose of this paper is to present the experiences and views of women and men in the fishing communities in relation to disaster response and the state of their livelihoods; their perceptions of the changes and how they mitigate such disasters. This paper examines the trend and patterns of coastal development and coastal management practices in Kerala. It analyses the implications of these development on the ecosystem services and capacities of people dependent on coastal resources for their livelihoods. The paper critically examines the planned adaptation or structural hazard mitigation strategies that have evolved to deal with coastal hazards. The linkages between these mitigation strategies, ecosystem services and population vulnerability are further analysed. This paper is based on review of secondary sources of literature related to coastal development and planning, structural mitigation statistics and population vulnerability along the coasts of Kerala.

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IMPACTS OF NATURAL DISASTERS AND ITS COPING STRATEGIES AT KAZIRCHARVILLAGE IN MULADI UPAZILA, BARISAL

Md. Humayain Kabir, Md. Tanvir Hossain

Abstract

South-western coastal region of Bangladesh is well known as landing station of different natural disasters. Local communities of this region have a long history of coping with adverse effects of these disasters as best they can. Consequently, this research explores the impacts of natural disasters and its coping strategies of the Kazirchar villagers in Muladi Upazila of Barisal. In this study, well-structured questionnaire survey, and focus group discussions were conducted to collect primary data. The study found that, the most prevalent coastal disaster in Kazirchar village was cyclones and 48% of surveyed people opined increased cost of living was the main reason for increasing the vulnerability. To cope with, about 58% people need to travel long distances to collect drinking water. On the other hand, during flood,26% people take shelter on government land whereas 40% share their houses with the neighbors on high area. This study also found that villagers (60%) in flood prone site built their houses on raised land while 20% of people used Muchan frequently to rise up their homesteads and save their lives. Based on the resilience index, the study showed that the overall disaster resilience of this village was low. It is expected that this study will be act as reliable source of information for taking natural disaster management initiatives and policies to make more resilient communities in Kazirchar village.

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POST-DISASTER ECONOMIC VULNERABILITY OF FEMALE-HEADED HOUSEHOLDS

Isaias S SEALZA
Xavier University, Philippines

Abstract

A simple analytical framework and a random selection of households are used in this paper to proffer new evidence on the continued economic vulnerability being experienced by the survivors of a disaster that occurred three years ago. The circumstance is particularly hard for female-headed households (FHHs). This paper compares the FHHs and the male-headed households (MHHs) in terms of household earnings, structural factors (factors that are difficult to change) and "programmatic" factors (factors that can be addressed by development efforts from the outside). The hypothesis that the "FHHs are likelier than MHHs to belong to the lower end of the income distribution" is supported by the data. This is due mainly to the fact that MHHs in general have regular source of income in skilled occupations, while a large percentage of the FHHs do not have regular employment and have to rely on intermittent work opportunities in the neighborhood. The feminization of poverty thesis finds support in this study, and points to the need for better policy options for women in post-disaster condition. Some recommendations are given in the paper.

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SOCIO ECONOMIC IMPACT OF COASTAL HAZARD IN KERALA

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CIAS/SIS, Jawaharlal Nehru University,New Delhi- 110067

Abstract

The major activities of livelihood in the coastal areas, such as fishing, agriculture, livestock and non-farm activities have been disrupted by coastal hazards. The local people of fishing communities refers to natural hazards that, impacting the upon fisher-folks' livelihoods as "kolaru". This encompasses the inter-linkages between various natural phenomena such as strong winds and heavy rains, huge waves, turbulent seas, resulting surges often accompanied by thunder and lightning. The Tsunami of 2004 exposed the disadvantages of the coastal fisher population in terms of their resilience and coping capacity. Almost 13 lakhs of people in 187 villages of Kerala were affected by Tsunami with a death toll of 177 persons and 13,735 house damages.

The purpose of this paper is to present the experiences and views of women and men in the fishing communities in relation to disaster response and the state of their livelihoods; their perceptions of the changes and how they mitigate such disasters. This paper examines the trend and patterns of coastal development and coastal management practices in Kerala. It analyses the implications of these development on the ecosystem services and capacities of people dependent on coastal resources for their livelihoods. The paper critically examines the planned adaptation or structural hazard mitigation strategies that have evolved to deal with coastal hazards. The linkages between these mitigation strategies, ecosystem services and population vulnerability are further analyzed. This paper is based on review of secondary sources of literature related to coastal development and planning, structural mitigation statistics and population vulnerability along the coasts of Kerala.

Key Words: *Population vulnerability, Kerala fisher folk, coastal hazards, disaster mitigation, Adaptation to Hazards*

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SOCIAL AND PSYCHOLOGICAL IMPRINTS OF DISASTERS
UNDERSTANDING THE SOCIAL AND PSYCHOLOGICAL IMPACT OF DISASTERS ON THE DISASTER EFFECTED PEOPLE OF UTTARAKHAND

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Dr. Kapil Joshi,*IFS,*
Chief Conservator of Forest, Uttarakhand, India

Abstract

400 villages in the state of Uttarakhand have been marked for rehabilitation as a preventive measure in the post disaster scenario of 2013. 16th June, 2013 witnessed a sudden and unfathomed disaster in the hill state wherein thousands of people died and went missing. This paper which is a sequential expression, of the authors on the subject highlighting various aspects of disasters puts forth the narrative of the social and psychological imprints of the disasters on the effected people.

Disasters have debilitating effects not only during the time they take place but also they keep on effecting the effected for a very long time. Disasters also effect the not so effected people with a fear of recurrence. People who have to be compulsively rehabilitated keep on analysing the effects and the impact with an everlasting imprint of disaster on their lives because of the loss of property and life (an irreparable loss). People who have to be preventively rehabilitated also keep analysing their loss in terms of the insecurity they face with a radical change in their lives.

Problem Statement

What are such losses? Can such losses be quantified? What permanent and collateral change/damage such losses bring especially in terms of social and psychological impact?

Objective and Methodology:

This paper tries to answer these long lasting questions through an imprint analysis based on a reflexive narrative of the narratives gathered from the disaster effected people of the state of Uttarakhand.A detailed research was conducted through story sessions of the disaster effected people in the remote areas of the state. The interviews were video recorded.

Respondents

Three kinds of respondents were chosen for the narration, which include:

- People who have recently faced disasters and are under rehabilitation process,
- People who have faced disaster earlier and have passed through rehabilitation process and
- People who are vulnerable and are facing rehabilitation because of the fear of a foreseen disaster.

A reflexive analysis of the imprint the respondents carry was done to analyse the socio-psychological impact they bear.

Conclusions

The conclusions are remarkable in terms of the strength of the imprints and the permanent impact people carry. The analysis and the lessons learnt may bring in directional changes in the disaster management approach especially towards the rehabilitation process also affecting the policy orientation and implementation.

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LANDSLIDES

- Guidelines About Preparing Standards of Hazard and Risk Map forLandslide and Rock Fall at Turkey -*Cigdem Tetik Bicer and Mehmet Akif Danaci*

GUIDELINES ABOUT PREPARING STANDARDS OF HAZARD AND RISK MAP FOR LANDSLIDE AND ROCK FALL IN TURKEY

Cigdem Tetik Bicer and Mehmet Akif Danaci

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Abstract

It is a fact that Turkey has all conditions required for natural disasters due to its geologic, geomorphologic, and climate characteristics. Landslides are the disaster type having the most damaging effect after the earthquake for Turkey. Mass movement guidelines prepared by AFAD for the production of landslide and rock-fall disaster hazard maps include a "practical" methodology that provides support in applications in addition to general and technical information. Up-to-date studies have been provided together with basic literature information on landslides and rock-falls in the presentation of general and technical information. Details are provided on the concept of landslides and its characteristics in the guideline and then stages of landslide inventory development have been focused on. Inventories are the foundation of mitigation efforts. Stages of technical analysis in such mapping efforts of landslides and parameters that especially need to be taken into consideration have been analyzed subsequently. Methods employed in such studies follow parameter assessments and then the concepts of landslide susceptibility, hazard and risk have been emphasized.

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Introduction

As is known, excessive casualties and damages are experienced in many parts of the world due to disasters. Extremely high economic losses are suffered. Furthermore, besides these direct losses, loss of markets, production, and labor, unemployment, and environmental damage should also be taken into consideration. Thus, it is evident that the actual losses are far beyond the estimated ones. It is a fact that Turkey has all conditions required for natural disasters due to its geologic, geomorphologic, and climate characteristics. Furthermore, unplannedurbanization and uncontrolled population increase are important factors triggering the increase of losses. Many citizens have lost their lives, and immense economic losses have been incurred to date in Turkey due to natural disasters. Table 1. provides an assessment demonstrating this.

According to Table 1, earthquakes, landslides, and floods are disasters causing the most damage in Turkey. This data summarizes the overall disaster profile of Turkey for the past 50 years and consists of evaluations of the database of AFAD (Disaster and Emergency Management Presidency). Furthermore, when the distribution of disaster types affecting settlements (province, district, township, and village) based on the said database is examined (Table 2), earthquakes, floods, and landslides once again appear to be the disaster types causing the most damage, and it can be observed that 43.75% of settlements in Turkey have experienced a disaster type at least once.

Table 1. Number of Disasters and Disaster Victims According to Disaster type (Gökçe et al., 2008).

	Disaster Victims					
Disaster Type	***Disaster Number***	***Effective Transfer***	***Additional Transfer***	***Ineffective Transfer***	***Transfer Cancellation***	***Number of Total Affected Disaster Victims***
Landslide	*13494*	*65759*	*2622*	*3998*	*13034*	*59345*
Rock-Fall	*2956*	*19699*	*935*	*2442*	*3654*	*19422*
Flood	*4067*	*29020*	*506*	*1197*	*8566*	*22157*
Earthquake	*5318*	*157794*	*45*	*637*	*235*	*158241*
Other Disaster	*1175*	*11309*	*8*	*85*	*2165*	*9237*
Avalanche	*731*	*4409*	*181*	*336*	*542*	*4384*
Multiple Disasters	*2024*	*17221*	*629*	*838*	*6478*	*12210*
Unclassified Disasters	*42*	*0*	*0*	*0*	*0*	*0*
Total	***29807***	***305211***	***4926***	***9533***	***34674***	***284996***

Table 2. Number of Settlements Affected by Disasters According to Disaster type (Gökçe et al.,2008).

Disaster Type	**Number of Settlements Experiencing a Disaster**	**Rate in the Total Number of Settlements**
Landslide	*5472*	*15.31*
Rock-Fall	*1703*	*4.76*
Flood	*2924*	*8.18*
Earthquake	*3942*	*11.03*
Other	*992*	*2.78*
Avalanche	605	1.69

When Table 1 and Table 2 are evaluated together, even though rock-falls have been dealt with separately in these tables, if rock-falls are fundamentally considered to be included under landslide types and mass movements, it can be said that landslides are the disaster type having the most damaging effect for Turkey.

The Landslide Concept

The landslide concept is defined by Cruden and Varnes (1996) as the downward movement of rock, debris, and earth material or a mixture of them with the effect of gravity (Figure 1). Landslides are fundamentally included under mass movements. For the sake of this guideline, landslides must be regarded as downward movements of the abovementioned natural materialswith the effect of any triggering element or preparative parameter. Furthermore, it must be noted that movements such as subsidence or lateral spreading are excluded, and that identifications and evaluations are made considering rock-fall, slide, flow and other mass movements as a combination of them, which are frequently observed in our country.

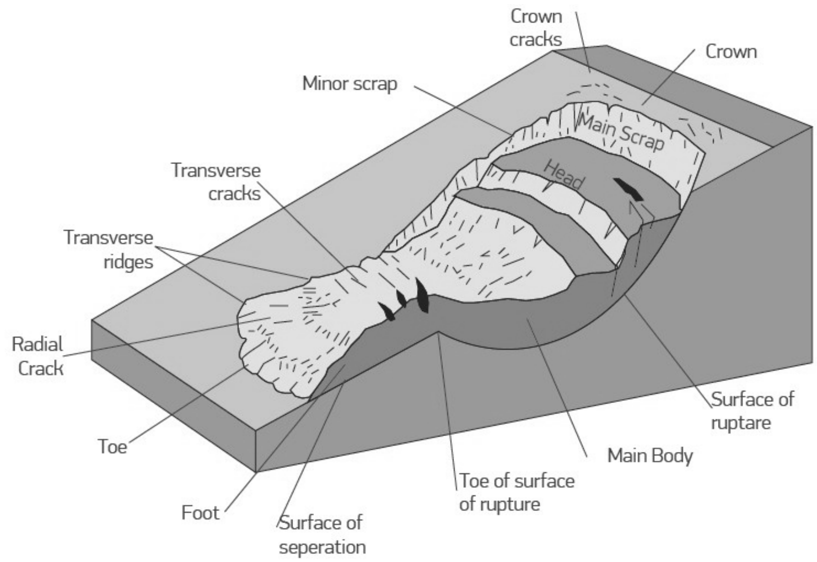


Figure 1. A rotational Landslide and Elements (http://pubs.usgs.gov).

Landslides may be triggered both by geological, geomorphologic, climatic factors and processes and several human activity factors and also by processes related to nature and human effect. Furthermore, a mass movement occurs in a certain manner due to geomorphologic properties resulting from many factors and a successive chain of events determining the velocity of the movement on the slope and increasing and/or decreasing the mass slide rate. Due to its negative effects created both in our country and over the world, landslides are among significant natural disasters. Landslides not only cause loss of life and property in settlement areas affected by them but also can lead to damage and losses in areas having an economic value such as highways and railways, agricultural and forest lands. Moreover, landslides which may cause a negative effect on the quality of streams are also likely to lead to some problems in socio-economical terms such as urbanization and protection of natural habitat and life quality of society (Schuster and Fleming, 1986). On the other hand, landslide damages are mostly misevaluated within excessive precipitation processes and earthquakes, which are one of the most important factors triggering a landslide, and thus the extents of landslide damage are considered to be lower than expected and/or what they really are (Schuster, 1996).

Major Landslides in Turkey

Considering geological and geomorphologic properties, the Black Sea Region, in particular, as well as the Eastern Anatolian and Central Anatolian Regions include areas where landslides frequently occur in our country. In the study carried out by Gökçe et al. (2008) analyzing the spatial and statistical dispersion of disasters, 13494 of disasters are recorded to be landslides and 2956 are recorded to be rock-fall in the disaster data inventory among disasters occurring in Turkey between 1950 and 2008. The total number of disaster victims affected is given as 78,767 for the abovementioned two types of natural disasters (Gökçe et al., 2008). Another concern emphasized in the mentioned study is the observation of a landslide incident in 5472 settlements (% 15.31) out of 35.741 kept in the concerned database (province, district, township, municipality and villages). This rate is 1703 (% 4.76) for rock-falls; the number of incidents and locational distribution of landslide and rock-falls according to provinces have been presented in Figure 2, Figure 3, Figure 4 and Figure 5.

Figure 2. Locational distribution of landslides in Turkey between 1950 and 2008 (Gökçe et al., 2008).

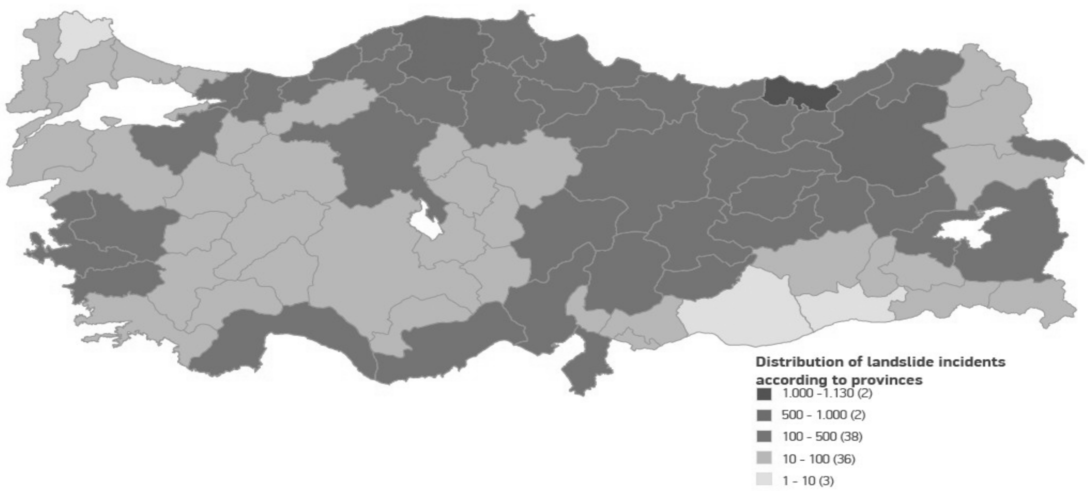


Figure 3. Distribution of the number of landslide incidents occurring in Turkey between 1950 and 2008 as to the provinces (Gökçe et al., 2008).

Figure 4. Locational distribution of rock-falls occurring in Turkey between 1950 and 2008 (Gökçe et al., 2008).

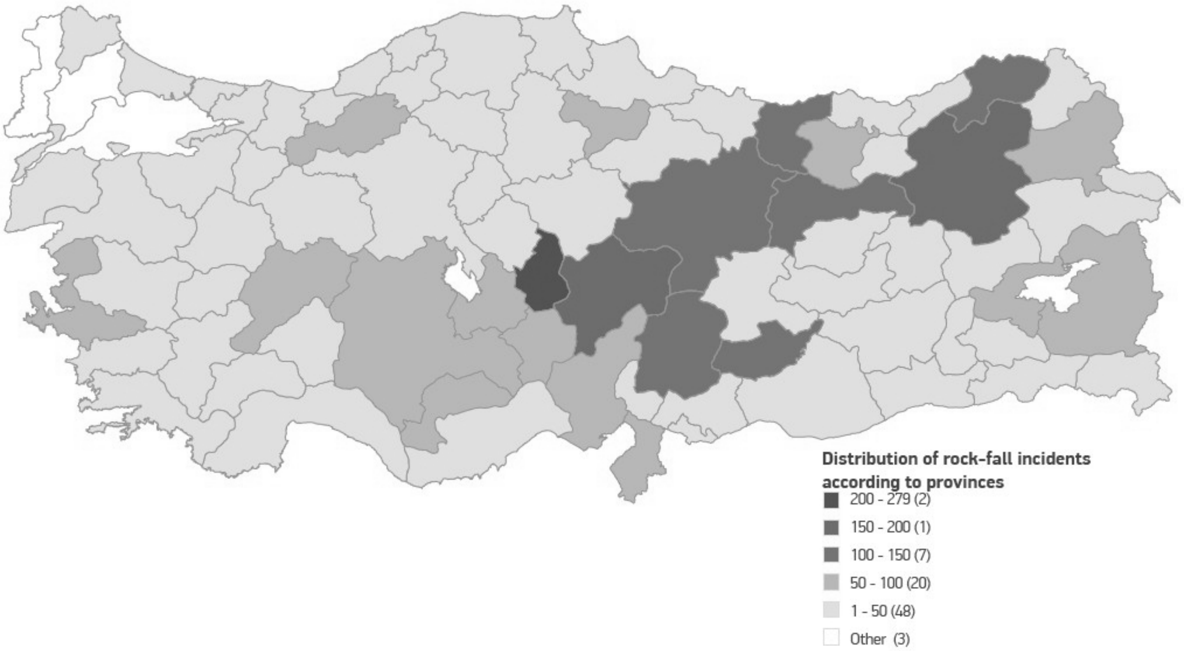


Figure 5. Distribution of the Number of Rock-Fall Incidents occurring in Turkey between 1950 and 2008 as to the Provinces (Gökçe et al., 2008).

The landslides of 1929, 1950, 1952, 1985, 1988, and 1990 in Turkey, caused loss of life and property to a great extent, particularly in the Black Sea Region. The Tortum, Geyve, Ayancık, Sinop, Of, Sürmene, Sera/Trabzon and Maçka/Çatak landslides are some of them. For example, 65 people lost their lives and substantial damage arouse due to the landslide on 21.06.1990 in the Maçka/Çatak region following heavy rainfall (Öztürk, 2002). Another debris/mud flow type landslide on 13July 1995 in Senirkent (Isparta) caused 74 casualties and buried thousands of houses under the earth. 15 people died and the village mosque and 21 houses were buried under the earth after a landslide on 17.03.2005 in the Kuzulu neighborhood of the Sugözü village of the Koyulhisar district of Sivas province. The volume of the material moving at thetime of the landslide was approximately 12.5 million m^3 and the landslide occurred in the form of rotational instability. As a result of the landslide on 26.08.2010 in the Gündoğdu town of the Rize province, 13 citizens lost their lives and substantial damage was suffered. These landslides records are reflected in the press and it can be said that the problem of landslide in Turkey is of much more critical extents considering thousands of other landslides, which could not be kept in records and occurred away from settlements (Figure 6).

Figure 6. Some landslide cases from Turkey

As it can be understood from these examples, landslides and consequent damages in Turkey are extremely important. Considering the number of natural disaster types (Figure 7) occurring in our country between 1900 and 2014, it can be said that landslides (the number of ones kept in records and occurring in settlements) occur much more frequently, taking the number of unrecorded ones into consideration, and that arising loss and damages are much more than expected or estimated.

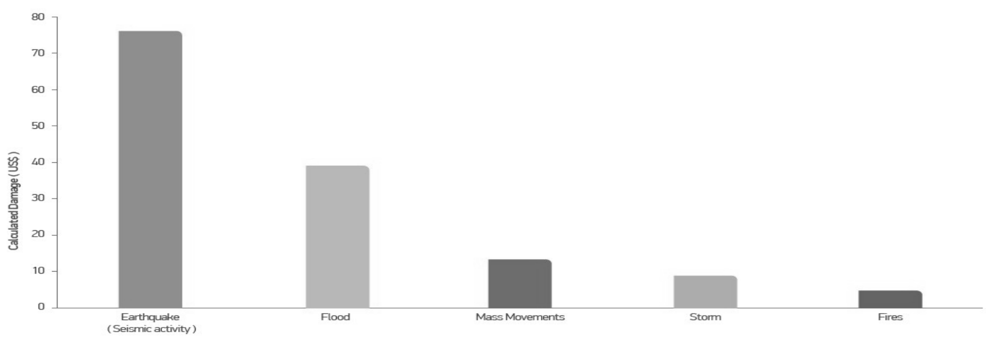


Figure 7. Natural disasters occurring in Turkey between 1900 and 2014 and their numbers(EM-DAT, 2014).

Landslide Inventory

Landslides are likely to progress depending on several parameters such as hydrological, climatologic parameters and vegetation/land use as well as geological and/or morphological processes; and may be triggered by some factors such as earthquake, rain and human effect on nature. Furthermore, landslides also play an effective role in the development of the land surface (Brabb and Harrod, 1989; Harmon and Doe, 2001). Carrying out a detailed landslide inventory and mapping on landslides, which is a kind of major natural disaster affecting human life, is an important issue required to be taken into consideration as the first step of all kinds of studies regarding landslides. In addition, spatio-temporal landslide analysis is the basis of every stage of mitigation efforts and of finding out the development of the land surface (Soeters and Van Westen, 1996; Guzzetti et al., 2000; Galli et al., 2008; Booth et al., 2009; Guzzetti et al., 2012). Landslide inventory maps include extremely important information for decision makers, planners and local authorities in terms of practice. Therefore, landslide inventory maps are generated at various scales from a local scale to greater scales at many different locations around the world by using various methods; and landslide characteristics are kept in databases. Furthermore, only 25% of landslide inventory maps are used directly and effectively in practice (Aleotti and Chowdury, 1999); spatial dispersion, sort and size data as to the landslides are gathered by only 1% in systematical evaluation (Guzzetti et al., 2012). When considered in general terms, it is necessary to specify landslide location, sort, size and effects as well as time of occurrence and features, if any, such as triggering parameters regarding the generation of landslide inventory maps (Guzzetti et al., 2000; Galli et al., 2008; Guzzetti et al., 2012). The objectives of generating landslide inventory maps are summarized below (Brabb, 1991):

- Indicating the locations of landslide occurrence at a local, regional or country scale and composing the documentation accordingly.
- Examining and proving the modification and effects of mass movements on the earth.
- Demonstrating the spatial dispersion, sorts and activity of landslides in such a way as to be related to geomorphologic and geological characteristics.
- Forming a base in such a way to include data to be the basis of landslide hazard and risk evaluations.

There are many methods in generating landslide inventory maps, which are accepted in the literature. Those which are frequently used are summarized below (Soeters and Van Westen, 1996; Guzzetti et al., 2000; Metternicht et al., 2005; Lee and Lee, 2006; Nichol et al., 2006; Weirich and Blesius, 2007; Galli et al., 2008; Van Westen et al., 2008; Booth et al., 2009; Marcelino et al., 2009; Alkevli and Ercanoglu, 2011; Guzzetti et al., 2012).

- Topographical map and Digital Elevation Model (DEM) analysis
- Aerial photo interpretations
- Field surveys/onsite geomorphologic analysis.
- Printed or digital map archives
- LIDAR (Light Detection and Ranging) implementations
- Utilization of satellite images

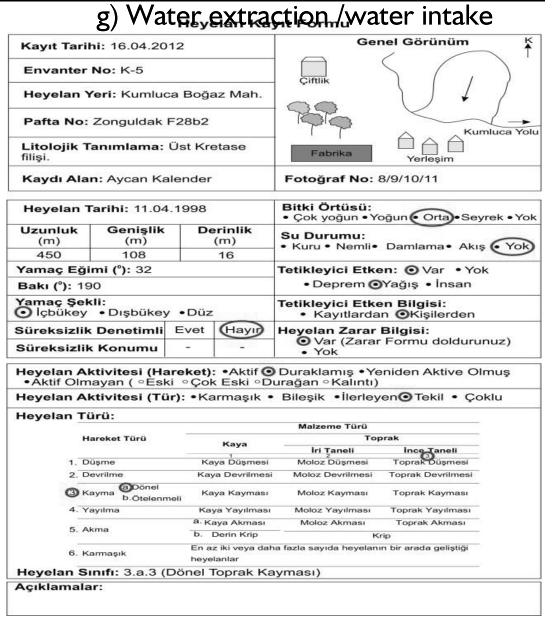
While the first four methods out of which are used for generating landslide inventory maps are regarded to be "classical" or "traditional, the " use of LIDAR and optic/passive or radar/active satellite images is identified as "new" or "current" methods (Nichol et al., 2006). On the other hand, interpretation of aerial photos, field surveys, which are directly carried out on the field (geomorphologic analysis) or the combination of them are the most frequently used and recognized methods around the world in terms of generating landslide inventory maps (Guzzetti et al., 2000; Metternicht et al., 2005).

Creating Landslide Inventories and Standardization

Constituting the basis of landslide practices, creating landslide inventory efforts are based on the studies composed and published by WP/WLI (1991) for the first time. Despite other studies carried out afterwards regarding landslide inventories to be created for recording the landslide characteristics (Soeters and Van Westen, 1996; Cruden and Varnes 1996; Fell et al., 2008a and b; Van Westen et al., 2008), it is still hard to refer to a standard landslide inventory form which is universally valid. Furthermore, both in Turkey and around the world, the forms and data are used, which are recommended in abovementioned practices and mostly updated by the researchers according to their objectives considering areal conditions on which they carry out their studies. All in all, the aim of creating landslide inventories is to determine the landslide locations and the factors leading to a landslide and also to present the landslide characteristics. Factors leading to a landslide are examined generally in four main groups, and they have been presented in Table 3. As a matter of fact, the main reason for the inability to determine a standard is that all the below mentioned parameters are not active in each landslide incident. There are main factors and sub-groups given here it must be considered that they all have the potential to lead to a landslide in different ways. Apart from these, it must be remembered that there are many quality-influencing parameters such as the objective of study, access to data, financial conditions and time in terms of creating landslide inventories and contents to form a base for landslide evaluation (Figure 8).

Table 3. Factors Leading to a Landslide (Cruden and Varnes, 1996).

Main Factors	Sub-factors
1) Geological Reasons	a) Poor geological material
	b) Susceptible geological material
	c) Decayed surfaces
	d) Materials exposed to shear zones
	e) Jointed and fissured geological material
	f) Discontinuity such as bedding and faulting
	g) Material properties (permeability, low strength and etc.)
2) Morphological Reasons	a) Volcanic tectonic uplift
	b) Fluvial or glacial erosion
	c) Stream erosion
	d) Extinction of vegetation
	e) Rain reception /non-reception, vaporization
3) Physical Reasons	a) Heavy sudden rain
	b) Sudden snow melting
	c) Long period of rain
	d) Floods
	e) Earthquakes
	f) Volcanic activity
	g) Freezing-thawing
	h) Inflation
4) Human Factor	a) Excavation
	b) Loading
	c) Destruction of woodlands
	d) Irrigation
	e) Mining activities
	f) Blasting
	g) Water extraction /water intake



Heyelan Kayıt Formu

Kayıt Tarihi: 16.04.2012
Envanter No: K-5
Heyelan Yeri: Kumluca Boğaz Mah.
Pafta No: Zonguldak F28b2
Litolojik Tanımlama: Üst Kretase filişi.
Kaydı Alan: Aycan Kalender

Genel Görünüm
K
Çiftlik
Fabrika
Yerleşim
Kumluca Yolu

Fotoğraf No: 8/9/10/11

Heyelan Tarihi: 11.04.1998

Uzunluk (m)	Genişlik (m)	Derinlik (m)
450	108	16

Yamaç Eğimi (°): 32
Bakı (°): 190
Yamaç Şekli: İçbükey • Dışbükey • Düz

Süreksizlik Denetimli	Evet	Hayır
Süreksizlik Konumu	-	-

Bitki Örtüsü: • Çok yoğun • Yoğun • Orta • Seyrek • Yok
Su Durumu: • Kuru • Nemli • Damlama • Akış • Yok
Tetikleyici Etken: Var • Yok
• Deprem Yağış • İnsan
Tetikleyici Etken Bilgisi: • Kayıtlardan Kişilerden
Heyelan Zarar Bilgisi: Var (Zarar Formu doldurunuz) • Yok

Heyelan Aktivitesi (Hareket): • Aktif Duraklamış • Yeniden Aktive Olmuş • Aktif Olmayan (◦ Eski ◦ Çok Eski ◦ Durağan ◦ Kalıntı)
Heyelan Aktivitesi (Tür): • Karmaşık • Bileşik • İlerleyen Tekil • Çoklu

Heyelan Türü:

Hareket Türü		Malzeme Türü		
		Kaya	Toprak	
			İri Taneli	İnce Taneli
		1	2	3
1. Düşme		Kaya Düşmesi	Moloz Düşmesi	Toprak Düşmesi
2. Devrilme		Kaya Devrilmesi	Moloz Devrilmesi	Toprak Devrilmesi
3 Kayma	a Dönel b. Ötelenmeli	Kaya Kayması	Moloz Kayması	Toprak Kayması
4. Yayılma		Kaya Yayılması	Moloz Yayılması	Toprak Yayılması
5. Akma		a. Kaya Akması	Moloz Akması	Toprak Akması
		b. Derin Krip	Krip	
6. Karmaşık		En az iki veya daha fazla sayıda heyelanın bir arada geliştiği heyelanlar		

Heyelan Sınıfı: 3.a.3 (Dönel Toprak Kayması)
Açıklamalar:

Figure 8. Landslide registration form (In Turkish) recommended.

Landslide Analysis Stages

Extremely detailed analysis should be conducted fundamentally for determining how and under which process(es) landslides occur. These analyses change mostly according to the purpose of the study, scale to be worked with, financial conditions and time. What should be considered is the necessity of having the information on potentially where landslides can occur. Generally, areas where landslide can occur considering geological, geomorphological and environmental conditions can be summarized as follows (Fell et al., 2008a):

- If there is a record of a landslide in a region:
  - Recurrence of deep slides on natural slopes is possible.
  - Recurrence of shallow slides on natural slopes is possible. Rock-falls on steep slopes are possible.
  - Landslide can occur in regions where excavation on highways and railways are performed and there are retaining walls depending on urban development.
  - It is possible to occur in areas which are known as inactive but can be activated due to toe erosion (via stream or erosion processes).
  - It is possible to occur as debris flow or landslip that previously occurred on the slopes.
- If there is no landslide record in a region, but topographic characteristics are convenient:
  - Steep slopes
  - Slopes having greater than 35^0 gradients (sudden landslide)
  - Slopes having gradients of 20^0-35^0 (possible landslide)
  - Steep and upper slope excavations (highway, railway, mine excavations)
  - Steep slopes where forest fires occurred or vegetation was destroyed
  - Old or inactive landslide areas where the groundwater level increased.
- If there is no landslide record but geological and geomorphological characteristics are convenient:
  - Degraded basalts on more competent rocks (sliding can occur along the border)
  - Degraded granite or volcanic rocks
  - Degraded stratified rocks (clay stone, shale, and silt stone) and sandstone or limestone Competent rocks on marl or shale (e.g. thick layered limestone)
  - River banks subjected to active erosion or floods.
  - Steep slopes affected by major earthquakes or excessive precipitation
  - Clay or thick silt sediments having high susceptibility
  - Slopes constantly washed away/caved by a river or the sea
  - Loose, saturated soils prone to liquefaction in a seismically active region
- If there are regions wherein materials will move fast as a result of failures:
  - Loose silty/sand fills
  - High sloped fills
  - Great retaining walls
  - Mine tailings
  - Waste dams

Areas in which forestry and agricultural activities are conducted

The aforementioned parameters indicate areas where a landslide may occur and should not be perceived as a stand-alone determining factor. It should be kept in mind that such areas are potential areas of landslide, but these areas should be assessed by detailed landslide analyses.

Rock-Fall Analysis

A rock-fall is a type of slope instability where discontinuity restricted rock blocks move rapidly down slope from the release zone as a result of loss of stability by small movements towards the free surface in articulated rock environments surfaced on higher altitudes of steep topographical areas. Movement of the rock block is mostly of a down fall nature in steep slopes and continues bouncing and rolling depending on the decrease of grade. Due to its high velocity at the time of incident, rock-falls can be highly dangerous for transportation networks and settlements depending also on the volume of the block (Figure 9). The volume of the falling blocks of rock is related to such discontinuity characteristics as the set number, inclination and frequency of discontinuity in the release area. Maps differentiating areas where rock-fall incidents can be observed and run-out distances provide decision makers with significant information in site selection. Rock-fall analysis can be performed using a wide range of data parameters such as the location where the large scale (in detail) block of rock started to move, the weight of the rock block, the shape of the rock block, lithology, two-dimensional (2D) slope profile or three-dimensional high-resolution numerical models of land (DEM, 3D topography), tangential, and normal energy attenuation coefficient. It is possible to receive such outputs as the energy of the rock block at the time of movement, the movement track (path) of the rock block and run-out distance. However, for preparation of maps representing the rock-fall potential on a regional scale and the possible areas to be affected, implementation of rock-fall analysis is restricted regarding the practical values and it is particularly more significant in terms of prevention efforts for the element (structure) under any risk.

Figure 9. Some Examples of Structures Damaged by a Rock-Fall

Rock-falls occur depending on the presence of steep topography under geological environments which are convenient for discontinuity characteristics of the rock mass. However, compared to mass wasting, it is not possible for rock-falls to determine a triggering limit value necessary for a conversion period or a specific incident volume with regard to triggering elements such as rain or earthquakes. In this respect, it is also not possible to expect potential rock-fall maps to be produced realistically related to triggering elements using a proper approach with the terminology in mass wasting.

On the other hand, it is possible to produce rock-fall hazard maps in such areas to be affected by aprobable rock-fall depending upon the number of rock-fall, kinesthetic energy (velocity) and movement track (path) elevation parameters, which can be determined indirectly.

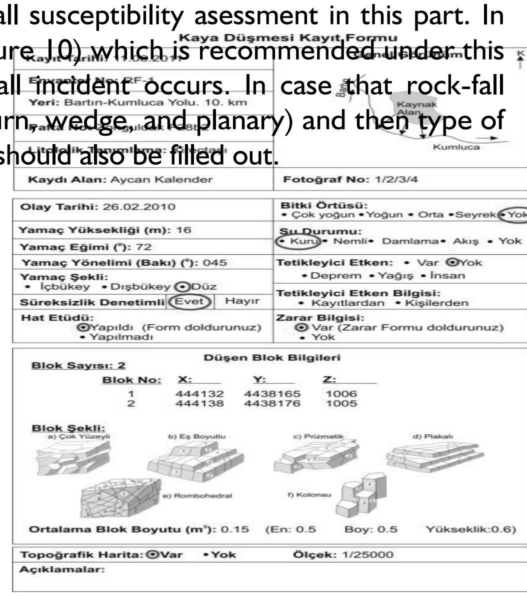
When studies on rock-falls are reviewed, it can be observed that those maps on which active release areas and different effect zones are marked depending on the run-out distance are sometimes called rock-fall hazard maps. Interpreting the rock-fall hazard maps by marking the habitats, residences, power lines and similar sites is considered to be a rock-fall risk assessment. However, it is preferable to call them a rock-fall susceptibility map for using a proper terminology in those maps where zones are differentiated from a rock-fall incident starting from the release zone and which can be affected at different levels that can be compared.
In practice, the following questions should be addressed with regards to producing a rock-fall hazard map at a regional scale (Larcher et al., 2012).

- Are there any active release areas and where are they, if any?
- Which is the greatest run-out zone on the site?
- Are the residences, infrastructure, power lines, roads and etc. affected?
- Is there any woodland (forest) between residential areas and active releases?

Production of rock-fall susceptibility maps is of great significance with regards to zone utilization and planning. However, producing such maps at a regional scale by means of deterministic rock-fall analysis approaches that can be applied properly at small fields (at great scales and details) is hard to be applied in practice, in spite of implementations in the literature, because they require a great number of input parameters.
On the other hand, regional scale rock-fall maps can be prepared in such a nature as to meet the basic needs in spite of being rough as compared as of the digital elevation model (DEM; Digital Elevation Model) with empirical approaches developed according to the experience utilized from previous incidents.

Model Implementation for Rock Fall

An implementation is presented for practical use of rock-fall susceptibility asessment in this part. In order to carry out the procedure, the Rock-Fall Record Form (Figure 10) which is recommended under this guideline must initially be filled out at the site where the rock-fall incident occurs. In case that rock-fall incidents start by discontinuity inspected instabilities (such as overturn, wedge, and planary) and then type of instability converts to a rock-fall incident, the Scanline Survey Form should also be filled out.


Kaya Düşmesi Kayıt Formu

Yeri: Bartın-Kumluca Yolu. 10. km

Kaynak Alan

Kumluca

Kaydı Alan: Aycan Kalender | Fotoğraf No: 1/2/3/4

Olay Tarihi: 26.02.2010	Bitki Örtüsü: • Çok yoğun • Yoğun • Orta • Seyrek • Yok
Yamaç Yüksekliği (m): 16	Su Durumu: • Kuru • Nemli • Damlama • Akış • Yok
Yamaç Eğimi (°): 72	
Yamaç Yönelimi (Bakı) (°): 045	Tetikleyici Etken: • Var • Yok • Deprem • Yağış • İnsan
Yamaç Şekli: • İçbükey • Dışbükey • Düz	
Süreksizlik Denetimli: Evet / Hayır	Tetikleyici Etken Bilgisi: • Kayıtlardan • Kişilerden
Hat Etüdü: • Yapıldı (Form doldurunuz) • Yapılmadı	Zarar Bilgisi: • Var (Zarar Formu doldurunuz) • Yok

Düşen Blok Bilgileri

Blok Sayısı: 2

Blok No:	X:	Y:	Z:
1	444132	4438165	1006
2	444138	4438176	1005

Blok Şekli:
a) Çok Yüzeyli b) Eş Boyutlu c) Prizmatik d) Plakalı e) Rombohedral f) Kolonsu

Ortalama Blok Boyutu (m^3): 0.15 (En: 0.5 Boy: 0.5 Yükseklik:0.6)

Topoğrafik Harita: • Var • Yok Ölçek: 1/25000

Açıklamalar:

Scanline surveys must be carried out in accordance with ISRM (1981) standards. After obtaining the data, the DEM must be generated regarding the area in question.

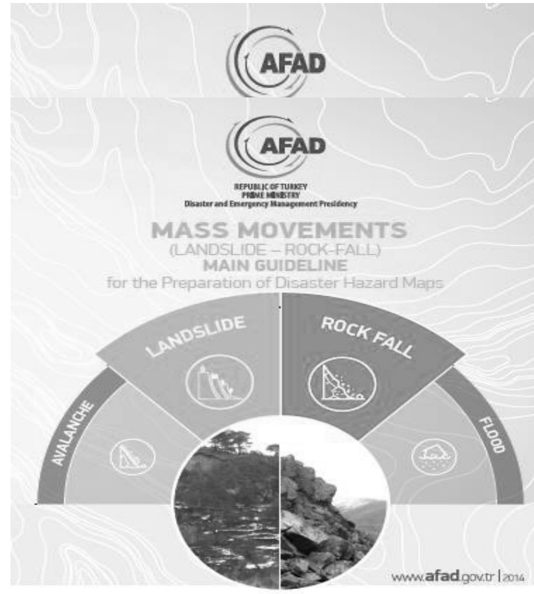
Considering the base map scale to be used, it is possible to determine the areas which can be a release area for rock-fall incident by using the slope index map to be generated by the DEM.

For instance, if a DEM of 25mx25m solution to be generated by a topographical map of 1/25.000 scale, the areas at or over 43^0 on the slope index map produced by the DEM can be regarded to be release areas in the first step.
s

Upon the interpretation of field observations and, if possible, aerial photos or satellite imaging, release area limits must be finalized and kept on the GIS platform, which is used statistically.

Conclusion

Turkey, like many other parts of the world, has suffered many casualties, the loss of property, and damage to its economy due to natural disasters. A vital tool to minimize damage caused by disasters is the development of an integrated disaster hazard and risk map at a country, regional, and provincial level. Utilizing such maps enables decision-makers and local administrations to carry out robust planning and provides important guidelines to ensure that sites selected for development purposes are safe from the risks or landslides or rock-falls. AFAD has taken a leading role in raising disaster awareness in our country and in putting this awareness into practice. Its efforts in this regard have increased in recent years. The preparation of the disaster hazard maps is one of the most important products of these efforts. Within the framework of this, significant international literature on the subject was reviewed, and the main guidelines and the accompanying practical guidelines have been developed taking into consideration the requirements for Turkey. Turkeywill be share this important information guideline with other countries and NGO's.



AFAD, Department of Planning and Mitigation's
ANKARA, 2014

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ANKARA, 2014

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LESSON LEARNT

- Evaluation of Post- Tsunami Resettlements in Kerala- Lessons from Alappad, Kollam. - *Shyni.K1 and Dr. HaimantiBanerji*
- Behavioral Aspects of Emergency Response Teams - Responding to Emergency more effectively through learning after a Disaster - *Shri Jayanta Bordoloi,CE (S&E) Ms. M.B.Sarma,Sr.Manager (S&E)*

EVALUATION OF POST-TSUNAMI RESETTLEMENTS IN KERALA
- LESSONS FROM ALAPPAD, KOLLAM

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Abstract

A devastating Tsunami originated due to a quake beneath the Indian Ocean in December, 2004 destroyed communities, family networks, homes and livelihoods in the Southeast Asian countries. About 219 coastal villages across three southern coastal districts of Kerala were also affected badly during the Tsunami. The post-tsunami rehabilitation strategy adopted by the then government was to relocate and resettle the people to inland areas. Through a structured questionnaire this study has attempted to evaluate two such post tsunami resettlement examples taken up by two different NGOs based on parameters like durability, adaptability, sustainability of livelihood and perception of safety by the households. The ultimate goal of this study is to evaluate the new settlements in terms of design, construction, and post-occupancy problems after ten years of occupancy and to understand the overall satisfaction with the new built environment and the allied facilities. Though there are similarities in the design and construction processes, in the housing and other amenities, remarkable difference in the overall life satisfaction between the two resettlements has been observed. Hence learning from these problems, proper strategy for sustainable resettlement of disaster displaced community need to be planned in the context of Kerala. But this would require further research to identify the reasons for such differences in satisfaction level among different resettlement attempts and that between the households within the individual resettlement.

Keywords: *post-disaster resettlements, post-occupancy problems, overall life satisfaction*

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Introduction

The 26th December 2004 Indian Ocean tsunami caused substantial destruction and casualties in the coastal regions of Kerala. Though Kerala suffered relatively lower loss of life,compared with other regions affected, thetsunami devastated communities, family networks, homes and livelihoods in 219 coastal villages across three southern districts, namely; Kollam, Alappuzha and Ernakulam [5]. The Government and many other national and international agencies responded very promptly in providing immediate relief and followed by massive programs for reconstruction and resettlement of disaster displaced community.As the Kerala government was not prepared to carry out such largescale housing reconstruction activities inemergency, reconstruction activities were carried out with the participation of various registered NGOs and other voluntary agencies. Almost 22national as well as international NGOs and other agencieswere involved in the housing reconstruction activities under the supervision of various government departments.The aim of thecurrent study is to compare two such resettlements developed by two different NGOs; Quilon Social Service Society of QuilonDioicese (QSSS)and Church's Auxiliary for Social Action (CASA) in the AlappadPanchayath of Kollam district. In both the resettlements, the post-occupancy problems of the post-disaster housing after ten years of occupancy have been investigated mainly under the items of location of resettlement, design, construction, and socio-economic and cultural problems.The following sections summarizes the impact of Tsunamiin Kerala as well in the area under studyviz; the Alappad fishing village, the strategy for housing rehabilitation, followed by the study approach. Later sections focus on the case study of resettlements, the methodology for conducting the case study and then the detailed analysis of the two settlements. Finally the studyexamines the level of overall satisfaction of the resettled community in the new built environment which highlights the important post occupancy problems encountered bythe resettled communities.

Impact of Tsunami 2004 in Kerala

Though Kerala coast was considered as a shadow zone as far as tsunami hazards are concerned, the effects of tsunami were felt all along the coast of Kerala. The tsunami caused destruction of property and utilities, leaving thousands injured and homeless and damage worth crores of rupees(Table 1).The tsunami effects varied greatly across different parts of the coast due to the variation in the topological and geographical features, the proximity of habitats to the coastline and the density of development of the areas as well as the hazard features like number of waves experienced, inundation distance and height of the waves. In Keralatsunami-related damage was experienced along 250 km of flat coastal land in three southern districts, Ernakulam, Allapuzha, and Kollam.The coastal areas of Kerala, especially the affected districts have long stretches of lakes, lagoons, and ponds connected by a network of canals called "backwaters" or kayals[1]. Major damage in Kerala occurred in two narrow strips of land bound on the west by the Arabian Sea and on the east by networkof suchbackwaters.In Kerala, 238 persons lost their life in tsunami and caused destruction and damages to life supporting structures all along the coastal belt. Though major impact was concentrated in three southern districts, the State Government declared 219 villages in nine districts (out of 14 districts) as being affected by Tsunami after assessing the degree of damage in other areas also. A total of 2.4 lakh persons were evacuated and accommodated in 269 relief camps across the various coastal regions. Fisher folk were the most affected segment, which endured damage due to loss on housing and livelihoods**[5].**The tsunami caused much damage to the housing and other infrastructures along the coast and tothe bridges and roads connecting the village to the mainland. The seawalls along the coast, ofabout 0.75–1 m high were dislodged at many locations, and boulderswere thrown as far as 30 m away. Due to large sanddeposits by the tsunami, the available draft was reduced in the backwatersin the affected regions which affected the ferry movement in post disaster and dredging was required.About 60 km of major district roads and some village roads along the coastline inthe districts of Allapuzha and Kollam were badly damaged, primarily becauseof scouring that washed out the shoulders of roads and eroded the top layer ofpavements. The tsunami also deposited large volumes of sand and other debris, in the mainland **[1].**Four minor ports Vizhinjam, Neendakara, Beypore, and Azhikkaland eight fishingharbors in Kerala were affected due to huge sand deposits by the tsunami.The sectors of Agriculture, Fisheries, Animal husbandry and Industries suffered damages. Schools, Anganwadis, Roads, culverts, drains, PHCs, medical centers, water supply systems, electricity lines, telephone exchange etc. have also suffered heavy damages. Boats, Webbings, Out Board Machines, In Board Machines, other fishing equipment etc. have also been damaged, affecting the livelihood of fishermen community. Shops, vehicles, furniture and household articles inside the damaged houses have been either washed out or damaged beyond repair.

The Impact of Tsunami in Alappad Fishing Village, Kollam.

One of the regions in Kerala, severely affected by Tsunami 2004 was a coastal stretch of about 40 km long extending from Trikunnapuzha in the Allapuzha district to Karunagapallyin the Kollam district. The strip has a maximum width of less than 1 km and is bound by the open coast on the west and Kayanakulam Lake and backwaters on the east. The width of the land strip is less than 0.5 km at many places(Fig 1). As a result, the tsunami waves struck the entire strip of land, travelled across the backwaters, and rolled onto the opposite bank. Alappad panchayath, lying along this coastal stretch, was the most affected regions in Tsunami 2004 with a death toll of 143 out of the 238 in the state and left thousands homeless[5]. This unprecedented calamity impacted the already delicate economy of the Alappad causing havoc and hardships to the people. The infrastructures like houses, roads,telecommunication network, sea walls, harbour, fisheries, water supply, electricity, industries, agriculture, and animal husbandry were badly hit by the tsunami attack [8].

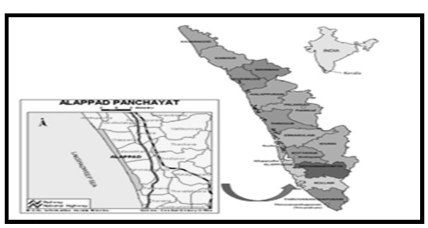

Fig. 1 Map of AlappadPanchayath

The Alappad coastal village, situated on a narrow strip of land sandwiched between the Arabian Sea and the TS Canal is approximately 16 km long and its narrowest point is as thin as 33 meters. The village is connected to the mainland by a bridge at the southern part of the land strip, as well as by country boat ferries, operated by the Panchayath and private parties. The village is densely populated with a density of 2,652 per km^2, versus the state average of 762 per km^2 on both sides of the coastal road that barely separates the lake from the sea [1]. Most of the affected belonged to fishermen community with fishing and allied activities as livelihood options. About 2,194 houses were completely destroyed and 3,000 houses were seriously damaged in the village alone [4] (Fig 2). Fishing boats, nets, houses, shops and other establishments were either destroyed or severely damaged along the coast. So in post tsunami, Alappad received the maximum attention from the government for Reconstruction & Rehabilitation activities. Almost five thousand houses were reconstructed in Alappad village alone. Hence the Alappad area was selected for conducting the case study.

Fig.2 Pattern of Housing damages inAllapadPanchayathduring Tsunami2004

Strategy of Government for Rebuilding

The post tunami relief and rehabilitation works in Kerala were classified into three categories viz., short term, medium term and long term. While the shortterm relief measures were to be completed within a period of six months, the medium term projects were to be completed within a period of two years. The longterm project required more than two years for completion. The sector-wise details of requirement of funds sought for by State Government in February 2005 were as indicated below [5].

Table 1: The Sector-Wise details of Requirement of Funds

Sl No	**Sector**	**Requirements of Funds(Rupees in Crore)**			
		Short Term	**Medium Term**	**Long Term**	**Total**
1	Rescue and Immediate Relief	173.35	-	-	173.35
2	Housing Sector	131.45	640.78	-	772.23
3	Damage / Losses in other sector including	215.02	304.72	30.0	549.74
4	Repair, reconstruction and restoration of infrastructures	170.17	585.23	19.31	774.71
5	Other items	1.00	100.00	-	101.00
	Total	***690.99***	***1630.73***	***49.31***	***2371.03***

In post Tsunami, relief operations were carried outby the District Administration with the help of various voluntary organisations as well as local people. Apart from the Government Departments like Fisheries and Harbour Engineering, other implementing agencies like the Kerala State Co-operative Federation for Fisheries Development Limited (Matsyafed) – an autonomous institution under the Department of Fisheries, the Kerala Fishermen Welfare Fund Board (KFWFB), the Kerala Water Authority (KWA), the Kerala State Electricity Board (KSEB), the Kerala State Housing Board (KSHB), etc. were also involved in relief and rehabilitation operations [7].The government also encouraged participation of NGOs and Voluntary Agencies in various types of services in the Disaster Zone as well as in the relief camps. They distributed various materials to the Tsunami affected families, rendered medical treatment, psychological counselling as well as constructed houses for the Tsunami affected families. Some of the agencies also offered to construct hospitals, community halls, Anganwadis, internal roads etc.A total of 53 relief camps were operated in different locations accommodating about 38000 people. Once the process of running the relief camps was streamlined, temporary shelters were constructed to accommodate the homeless with the help of agencies like Kerala State Housing Board (KSHB) and Kerala State Nirmithi Kendra (KESNIK). Thus, about 1400 temporary shelters were completed within one month of Tsunami in safer locationswith all the essential services like water supply, sanitation and electricity [8].

Regarding the long term rehabilitation of the disaster affected, three programs were undertaken by the government namely (1) TEAP (Tsunami Emergency Assistance Project) funded by ADB (Asian Development Bank), (2) TRP (General) i.e. Tsunami Rehabilitation Programme (General Package) funded by Central Government and (3) TRP (Special) i.e. Tsunami Rehabilitation Programme (Special Package) funded by Central Government. Tsunami Emergency Assistance Project (TEAP) funded by the ADB assisted in livelihood restoration; putting up transportation facilities like roads, bridges and harbours; restoring local infrastructure in the area of water supply and sanitation; and introducing capacity building initiatives.The TEAP funds allocated for the 32 projects were distributed through the Public Works Department (PWD) Roads and Bridges, Kerala Water Authority, Kerala State Electricity Board (KSEB), Fisheries Department and Harbour Engineering Department (HED). Under the Theeramytri project of the Fisheries Department, different projectswere launched to start enterprises forgenerationof alternate livelihood options for the tsunami affected. Moreover, a special Package was announced for the AlappadPanchayath under the Tsunami rehabilitation programme (TRP) funded by the Government of Indiain 2008. The projects were planned and implemented under two TRP schemes: TRP special package of Rs 43.3 croresforAlappad alone and TRP general packagefor the whole of Quilon District Rs 1,441 croresout of which Alappad was allocated a good amount[4].

Housing Reconstruction Strategy

The tsunami caused widespread damage to housing and almost 20000 houses(Ministry of Home Affairs) wereestimated as either destroyed or damaged inKerala. Almost all the affected houses in Kerala belonged to puccacategory. Houses mostly in close proximity to coastal areas were damaged beyond repair. The total housing and property damage in Kerala was estimated to account for 772.23 crores(Table 1). Government and the NGOs responded very promptly in setting up temporary shelters for housing the dispossessed and followed it up with massive programmes for construction of permanent houses for the affected people.

Reconstruction of Partially Damaged Houses

For those families that suffered partial damages to houses, the State Government offered to pay cash ranging from a minimum of Rs.5, 000/- to a maximum of Rs.25, 000/- based on the estimate prepared by the government engineers. At the same time, for those who are not willing to opt for the above option, government offered to undertake the repairs directly at government expense[8].

Reconstruction of Fully Damaged Houses

For the Tsunami victims, who lost their houses fully, the State Government had offered two options viz; rebuilding in the land possessed by the families and relocating those who don't own safe land for housing.For rebuilding, the government decided that no new houses would be built at Govt. expense on the western side of the coastal roads and instead the families who lost their houses fully in that area would be provided new houses on the mainland. However, Government decided to allow construction of new houses on the eastern side of the said-road[8].Accordingly, families possessing land were allowed to reconstruct in their own land and were given financial assistance for construction of house. But only 50% of the eligible beneficiaries had their own land for reconstruction. Hence new houses had to be constructed in inland areas devoid of any disaster risk for resettling the communities in the severely damaged coastal stretches. The district administration purchased land on 'negotiated purchase basis' from land owners who expressed willingness to sell their land. Out of the projected funds of Rs 772.23 crore, for the rehabilitation, Rs 131.45 crore was meant for short term requirements. This included funds for construction of 2919 houses and construction with cost of land for 647 houses for Tsunami victims. GOI sanctioned (January 2005) Rs 50 crore (construction cost: Rs 40 crore; Land cost: Rs 10 crore) as financial assistance for housing sector as part of the Rajiv Gandhi Rehabilitation Program (RGRP)[8].

With regard to the resettlements, Government appointed an expert committee to finalise the house design with disaster resistant parameters and to decide the location of the houses.For the permanent houses two types of designs were suggested by the government viz; normal house in the safe locations and disaster resistant houses in vulnerable locations and suitable designs were developed with thehelp of experts from IIT Madras [8]. The unit cost was fixed at Rs. 1.75 lakh for a normal house and between Rs. 2.75-3.25 lakhs for fortified houses, and the government provided land (where required) for the relocation of houses and subsidised the cost of each house to the tune of Rs. 50,000[9].The State Government decided to permit the Voluntary Organisations/Non-Governmental Organisations, etc.(Table 2), to undertake construction of permanent houses to Tsunami victims and the rest of the money was raised by the NGOs themselves. In addition to this, under a TRP special package, 724 houses were constructed at Alappad. Peoplewere given Rs 3 lakhs each to construct houses on their own land in AlappadPanchayat itself. Under this package, houses were reconstructed for those in AlappadPanchayat who resided on the eastern side of the road. The cost of each house was Rs. 3 lakhs. The general features of the houses were as follows: Each house had a plinth area of 430 Sq.Ft. with two bed rooms, a small hall, an open verandah, a kitchen, a toilet cum bathroom and a stair case(Fig 3 & 4). The house had watersupply and electricity connections also. However, subsequently there was a demand from various quarters that the houses to be constructed in the Disaster Zone should also have a first floor. Government studied the demand and agreed to modify the design by shifting one of the bedrooms from the ground floor to first floor with an additional toilet [7], (Fig 5).

Table 2: Details of Houses Constructed in Alappad by NGOs

Sl. No	Agency	No. of Houses Allotted		Total
		Disaster Resistant Houses	Normal	
1	MathaAmrithanandaMayi Math	1088	405	1493
2	CASA	17	56	73
3	Kerala Catholic Bishop Council	287	176	463
4	Marthoma Syrian Church	22	54	76
5	MalayalaManorama	50	45	95
6	Good Samritian Project India	-	30	30
7	World Vision India	400	91	491
8	Most Rev. Dr. K P Yohannan	10	-	10
9	Malankara Orthodox Church	20	-	20
10	K E Abraham Foundation	-	12	12
11	Carbon Lorraire Pvt Ltd	16	-	16
12	Infarm Agro Movement	-	10	10
13	Christian Church of Christ Valakom	-	9	9
14	Oxfam International Trust	-	41	41
15	Salvation Army, TVM	-	23	23
16	PoabesThiruvalla	-	9	9

17	KSEB Association	-	1	1
18	Oisca International	2	-	2
19	National council of YMCA	-	21	21
20	CPIM	10	59	69
21	Kerala State Housing Board	-	3	3
22	Union Bank of India	2	-	2
	Total	***1924***	***1045***	***2969***

Ref: 8. Official Website of Kollam District

General Features of the Housing Unit

A typical plan was suggested by the government for the houses in all the resettlements maintaining equity in housing facilities. The details of the housing unit are given below.

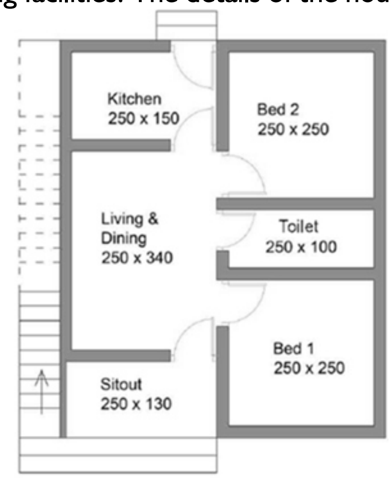

Fig.3. Typical plan

Fig.4 Typical View of house in resettlements

Fig. 5 Typical View of house on individual site.

Spaces within the unit

- 2 Bedrooms
- Kitchen
- Living room
- 1 toilet
- Sit out
- Staircase (outside the unit)

Other services like; electricity, piped water was also provided. Though municipal water connection is provided, it is observed that some households have individual well in their plot due to in sufficient water supply. Individual septic tank was provided from every unit but no leach pit was available for waste water disposal. For

Solid waste disposal people were using vacant patches of land available in the settlement. Provision for rainwater harvesting was also lacking in the houses.
Materials for construction:

As disaster, resistant construction was a mandatory requirement by the authority, the materials like concrete and brick were used for super structure. Wherever the soil was loose deep foundation was given using appropriate materials. Cement flooring was given with red oxide coating and for windows concrete frame and wooden shutters were provided. Walls were plastered and finished white cement.

The Study Approach

In this study both qualitative and quantitative approaches were employed to examine the post occupancy problems in the post tsunami resettlements, in terms of suitability of the location of resettlement projects , the quality of housing units and the built environment as well as the overall satisfaction with the resettlements. The research for this paper is based primarily on visits to villages fully or partially rebuilt by various agencies after Tsunami 2004.The villages were selected at random and in each village household survey was administered by using semi-structured questionnaire. Informal discussions were held with village residents simultaneously during survey. Locked-up houses were observed and enquiries made of neighbours about their status.Papers relating to the Tsunami were also reviewed, as well as reports and independent evaluations done by agencies and individuals were also reviewed.

The Case Study of Tsunami Resettlements in Alappad Village

In 2014 a case study was conducted in two post disaster resettlements in Tsunami hit areas of Alappad, constructed by two different NGOS, namely QSSS (Quilon Social Service Society of QuilonDiocese under Kerala Catholic Bishop Council) andCASA (Church's Auxiliary for Social Action) in order to understand the key issues and problems experienced by the communities during their ten years of occupancy in the new built environment (Fig 6& 7).

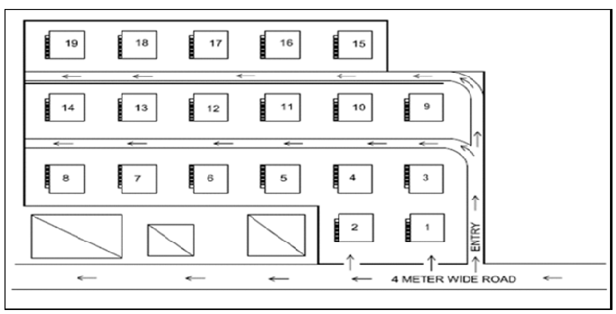

Fig. 6- Layout of QSSS resettlement at Alappad

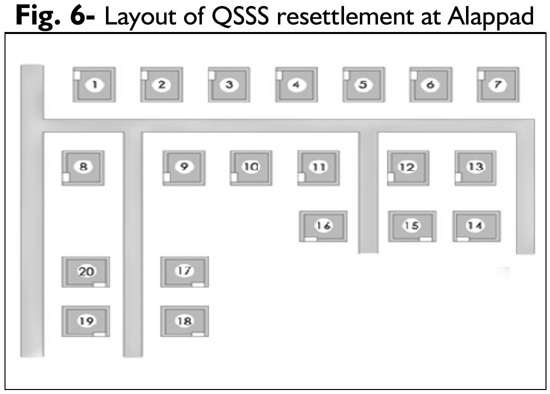

Fig. 7 Layout of CASA Resettlement at Alappad

Methodology

The methodology of the study was based on site observations and application of the household survey addressing, (1) demographic characteristics of the household; (2) Quantity and Quality of Housing

Facilities (3) Satisfaction with current Livelihood opportunities (4) Overall satisfaction withthe post disaster housing environment. Within each village, the research focused on the following aspects:

- Durability-how well the houses had fared physically since completion.
- Adaptability-flexibility in the space and structure to meet the changing requirements as well as cultural acceptability
- Livelihood Sustainability- how the location and the houses contribute towards sustaining the livelihoods
- Perceptions of safety- structural safety as well as psychological safety

The ultimate goal of this study is to compare the new settlements in terms of design, construction, and post-occupancy problems and to understand the overall satisfaction with the new built environment and the allied facilities.

Analysis of Post Disaster Housing by QSSA and CASA

From thesurvey, site observations and the informal discussions with the householdsome important problems affecting the overall perception on satisfaction level with the dwellings and environment were identified.

- Durability of the Post-Disaster Housing:From the observation it is evident that the low construction quality of houses was causing some serious problems almost in every dwelling in both the resettlements. Damages like crack, peeling of plaster, dampness, leak, etc were seen in many houses.The exterior walls, facades were not water-resistant to rainand there was always water leakage from exterior walls of the dwellings. The building materials for windows, doors, paintings,etcwere also of low quality. As per discussion with the households it is understood that no maintenance or surveillance was carried out either by the NGO or by the government. All the repairs have to be done by themselves which many households could not afford to.

- Adaptability:The study finds that the average house hold size in both the settlements was 5-6. As the number of people varied in each household, the space in the housing unit was not sufficient to meet the varying requirement of each household. Hence, it is observed that, some households expanded the hall by attaching the kitchen space to it and constructed kitchen and store outside. In most of the houses the toilet provided inside was used as storage space(Fig.8). Though the spatial arrangement in the housing unit provides flexibility for horizontal as well as vertical expansion, the horizontal expansion reduced the open space around the house, making the settlement congested, as the individual plot was only 3- 3.5 cents,. Not only that, sincemost of the households of the post-disaster housings belonged to lower income, extension of the house was not affordable by most of the households. Majority of the household suggested that it would be more comfortable if they had more area to the spaces. This shows that "one size fit for all" is not an adaptable design solution in resettlement planning, to meet the varying requirements of the resettled households with varying demographic and socio- economic characteristics.

***Fig*. 8.**Horizontal Expansion of the Housing Unit

Another key finding of the study is that the new built environment is not providing cultural continuity when compared with the pre-disaster environment. In their old settlement, the entire sea beach provided enough open space for social interaction. Most of the fishing allied livelihood activities were oriented in the open space in and around the fishing village. But the new settlement lacked any such common open space for interaction and home based livelihood activities. It was also seen that social interaction between communities had decreased due to the structure of resettlement layout. In QSSS settlement the layout is linear in pattern with no common space in between and only the central units are having scope for interaction due to its placement, but the farther units are very much isolated. Moreover, the people in the new neighbourhood were not the same as before which is another reason for less interaction between the people.

Instead in CASA settlement, almost a grid iron pattern was followed for the settlement layout which resulted in to clustering of the units. Hence though common open space was absent, abetter social interaction among the neighbours was observed in CASA settlement, than the QSSS settlement.

- Livelihood Sustainability:Fishing and allied activities are the major sources of livelihood for the tsunami affected communities. Hence the study tried to understand how the location and planning of the new settlement have contributed towards sustaining the livelihoods. As the link between employment in fishing and housing is very strong, any measures that affect housing location and their spatial configuration have immediate implications for the livelihoods of fisher families, and vice versa.Houses of fishermen aremostly situated near seashore as close as 20 m.Before the disaster, since the houses were located near the coastal regions their workplace was more close and accessible too. But now, since the resettlements are located 3-5km away from the sea, connectivity to livelihood network was raised as a major concern regarding the new location. From the studies, it is understood that people are relying on their own resources or vehicles like Bus, bike, cycles, etc, for accessing the beach for fishing which increased the expenditure for daily travel. The mode of transport used by the households in QSSQ resettlement is given below.

Hence the study observed that majority of the community is dissatisfied with their current location mainly because of distance to workplace. This issue has resulted in the slight shift in occupation from fishing and allied to non- fishing activities. Moreover, in pre-disaster, when the male members of the fishing community go for fishing, the female were involved in other employment generating activities like drying fish knitting the net, etc., on the open sea shore. But now there is no open space in the resettlements for carrying out such livelihood activities, which eventually resulted in to decrease income earned by a family. This reduction in the household income identified as serious concern for female headed households. Majority of households do have an income ranging between Rs.1500 to Rs.3000 only.

Hence it can be seen that the only 27% of the households in the QSSS resettlement is satisfied with the livelihood opportunities mainly because of the proximity of work place.

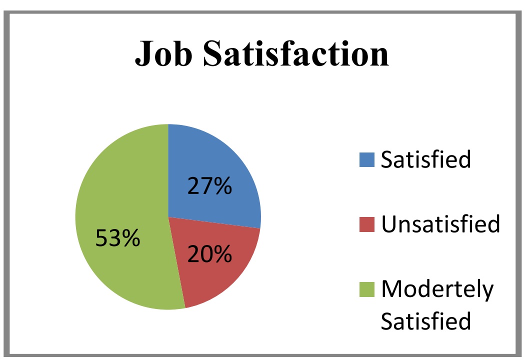

Fig. 9 Level of Job satisfaction in QSSS Resettlement

But in CASA resettlement no change in the occupation of the family members is observed even after the disaster. Tsunami which happened in 2004 was awful but the fishermen still resumed their job in which they found satisfaction.

In short the connectivity with the livelihood networks was the primary problems which the households complained. It was observed that some of the houses were unoccupied and some were given for rent to the relatives of the owner and in some units people had started home based livelihood activities like Pappad Making which also points towards the dissatisfaction in continuing the pre disaster livelihood after disaster resettlement.

- Perceptions of safety:Most of the household generally enjoy a sense of safety as the region is devoid of any risk of disasters. And they also felt structural safety in the new settlements, as the house is of better of quality than pre disaster structures. This finally resulted in to better psychological safety in the relocated environment. Moreover the households generally did feel secure in the new neighbourhood also.

Assessment of Overall Life Satisfaction

Though the disaster displaced community were provided with better quality housing and essential facilities along with complete ownership of plot and property in the resettlement,the study revealed that, the sense of attachment to the new built environment is less compared to pre disaster situation. It was observed that some of the houses were unoccupied and some were given for rent to the relatives of the owner. The informal discussions with the households also show that the change in settlement and the loss of home have affected them emotionally. The kind of social interaction they had before is absent as there is no proper homely environment in the new location providing interactive spaces or green pockets.Moreover people are not satisfied with the external assistance offered for the long term recovery from the disaster impacts. After the disaster happened, none of the families received any kind of counselling and no mitigation programs were conducted. Except for one or two houses, none of the houses got replacement of household items also.Travelling expenses increased as the distance from the workplace has increased considerably. People also have complaints about lack of street lights on roads by which they find difficulty in travelling at night. All thesepost occupancy problems have resulted in to a lower level of life satisfaction in the new environment, as evident from the survey.

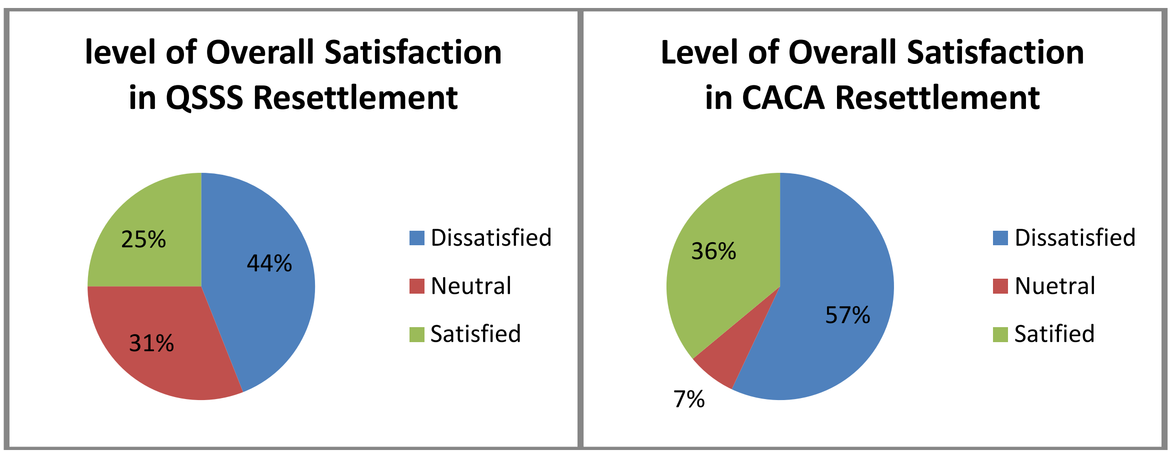

Fig. 10 Level of Overall Satisfaction in the Resettlements understudy

Conclusion

From both the survey and site observations, some important problems affecting the adaptation of victims to their new dwellings and environment were identified and examined.Low construction quality of houses and accessibility tolivelihood networks were the primary problems which the households complained about. And they also pointed out the need for external assistance for repair and maintenance as their incomes do not suffice these requirements. Because of these impending issues during post occupancy, the disaster resettled community is not fully satisfied with the new built environment. Hence learning from these problems, proper strategy for sustainable resettlement in future context of disaster displacement need to be planned in the context of Kerala.Moreover there is also difference in satisfaction between the resettlements though equal facilities and opportunities for rehabilitation wereoffered for resettling a community with similar socio economic characteristics, displaced by same disaster with almost similar socio economic impacts. Disaster literatures show that resettlements are end products of political decisions, governmental regulations andtechnological assessment, and are designed and delivered mostly by outside agencies, without prior understanding aboutthe socio economic and cultural contexts of the affected communities. Hence there is a need to explorethe factors for such difference in satisfaction level among different resettlements and that between the households within the individual resettlementfor sustainable recovery disaster displaced communities.

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BEHAVIORAL ASPECTS OF EMERGENCY RESPONSE TEAMS

- RESPONDING TO EMERGENCY MORE EFFECTIVELY THROUGH LEARNING AFTER A DISASTER

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Abstract

The paper deals with an example of a real blow out scenario of an oil well and subsequent control measures taken by the emergency response teams to extinguish the fire and control the well which took almost three weekstime . A video footage will be shown and step wise analysis would reveal the common mistakes behavioral aspects) that takes place in actual emergency scenario specially when a disaster (eg. blow out) takes place. It also deals with the learning experience during such major disasters which normally is not envisaged during the periodic onsite /offsite disaster management mock drill . The paper will also highlight the corrective action implemented by the emergency response team later when such similar incidents of blow out in a gas well took place.

Though as per the Safety Management System, 'Onsite' and 'Offsite' mock drills are a regular practice, however it is worth mentioning that response in an actual scenario unearth various hidden positive and negative points/ facts and has significant advantage over simulated drills which has far reaching contribution to our learning.

We at OIL situated in the North East and at the remotest part of the country have a well defined emergency response and disaster management plan with roles and responsibilities clearly spelt out. We also have a mutual aid agreement with neighboring industries. In the recent past, by virtue of being a mutual aid partner there had been various occasions when we had to respond to emergency scenarios of the said mutual aid industries and vice versa. It has been observed that lot of things could be learnt over the years through such actual scenario exposure. It is therefore imperative that whether there exist a Mutual Aid Plan or not, volunteering ourselves to participate actively in the emergency response of actual situations, in similar industries across the country will help us immensely in our learning process.

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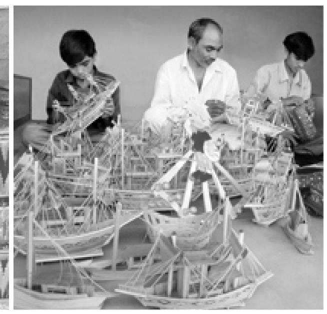

- Disaster Management of Thane Cyclone on Sugarcane over the coastal part of Cuddalore District, Tamil Nadu - *Dr. R.S. Purushothaman*
- Agronomic Remodelling, Revitalization of Cyclone prone Agricultural Ecosystem of Coromandel Coast - *M.S.Aneesa Rani , V.Prema , C.Prabakar and V.Ravi*

DISASTER MANAGEMENT OF THANE CYCLONE ON SUGARCANE OVER THE COASTAL PART OF CUDDALORE DISTRICT, TAMIL NADU

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Abstract

The Sugarcane Research Station of Tamil Nadu Agricultural University is situated at Semmandalam,Cuddalore district of Tamil Nadu which is 4 km from the shores of Bay of Bengal It has cultivable extent of 136 acres and located at 11.46 N latitude and 79.46 E longitude and the altitude is 4.6 m above MSL .A very severe THANE cyclonic storm developed over the Bay of Bengal during last week of December 2011 crossed between Puducherry and Cuddalore coast between 06.30-07.30 hrs IST of 30th December 2011 with a wind speed of 120-140 kmph.Heavy rainfall of about 90-100 mm received in a short span of time caused water inundation in almost all farm land of Cuddalore districts.It caused damage to the extent of Rs.5.25 crores in this station alone.Due to precautionary forewarning given in the mass media the damage to the lives was limited.The major crops likes sugarcane,paddy,blackgram,groundnut,coconut,cashew,jack,banana,tapioca,guava,casuarinas etc.,were severely damaged in the Cuddalore,Kurinjipadi,Annagramam and Panruti blocks of Cuddalore district.Sugarcane was severely affected in 5270 ha cut of 29700 ha of crop grown in the Cuddalore district.Due to high wind speed and heavy downpour the sugarcane were uprooted,lodged, broken buds started sprouting and inundation of water resulted in yellowing,sprouting of buds with formation of aerial roots and ultimately resulted in the loss of quality.

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Precautionary Measures to be taken for Saving the Standing crop

- The crop in the early maturity stages has to be harvested on priority basis: Cane cutting order has to be issued immediately for cutting of sugarcane from the concerned sugar factory in order to minimize the economic loss to the farmers.
- For young crop (3 months old) recommended top dressing of fertilizer should be done immediately and foliar spray TNAU Sugarcane booster @2,3,4 kg/ac to the crop of 40,60 and 75 days after planting at 15 days intervals.
- Common Micronutrient mixture : To provide all micronutrients to sugarcane, 50 kg /ha of micronutrient mixture containing 20 kg Ferrous sulphate,10 kg Manganese sulphate, 10 kg Zinc sulphate, 5 kg of Copper sulphate, 5 kg of Borax mixed with 100 kg of well decomposed FYM, can be applied for improving the crop stand after the cyclone damage.
- For 4 to 6 month age affected crop, management operation like lifting lodged canes.
- Six to seven month age old crop can be used as seed cane if there is no rooting in internodes and allow the plant crop for ratooning.
- Wherever cogeneration and ethanol production facilities are available in the sugar factoriesthe damaged young crop can be harvested and diverted for crushing.

Other Important Management Strategy:

Detrashing: Remove unwanted bottom dry and green leaves. Sugarcane stalk bears large number of leaves (30-35) equal to the number of inter-nodes and all these leaves are not productive, only top eight to ten leaves are required for optimum photosynthesis. In fact the bottom green leaves are parasitic on the upper productive leaves and drain out the food reserves (photosynthates) which otherwise could be used for stalk growth. Therefore, in sugarcane it is important to remove the lower dry and green leaves.

Advantages of Detrashing:

- Maintaining clean field
- Enhances air movement and enriches CO_2 within the crop canopy providing an ideal micro-climate for unrestricted growth of cane
- More food material is made available for stalk growth
- Reduces the problem of infestation of several insect-pests like scales, mealy bug, white flies etc
- Reduces bud sprouting due to accumulation of water inside the sheath in some varieties.
- Bud sprouting is not desirable as it would reduce main stalk growth and affect sugar accumulation
- A clean field minimizes rodents, rats, squirrels in the field which may otherwise cause damage to the crop
- Facilitates easy and economy in harvesting besides clean canes for crushing
- Detrashed trash can be used as a mulch for moisture conservation
- Clean leaves can be used for composting.

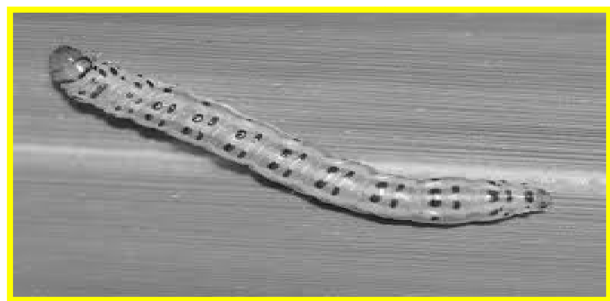
Propping: Tying the leaves together using the bottom dry and green leaves it is primarily done to check lodging of cane. Usually the trash without removing from the cane is twisted to form a sort of rope and cane stalks are tied together. Single clump propping, double line propping and earthing up can be done for minimizing the yield and quality loss.

Advantages of Propping:

- Prevents the lodging.
- Extensively followed in the coastal belt where cyclone effect is very severe.

Removal of Water Shoots: Water shoots are the late-formed tillers or side shoots, which are robust and fast growing. They originate mainly due to plentiful supply of water, inadequate earthing-up and late fertigation. These water shoots, as the name indicates, contain lot of water and less sucrose and more of reducing sugars.Water shoots affects the growth of adjacent stalks. They harbour insect-pests and when they are harvested and sent to mill for crushing, lead to reduced juice quality and affect sugar recoveries. Therefore, it is advisable to remove water shoots as and when they arise. The water shoots can be used as cattle feed.

Internode Borer:(*Chilo sacchariphagus indicus*): For managing this release egg parasitoid, *Trichogramma chilonis* at the rate of 2.5 cc / release/ha. The same may be repeated for fifteen days interval will be necessary. Installation of internode borer sex pheromone traps @ 20 no.s/ha for monitoring of pest density. During rainy weather and when ants are present, release the parasite through mosquito net covered plastic disposable cups. Detrash the crop on the 150th and 210th day after planting.



Yellow Leaf Disease (YLD): Sugar cane yellow leaf virus (SCYLV), the causal agent of an emerging aphid vectored disease called yellow leaf, is present in numerous sugar cane countries worldwide. The most characteristic symptom is a yellowing of the midrib of sugarcane leaves, but the midrib coloration can also turn pink. These symptoms are not specific to yellow leaf and can be caused by various biotic or abiotic stresses. Avoid the selection seed material from the YLD affected field.

Drainage: Provision of drainage channels of 60 cm deep and 45 cm wide for removing excess inundating water in the sugarcane field to save the crop from water logging situation due to Thane cyclone. In the research farm all along the boundary drainage channels were digged with the help of JCB excavators for approximately 2 km distance and the stagnating water drained into the *Then Pennai River* which is running parallel to the farm

Quality: Water logged conditions hasten maturity. Juice quality becomes poor with reduced sucrose level, high amount of invert sugars, gums, non-proteinous nitrogen content in juice. The recovery will be drastically affected. Also, there could be considerable difficulties during manufacture. The juice quality depression is rapid during the post water logging period. A typical quality changes due to water logging are presented in the following table.

Juice Quality under Water Logging

Quality attribute	Normal cane	Water logged cane
Brix (%)	22.08	18.73
Pol (%)	18.37	13.15
Purity (%)	83.27	70.28
Invert sugars (%)	1.23	6.60
Total colloids (%)	4.36	6.20
Gums (%)	0.68	4.17
Non-protein N (%)	0.22	0.39
Ash (%)	3.63	7.03

Resilient Electrical Network and Telephone underground Cable Adopted: Conversion of both overhead lines in to underground separately in order to tide over the damages happened due to the repeated occurrence of cyclones in the vulnerable coastal areas.

Harvesting: The canes may be harvested as early with the help of mechanical harvester before the deterioration of cane juice starts in the cane like breaking down of sucrose into glucose and fructose.

Thus, by adopting the aforesaid management strategies, losses in sugarcane can be minimized from the water and wind based disasters. By adopting these technologies cane productivity and quality is improved to sustain the economic condition of the farmers in the cane productivity and quality in the vulnerable coastal areas often prone for the cyclone.

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AGRONOMIC REMODELLING, REVITALIZATION OF CYCLONE PRONE AGRICULTURAL ECOSYSTEM OF COROMANDEL COAST

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Introduction

The Coromandel Coast is the south-eastern coastal region of the Indian Subcontinent, between the Eastern Ghats and the Bay of Bengal of the Indian Ocean. The coastline runs between False Divioint in the north to Kanyakumari in the south. Its definition can also include the north-western coast of the island of SriLanka. The coastline forms a part of TamilNadu and Andhra Pradesh. The important ports include Chennai, Thoothukkudi, Nellore, Ennore and Nagapattinam, which take advantage of their close proximity with regions rich in natural and mineral resources and good transport infrastructure.

Historically, Coromandel coast is prone to frequent storms and cyclones. The recent experiences with cyclones 'Thane' and 'Nilam' exposed the higher degree of vulnerability of the Coromandel ecosystem for such havocs. The cyclones Thane and Nilam hit the Coromandel coast on 30th December 2011 and 30th October 2012, respectively, devastating and destructing six coastal districts in Tamil Nadu and Pondicherry.

The agricultural-ecosystem of Coromandel coast particularly, the Cuddalore and Villupuram districts experienced an unprecedented disturbance consequent to cyclone Thane which was declared as a 'National Disaster'. It led to the damage of 1,93,479 ha of agricultural crops and 43,715 ha of horticultural crops, leaving the livelihood concern of the farming community at stake. On one side, on a macro view Thane and Nilam cyclones have impacted so much negatively on the agricultural ecosystem which is definitely to be restored and on the other side, at a micro-level the livelihood security of the farmers of this region has met with a severe and very serious blow which is also to be certainly addressed with. Eventually it is also a fact that the damage became intolerable since majority of the farmers were adopting a mono-cropping system of farming. Crop diversification almost remains as a forgotten concept in the region, and farmers are unaware of the alternative crops which could be cultivated in their land, since the present system has been followed for decades/ centuries together

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Storms and Cyclones in Coromandel Coast

Sl. No.	Date	Landfall/Devastation
1	December 1-8,1972	Crossed Tamil Nadu coast close to and north of Cuddalore on 5th December and Maximum wind speed recorded at Cuddalore was 111 KMPH to 148 KMPH. 80 People killed and 30,000 people rendered homeless due to flood. Total loss Rs. 40 crores.
2	November 8-12, 1977	Crossed coromandal coast within 10 km to south of Nagapattinam early in the morning of 12th around 2230 into 13th. Maximum wind recorded about 120 KMPH. 560 people died and 10 lakh people rendered homeless. 23,000 Cattle heads perished. Total damage to private and public

		property estimated to be Rs. 155 crores.
3	November 27-30 , 1984	Crossed Tamilnadu coast between Cuddalore and Nagapattinam in the afternoon of December 1. About 35,000 people were affected in Tamilnadu. 50,000 acres of land was submerged.
4	November 11-15 1991	Crossed Tamil Nadu Coast north of Karaikal 185 people died and 540 cattle perished 16 people died in A. P.
5	November 11-17 1992	Crossed near Tuticorin (Tamil Nadu).175 people died and 160 reported missing.
6	December 01- 04 1993	Crossed on 4th Nov. 30 Km north of Karaikal.100 People died in Tamil Nadu.
7	28 November- 06 December1996	Crossed near Chennai on 6th Dec.1996. The cyclone persisted for 9 days which is reported to be very long life compared to any cyclone in the Indian Ocean. It caused severe damage to life and property.
8.	**Tsunami** December 24,2004	Lakhs and lakhs of people died or lost their homes, families and livelihood security.
9.	**Fanoos** December 7-10, 2005	30,000 residents evacuated from Coromondal coast. Heavy rainfall of 350mm reported with strong wind.
10.	**Nisha** 25-11-2008 – 29-11-2008	Atleast 189 people were killed by heavy rains & floods. A maximum of 990mm rainfall noticed with heavy wind.
11.	**Jal** 31-10-2010 – 08-11-2010	Atleast 5 people killed, 30,000 acres of land devastated. Region faced heavy and continuous rainfall.
12.	**Thane** 25-12-2011 – 31-12-2011	Atleast 46 people were dead in Cuddalore district. Fishing activities came to complete halt for more than 15 days. 3,00,000 lakh trees were uprooted.
13.	**Nilam** October 28, 2012	More than 10 people were killed, 9000 trees were uprooted, 30,000 ha. agriculture land was damaged. Schools and colleges remain closed for 3 continuous days.

The recent experiences with cyclones 'Tsunami', 'Thane' and 'Nilam' exposed the higher degree of vulnerability of the coromandal ecosystem for such havocs. The cyclones Thane and Nilam hit the coromandal coast on 30th December 2011 and 30th October 2012, respectively, devastating and destructing six coastal districts in Tamil Nadu and Pondicherry.

The agricultural-ecosystem of coromandal coast particularly, the Cuddalore and Villupuram districts experienced an unprecedented disturbance consequent to cyclone Thane which was declared as a 'National Disaster'. It led to the damage of 1,93,479 ha of agricultural crops and 43,715 ha of horticultural crops, leaving the livelihood concern of the farming community at stake. On one side, on a macro view Thane and Nilam cyclones have impacted so much negatively on the agricultural ecosystem which is definitely to be restored and on the other side, at a microlevel the livelihood security of the farmers of region has met with a severe and very serious blow which is also to be certainly addressed with. Eventually it is also a fact that the damage became intolerable since majority of the farmers were adopting a monocropping system of farming. Crop diversification almost remains as a forgotten concept in the region, and farmers are unware of the alternative crops which could be cultivated in their land, since the present system has been followed for decades/ centuries together.

Existing Agronomical Scenario in Cuddalore and Villupuram Districts

Principal Crop Coverage:

Sl. No	Crop	District	
		Cuddalore (ha.)	Villupuram (ha.)
1	Paddy	1,11,517	1,48,544
2	Other cereals	17,031	19,803
3	Black gram	46,083	17,276
4	Other pulses	1,964	2,487
5	Turmeric	202	2,043
6	Sugarcane	27,482	54,139
7	Banana	4,805	1,105
8	Mango	693	1,615
9	Jack	811	44
10	Guava	446	398
11	Cotton	4,630	6,519
12	Groundnut	13,249	47,957
13	Coconut	2,513	1,995
14	Oilseed	19,819	54,946
15	Cashew	31,000	10,000
16	Tapiaco	3,080	11,013
17	Vegetable	3,950	12,185

Cropping Pattern and Contingency Crop Plan for the Districts: The changing climate is a major concern for agricultural productivity in general and food security in particular (Brahmanand et al.,2013) We must be well prepared for facing the natural disasters with a contingency crop planning. Contingency plan can be defined as a plan aimed and executed for an outcome other than in the usual or expected plan. Change in crop selection, varieties, duration, schedule of sowing, fertilizers etc., form the components of contingency crop planning.

Crop models have many current and potential uses for answering questions in research, crop management and policy making. Models can assist in synthesis research understanding about the interactions of crop type, genotype and the environment and can assist policy makers by predicting soil erosion, leaching of agrochemicals, effects of climate change and large-area yield forecasts (Boote et al., 1995)

Cropping Pattern - Cuddalore District

- Mean annual rainfall (mm) -1248.1
- Cold weather period (Jan.-Feb) -65.6 mm
- Summer (March-May) -92.4 mm

- South West monsoon season (June-Sept) -373.6 mm
- North East monsoon season (Oct.-Dec.) -716.5 mm

- **Command areas (Chidambaram and Kattumannarkoil areas): Heavy clay soils Existing**
  - Rice (June-Sep.) - rice (Oct.-Jan.) - pulses / gingelly (Feb.-May)
  - Rice (Aug.-Jan.) - pulses/sesame/cotton (Jan.-Apr)
  - Sugarcane (Dec.-Nov.) - ratoon sugarcane (Dec.-Nov.) - rice (Dec.-May) - groundnut (June-Sep./Oct.) - 3 years' rotation

Blanket Alternative Options

Normal year:Maize /vegetables/pulses/sesame/green manure (June-Sep.) - rice (Aug.- Feb.) - pulses (Feb.-May)

Moderate drought year: Maize/vegetables/sesame/green manure (Jun.-Sep.) - rice (Aug.-Feb.) – gingelly (Feb.-May)

Severe drought year:Millets/green manure/gingelly (June-Sep.) - maize/ fodder (Oct.-Feb.) – gingelly (Feb.-May)

- **Tankfed Areas: Tank Alluvium (Heavy Clay Soils) Existing**
  - Rice (Aug.-Jan.) -pulses (Jan.-Apr.)

Blanket Alternative Options

Normal year: Vegetables (Aug.-Jan.) - gingelly (Feb-May)

Moderate drought year: Pearl millet + cluster bean (Aug.-Jan.) - pulses (Feb.-April) ,Pulses (June-Sep.) - wheat (Nov.-Feb.)

Severe drought year: Wheat / fodder / pulses (Nov.-Feb.)

- **Well Irrigated Areas: Laterite, Red and Black Soils Existing**
  - Sugarcane (Dec.-Jan.) - ratoon sugarcane (Jan.-Nov.) - rice (Dec.-May) - groundnut (June-Sep./ Oct.) 3 years' rotation
  - Rice (Aug.-Jan.) - groundnut (Feb.-Apr.) – gingelly (Apr.-June)

Blanket Alternative Options

Normal year

- Maize (June-Sep.) – marigold (Oct.-Feb.) - pulses (Feb.-May)
- Vegetables (June-Oct.) - maize (Oct.-Jan.) - pulses (Feb.-May)
- Vegetables (Jun.-Sept.) – sugarbeet (Sept.-Feb) – pulses (Feb-May)
- Groundnut (Jun-Sept) – sugarbeet (Sept.-Feb) – Sweet sorghum (Feb-May)
- Groundnut (Jun-Sept.) – jatropha (Sept. sowing)

Moderate drought year

- Vegetables (May-July) - maize/sunflower (Aug.-Dec.) groundnut gingelly (Jan.-April)
- Groundnut (Jun-Sept) – jatropha (Sept. sowing) (under drip irrigation)
- Maize (Jun-Sept) – sugarbeet (Sept.-Feb) – pulses (Feb-Apr)

Severe drought year

- Pearl millet / sorghum / *Periwinkle* / senna (July-Oct.) - wheat (Nov.-Feb.) - cluster bean / bhendi / lab lab/ watermelon (Feb.-May)
- Jatropha (Sept. sowing)

- **Rainfed areas: Laterite and black soils Existing**
  - Pearl millet (June-Sep.) - groundnut (Oct.-Feb.)
  - Gingelly(June-Sep.) - groundnut (Oct.-Feb.)

- Groundnut (June-Sep.) - gingelly(Oct.-Feb.)

Blanket Alternative Options

Normal year

- Maize (Jun.-Sep)-groundnut (Oct-Feb)
- Groundnut (June-Sep.) - pulses (Oct.-Jan.)
- Ashwagandha (June – Jan.) (June-Jan.) - pulses/gingelly (Feb.-May)

Moderate drought year

- Maize (heavy soil) / sunflower / sesame/ varagu (Oct.-Jan.)

Severe drought year

- Pearl millet / horsegram /sunflower / minor millets / pulses (Oct.- Jan.)

Along with above pattern…

- *20-30% of cultivable area to be allotted for Perennial crop like – Mango (Red laterite soil) / Sapota (All soils) / Jack (All soils) / Casuarina (All soils) / Cashew (Red laterite soil) / Amla (Problem soil) / Guava (Alluvial and red laterite soil) / Jatropha (All soils) / Gliricidia (All soils) / Simarouba (All soils).*
- *Wind break / Shelter belts with Bamboo / Tamarind /Java plum / Neem tree to be added.*
- *Dairy, sheep, poultry, sericulture and apiary to be considered.*

Cropping Pattern - Villupuram District

- Mean annual rainfall (mm) -1030.0
- Cold weather period (Jan.-Feb) -35.1
- Summer (March-May) -77.1
- South West monsoon season (June-Sept) -433.0
- North East monsoon season (Oct.-Dec.) -484.8

- **Command areas (Sathanur) - Heavy Clay and Sandy Soils Existing**
  - Rice (Aug.-Jan.) -pulses/gingelly (Jan.-April)

Blanket Alternative Options

Normal year

- Rice (Aug.-Jan) – pulses/sesame/maize (Jan.-April)

Moderate drought year

- Maize/pearl millet (Aug.-Dec.)-pulses (Jan.-March)

Severe drought year

- Pearl millet / sorghum / fodder (Oct.-Jan.)
- Vegetables (lab lab / cluster bean / bhendi) (Oct.-an.) for heavy soils

- **Tank fed areas: Tank alluvium (Heavy clay and laterite soils) existing**
  - Rice (Aug.-Jan.) -pulses (Jan.-April)

Blanket Alternative Options

Moderate drought year

- Pearl millet (Aug.-Jan.) - pulses (Feb.-April) Pulses (June-Sep.) – wheat (Nov.-Feb.)
  Severe drought year
- Wheat / fodder (Nov.-Feb.)

- **Well irrigated areas: Laterite, red and black soils Existing**
    - Rice (Aug.-Jan.) - groundnut (Feb.-April) – gingelly (April - June)

Blanket Alternative Options

Normal year

- Sugarcane (Dec.-Jan.) – ratoon sugarcane (Jan.-Nov.)-rice (Dec.-May) - groundnut (June - Sep./Oct.) - 3 years rotation
- Maize (June-Sep) – marigold (Oct.-Feb.)- pulses (Feb.-May)
- Vegetables (June-Oct.) - maize (Oct.-Jan.) - pulses (Feb.-May)
- Vegetables (Jun.-Oct) – sugarbeet (Nov.-Feb) – pulses (Feb-May)
- Sugarcane (Dec.-Jan.) – ratoon sugarcane (Jan.-Nov.)-rice (Dec.-May) - groundnut (June - Sep./Oct.) - 3 years rotation
- Sweet sorghum (Jun-Sep) – sugarbeet (Nov-Feb) – Gingelly (Feb- May)
- Vegetables (Jun.-Sept.) – sugarbeet (Sept.-Feb) – pulses (Feb-May)
- Groundnut (Jun-Sept) – sugarbeet (Sept.-Feb) – Sweet sorghum (Feb-May)
- Groundnut (Jun-Sept.) – jatropha (Sept. sowing)

Moderate drought year

- Vegetables (lab lab / cluster bean / bhendi) (May-July) – maize/sunflower (Aug.-Dec.) - groundnut / gingelly (Jan.-April)
- Maize (Jun-Sept) – sugarbeet (Sept.-Feb) – pulses (Jun-Sept)

Severe drought year

- Pearl millet / sorghum / *Periwinkle* / senna (July-Oct.) - wheat (Nov.-Feb.) – lab lab / cluster bean / bhendi / watermelon (Feb-May)
- Jatropha (Sept. sowing)
- Groundnut (Jun-Sept) – jatropha (Sept. sowing) (under drip irrigation)

- **Rainfed Areas: Laterite, Red and Black Soils Existing**
    - Pearl millet (June - Sep.) - groundnut (Oct.-Feb.)
    - Gingelly (June-Sep.) - groundnut (Oct.-Feb.)
    - Groundnut (June-Sep.) – gingelly (Oct.-Feb.)

Normal year

- Maize /pearl millet (June-Sep.)-groundnut (Oct-Feb)
- Groundnut (June-Sep.) - pulses (Oct.-Jan.)
- Ashwaganda (June-Jan)-pulses (lablab) (Feb-May)

Moderate drought year

- Maize (heavy soils)/sunflower + pulses / gingelly (Oct.- Jan.)
  Severe drought year
- Pearl millet / horsegram / sunflower / minor millets / pulses (Oct.- Jan.) – sugarbeet (Sept.-Feb) – pulses (Feb-Apr)

Along with above pattern…

- *20-30% of cultivable area to be allotted for Perennial crop like – Mango (Red laterite soil) / Sapota (All soils) / Jack (All soils) / Casuarina (All soils) / Cashew (Red laterite soil) / Amla (Problem soil) / Guava (Alluvial and red laterite soil) / Jatropha (All soils) / Gliricidia (All soils) / Simarouba (All soils).*
- *Wind break / Shelter belts with Bamboo / Tamarind /Java plum / Neem tree to be added.*
  Dairy, sheep, poultry, sericulture and apiary to be considered

Punithavathi et. al., (2012) has assessed the impact of Thane and consequent losses in various aspects like agriculture, transport, communication and another infrastructure. But the study has not made any references to the disturbed agro-ecosystem of the region. Also, no recommendations were made for restoration of ecosystem and dependent agriculture.

Ronald (2012) studied the impact of Cyclone Thane on the cashew ecosystem of coromandal coast. He has inferred out that century old cashew ecosystem experienced an unprecedented disturbance affecting all the ladders of cashew ecological pyramid. Though the author has suggested remedial measures for restoration of ecosystem, the livelihood concerns of cashew farmers were not addressed and demerits of cashew as monocrop was not taken into account for working out the long run strategies.

Narayansami et.al., (2012) has stated that in the context of post Thane, the entire bio diversity of Cuddalore district seem to have been severely affected which would have an impact on the total ecosystem of the district and the livelihood of the community. The study though points out the impacts of Thane on the ecosystem and livelihood security of the community, it has not come out with any solid solution to address the crux of the issue.

Brenda et al., (2011) B.Lin has stated that, the belief that monoculture are more productive than diversified systems has been the hindrance in promoting crop diversification. Crop diversification can be implemented in a variety of scales allowing farmers to choose a strategy that increases resilience and provides economic benefits. Hazra C.R., et al., (2011) has indicated that crop diversification is an effective tool to mitigate risk in agriculture. He has also quoted that fragmented land holdings and heavy dependence on rainfall are certain constraints encountered in the way of crop diversification.

Peng Renkang, et al., (2008) has described the importance of maintenance of agro ecosystem for better productivity and longevity of major tree plantation. The study explained the various ladders present in the ecological pyramid of an established cashew ecosystem. The Study however did not express any risk mitigation strategies in case of severe havocs as happened with cyclone Thane.

In a long-run perspective, in order to restore the damaged agro-ecosystem of coromandal coast, it is vital that a risk tolerant, havoc resilient agriculture model has to be evolved with addition and deletion of certain crops. A cropping pattern accommodating the concept of crop diversification probably with a tree-annual crop mix and wind breaks needs to be designed considering the socio-economic and agronomical factors of each village in the region.

Key Technical Points to be Considered while Suggesting Alternative Model.

- Deep rooted perennial crops, sturdy and wind tolerant crops would be recommended.
- Annual crops which are commercially valuable, short duration will be selected and recommended based on soil depth and type.
- Monocropping would be discouraged as it leads to total devastation of the crop.
- Multiple cropping or multitier cropping system or cropping sequence preferably integrated mixed farming system including animal and bee component would be suggested for sustainable enhancement of livelihood of the farmers of cyclone-prone areas.
- Farm level and community level, wind breaks and shelter belts with trees like Bamboo, Tamarind, Java plum, Neem tree and Jack tree would be suggested to reduce the wind speed and damage

Crop Management Strategies and Crop Models for Cyclone hit Coastal Saline Soils of Coromandel coast

- **Soil Reclamation and Crop Model with Saline Tolerance :** In coastal saline soil, the salinity status widely fluctuated from ECe 0.5 dSm-1 in monsoon to 50 dS m^{-1} in summer /dry month. Saline soils can be classified as the soils having pH less than 8.5, ESP less than 15, and preponderance of chlorides and sulphates of sodium, calcium and magnesium. Saline soils can successfully be cultivated by removing excessive soluble salts through reclamation techniques. Reclamation of saline soils depends on the local conditions, available resources and the kind of crops that can be grown during reclamation. Reclamation of saline soils is by reducing the soil salinity to acceptable levels. In saline soils, maintenance of crop productivity at optimum level requires consideration of salt distribution within root zones that is influenced by the water extraction pattern of the crop, the method of water application, soil profile modifications, mulching, rainwater leaching and adoption of an appropriate corp rotation involving salt tolerant crops/cultivars(US Salinity Laboratoty,1954**).**

- **Shelter Belt Plantations:** Shelterbelts are barriers of trees that are planted to reduce wind velocities and prevent wind erosion. In coastal areas, shelterbelt plantation of casuarinas is one of the most suitable and effective alternative to minimize the impact of wind velocity and saline effect. It protects the agricultural crops and human habitations. The tree selected for barrier should also be tolerant to salinity. The barrier should be established perpendicular to the direction of the prevailing wind. Casuarina equisetifolia and eucalyptus are the species best suited for Coromandel Coast. Fast growth, straight stems, wind firmness, deep root system are essential characteristics of barriers. Growing several tiers of wind-brake plants reduce wind speed.
- **Soil-Binding Crops:** Along low lying areas, growing soil binding crops along shore villages will prevent erosion of sand. Vettiver is one such crop which tolerated salinity in coastal soils and binds the soil thus acting as an erosion barrier. The crop also tolerates heavy winds during cyclone.
- **Low Cost Poly Tunnels for Growing off-Season Vegetables:** Waterlogging due to cyclonic rainfall prevents growing vegetables in the shore villages. Raising seedlings and growing vegetables in media in protected cultivation method in tunnel system of polyhouse cultivation, would enable farmers to get an off-season vegetable yield and income. Raised beds with creeper vegetables like cucurbits namely watermelon, pumpkin, ridgegourd, cucumber, short duration crop like amaranthus and bittergourd could be planted at a wider spacing.
- **Bio-Drainage Plants After Cyclone:**Water-logging in coastal regions is an inevitable measure. Heavy rains, poor drainage lead to flooding in wider areas. Biological drainage by selective crops like casuarinas, eucalyptus is a promising tool to improve drainage situation. Cyclone-prone areas planted with Colocasia, casuarinas, eucalyptus, vettiver would enable to mitigate the water logging (Kumar,A et al.,2010.)
- **Tolerance to Lodging:**Crops which would tolerate lodging due to heavy winds are to be selected. This lodging followed by submergence due to rains lead to complete damage of economic parts, if it is a seed or fruit crop. Selecting a root crop which does not get damaged to lodging of shoots like vettiver would be a great boon to the coastal ecosystem.
- **Staggered Planting:** Trees or crops at uniform height get completely damaged to cyclonic storms. Large scale damage is possible if the crop is in uniform growth stage. Staggered planted casuarinas and eucalyptus as a wind break would arrest the storm with minimum damage to crops. Vettiver planted in alternate pattern to casuarinas perpendicular to wind direction helps to create a protection wall against the storm. Villages in Kurinchipadi of Cuddalore district adopt this pattern of cropping system to escape from major crop loss.
- **Pruning to Reduce Biomass Weight:** Pruning is the removal of branches to an extent to reduce the weight of the canopy thus reducing resistance to wind. Trees like cashew are having heavy branches which break easily to forceful winds.

Technology Interventions in Cashew

A technology of High Density Planting system was standardised at at Regional Research Station, Tamil Nadu Agricultural University, Vridhachalam and disseminated to thane-cyclone hit farmers of Cuddalore and Villupuram districts/ through mass campaign and on-campus programmes. Pruning technology also standardised at Regional Research Station, Tamil Nadu Agricultural University, Vridhachalam to reduce the size of the canopy during July-August and induce the flowering shoots. This reduction of canopy would help the plants to avoid lodging due to weight of the heavy branches. This technology was disseminated to farmers of thane cyclone affected villages. Farmers of 862 ha of cashew who adopted High Density Planting System were trained with this pruning technology. Field level demonstrations were conducted to train the farmers practically on pruning and training.Production of VRI 3 cashew grafts to the tune of 2.5 lakhs were produced and supplied for mass replanting program of Government of Tamil Nadu.

Crop Contingent Measures Extended by Government of Tamil Nadu in Thane Cyclone Damaged Coastal Districts

Government of TN, with its ministries and state agriculture and horticulture departments has taken steps to mitigate the devastation of crops namely cashew, Jackfruit, banana, paddy, groundnut and vegetables. Maximum damage was caused to cashew and jackfruit trees.

After the hit of Thane cyclone on 30.12.2011, short -term, long- term measures were adopted in mitigation plans by Government of Tamil Nadu. Special Package was implemented under cyclone thane rehabilitation program. Totally 48,040.90 ha of horticulture crops was damaged which includes the perennial crops like cashew in an extent of 36,517.08 ha in the districts of Cuddalore and Villupuram.

Hon'ble Chief Minister announced a Special Package on 4.2.2012 for horticulture crops to rehabilitate the affected farmers at an outlay of Rs.724.26 crores to be implemented for a period of five years. 22,666 number of vegetable minikits were completely distributed. 41,176 number of pulses mini-kits distributed, flower crops re-cultivated in an area of 180.9. ha, tuber crops re-cultivated in an area of 2,182 ha. Spice crops re-cultivated in area of 589.30 ha. Non-perennial fruit crops such as banana re-cultivated in an area of 4,580.930 ha and medicinal plants in an area of 41 ha.

Cashew replanting has been done in an area of 8,228.40 ha with proposed target of 8,678.59 ha which included the area replanted by gap filling in partially affected fields in an extent of 7,428.59 ha. Planting done at 7 x 7m spacing of cashew grafts in an area of 350 ha and at 5 x 4 m under high density planting system of cashew orchard with drip irrigation under NMSA during 2014-15. To improve micro-irrigation facilities to High Density Cashew Orchards, the government sanctioned a sum of Rs.1,140 lakhs to provide 270 number of bore wells to 60 joint liability groups (JLGs) and 210 individual farmers of Cuddalore and Villupuram districts. Totally 149 borewells have been dug at an outlay of Rs.686.185 lakhs.During 2014-15, 450.19 ha was brought under Cashew High Density Planting system, with 862 ha of cashew with HDP and Borewell system.

Natural disasters could not be stopped but we can improve the level of anticipated well-programmed cropping programme to face such disasters without much loss. There are some practices which can provide better resistance to cyclones and reduce the damage to some extent. Cycone-resilient agriculture production systems suitable for specific agro-ecosystems are to be evolved.

An integrated farming system combined with crop diversification comprising of wind tolerant, salt tolerant crops, crops tolerant to water-logging, lodging, crops which would bind soils avoiding erosion is to be formulated at this juncture for the cyclone prone Coromandel Coast. For example, short duration vegetable crops like coriander, amaranthus during rabi season alternated with vettiver parallel to the shelter belts zone of casuarinas and eucalyptus would be a better alternative crop model. Suitable technological interventions compatible with the farming system would restore the climate resilient agricultural ecosystem of the coromandel coast.

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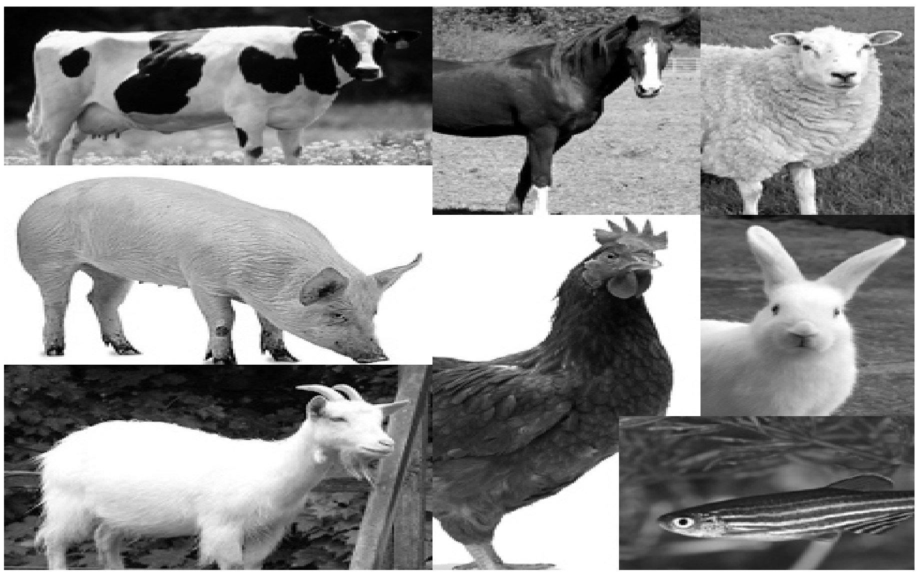
LIVESTOCK



- Livestock Disaster Management in Tamil Nadu - An analysis - *Dr.P.Mathialagan 1 and Dr.N.Vimal Rajkumar*

LIVESTOCK DISASTER MANAGEMENT IN TAMIL NADU - AN ANALYSIS

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Introduction

DISASTER is defined as 'Catastrophic situation in which the normal pattern of life or ecosystem has been disrupted and extra ordinary emergency interventions are required to save and preserve lives and or the environment' (Vinod *et al,* 2012).Natural disasters are consequences of a natural hazard like an earthquake, landslide, cyclone, flood, or tsunami which affects human activities. Human vulnerability to disasters is increased by poverty and the risk potential for disasters. A lack of planning, preparedness and appropriate emergency management systems can lead to devastating to human, animal, economic, and environmental. The impact of natural disasters has been reduced by increasing preparedness for them, and when a disaster occurs, rapidly and effectively assessing the impact of same.

Tamil Nadu covers an area of 13, 00,582 kms and has a coastline of about 1,076 kms which is about 15% of the coastline of India. The geographical setting of Tamil Nadu makes the state vulnerable to natural disasters such as cyclones floods and earthquake-induced tsunami. About 8% of the state is affected by five to six cyclones every year, of which two to three are severe. Cyclonic activities on the east coast are more severe than on the west coast, and occur mainly between April-May and October-November. Tamil Nadu is also subjected to annual flooding, including flash floods, cloudburst floods, monsoon floods of single and multiple events, cyclonic floods, and those due to dam bursts or failure. Every year, on average thousands of people are affected, a few hundred lives are lost, thousands are rendered homeless and several hectares of crops are damaged. Tamil Nadu is also prone to very severe damaging earthquakes. Its people feel much more vulnerable to earthquake-induced tsunamis since the 2004 Indian Ocean tsunami, which affected the coast of Tamil Nadu is destroying much of the marine biology and severely damaging the ecosystem. Crops, settlements, trees, livestock, birds, fishes, wildlife and properties were destroyed.

The State has been a victim of natural calamities such as cyclones, tsunamis, and floods in some years and severe drought in certain years. According to the National Institute of Disaster Management, 13 districts of Tamil Nadu are vulnerable to high or very high cyclonic impact and flooding. Keeping the above facts an analysis had been made to find out the impact of Cyclone and flood disasters on livestock sector in the Cuddalore District of Tamilnadu.

Materials and Methods

Ex post facto research design was followed in this study. The data were collected from the victims of thane by conducting field visits. Secondary data is also collected from different sources of the information like Animal Husbandry Department, Revenue Department. Thus, this study comprises of both primary as well as secondary data. The researcher applied simple statistics and descriptive.

Tsunami in the Indian Ocean

On 26 December 2004, an earthquake of magnitude 9.3 on the Richter scale, with its epicentre off the coast of Sumatra, triggered the tsunami in the Indian Ocean at 6.29 a.m. IST. The seismic fault ran north to south beneath the ocean floor, while the tsunami waves shot out west to east. Within minutes of the earthquake, the first tsunami struck the Indonesian island of Simeule, located approximately 40 km from the epicentre. The earthquake was felt widely along the coasts of India. The disaster continued in the form of giant waves that swept across eleven nations, including the southern parts of India, washing away thousands of lives and livelihood ruthlessly. The death toll in India was 12,405; the number of people missing, 5,640. Those displaced totalled 6,47,599. Seventy five per cent of the fatalities were women and children; while 787 women became widows and 480 children were orphaned. Across the entire Indian coast affected by tsunami, an estimated 1,089 villages were affected, 1,57,393 houses were destroyed and approximately 7,30,000 individuals were forced to leave their homes. 83,788 boats were damaged or destroyed, 31,755 livestock were lost and 39,035 hectares of ripe agricultural land was damaged. (Source for all figures: Government of India, Ministry of Home Affairs Report, 25 May 2005). The total estimated value of damages: US $2.56 billion (Approx. Rs.11300 crore) and total estimated need for long-term recovery US $2.1 billion (Approx. Rs.9240 crore).

After the Andaman and Nicobar Islands, the state of Tamil Nadu was the worst affected. Tamil Nadu has a coastline of 1,076 km (12% of the total coastal length of the country) of which 60 km is on the west coast (Kanniyakumari district). The devastating waves that lashed several coastal districts of the state (Chennai, Tiruvallur, Kancheepuram, Cuddalore, Nagapattinam, Tiruvarur, Thanjavur, Thoothukudi, Ramanathapuram, Tirunelveli, Kanniyakumari, Pudukottai and Villupuram) left at least 7995 dead and rendered thousands of people homeless. The cattle lost were estimated about 5,476. Total area affected 2487 ha covering 362 villages had devasted by the giant waves. Length of coast affected 1200 km with extent and penetration of 1-1.5 km. The height of tsunami has been recorded about 7-10 metres.

More than 10 lakh people were directly or indirectly affected by the tsunami in Tamil Nadu. The majority of those affected had fisheries and farm-based livelihoods or were employed in associated enterprises. While fisheries were the worst hit, crops and livestock also suffered substantial losses. Nagapattinam, Kanyakumari, Cuddalore, Kanchipuram, Villupuram and Chennai districts were the most severely affected. The other districts were moderately affected. Nagapattinam was the worst hit, accounting for about 76% of the deaths in the State, besides heavy loss of cattle, houses and property.

Case study on Tsunami at Cuddalore district

Tsunami struck cuddalore coast around 8.50 am on 26th December 2004. The tsunami was lasted for only 20-30 minutes. The aftershocks of the tsunami are very high. People lost their lives, properties, belongings and livelihood. Nearly 1.5 km of cuddalore coast was inundated with sea water. The fertility of the land was affected up to 1.5- 3km and they turned into saline up to 5 km. Several hundreds of Cattle, Buffaloes, Sheep and Goats supposed be tied in the shed and grazing in the mangrove forest died due to drowning in *tsunami* water and death was due to mainly suffocation.

Most of the stray cattle and stray dogs escaped from this *tsunami*, But few stray cattle which escaped after swallowing *tsunami* water died in another few days.

Immunisation

Animals were vaccinated against FMD and HS to avoid outbreak during the post tsunami period.
Nearly 50,000 doses of HS and 20,000 doses of FMD were administered in the affected area. No epidemics of livestock diseases were noticed in post *tsunami*.

Compensation

- Rs. 10,000 each to owners of cows and buffaloes
- Rs. 5,000 each to owners of Calves and Bullocks
- Rs. 1,000 each to owners of Sheep and Goat
- Total amount spent- Rs.21,11,000

Post TSUNAMI observations in Cuddalore District

Low Milk yield.

- Dermatological problems in animals that have contacted the sea water.
- Loss of grazing land near coastal area
- Less attention of livestock owners on animal husbandry due to trauma and mental agony.
- Loss of body weight in sheep and goat due to lack of grazing ground.

Cyclone Disaster – National perspective

About 8% of the area in the country is prone to cyclone-related disasters. Recurring cyclones account for large number of deaths, loss of livelihood opportunities, loss of public and private property and severe damage to infrastructure, thus seriously reversing developmental gains at regular intervals. Many powerful cyclones in India including the 1737 Calcutta cyclone, the 1970 Bhola cyclone and the 1991 Bangladesh cyclone have led to widespread devastation along parts of the eastern coast of India and neighboring Bangladesh. Widespread death and property destruction are reported every year in exposed coastal states such as Andhra Pradesh, Orissa, Tamil Nadu, and West Bengal. India's western coast, bordering the more placid Arabian Sea experiences cyclones rarely; these mainly strike in Gujarat and less frequently in Kerala. In terms of damage and loss of life the Super cyclone was struck in Orissa on 29 Oct 1999 was the worst in more than a quarter-century. With peak winds of 160 miles per hour (257 km/h) it was the equivalent of a category- 5 hurricane. Almost two million people were left homeless another 20 million people's life were disrupted by the cyclone. Officially 9,803 people died from the storm and unofficial estimates place the death toll at over 10,100 persons. (Disaster Management in India - A status report, 2004)

Cyclone History of Cuddalore District

Like the rest of the shore of the bay of Bengal, Cuddalore had been prone to cyclone. The hurricane of April 13,1749 wrecked three vessels between Cuddalore and pondicherry. Seven hundred and fifty men lost their lives. A cyclone in December 1760 caused damage to the six ships in the Pondicherry road. There were violent storms on the coast in 1752, 1784, 1795, 1808, 1820, 1851, 1840, 1842, 1853, 1871 and 1874. In the storm of 1853 seven vessels were wrecked between Cuddalore and Portnovo.

In the recent past, a severe cyclone crossed Tamilnadu coast close to and north of Cudalore on 5th December (December 1-8,1972) and was within 50 km of Cuddalore. Maximum wind speed recorded at Cuddalore was 111 KMPH to 148 KMPH (60-80). Eighty People killed and 30,000 people rendered homeless due to flood. Total loss Rs. 40 crores. (http://www.imd.gov.in/section/nhac/static/cyclone-history-bb.htm)

Floods in the 19th Century

There were high floods in the Gadilarn in 1864 and in Pennayar in 1874.Of these floods the flood of 1884 was the worst. In 1884, rivers Pennayar and Gadilam were united due to heavy flood. Their waters swept through the town for twenty four hours. 'The current tore across the plain round which the offices stand to a depth of five feet, and a youth narrowly escaped drowning close to the Old time gun there. Thus the floods were the source of de-urbanization of Cuddalore in the 19th century

THANE cyclone

Very severe cyclonic storm Thane was the strongest tropical cyclone of 2011 within the North Indian Ocean. Thane initially developed as a tropical disturbance within the monsoon trough to the west of Indonesia. Over the next couple of days the disturbance gradually developed further while moving towards the northwest, and was declared as Depression during December 25, before being declared Cyclonic Storm Thane during the next day. As it was named, Thane started to turn towards the west under the influence of a subtropical ridge of high pressurebefore its development slowed down during December 27, as a strong outflow and marginally favorable sea surface temperatures fought with persistent vertical wind shear. After its development had slowed down during December 27, Thane became a Very Severe Cyclonic Storm during December 28, before as it approached the Indian states of Tamil Nadu and Andhra Pradesh, it weakened slightly. Thane then made landfall early on December 30, on the north Tamil Nadu coast between Cuddalore and Puducherry and rapidly weakened into a depression. http://en.wikipedia.org/wiki/Cyclone_Thane).Thane cyclone was mainly affected the areas of Cuddalore, Puducherry, Villupuram, Kanjipuram, Thiruvallur, Chennai, Napattinam, Thiruvarur, and Thanjavur.

Thane Disaster Preparedness by the Government

The weather bulletin has warned that extensive damage may be caused to houses with thatched roof and huts along the coast. Tidal wave with height reaching over one meter above astronomical tide could inundate the low lying areas of Chennai, Thiruvallur, Kanchipuram, Cuddalore, Villupuram and Nagapattinam districts of Tamil Nadu and Puducherry, when the storm crosses the coast. Great Danger Signal Number Eleven has been hoisted at Puducherry and Cuddalore ports, while Great Danger Signal number nine has been hoisted at Chennai and Ennoore ports. The velocity of cyclone and the intensity was almost clearly given in advance through the forecasting.

As the Sea was very rough and high along and off Tamil Nadu coast and Puducherry. Fishermen have been advised not to venture into sea.

On the day of Thane Cyclone

Thane crossed the Tamil Nadu coast and causing extensive damage to Cuddalore and the neighbouring Union Territory of Puducherry which remained cut-off from the nearby districts of the state. Cyclone Thane has made landfall on the southern Indian coast, battering the area with rain and strong winds. Winds of 140km/h (86mph) have damaged houses and uprooted trees and electricity poles. The Gale wind speed is maximum speed of 145 km/h at Pondicherry and Cuddalore. In these areas the sea waves 1.5m high and were hitting the shores. Puducherry was caused extensive damages in cyclonic storm. Puducherry was cut off from the neighbouring districts of Villupuram, Kanjipuram and Cuddalore in Tamil Nadu as several trees fell on the roads due to the impact of gale winds. Power supply was suspended since the previous night as a precautionary measure.

Cyclone Thane hit Tamil Nadu coast on 29th and 30th of December 2011 destroyed houses, boats, standing crops, livestock and livelihoods. As per the Government sources the cyclone killed 40 people and Cattle Loss was 271 besides a number of poultry sheds had been either partially or totally damaged. Deaths in Cuddalore occurred mainly due to electrocution, falling of trees and collapse of house or walls. A number of cows, goats and buffaloes were killed in many villages. Trees, lamp posts and electric poles were uprooted, hand-pumps and bore wells have been damaged that lead to water scarcity and lack of safe drinking water. Major roads were blocked in almost all areas of Cuddalore district for a whole week.In addition to the loss of livestock, Thane has created a number of havocs on its trail.

Impact of Thane on the Livestock

Lush green wild grasses in community lands were main sources for grazing for the livestock. After cyclone of 130 to 140 km speed complete vegetation both in open land and trees were lost. This will result in reduced milk and meat production.Livestock loss was mainly due to wall collapse and Electrocution. In few places sheep which were kept in open area without shelter died due to direct exposure to high velocity cyclone

Impact of Thane

Direct impact: The damage was extensive to the thatched houses, electrical poles and transformers. Major crops affected were Sugarcane, Paddy and to some extent horticultural crops like Cashew and Jack. The large farmers could able to recover mostly through raising loans by pledging jewels and selling some assets The cattle, buffaloes, sheep and goat are not affected much and the livestock owners did not face much problem. Whereas, the poultry farms were completely destroyed and most of them are yet to recover. The poultry farmers were the worst affected. Most of the poultry farms were either totally or partially collapsed. In some areas poultry farmers could not establish and left the farms as such mainly due to lack of government assistance and inability to raise the funds required to reestablish the farms.

The very next day of the cyclone, Bio security instructions were provided by health department without any inputs to bury the dead birds and animals. The dead birds as well as dead animals were buried by the farmers' themselves without any assistance from the Govt.

Indirect Impact: The indirect impact was on inadequate labour availability leading to increased wages. The indirect damage is also quite perceptible in terms of difficulty and expenditure on disposal of dead birds, hike in labour wages, bank loanees have become defaulters because of their inability to repay the bank loans and increased cost on poultry shed construction.

Economic Impact: The impact on economy was high in terms of income loss and indebtedness. The indirect impact was on high labour wages, difficulty in getting back to normalcy with respect to their livelihood options.

Social Impact: In addition to economic impact the affected families have been suffering with mental agony, inability to meet the daily family needs and postponement of family ceremonies.

Relief Measures taken by Government: The Government of Tamil Nadu through the department of AH has been implementing several livestock development schemes which include priceless goat distribution, IAMWRAM Accelerated Fodder Development Programme (AFDP) and livestock insurance schemes even before Thane cyclone hit Cuddalore coast. Although it is impossible for any govt. agency to provide cent percent relief to all the affected families, the Govt. of Tamil Nadu attempted to provide relief to some extent. Priority was given to restore normalcy i.e. restoring electricity, water and shelter. Compensation was paid to the affected families based on the estimates given by the Village Administrative Officers.

Sl. No	Loss of Life	Nos	Amount disbursed (in Lakhs)
1	Human Loss	40	80,00,000
2	Cattle Loss	271	21,71,000

- Rs. 2500/- to Rs.5000/- for house repair / rebuilding
- Rs.7000 to 9000/- per hectare for loss of paddy, coconut, cashew, casuarina plantation
- Coconut saplings and Rs.500/- for planting
- Upto Rs.50,000/- or 25% of the depreciated shed value – whichever is less- for commercial poultry farm shed loss
- Compensation had been issued to 127 poultry farms (103 farms under contract farming and 24 farms maintained by owner) to the tune of 44,48,855 /= (G.O.(Ms). No.152 Dated 30.04.2012 of the Revenue (D.M- II) Department)

In Addition, the following are the Non-Government Organizations which came forward to rescue the affected people in different ways

- Anantha Vikatan: provided free labour for clearing debris
- NGOs like MNT, Real, Dhan Foundation, ADRA India
- Insurance coverage for dead cattle

Needs of the Farmers Affected by Thane Cyclone

- Alphabetical selection of village panchayats is done only for distribution of Priceless Goat scheme of Govt. of Tamil Nadu and not for providing cyclone compensation
- The integrators prefer thatched roof whereas poultry farmers consider sheets as roof material (asbestos or GI sheet) to avoid risk during cyclones. This needs to be sorted out.
- No specific/special long time schemes on agriculture/livestock livelihood for affected farmers were taken up
- Immediate release of the compensation to the affected poultry farm owners to re-construct the poultry sheds.
- Provision of interest free loans through nationalized banks as instructed by lead bank to enable the affected farmers to revive their farms.

TANUVAS Initiatives

Over the decades the increasing numbers of natural and manmade disasters and loss of lives and livelihoods of people has increased the awareness on disaster worldwide. We have to be prepared for disasters with action plan for Prevention, Mitigation, Preparedness, Response and Recovery for various disasters like Tsunami, earthquake, harricane, cyclone, cloudburst, landslide, mudslide, floods, drought, nuclear & chemical disaster and bioterrorism. The plans whatever we have in our hand is been made for human being but we are not prepared to respond for the animals in emergencies. Hence, the Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) in association with National Disaster Management Authority (NDMA) and World Society for the Protection of Animals (WSPA) has initiated the following activities in this line.

- **Organisation of National Symposium on "Veterinary Emergency Response during Disaster":**A One day National Symposium on "Veterinary Emergency Response during Disaster" was organised by Tamilnadu Veterinary and Animal Sciences University, National Disaster Management Authority (NDMA), New Delhi and World Society for the Protection of Animals (WSPA), New Delhi on 12.08.2013. A total of 121 participants including research scientist, teaching faculty and post graduate students participated in this symposium.

- **Establishment of Veterinary Emergency Response Unit (VERU):** Veterinary Emergency Response Unit (VERU) has been established at Madras Veterinary College College in collaboration with National Disaster Management Agency (NMDA) and World Society for Protection of Animal (WSPA)

- **National Level Consultation Meeting:** A national level consultation meeting was held at Madras Veterinary College on 09.11.2013 to prepare a module for Skill oriented training programme for the first responders and training of trainers (TOT).

- **VERU Training and Simulation exercise on management of animals during Tsunamis and Floods:** The first south zone Veterinary Emergency Response Unit (VERU) training programme for the final year B.V.Sc students was organized from 17.07.2015 to 20.07.2015 to impart skill in Veterinary emergency management.

Conclusion and Recommendation

The present study has been carried out in order to identify the effect of the 'Thane' cyclone especially on livestock sector in the cyclone affected places of the Eastern coast of Tamil Nadu. The Government has taken the steps of disaster risk reduction which has economic, Political and administrative elements. District Disaster Management Committee which draws up the plans should consists of veterinary doctors/paramedics along with others. The plan must encompass prevention, mitigation and preparedness measures. The Disaster

Management Teams at the village level will consist of members of voluntary organizations and other non-governmental organizations as well as able volunteers from the village.

Suggested Disaster Mitigation Strategies

- **Reporting System to be Stream Lined:** Livestock owners are ignorant about the system i.e. whom to report & when to report and the procedure to be followed to avail compensation for the loss of livestock.

- **Registration of all Livestock Farms - Local VAS:** Now there is no system of registration of the existing farms and it is difficult for the veterinarians to keep track of livestock farms. Hence, registration of livestock farms must made mandatory and the livestock farmers must be informed to register their farms with local VAS.

- **Documentation of Loss of Livestock during Natural Calamities:** It is very difficult to get the number of livestock lost and to assess the quantum of such losses during natural calamities. Hence, it is suggested that the concerned district administration may seek the help of volunteers from nearby professional college for documentation of livestock losses. This will help in accelerating the process of assessing the extent of damage & payment of compensation.

- **Single Window System in Relief Distribution:** It is very much necessary to formulate a single institute or official set up for relief distribution including the NGOs. Because the farmers reported that few farmers received the relief money/material from various organizations and many were neglected by them.

Scope of Intervention: The farmers made the following suggestions to help them come out of the damage caused by the cyclone

- Financial assistance for complete restoration
- Easy availability of loans
- Government to initiate contract farming
- All livestock/poultry schemes to be introduced in the affected villages
- Fodder and feed supplementation to the livestock in affected villages
- Frequent visit of Government officials to the affected villages for speedy recovery

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MEDIA AND DISASTERS

- Earthquake Reporting and Reporters: Challenges and Problems - *Ms. Meera Amatya*
- Role of Media in Disaster Management - *Sagat Shaunik*

EARTHQUAKE REPORTING AND REPORTERS:
CHALLENGES AND PROBLEMS

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Abstract

*A **natural disaster** is a major adverse event resulting from natural processes of the Earth. Examples include floods, volcanic eruptions, land slide, earthquakes, tsunamis, and other geologic processes. A natural disaster can cause loss of life or property damage, and typically leaves some economic damage in its wake, the severity of which depends on the affected population's resilience, or ability to recover.Millions of people are affected by natural disasters every year, and the impact can be tragic. The number of people affected by natural disasters around the world is rising. Over the past two years, 700 natural disasters were registered worldwide affecting more than 450 million people, according to a new IMF study. Damages have risen from an estimated $20 billion on average per year in the 1990s to about $100 billion per year during 2000.*

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The Crucial Role of Media to Manage the Earthquake 2015

The April **2015 Nepal earthquake** also known as Gorkha Barpak earthquake killed 8,857 dead in Nepal (officially) and 9,018 people injured. It occurred at 11:56 NST on 25 April, with a magnitude of 7.8. Its epicenter was west of the district Kathmandu named Barpak of Gorkha district. It was the worst natural disaster to strike Nepal since the 1934 Nepal–Bihar earthquake. This affected India, Chaina and Bangaladesh including Nepal. The earthquake triggered an avalanche on mount Everest which killed at least 19. Similarly the earthquake triggered another huge avalanche in the Langtang valley. Hundreds of thousands of people were made homeless with entire villages flattened, across many districts of the country. Centuries-old buildings were destroyed at UNESCO world heritage sites in the Kathmandu valley like Kathmandu Durbar square,the Patan Durbar square, the Bhaktapur Durbar square, the Changu Narayan Temple and the Swaymbhu Nath Stupa etc. No one can ever be totally prepared for a natural disaster, but knowing what to do before, during, and after can make a crucial difference. In earth quake 2015 media has played a vital role to provide the relief and rescue, whatever the journalists itself were facing the same problem. There is no specific policy for journalists to provide the training of safety and disaster reporting from government and media house itself. That's why journalists had to face the various challenges during the reporting on earthquake 2015.

Methodology

The proposed study will focus on the policies made by Nepalese Government and media houses itself on Disaster Management and safety of journalists. Both primary and secondary data will be collected with stake holders. The study will be focused on Earthquake 2015 in Nepal.
The research problem in my research studyis "In Nepal, how media is playing a role in disaster management and playing the role as facilitator in providing relief and rescue at present situation and its impact in **Development** of Nepal?" For the purpose of answering this broad question, **this study will answer the** following questions:

- What is the situation of Disasters and its management in Nepal?
- What is the role of media in managing disaster and facing the challenges and problems of journalists itself?

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ROLE OF MEDIA IN DISASTER MANAGEMENT

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Abstract

There has been an ongoing and continuous debate on the role of media in disaster management. However, the need for essential communication at levels of strategic/national importance, personal, provisional and political; make media an important tool for information dissemination.

In the wake of recent disasters like the Earthquake in Nepal, the need for 'sensitivity' of media towards victims and aid recipients, in terms of reportage have been found wanting. Further, personal bias of the media was discovered in the aftermath of Hurricane Katrina, where it was first revealed that a disaster had both colour and class components; which were unintentionally fueled by media. Therefore, the need for alertness, accuracy and rumour avoidance becomes the responsibility of the media agency to ensure that a 'do no harm approach' is followed while informing citizens.

This requires collaboration across all agencies: government, NGO, corporates, selfhelp groups etc. who have to work and train together for deepening democracy through community participation.

The media has the ability to reach the 'Last Mile' through social media and other platforms as demonstrated in previous disasters. Thus, the ability to provide Social Justice and Inclusion can be enhanced if decision makers can effectively use media for identifying who is actually the most affected and their location. Here, we do not intend sensationalism but a spirit of inquiry in to who is the neediest.
Thus, media can be developed as 'eyes on the ground' through integration of multiple media platforms. This has potentials for aiding better development, recovery &rehabilitation. This paper will explore all these concepts.

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Introduction

Research and development in technology and our knowledge sources has deepened our capabilities in mitigating, responding to, and overcoming disasters. Here, timely information provided by early warning systems, forecasting and scientific knowledge has helped enhance our response-capabilities. In addition, indigenous knowledge systems developed over centuries of lived experience, have helped communities overcome many disasters. Yet, information remains the crux of how communities respond to, mitigate or adapt with disaster outcomes. Thus, communication of knowledge systems becomes the key determinant of who survives and how? Media, in its various forms, serves as the medium of passing the message from the sender to receiver. It serves as a powerful tool that can *educate, warn, inform, and empower people to take practical steps to protect themselves* from disaster and other threats. In this paper, the author argues for the need of integrating media and it's agencies within disaster management plans in order to work with response-agencies across the nation as well as with international organisations. By working together in the pre-disaster phase, the likelihood of coordinated disaster response and management can be increased substantially and thereby improves the overall response capability, while reducing recovery time in the aftermath of the disaster.

Disaster-Media as Information

Iqbal et al. (2014) see media reporting as the most important source of information on hazards and disasters for people. Scanlon et al. (1985) see the role of media in all phases of the disaster cycle through their: pre-disaster education, disseminating warning (during) processes and providing information and advice to victims and others in the wake of disasters (after). They felt that it could also assist in stimulating effective disaster relief. Further, they found that the media might inform officials that an emergency actually exists! With their examples, of a case of reporting on flash-flooding instances in select areas or of radio-shows informing authorities about incoming tornadoes in the USA etc.

Yet, the media can be problematic when convergence (Scanlon et al., 1985) of both curious and genuine information seeking behaviour creates pressures on managers. These demands may interfere with effective response. A lack of information can also spread rumors, thereby altering the reality of disaster. This can be particularly harmful when these myths begin to determine the response of various agencies. Thus, Iqbal et al. (2014) proposed the need for a code of conduct in reporting disasters and sought training programmes to help teach disaster reporting-skills. They argued that highlighting the dramatic components of a disaster within *'breaking news'*, often leads to the loss of the original context of what lead to the disaster (cause and effect). Journalists collect information competitively and therefore, managing the requirements of the media house and of getting the news requires additional training in a context of disaster.

In a particular instance of Hurricane Katrina, the media faced immense criticism for providing sketchy information and presenting rumors as facts (Mann, 2007; c.f. Iqbal et al. 2014). Further,
in the context of Pakistan, it was found that the media's constant criticism of the government's response in different disasters, actually resulted in public ire and reduction in foreign aid to the government. Here, the aid shifted directly towards NGOs and other agencies. Yet, as the media continued to cover the disaster, it acted as a bridge of communication between affected people, general public and national and international aid agencies (Iqbal et al. 2014).
The power of the media is particularly observed when the victim is brought home, across global television screens and the world sees the horrors that people face in the aftermath of a disaster (Guion et al., 2007). This intersection (ibid, 2007) of media and disaster management, exposes inherent vulnerabilities of people living in poverty, social exclusion and other forms of socio-economic crisis, whether in New Orleans; Pakistan or any other country.

Uncertainty in Disaster Reporting

There are problems in reporting on disasters as the media is often unable to cope with the sheer diversity and magnitude of the impact of disasters (Sen, 2005). Gregory Button (2010) studied many disasters to suggest that a *'calamity is suffused with uncertainty'*. He states that there is 'incomplete' and 'typically conflicting information' about the nature and extent of risk, in the aftermath of a disaster.

He argued that uncertainty does not simply exist- it is produced! Since disaster-responders including media, public agencies, environment groups etc, *release a cacophony of communications that the affected population often sees as conflicting and confusing* (Button, 2010); this *Informational uncertainty* can create individual and community-wide stress and result in a lack of effective coordination between responding organisations (ibid, 2010). In addition he adds that *the production of uncertainty can result in new political, economic and social formations* (Button, 2010).
While the media seeks immediate answers to meet daily deadlines and the public demands instant answers, science, by virtue of its methodologically rigorous approach, cannot readily respond to these demands. Moreover, some uncertainties cannot be adequately addressed because sufficient scientific information does not exist (Nelkin, 1985; c.f. Button, 2010).

In science, "*absolute certainty is almost never attainable*" especially in the limited time frame available to respond to complex social-ecological dynamics characterizing most disasters (Button, 2010). It is this factor, which is manipulated by corporate interests in order to avoid liability and future-losses owing to litigation. Thereby they call for better science! Further, in order to avoid public scrutiny, *Government officials and scientists may sometimes act in collusion with corporate interests or try to maintain a 'false sense of security'* (Button, 2010). On the contrary, other actors in similar positions strive to provide alternative disaster narratives (Benessaiah, 2012).

Using scientific uncertainty, the *official* narrative can be undermined and the event is then limited in scope in order to prevent further government interference. The use of terms like *"junk science", "irrational"*, or *"very emotional"* manipulates science and the narrative. Button argues that this does not lessen uncertainty but sometimes increases its production.

Citizen science (Benessaiah, 2012) is further suppressed as the powerful elite co-opt (Button, 2010) the scientific process. Here, neither the law nor regulating agencies can help as the information of what science and how safe it is- is again questionable due to uncertainty. Uncertainty is just as endemic in science as in other realms of life,which is why it is increasingly used as a tactic to create further uncertainty (ibid, 2010).

Public Relations skills, paid media and others can then be used *to reassure and downplay the disaster, or, as a political strategy, contribute to a climate of amplified uncertainty* (ibid, 2010). This means that a disaster is political as much as it is natural or man-made. Uncertainty is then used as an instrument to garner public opinion either for or against a particular interest group- political, corporate or others.

The conscious tendency to manufacture, revise or withhold knowledge politicises the discourse in the wake of disasters (ibid, 2010). The media can influence how we see the world, or atleast what we see. This bring informational uncertainty to the home. What it doesn't bring in, is who is creating it? Thus, Button (2001) warns that *disaster analysis must examine power relations among the various agencies and institutions involved in the event and the people affected by disaster.*

Reporting Katrina: Myths and Stereotyping:

Media research in the USA showed the re-emergence of mythological beliefs in the aftermath of 9/11. In addition, the idea that people panic and loot in the aftermath of disaster was popularised. Yet, the problem lay in who controls the information. There was a larger sense of calm, yet the notions remained. The most problematic issue after Katrina was that '*incorrect assumptions about the potential for looting and social breakdown lead to misallocations of public safety resources that could have been put to better use in providing direct assistance to victims'*.

It was also found that disaster had colour when, *African Americans were consistently described as "looting" goods, while whites engaging in exactly the same behaviors were labeled as "finding" supplies* (Tierney et al., 2006). *At a more macro level, however, media treatments of disasters both reflect and reinforce broader societal and cultural trends, socially constructed metanarratives, and hegemonic discourse practices that support the status quo and the interests of elites. Thus, myths concerning the panicky public, the dangers presented by looters, and the threat disaster victims pose to the social order serve to justify policy stances adopted by law enforcement entities and other institutions concerned with social control (ibid, 2006).*

The consequence of myths was that both media reporting and official discourse following Hurricane Katrina upheld the mythical notion that disasters resulted in lawlessness and social breakdown. Yet, media also helped people reunite, it provided information and other details. Albeit, some were distorted versions of reality or mere over-simplifications. Once the initial media frenzy finally died down, journalists themselves were among the harshest critics of Katrina reporting. For example, in a September 29 segment that aired on the News Hour with Jim Lehrer, media analysts, a journalist who had covered the Katrina disaster, and a military official were unanimous in their condemnation of how the media promoted myths of looting and violence in stories that were based almost entirely on rumor and hearsay. Noting that media reporters had by and large never actually witnessed lawlessness and violence in New Orleans, News Hour guests gave numerous examples of the ways in which the media fell short of its duty to report facts, as opposed to rumors (Tierney et al., 2006).

The Need for Collaboration

From the above, we understand that the media, government, and other stake-holders cannot act independently. Scanlon et al. (1985) sited the michi earthquakes in New Brunswick in 1982, to say that media could access information, which even scientists and other bureaucrats could not. Thereby, the media became the sole source of information. Thus, *a disaster organization which is not a center of information will find it difficult to remain a center of control* (Scanlon et al., 1985). Further, the media is able to spend a lot of money and efforts in order to get information that is deemed worthy of news. Thus, technical issues become the only problem. Although the lack of technical know-how poses problems in disaster situations, the mere access to information makes media a key response agency. Thereby, catering for media relations within a disaster management agency becomes indispensable.

Henstra & McBean (2005) suggest that *it is better to make policies for disaster mitigation during "normal" periods, where there is less political pressure to act quickly and where policy can be formulated without specific reference to the most recent catastrophic event.*While Parasuraman(1995) called for comprehensivedisaster management plans at all levels, he highlighted that it was useful to learn from everyone's experiences. He stated that'*continued collaboration of government departments and NGOs, and enhanced participation of the community are crucial for the successful implementation of theprogramme for reconstruction and rehabilitation'* in his study of disaster affected regions in Maharashtra.

Chan J.C (web-report) studied the UK riots of 2011, to find that rioters used social media to instantly share the location of unprotected areas and move there immediately, thereby overwhelming the authorities response capabilities. He found that social media's collective and connected nature brings people together. Then complete and clear messages could be used to collaborate for a common objective. Thus, social media could then be a tool for the disaster cycle of preparedness, response and recovery.

These principles differ in context of mass media like newspapers, television, radio and the internet. Nair (2010) refers to mass media as the gatekeepers of information which can *support or obstruct the disaster management of government agencies and relief organizations* (Anzur, 2000, c.f Nair 2010). As gatekeepers, the mass media decides what information gets disseminated and what gets withheld. Further, even when emergency communications media are operating as designed, messages are typically difficult to understand and interpret during major crises (Tierney, 2005).

This is due to vague and often conflicting information (uncertainty). Nair (2010) then gives a three-dimensional approach to understand disaster communication via mass media where he reflects on: *stage (disaster prevention, acute disaster situation, disaster coping), audience (directly affected vs.. Unaffected population) and level of effects (individual vs. collective)*. Since mass media has to perform the function of both watchdog and public arena, it has goal conflicts with disaster management (Nair, 2010), as the official narrative must be followed when the State is responsible for the overall response. Thus two factors emerge from the available literature- the first is that local media can help increase disaster knowledge and awareness. The second is the need for starting dialogue with the media and negotiating rules for reporting during acute disasters.

Now, in order to work together, disaster management agencies have to identify the local media and its existing capabilities. Then a plan which includes them, identifies responders and trains them has to be made. The media has to be given an active role during the testing of such plans and criticism must be taken from all sides. Once, the plan is actually created it needs to be tested regularly and disseminated to all concerned individuals.

Scholars across the literature (Gui on et al., 2007; Button, 2010 etc) then suggest that, even after the disaster is over, and the media packs its bags (Button, 2010), the media relations must be continued and further enhanced. Also, *the material gathered by the media before, during, and after the disaster should be* *collected for official review, training, and for future public education. And, the local media should be asked once again to assess what happened and to write a new and better disaster plan* (Scanlon et al., 1985).

Conclusion

The lack of integration of media with disaster, crisis and emergency management plans in India resulted in the media being accused of *closing strategic choices available* during the 26/11 siege of Mumbai. It has also been described as the "*mediatized*" *terror experience of* "*slow hemorrhage of public confidence*" (Muralidharan, 2008; c.f. Udupa, 2009). As this paper shows, the media must be taken as a stakeholder along with other agencies in disaster management. Further Udupa (2009) argues that the *'impetuous media bashing is not only unnecessary but detrimental to any future plans of integrating media management with the disaster management apparatus'.* It is no longer possible for a complete media blackout as some information always travels even by word of mouth. The complete ban of media will lead to rumour mongering and curtailing of freedoms, and therefore nations must plan for media in disaster management (Udupa, 2009). In addition, there is a need to *draw up country-specific master plans with a mechanism to integrate disaster management issues within nations* (Sen, 2005). Here decisions on the role of media will play a major determinant on how we manage future disasters.

In a conclusive note on media roles, it has been observed that journalists should not be told what to do, rather, they should be allowed to do their jobs. Stakeholders must work with them so that the truth comes out and the correct news is reported in a matter that captures the diverse realties and complexities of disaster. Establishing the Communications Units/Sections like PROs, Media

Officers, Public Information officers etc. within agencies and the disaster incident command system can help improve collaboration across all agencies. As further disaster-research and media roles are explored, the ability to reach the 'Last Mile' through social media and other platforms can enable social justice and inclusion. Further, if decision makers can effectively use media for identifying who is actually the most affected and their location, there is a possibility of better governance. The media through collaboration, training and improvisation can deepen democracy by acting as both watchdog and public agency; that does not intend sensationalism but a spirit of inquiry in to who is the neediest. By doing so, it can become the'eyes on the ground' for aiding better development, recovery &rehabilitation. A 'do no harm approach' and seeking constant feedback will further improve its credibility, accuracy and role in disaster management. The ultimate goal being to serve the very society that it represents!

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Non - Governmental Organizations

- Role of NGOs in Disaster Management: Some experiences of Local NGOs involvement in Disaster Management in Sri Lanka - *K. D. Chithrapala*
- Sustainable NGO Government Partnership at Microlevel for Community Managed Disaster Risk Reduction - *Neena Joseph*
- Role of Indian NGOs In Natural Disaster Management - *Bhagwansing M. Bainade*
- Strengthening The Role of NGOs In Disaster Management – Multi Stake Holder Participation Green India (Nellore – AP) experiments - *Dr. Ch. Murali Krishna*

ROLE OF NGOs IN DISASTER MANAGEMENT:
SOME EXPERIENCES OF LOCAL NGOs INVOLVEMENT IN DISASTER MANAGEMENT IN SRILANKA

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Abstract

The Role of NGOs in Disaster Management has been visible and un-debatable due to their Commitment and ground rooted activity accomplishment during the past few decades particularly in Asian region. The strengths of NGOs in approaching and mobilizing the Communities, efficient Management of resources, flexible working style and negotiation skills made NGOs role in the society acceptable to the Civil Society as well as to the formal sector institutions / Government.

The recognition of engagement of NGOs in Disaster Management by the donors as well as other Development partners compelled the National and Provincial Governmentsto provide space for NGOs to be active in Disaster Management initiatives. During the past major disasters, such as 2004 Tsunami, 2011 Floods and 2014 landslides in Sri Lanka, it was evident that the Local NGOs have played a significant role in providing immediate relief and rescue support, Post disasterrelief activities including shelter, Health and Sanitation, Counselling, Livelihood support and gradually restoring the lives of the affected families alongside with the Government agencies and Private Sector.

The National Disaster Management Centre of Sri Lanka under the Ministry of Disaster Management has made provisions to engage NGOs and CSOs not only in post Disaster Management but in pre-disaster awareness and Preparing to face disaster situations. The NGOs being always closely working with communities can act faster and communicate effectively with vulnerable groups which is a process that can be strengthen by the Government in order to minimize the effect of Disasters and save the lives and properties. Therefore, a well-coordinated and integrated approach of Disaster Management by the Government and NGOs would no doubt generate positive impacts than work in isolation.

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SUSTAINABLE NGO GOVERNMENT PARTNERSHIP AT MICROLEVEL FOR COMMUNITY MANAGED DISASTER RISK REDUCTION

Neena Joseph

Abstract

*Disaster Risk Reduction Management (DRRM) initiatives attract less political and financial commitments from government compared to rescue; relief and reconstruction and rehabilitation components of disaster management. The **importance** of DRRM is eclipsed by the **urgency** of the other components. Further, the invisibility of DRRM makes it less expedient politically. For the robustness and sustainability of risk management initiatives at microlevel, gradual building up of community risk reduction culture and ultimate owning up by the community are crucial. This requires protracted and persistent effort and can be undertaken best by NGOS who has to withdraw once the project is created and the community is empowered to carry out the work. But the phenomenal efforts of community mobilization and skill building will be wasted if the DRRM initiatives are not sustainably continued and not integrated into the government's endeavours . Huge opportunity cost will be entailed by way of the missed opportunity of NGO government synergy. A credible and committed NGOs can come up with good models, mobilize community, develop cpapabilities and build up lateral and vertical synergies with bureaucracy and local self-governments. Such initiatives get maximum support from all directions, especially during the aftermath of a major disaster. But the sustainability of such projects are beset with problems such as intersectoral rivalries, ego clashes, habit of working in silos, dearth of ideas related to relevant activities during the non-disasterperiods, change of leadership in the relevant sectors, absence of political and financial prioritization of DRRM, lack of proactive measures to forge linkages from both sides etc. But there is encouraging trends in the transformation of the legal and governmental ecosystem. The post 2015 framework has identified the leadership and empowerment of local authorities and communities (Patra et.al,2014). Asthana (2014) argues that time has come up for risk reduction initiatives in the wake of the international attention on climate change adaptation and sustainable development with their conceptual underpinningsof looking at disasters as something endogenuous and which need to be incorporated into development planning and that this is impossible without community involvement. The draft National Disaster Management Guidelines, Community Based Disaster Mnagement ,2014 prepared by National Disaster Management Authority spells out the broad scope of community involvement plugs the gap related to community involvement in the Disaster Management Act ,2005 India. Sendai framework for disaster reduction (2015),the successor to Hyogo framework spells out very focusedly, specific actions which need to be undertaken : understanding disaster risk, strengthenng disaster risk governance ,investing in risk reduction for resilience and enhancing risk preparedness for effective response. Nambiar (2015) expatiates on the need for involving community in risk identification, risk planning and risk management and the collective responsibility for mitigating vulnerability. Stanganlli (2008) discusses each aspect of Hygo approach in relation to Italian experience. Krishna (2015) advocates the need for making disaster preparedness as a culture and conscious practice in line with Cuban experience and how Orissa can adapt this approach. There is plethora of studies on disaster preparedness and about community participation. But there are no studies on the sustainabity aspects of Government NGO partnership in DRRM and the ground realities of microdynamics involved therein.*

The location of study is Elamkkunnathupuzha Panchayat, Ernakulam district, Kerala, India. Ernakulam Social Service Society (an NGO) had undertaken Community Managed Disaster Risk Reduction project in 3 grama panchayats (grassroots level local governance institutions) in the district. . The project was wound up in 2013. This particular panchayat is selected because, it has the maximum number of population and maximum length of coastline and hence the most prone to water related disasters .

The study attempts to answer the following questions.

- *What are the issues and problems in sustaining partnership with the government ?*

- *What are the possible range of activities which can be undertaken by the community during non-disaster periods?*
- *What can be done to generate more government NGO synergies?*
  The study seeks to find answers to the above questions through interviewing key informants including relevant persons from the community, NGO, local self government and bureaucracy. FGD will be conducted with representatives from each of the above 4 groups. In the FGD conducted for the community, representatives of the early warning team and co ordination committees will be selected. Sendai Framework for Disaster Reduction, 2015 will be used for analysis.

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ROLE OF INDIAN NGOs IN NATURAL DISASTER MANAGEMENT

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Abstract

Volunteerism and social service has deep roots in India. NGO's are meant for nonprofit companies or state-specific public charitable trust. NGO's work on a variety of areas like sectorial development interventions, humanity assistance, etc. NGO's plays important role in each stage of disaster management cycle. NGO's playing very important role in providing humanitarian assistance to disaster affected people in most of the server natural disasters in various areas of country. In the resent past the role of NGO's in disaster management has stated changing from providing post disaster relief to strengthening pre-disaster preparedness and mitigation through capacity building, public awareness campaigns, mock exercises, etc.

In this paper, we have studied the role of Indian NGO's in natural disaster management we have took base of various resent disasters for the study of this research paper.

Key Words *- NGO's, Disaster Management, Natural Disaster, Role, Volunteerism.*

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STRENGTHNENING THE ROLE OF NGOs IN DISASTER MANAGEMENT – *MULTI STAKEHOLDER PARTICIPATION- GREEN INDIA (NELLORE – AP) EXPERIMENTS*

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Disaster is a terrible word. It has multifarious implications. It means many things to many people. It sounds a alarm even to hear. It is dreadful in its aftermaths. Disaster is a sudden catastrophic experience that brings with it damage and loss to lives and properties. It is described as a devastation and destruction caused even to a prosperous civilization. It is an unpredicted fall and fury of Nature that results in inexplicable sorrow to the location that engulfed it. Naturally, it sounds a death knell and threat to the unprepared humans and other species.

Disaster mitigation has assumed global significance and universal alertness among the various nations across the world. With a view to save the humanity and the material prosperity from the scourge of disasters, every country has developed its own strategy to minimize damages caused by these disasters-either man-made or Nature-made. We had seen the terrible impacts of the disasters across the world in the recent centuries especially those caused by floods and Tsunamis, which left behind the indelible and horrible impressions behind on the sands of time.

In the backdrop of these disasters, the role played by the stakeholders especially the Non-Governmental Organizations (NGOs) is predominant and paramount. In India, we have thousands of NGOs who serve shoulder to shoulder with the Government in mitigating the disasters which are well-equipped with a tank of information and strategies for management. Few of them have developed expertise in meeting the challenges that confront the Government when a disaster befalls. They are either the front liners in social sector or spiritual domain or the blend of both or else. The Government itself cannot be expected to do everything in such a sad situation. Therefore, the NGOs are the trusted agents to share the brunt of burden in terms of facilitating the public needs and to respond the call of the people.

In Nellore, Andhra Pradesh, India, Green India is formidable serving NGO which designed and developed its own strategies to prevent disasters especially along the coast line of Bay of Bengal. This paper is presented basing on its own experiences and experiments in this regard.

The best lessons learnt out of the horrible neither Tsunami that caused tremendous devastation to the unprepared lakhs of people neither could neither be ignored nor its impacts taken easily. It is evident that while the built up structures are pulled down or flooded away in the Tsunami of 2004, the trees and Green Wall developed across the coast stood as a protective fence against the force and the velocity of the Tsunami. Therefore, it is a lesson that across the vulnerable coasts, development of tree plantation is one such workable option. Green India, hence, made it a point that development of GREEN WALL covering the coast line with Palmyra tree plantation is the need of hour.

Now let us examine the nature, course and consequences of disasters and what strategies could be effectively advanced to manage or mitigate this evil of disasters.

Disaster Management, Floods, Earthquakes, Cyclones and Landslides

Disaster is a sudden, calamitous event bringing great damage, loss, destruction and devastation to life and property. The damage caused by disaster is immeasurable and varies with the geographical location, climate and the type of the earth surface. This influences the mental, socio-economic, political and cultural state of the affected area. Generally, disaster has the following effects in the concerned areas**,**

- It completely disrupts the normal day to day life
- It negatively influences the emergency systems
- Normal needs and processes like food, shelter, health, etc. are affected depending on the intensity and severity of the disaster.

It may also be termed as "a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of the affected society to cope using its own resources."

Generally, disasters are of two types – **Natural** and **Manmade**. Based on the devastation, these are further classified into major/minor natural disaster and major/minor manmade disasters such as:

- Flood
- Cyclone
- Drought
- Earthquake

Minor Natural Disasters:

- Cold wave
- Thunderstorms
- Heat waves
- Mud slides
- Storm

Major Manmade Disaster:

- Setting of fires
- Epidemic
- Deforestation
- Pollution due to prawn cultivation
- Chemical pollution.
- Wars

Minor Manmade Disaster:

- Road / train accidents, riots
- Food poisoning
- Industrial disaster/ crisis
- Environmental pollution

Disaster Management- No Standardized Norms:

There are no standardized rules defining the different phases of the disaster management cycle. Different agencies use different cycles depending upon their objectives. However, while approaches vary, it is agreed that disaster management activities should be carried out in a cycle.

The Disaster Management Cycle

Disaster Prevention, Mitigation and Preparedness

The first important steps towards reducing disaster impact are to correctly analyze the potential risk and identify measures that can prevent, mitigate or prepare for emergencies. Information and Communication Technology can play a significant role in highlighting risk areas, vulnerabilities and potentially affected populations by producing geographically referenced analysis through, for example, a geographic information system (GIS). The importance of timely disaster warning in mitigating negative impacts can never be underestimated. For example, although damage to property cannot be avoided, developed countries have been able to reduce loss of life due to disasters much more effectively than their counterparts in the developing world. A key reason for this is the implementation of effective disaster warning systems and evacuation procedures used by the developed countries, and the absence of such measures in the developing world.

Three Terrible Disasters:

The three terrible disasters in the recent times dictate certain lessons. However, it clearly shows that in the case of Hurricane, Katrina, although the economic loss and damage to property were much higher, the number of deaths was remarkably less than that resulting from the Indian Ocean tsunami in Sri Lanka and the Pakistan earthquake. This is largely because in Sri Lanka and Pakistan, the victims were mainly communities living below the poverty line – a factor that significantly contributed to their vulnerability – and because effective disaster warning systems were not in place. In New Orleans, official warnings were dispatched in advance and many in the affected areas were evacuated in time.

Incident	Considered area	Number of deaths	Estimated financial loss
Indian Ocean tsunami (December 2004)	Sri Lanka	30,920 or 38,195 (two different official estimates)	US$1 billion damage and US$1.8 billion recovery costs
Northern Pakistan earthquake (October 2005)	Pakistan	87,350 (official) Over 100,000 (unofficial)	US$5 billion
Hurricane Katrina (August 2005)	New Orleans, USA	1,604 accounted for (both direct and indirect) 2,000 missing	US$25 billion-US$100 billion US$75 billion (according to the US National Hurricane Center)

In addition, the disaster management process was much better than what it had been in Sri Lanka and Pakistan, despite the heavy criticism it received.

Advance Warnings:

A warning can be defined as the communication of information about a hazard or threat to a population at risk, in order for them to take appropriate actions to mitigate any potentially negative impacts on themselves, those in their care and their property.

The occurrence of a hazard does not necessarily result in a disaster. While hazards cannot be avoided, their negative impacts can be mitigated. The goal of early public warning is to ensure to the greatest extent possible that the hazard does not become a disaster. Such warnings must be unambiguous, communicate the risks succinctly and provide necessary guidance.

The success of a warning can be measured by the actions that it causes people to take, such as evacuation or avoiding at-risk areas. In a disaster situation, there is no doubt that timely warnings allow people to take actions that saves lives, reduce damage to property and minimize human suffering. To facilitate an effective warning system, there is a major need for better coordination among the early warning providers as well as that handling logistics and raising awareness about disaster preparedness and management.

While disaster warnings are meant to be a public good, they are often most effectively delivered through privately-owned communication networks and devices. There are many new communication technologies that allow warning providers not only to reach the people at risk but also to personalize their warning message to a particular situation. Opportunities are available right now to significantly reduce loss of life and potential economic hardship if disaster warning systems can be improved.

It is important to note that disaster warning is indeed a system, not a singular technology, constituting the identification, detection and risk assessment of the hazard, the accurate identification of the vulnerability of a population at risk, and finally, the communication of information about the threat to the vulnerable population in sufficient time and clarity so that they can take action to avert negative consequences. This final component underscores the importance of education and creating awareness in the population so that they may respond with the appropriate actions.

Role of NGOs

As has already been said, the regional organization and NGOs provide specialized knowledge and advice in support of national efforts to develop or sustain the operational capabilities of countries that share a common geographical environment. Regional organizations are crucial to linking international capabilities to the particular needs of individual countries and in facilitating effective early warning practices among adjacent countries.

NGOs play a critical role in raising awareness among individuals and organizations involved in early warning and in the implementation of early warning systems, particularly at the community level. In addition, they play proactive role to help ensure that early warning stays on the agenda of government policy makers.The media plays an important role in improving the disaster consciousness of the general population and in disseminating early warnings. The media can be the critical link between the agency providing the warning and the general public.

Media as an Effective Instrument of Disaster Warning

Electronic Media is considered as the most traditional electronic media used for disaster warning, radio and television being primary warning agencies. The effectiveness of these two media is high because even in developing countries and rural environments where the tele-density is relatively low, they can be used to spread a warning quickly to a broad population. The only possible drawback of these two media is that their effectiveness is significantly reduced at night, when they are normally switched off.

After the Indian Ocean tsunami of 2004, many radio manufacturers considered introducing new digital radio alert systems that react even if the set is switched off. In order to trigger this alarm, a special flag integrated into the received signal from a terrestrial transmitter or a satellite would be used and the set would automatically tune to the emergency broadcast channel.

During the preparedness and response phases, GIS can accurately support better response planning in areas such as determining evacuation routes or locating vulnerable infrastructure and vital lifelines, etc. It also supports logistical planning to be able to provide relief supplies by displaying previously available information on roads, bridges, airports, railway and port conditions and limitations. Apart from this, activities such as evacuee camp planning can also be done using GIS.

Post-Disaster Operations

The most difficult period of a disaster is the immediate aftermath. This period calls for prompt action within an exceptionally short period of time. In the aftermath of any disaster, a significant number of individuals will be injured and/or displaced. Many of them may still be living with the trauma they have encountered, including loss of loved ones. Affected individuals may also be without food or other essential items. They might be waiting in temporary shelters, with no idea what to do next. Some might need immediate medical attention, while the disaster aftermath environment also creates ideal breeding grounds for possible epidemics.

- Tracing Missing Persons
- Coordinating Donor Groups
- Recording the Locations of Temporary Camps and Shelters

Disaster Recovery – Sophisticated Gadgets

Disaster reconstruction has to start as soon as the initial disaster cleanup has taken place. This is a very complex endeavor, requiring a huge array of skill sets and a thorough knowledge of an ever-increasing variety of techniques and equipment. A range of software tools are being used for these purposes. Thus, while the role of Information and Communication Technology in the long-term disaster recovery process is not as apparent as it is in disaster warning, there is no doubt that Information and Communication Technology is being used widely to expedite these activities.

Specific Disaster Management Software

Different types of software tools are being used to gather, store and analyze data related to disasters, not only in post-disaster conditions, but also as a long-term measure to mitigate the risk of the disasters. One such approach is known as DesInventar.

DesInventar is a methodical way to gather and store information about characteristics and effects of different types of disasters, particularly the ones not visible from global or national scales. This allows for the observation and analysis of accumulated data regarding these 'invisible' disasters at a global or national scale.

Despite the fact that disaster preparedness has not been identified as one of the Millennium Development Goals, it is apparent that proper mechanisms for disaster awareness and means of disaster recovery are essential to achieving the Millennium Development Goals. In particular, the Millennium Development Goal targets such as integrating the principles of sustainable development into country policies and programmes, and reversing the loss of environmental resources can never be achieved without giving due emphasis to effective disaster management strategies.

Disaster Management Legislation: Disaster Management Initiatives in India

The **National Disaster Management Authority** (NDMA), headed by the Prime Minister of India, is the Apex Body for Disaster Management in India. The setting up of the NDMA and the creation of an enabling environment for institutional mechanisms at the State and District levels is mandated by the Disaster Management Act, 2005.

Evolution of NDMA

Emergence of an organization is always an evolutionary process. Establishment of NDMA has also gone through the same processes. Towards this aim, the Government of India (GOI), in recognition of the importance of Disaster Management as a national priority, has set up a High-Powered Committee (HPC) in August 1999 and also a nation committee after the 2001 Gujarat earthquake, for making recommendations on the preparation of Disaster Management plans and suggestion effective mitigation mechanisms. The Tenth Five-Year Plan Document also had, for the first time, a detailed chapter on Disaster Management. Similarly, the Twelfth Finance Commission of India was also mandated to review the financial arrangements for Disaster Management. On 23 December 2005, the Government of India enacted the Disaster Management Act, which envisaged the creation of the National Disaster Management Authority (NDMA), headed by the Prime Minister of India, and State Disaster Management Authorities (SDMAs) headed by respective Chief Ministers of the States, to spearhead and implement a holistic and integrated approach to Disaster Management in India.
In the Indian context, let us examine the various forms of disasters.

Floods

A flood is an expanse of water submerging land. A flood is caused by excess water in a location, usually due to rain from a storm or thunderstorm or the rapid melting of snow. A flood happens when an area of land, usually low-lying, is covered with water. The worst floods usually occur when a river overflows its banks. The flood is constituted not only of the overflowing water but also of all other waters that are unable to drain off into water channels.

Causes of Floods

- When snow on a mountain melts or when a river or a lake of some sort overflows
- Flooding from water displacement, such as in a landslide,
- The failure of a dam,
- An earthquake induced tsunami,
- A hurricane’s storm surge or melt water from volcanic activity.
- Flooding of Coastal areas by high tides or by tsunami waves caused by undersea earthquakes.
- A flood that rises and falls rapidly with little or no advance warning is called a flash flood. Flash floods usually result from intense rainfall over a relatively small area.

Elements at Risk

- Buildings built of earth (mud), weak foundation and water soluble material.
- Basement of buildings.
- Utilities such as sewerage, water supply.
- Agricultural equipment and crops, vehicles, fishing boats etc.

Effects of Flood

- Physical damage- structures such as buildings get damaged due to flood water. Landslides can also take place. Top soil gets washed away
- Causalities - people and livestock die due to drowning. It can also lead to epidemics and diseases.
- Water supplies- Contamination of water. Clean drinking water becomes scarce.
- Crops and food supplies- shortage of food crops can be caused due to loss of entire harvest.

Cyclone

The name cyclone was first coined by Captain Henry Paddington, Chairman of Marine Court, Calcutta in 1848. It is derived from Greek word means coil of a snake. Cyclone is meteorological phenomena in which an area of low pressure characterized by inward spiraling winds that rotate counter clockwise in the northern hemisphere and clockwise in the southern hemisphere of the earth.

Near the places of their origin they are only 80 Km in diameter, but well developed cyclones have their diameter ranging from 300 to 1500 km. They move at faster rate over the oceans than over the land because the irregularities of the land surface retard their speed. The six main types of cyclones are polar cyclone, polar low, extra tropical, subtropical, tropical and musicale.

Polar Cyclone

Polar or arctic cyclones are vast areas of low pressure. A polar cyclone is a low pressure weather system usually spanning 1,000-2000 kilometers per hour, in which the air circulates in a counterclockwise fashion in the northern hemisphere.

Polar Low

A polar low is a small-scale, short-lived atmosphere system (depression) that is found over the ocean areas in both the Northern and southern hemispheres. They are part of the larger class of meso scale weather systems. Polar lows can be difficult to detect using conventional weather reports and are a hazard to high latitude operations, such as shipping and gas and oil platforms. Polar lows have been referred to by many other terms, such as comma cloud, mesocyclone, polar meso scale vortex, Arctic hurricane, Arctic low and depression.

Extra-Tropical

An extra tropical cyclone sometimes inaccurately called a cyclone is a synoptic scale low pressure weather system that has neither tropical nor polar characteristics. The “extra-tropical” refers to the fact that this type of cyclone generally occurs outside of the tropics, in the middle latitudes of the planet. These systems may also be described as “mid-latitude cyclones” or “post-tropical cyclones.

Sub-Tropical

A sub-tropical cyclone is a weather system that has some characteristics of an extra-tropical cyclone. It can in a wide band of latitude, from the equator to 50°C. ZIYAD is a very dangerous cyclone now affecting Mauritius.

Tropical

A tropical cyclone is a low-pressure cyclonic storm system. It is caused by evaporated water which comes off the ocean and becomes a storm. Typical cyclones are the worst natural hazards in the tropics. They are large revolving vortices in the atmosphere extending horizontally from 150-1000 km and vertically from the surface from 12-14 km. Strong winds spiraling anti-clockwise in the Northern Hemisphere blow around the cyclone center at the low level. At the higher levels, the sense of rotation is just opposite to that at the lower level. They generally move 300-5000 km per day over the ocean.

While moving over the ocean, they pick up energy from the warm water of the ocean and some of them grow into a devastating intensity. On an average, about 5-6 tropical cyclones form in the Bay of Bengal and the Arabian sea every year, out of which 2-3 may be severe.

Mitigation Policies and Strategies

Depending on their location and strength, there are various terms by which tropical cyclones are known, such as hurricane, typhoon, tropical storm, cyclonic storm and tropical depression. They are all cyclonic storm systems that form over the oceans. Tropical cyclones can produce extremely strong winds, tornadoes, torrential rain, high waves, and storm surges. The heavy rains and storm surges can produce extensive flooding. Although one cannot control cyclones, the effects of cyclones can be mitigated through effective mitigation policies and strategies.

- Installation of Earth Warning Systems fitted along the coastlines can greatly assist forecasting techniques, thus helping in early evacuation of people in the storm surge areas.
- Developing communication infrastructure such as Amateur Radio has today emerged as second line unconventional communications systems and is an important tool for disaster mitigation.
- Developing shelter belts with plantations of trees can act as effective wind-and tide-breakers. Apart from acting as effective windbreakers and protecting soil crops from being damaged, they also prevent soil erosion.
- Developing community cyclone shelters at strategic locations can help in minimizing the loss of human life. In the normal course of life, these shelters can be used as public utility buildings.
- Construction of permanent houses and appropriately-designed concrete houses that can withstand high winds and tidal waves.
- Training and education in terms of Public awareness programs that inform the population about their response to cyclone warnings and preparedness can go a long way in reducing causalities.
- Land use control and settlement planning units should be permitted in the coastal belt of 5 km from the sea, as it is the most vulnerable belt. No further growth of settlements in this region should be permitted. Major settlements and other important establishments should be located beyond 10 km from the sea.

Gujarat Experience

It has been several years since the earthquakes struck Gujarat on January 26, 2001; rehabilitation has been done on a massive scale. Gujarat's experience has taught that building shelters with less vulnerability to earthquakes should also take into consideration of the specific needs of the victims instead of being a top-down approach. The role of NGO's in this is very important. Their strength lies in their manpower, informality in operations and valuable human resources. Their ability to reach out to the community and sensitivity to local traditions is an asset in such situations. The initiatives of the International Fund for Agricultural Development in supporting the self-employed Woman association(SEWA) and the Government's initiative in community-based livelihood security for earthquakes and drought victims have the potential to shape future disaster response and development projects in Gujarat, the Gujarat Woman's Economic Development Corporation (GWEDC) initiative in reviving woman's businesses after the calamity also provides many practical lessons in regenerating local economies and artisan markets.

The coordination between Government, local NGO's and local community initiatives, both for rescue as well as rehabilitation, needs to be strengthened as this can cause delays, overlaps and waste of relief material and efforts.

Afforestation, the Need of the Hour

Forests are very important for us. It is unfortunate that we are ignoring its significance and are playing havoc with this one of the most vital aspects of Nature. Hence, we must be aware of this face and save trees to save our lives and our existence. In the early periods of civilizations, large parts of our country were covered with forests. The increase of the population of our country has led to the shrinking of forest area. The forests which purify air have been cut down and new cities and industries have been established in their place. The cutting of the forests causes what is called "The Green House Effect". It results in the heating of the earth's surface or global warming which has serious consequences for life on this planet. As a result coming generations are likely to suffer from incurable diseases. And what is extreme, even the existence of human kind might be in danger. Afforestation is the only measure that can be taken to avoid these disastrous havocs.

We know that Chipko Movement was started by Shri. Sunderlal Bahuguna to stop indiscriminate felling of trees in the Himalayas. But an all-out effort is needed. We can't thrust this responsibility only on the government or on the public institutions or on any particular person. It is the duty of all and all must work together to make it a success. A planned government effort is needed in every state. The government must invest in the afforestation of hilly and desert areas. It must raise green belts in areas which are subject to rapid erosion.

But at the same time awareness among the common people is greatly needed. Steps must be taken to create massive people's movement with involvement of women to achieve the objectives and minimize pressure on existing forests. People as a whole must be motivated to regard the planting and protection of trees as social duty. Saplings are planted every year no doubt but in absence of proper care they die by the next monsoon. Who is to look after them? It is the general public, whose pious duty is to water and save every plant growing on the land in their neighborhood. Educational institutions can play a key role in this regard. They can instill in the younger generation the need for planting trees. There are many social organizations that should come forward and promote common people for plantation. These organizations should also help the government so that it may implement its various programmes on conservation of forests successfully and rapidly. Our existence is bound up with the trees and therefore trees must be planted especially on the road side and near railway tracks. Forests are very important for us. It is unfortunate that we are ignoring its significance and are playing havoc with this one of the most vital aspects of nature. Hence, we must be aware of this face and save trees to save our lives and our existence. We very often talk on environmental pollution, but do nothing in this regard. Let's take a pledge to plant trees in more and more numbers and promote others for this noble cause.

Afforestation is the planting of trees for commercial purposes, usually on land supporting non-forest veld types, e.g. grassland or fynbos. This differs from reafforestation which is the restocking of existing forests and woodlands which have been depleted. Less than 0,5% of South Africa is covered by indigenous forests. Owing to their slow growth and sensitivity to logging, these forests cannot supply the majority of our country's wood requirements. Additional fast-growing trees are planted to cater for the demand for wood products. Commercial forests, or plantations, cover 1.1% of South Africa.

Woodlots and Agroforestry

The increasing demand for fuel wood and building material in rural areas has caused widespread deforestation of natural woodlands, riverine zones, and water catchments. To reduce this problem woodlots have been established at a number of villages throughout the country to supply fuel wood and poles. Many woodlots make use of wattle and gum trees and now cover a total area of roughly 14 000 ha in South Africa.

The incorporation of trees with crops, a system known as agro forestry, is one method of increasing fuel wood production that is gaining popularity in Third World countries. Trees grown amongst crops supply timber, nuts, fruit, and fodder for cattle. Appropriate species of trees enrich the soil, prevent erosion, retain water, and shield crops from damaging wind and excessive sunlight.

Afforestation and the Environment

The supply of wood and wood products from afforested areas has prevented the over-exploitation and destruction of our indigenous forests. However, unwise planning and management of afforestation can lead to negative environmental impacts. Habitats most severely affected by afforestation include wetlands, grassland, fynbos and indigenous forests. Good management, and planning that takes conservation of natural habitats into consideration, can overcome these problems, some of which are outlined below:

Wetlands: Plantations situated too close to wetlands and perennial streams, or in their catchments, leads to their eventual drying out as trees use large amounts of water. The endangered wattled crane is dependent on wetlands for breeding . *Grasslands:* These rich communities support a variety of animals, including threatened species such as oribis, Stanley bustards and blue swallows. Afforestation converts grasslands to plantations, and so these animals lose their `home'.

Fynbos: this unique habitat of the Western Cape is also seriously affected by the invasion of alien trees from digenous forests: When plantations next to indigenous forests are logged, trees may fall onto the forest margin and damage it. Once damaged, the forest margin can no longer protect the indigenous forest from fire. In addition, logging can destroy the diverse habitat where forest and grassland meet. The forest margin is an important food source for many forest animals, e.g. bushbucks shelter in the forest but feed mainly on the smaller plants in the forest margin. *River catchments:* Trees use large amounts of water. Afforestation in water catchments thus reduces runoff and water availability for other uses.

Afforestation and the Greenhouse Effect

Trees absorb carbon dioxide (CO_2) from the atmosphere during photosynthesis. It has been suggested that large scale afforestation could successfully absorb the CO_2 generated by the burning of the fossil fuels, coal and oil. The vast areas of afforestation required to achieve this would result in many negative environmental impacts. From a local perspective, in the short term such afforestation would cause as much environmental destruction as global warming could in the long term. A better approach would be to tackle this problem at its roots: reduce our reliance on fossil fuels and prevent deforestation of our natural forests. Fossil fuel combustion and deforestation together account for the majority of man-made CO_2 releases.

Did You Know?

In South Africa alien commercial forests cover about 3, 5 times the area (almost 1, 2 million ha) covered by indigenous forests (330 000 ha). Fifty-one per cent of commercial plantations are found in the former Transvaal and Orange Free State, 38% in KwaZulu/Natal, and 11% in the three Cape provinces combined. Plantation forestry started in South Africa in about 1888.

Disaster mitigation measures are those that eliminate or reduce the impacts and risks of hazards through proactive measures taken before an emergency or disaster occurs. One of the best known examples of investment in disaster mitigation is the Red River Floodway. The building of the Floodway was a joint provincial/federal undertaking to protect the City of Winnipeg and reduce the impact of flooding in the Red River Basin. It cost $60 million to build in the 1960s. Since then, the floodway has been used over 20 times. Its use during the 1997 Red River Flood alone saved an estimated $6 billion. The Floodway was expanded in 2006 as a joint provincial/federal initiative.

All-Hazards Approach

An all-hazards emergency management approach looks at all potential risks and impacts, natural and human-induced (intentional and non-intentional) to ensure that decisions made to mitigate against one type of risk do not increase our vulnerability to other risks.

Types of Disaster Mitigation

Disaster mitigation measures may be structural (e.g. flood dikes) or non-structural (e.g. land uses zoning). Mitigation activities should incorporate the measurement and assessment of the evolving risk environment. Activities may include the creation of comprehensive, pro-active tools that help decide where to focus funding and efforts in risk reduction.

Other examples of mitigation measures include:

- Hazard mapping
- Adoption and enforcement of land use and zoning practices
- Implementing and enforcing building codes
- Flood plain mapping
- Reinforced tornado safe rooms
- Burying of electrical cables to prevent ice build-up
- Raising of homes in flood-prone areas
- Disaster mitigation public awareness programs
- Insurance programs

However, in order to develop and sustain effective coastal bioshields active participation of the local community and local self-government is indispensable.

Effectiveness of Coastal Bioshields in Reducing the Impact of Natural Disasters

For a long time, local communities living around mangroves and other coastal vegetation have been aware of the effectiveness of this vegetation as shields against cyclones, storm surges and tsunami. For example, the people of Tamil Nadu state, have been calling mangrove forest as "*aalayaathi kaadu*" for thousands of years ("A*alai*" means waves and "*aathi*" means mitigate and "*kaadu*" means forest). This traditional wisdom is supported by experimental studies in the field and laboratory. Theoretical studies on wave forces and modelling of fluid dynamics suggest that tree vegetation may shield coastlines form tsunami damage by reducing wave amplitude and energy. Analytical models show that 30 trees - either mangrove or non-mangrove - per 100 m2 in a 100 m wide may reduce the tsunami flow pressure by more than 90% (Hiraishi *et al.*, 2003). Effectiveness of a coastal forest in mitigating the impact of natural hazards depends on the width, density and structure of the forest and the tree characteristics (height and diameter at breast height). A study indicates that for a tsunami wave height of 3 m, the effective forest width – mangrove or non-mangrove - is about 20 m and for 6 m high tsunami wave the effective width of forest is about 100 m. It has also been estimated that trees with 10 cm diameter at breast height is effective against 4.6 m tsunami waves and 35 cm diameter for 7 m (FAO, 2006). However, empirical and field based evidences were not available for long time. The super cyclone of Orissa in October 1999 and tsunami in December 2004 provided opportunities to collect field based evidences on the role of coastal vegetation in reducing the impact of such natural disasters.

Mangrove and Non-mangrove Bioshield and Tsunami

After 26th December 2004 tsunami the role of mangroves and other coastal vegetation in mitigating the impact of tsunami was evaluated scientifically following two kinds of approach.

Approach 1:In the first approach tsunami mitigating role of coastal vegetation was studied at macro level using pre and post tsunami high resolution remote sensing imageries. This study was carried out in the southern part of Cuddalore district and northern portion of Nagapattinam district, which were the worst affected areas of 2004 tsunami. The coastal vegetation of southern Cuddalore district consists mainly of mangroves (Pichavaram) whereas Nagapattinam study area is characterized by the presence of large casuarina shelterbelt (non-mangrove bioshield) plantations raised by the Tamil Nadu Forest Department since 1970s. The total length of the coast covered in this study was about 20 km and the land up to 1 km from the shoreline was taken up for the assessment. The height of the tsunami that hit these coastal areas was about 4.5m. Using Quick Bird satellite imagery of May 2003 (pre-tsunami), the study area was divided into three categories namely, i) dense tree vegetation, ii) open tree vegetation and iii) no tree vegetation. Mangrove forest with dense trees and thick casuarina shelterbelt areas were included in the dense tree vegetation category. All other woody vegetation, including degraded mangroves and gaps in plantations, were considered open vegetation. For post-tsunami damage assessment, IKONOS satellite imageries of December 29, 2004 (3 days after the tsunami) were used. Damages due to tsunami were divided into three categories namely, i) damaged (areas where all or most of the physical structures had been destroyed, removed or damaged), ii) partially damaged (some damage but most of the physical structures remain intact) and iii) undamaged (no damage visible on the ground or in the satellite imageries). A comparison was then made between the tree vegetation categories and the tsunami damage using chi-square tests. The results showed that within 1 km from the shore, there was statistically significant correlation between tsunami-caused damage categories and different tree vegetation densities: in particular, dense trees vegetation associated with undamaged areas and dissociated with damaged areas).

Approach 2: In this approach, two pairs of villages, one pair in mangrove situation and another pair in shelterbelt (non-mangrove vegetation) plantation area, were selected for the study. These villages were located more or less equidistance from the sea and at similar elevation. However, one village is protected by vegetation - either mangrove or shelterbelt - and another village is unprotected by such vegetation. Impact of tsunami on the villages is related to loss of lives, damages to houses and household properties, loss of boats and nets, etc. Some of the damages, for example, loss of boats and nets mostly happened in the boatyards and neither mangroves nor any other coastal vegetation cover these boatyards. Hence, loss of boats and nets was common to both protected and unprotected villages and thus, could not be taken as an indicator to assess if mangroves and shelterbelts lessened the impact of tsunami. Such a kind of misunderstanding was also encountered when total loss of human lives was taken as one of the indicators. Total loss of human lives in a village could not be considered as an indicator because some of them died while in the boatyards. Others lost their lives due to forceful entry of water into the villages. In order to solve these confusions and also to find out suitable indicators a series of discussions was held in the selected villages. On the basis of the inputs obtained the following indicators were selected: i) loss of lives within the village due to forceful entry of the tsunami waves, ii) number of houses damaged, either fully or partially and type of houses, iii) height of the water inundating the villages (identified as lines in the walls of the houses).

The results indicates that in the mangrove protected village of T.S. Pettai the loss of life and damage to houses was nil whereas in the mangrove-unprotected village namely, Muzhukkuthurai, 11 (2 percent) people died and 89 percent of the houses damaged due to forceful entry of tsunami water. In the case of casuarina shelterbelt plantation, 58 people died in the unprotected village and more than 50 percent of the houses were also damaged. In the shelterbelt protected village of Madavamedu, 13 people died and only 21 percent of the houses damaged (MSSRF, 2006).

Table 1 Distribution of tsunami damaged area with reference to tree vegetation cover (numbers in parenthesis indicate %)

Damage category/ tree cover	Damaged area (ha)	Partially damaged area (ha)	Undamaged area (ha)	Total (ha)
Dense tree vegetation	2.2 (0.5)	15.7 (3.5)	437.1 (96.1)	455.0
Open tree vegetation	30.9 (15.4)	84.4 (41.9)	86 (42.7)	201.3
No tree vegetation	502.9 (35.1)	384.2 (26.8)	547.0 (38.1)	1434.1

Issues Relating to Bioshield Management

The experiences of the community during the tsunami and anecdotal evidences published in the media about the role of mangroves and non-mangrove coastal vegetation in reducing the impact of tsunami brought changes in the mindset of coastal communities and the attitude of government agencies towards raising mangrove and non-mangrove vegetation as bioshields along coastal areas. The fishing community, which is normally reluctant to participate in restoring, conserving, raising mangrove and other coastal vegetation programmes, now shows lot of interest in restoring degraded coastal vegetation as well as raising plantations in new areas. This is indicated by the demands of the fishing community to government agencies and non-governmental organizations for raising mangrove or other tree vegetation in suitable places around their villages. Similarly, administrators and planners are willing to allot large parcels of wasted lands including saline affected areas to the coastal community to raise tree plantations, either mangroves or non-mangroves trees, as a protective cover along the coastal areas as a part of disaster mitigation initiatives. Considering all these, the coastal bioshield movement was initiated in 2005 by M.S.Swaminathan Research Foundation, which was subsequently followed by other non-governmental agencies.The role of coastal forests and man-made plantations in protecting coastal areas from tsunami and other natural hazards such as cyclones, storm surges was deliberated comprehensively in a technical workshop by Food and Agriculture Organization (FAO) in Bangkok in 2006. The workshop brought together the best available knowledge and experience to give a clear picture of the roles that forests and trees play in protection against hydro meteorological and geophysical hazards in the wider context of coastal planning and social, economic and environmental considerations. It also assessed the value of coastal vegetation compared to other commonly used hard (engineered) structures for coastal protection. The major findings in the workshop are:

Forests and trees can act as bioshields that protect people and other assets against tsunamis and other coastal hazards but whether they are effective and the degree of their effectiveness depend on many variables. These variables include characteristics of the hazards itself, the features of the site such as bathymetry, geomorphology and the characteristic of the bioshield such as type of forest/tree, width, height, density etc.Care must be taken to avoid making generalizations and creating a false sense of security that bioshields will alone protect against all hazards; The use of bioshields should be considered within the framework of disaster management strategies, which also include effective early warning systems and evacuation plans.Hence, The Founder and Managing Trustee of Green India designed and made it a point that development of GREEN WALL covering the coast line with Palmyra tree plantation.

The Merits of Palmyra Tree (Thadi in telugu name) Plantation Covering the Coast Line as follows.

Thadi scientifically known as *Borassus flabellifer* L. *Borassus* referred to 'growing spadix of the palm tree', *flabellifer*means 'fan-bearing' or 'fan shaped leaves' and is a State tree of Tamilnadu belongings to the family Arecaceae. Also it is Kalpavruksha in Andhra Pradesh for poor people.The palmyra palm is a very tall, single-stemmed evergreen palm tree that can eventually reach a height of 30 meters. The unbranched stem can be up to 1 metre wide at the base, narrowing to 40 - 50cm at around 4 meters and thereafter cylindrical; it is topped by a crown of up to 60 large, stiffly projecting fan-shaped-leaves.The tree is widely exploited and it has a very wide range of applications. Indeed, in India it is called the tree with 800 uses. It is cultivated in many tropical areas for its fruit, sap and many other items. It is one of the most important of the cultivated palms. It takes long time to bring a crop from seed to maturity (12 years or more)The palmyra is a very adaptable palm that can succeed in a wide range of conditions in dry to moist tropical and subtropical climates. It grows best at elevations below 800 meters. It can survive with as little as 250mm of rain in a year and cropping satisfactorily with 500 - 900mm per year. It will also grow and crop well with rainfall as high as 5,000mm per year. It grows best where temperatures never fall below 10°c. with an optimum temperature around 30°c, but it also withstands extreme temperatures as high as 45°c and as low as 0°c. Prefers a sandy soil, but plants are able to succeed under a wide range of conditions, Established plants are drought resistant and also survive in water logging areas. The palm starts flowering and fruiting 12 - 20 years after germination, usually in the dry season.

The plants has lot of ecological importance, ecologically palmyrah tree reduce the effects of strong winds. It binds the soil and prevents soil erosion. The plant has a lot of economic and medicinal value particularly with reference to roots, stem, leaves, fruit and sap etc.

Green India Experience

GREEN INDIA operating as an NGO at Nellore in the State of Andhra Pradesh, India, has been organizing operations across the coastline of Bay of Bengal in the state of AP for 8 years now. It has emerged as sustaining NGO accessing formidable strategies for disaster mitigation. It had taken up certain projects such as Green Wall as a part of BILLION TREE PLANTATION. The Tsunami-2004 has proved that trees withstand tsunamis stronger than buildings and structures. Taking clue from this, Green India had developed its strategies to outwit disasters.

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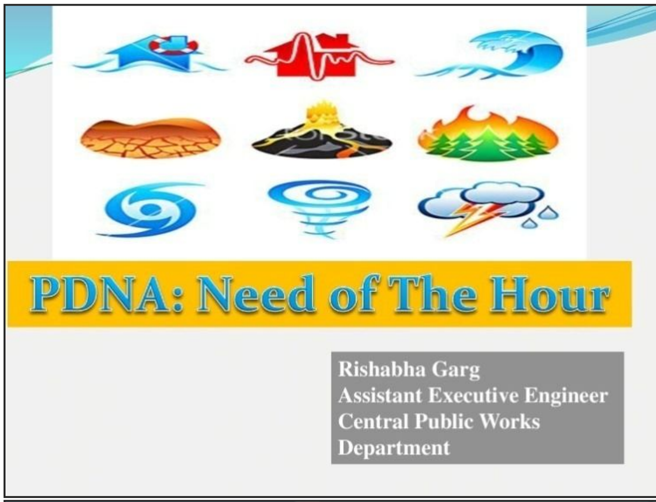
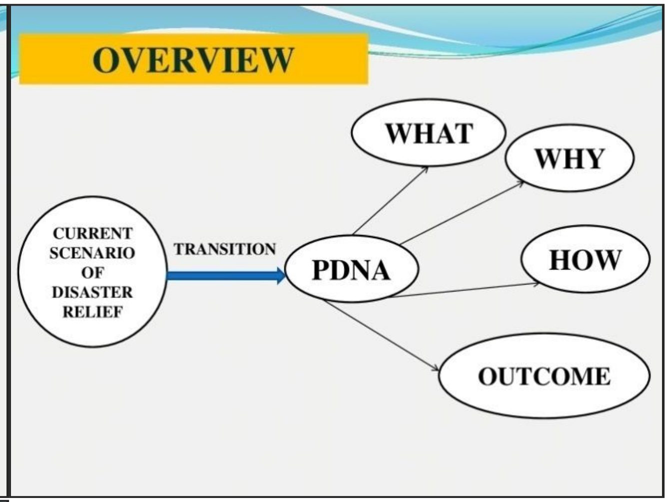
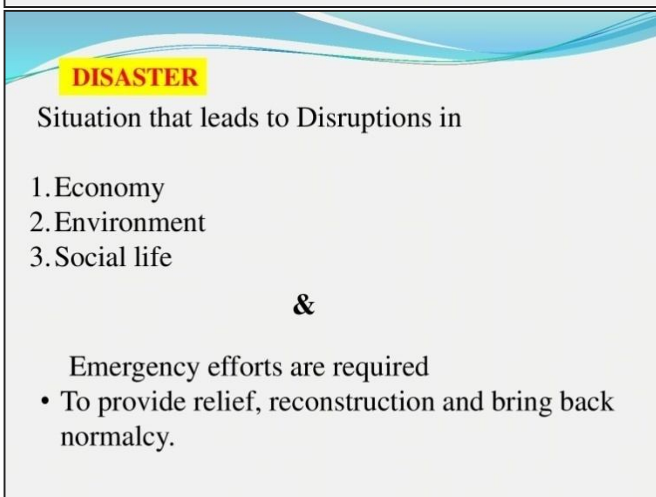
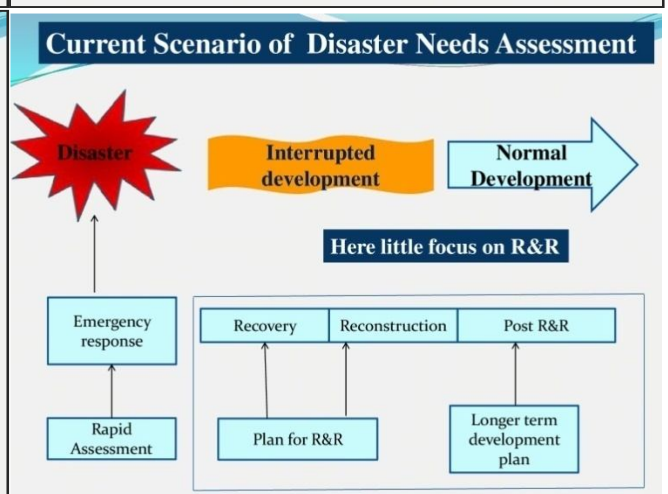
POST DISASTER NEEDS ASSESSMENT (PDNA)

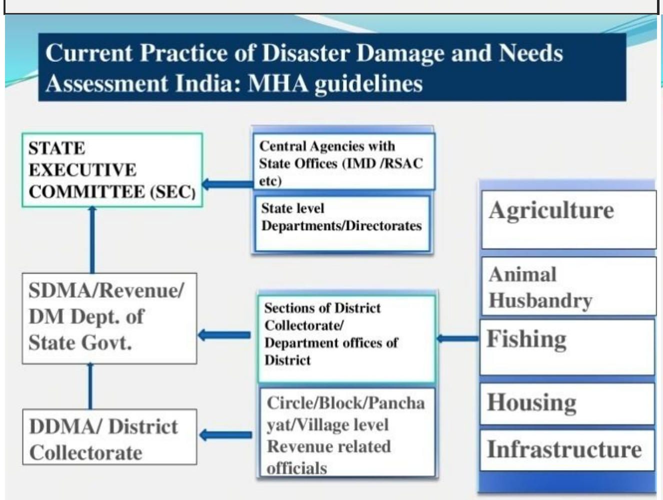
- Post - Disaster Needs Assessment (PDNA) - *Shri AK JHA, CE, CPWD*

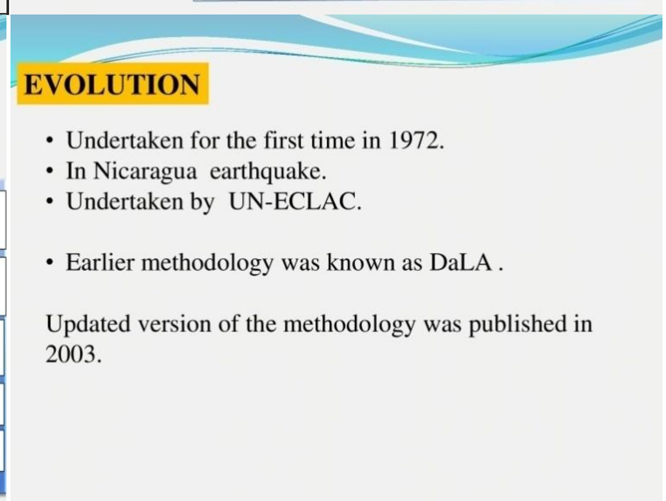

PDNA: Need of The Hour
Rishabha Garg
Assistant Executive Engineer
Central Public Works
Department


OVERVIEW
CURRENT SCENARIO OF DISASTER RELIEF
TRANSITION
PDNA
WHAT
WHY
HOW
OUTCOME


DISASTER
Situation that leads to Disruptions in
1. Economy
2. Environment
3. Social life
&
Emergency efforts are required
• To provide relief, reconstruction and bring back normalcy.


Current Scenario of Disaster Needs Assessment
Disaster
Interrupted development
Normal Development
Here little focus on R&R
Emergency response
Recovery
Reconstruction
Post R&R
Rapid Assessment
Plan for R&R
Longer term development plan


Current Practice of Disaster Damage and Needs Assessment India: MHA guidelines
STATE EXECUTIVE COMMITTEE (SEC)
Central Agencies with State Offices (IMD /RSAC etc)
State level Departments/Directorates
SDMA/Revenue/ DM Dept. of State Govt.
Sections of District Collectorate/ Department offices of District
DDMA/ District Collectorate
Circle/Block/Panchayat/Village level Revenue related officials
Agriculture
Animal Husbandry
Fishing
Housing
Infrastructure


EVOLUTION
• Undertaken for the first time in 1972.
• In Nicaragua earthquake.
• Undertaken by UN-ECLAC.
• Earlier methodology was known as DaLA .
Updated version of the methodology was published in 2003.

- In India the methodology partially adopted in 2001 Gujrat earthquake.
- Asian Disaster Preparedness Centre is helping India to formulate India centric PDNA methodology.
- The ECLAC methodology was also used in Tsunami post disaster assessments.

How can we mitigate adversities in case of disaster???

DISASTERS OCCURRED IN INDIA

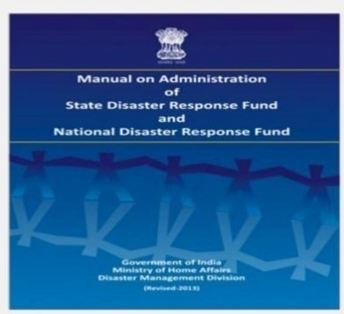
NEED for PDNA INDIA

An approach, which is

- **Scientific with Indian Standard**
- **Comprehensive with Economic, Social and Environmental aspects**
- **Systematic with Macro and Micro analysis**
- **Aligned with international methodology**

Where does current mechanism goes wrong

At the present time, the normal **scope of assistance** to be provided to disaster-affected population in India is defined by the ***National Disaster Response Fund*** **(NDRF)** and by the ***State Disaster Response Fund*** **(SDRF).**



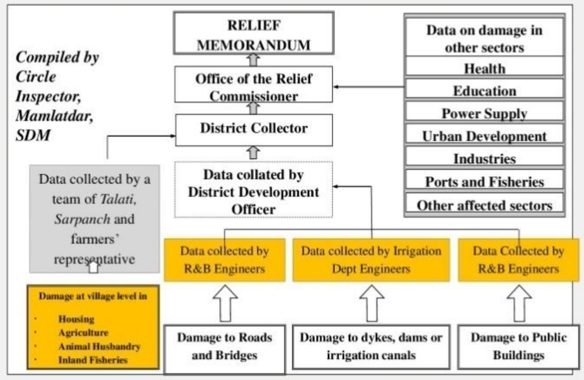
Post-disaster assessment in India

Two main types of post-disaster assessments are conducted in India:

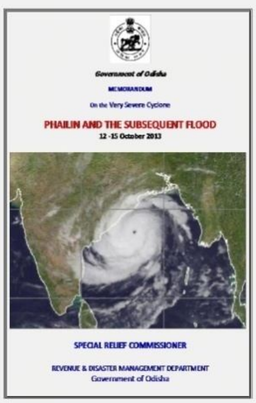
(a) **As per directives included in the Disaster Response Fund;** and

(b) In some cases, **broader post-disaster assessments of major events carried out by the affected State authorities with support from international agencies.**

The Relief Memorandum: Eg Gujrat



Model 1: By Government



CONTENTS

CHAPTER – I - Introduction (State vulnerability to cyclone)

CHAPTER – II - Cyclone Tracking

CHAPTER – III - Occurrence & Intensity

CHAPTER – IV - Response (Preparedness activities)

CHAPTER – V - Impact/ Damages

CHAPTER – VI - Assistance sought for

CHAPTER – VII - State Disaster Response Fund

CHAPTER – VIII - Appendix- I to Appendix - VIII

CHAPTER – IX - Conclusion

CHAPTER – X - Forecast of IMD about Very Severe Cyclonic Storm "PHAILIN"

CHAPTER – XI - Visual Accounts

CONTENTS

CHAPTER – I - Introduction (State vulnerability to cyclone)

CHAPTER – II - Cyclone Tracking

CHAPTER – III - Occurrence & Intensity

CHAPTER – IV - Response (Preparedness activities)

CHAPTER – V - Impact/ Damages

CHAPTER – VI - Assistance sought for

CHAPTER – VII - State Disaster Response Fund

CHAPTER – VIII - Appendix- I to Appendix - VIII

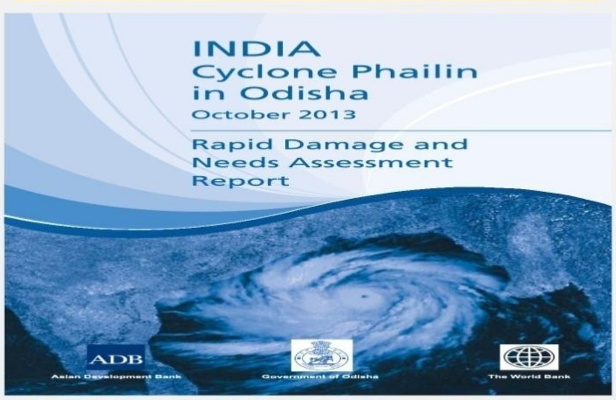
CHAPTER – IX - Conclusion

CHAPTER – X - Forecast of IMD about Very Severe Cyclonic Storm "PHAILIN"

CHAPTER – XI - Visual Accounts

Sector wise analysis is missing

Model 2: With the help of Government



Contents

ABBREVIATIONS & ACRONYMS		x
EXECUTIVE SUMMARY		xii
CHAPTER 1: INTRODUCTION		1
1.1	Vulnerability to Natural Disasters	1
1.2	The Disaster: Cyclone Phailin	2
1.3	State Government Response	4
CHAPTER 2: ... ASSESSMENT		5
2.1		5
		6
2.		6
2.4		7
CHAPTER 3: DAMAGE AND NEEDS ASSESSMENT		8
3.1	Housing	8
3.2	Public Buildings	11
3.3	Damage to Heritage Monuments	14
3.4	Roads	15
3.5	Urban Infrastructure (Water Supply, Roads, Drains and Sewerage)	16
3.5.1	Rural Water Supply and Sanitation	18
3.6	Agriculture	19
3.6.1	Horticulture	21
3.6.2	Irrigation Infrastructure	22
3.6.3	Livestock	24
3.7	Livelihoods	26
3.7.1	Fisheries	27
3.7.2	Non-farm Sector: Handloom, Handicraft and Small and Micro Enterprises	28
3.8	Power Infrastructure	30
3.9	Forest and Plantations	32

Damages and needs assessment to every sector is accounted for

Rapid Damage and Needs Assessment Report | ix

All sectors have been accounted for here ,thus includes as many people as possible and greater relief to people

List of Tables

Table 1	Preliminary Estimation of Reconstruction Cost	xiii
Table 2	Assessment Time Frame	5
Table 3	Damages to Housing	9
Table 4	Reconstruction Cost for Damaged Houses	10
Table 5	Cost for Providing Basic Services and Land acquisition	10
Table 6	Cost of Reconstruction, Providing Basic Services and Land Acquisition	11
Table 7	Damages to Non-Residential Buildings	12
Table 8	Damages to Residential Buildings	12
Table 9	Estimated Cost for Non-Residential Building	13
Table 10	Estimated Cost for Residential Buildings	13
Table 11	Damage to Heritage Monuments	14
Table 12	Estimated Cost for Heritage Monuments	14
Table 13	Damages to Roads	15
Table 14	Estimated Cost for Reconstruction	16
Table 15	Summary of Damage to Urban infrastructure	17
Table 16	Summary of Preliminary Estimation of Damage to Urban Infrastructure	18
Table 17	District-wise status and impact of damaged Rural Water Supply Schemes	19
Table 18	Reconstruction Cost for Rural Water Supply and Sanitation	19
Table 19	Agriculture Lands Affected	20
Table 20	District wise Estimated Loss to Agriculture Sector	21
Table 21	Horticulture Crop Production Details 2010-11	21
Table 22	Horticulture Crop Area Damaged	22
Table 23	Estimated Loss of Horticultural Crop in Three Districts	22
Table 24	Details of the Damage to Irrigation Infrastructure	24

x | INDIA: Cyclone Phailin in Odisha

What is the Difference?

- First type of assessment are normally included in the Relief Memoranda.
- These are prepared by State authorities to quantify the amounts of additional resources required from the central Government .
- National Disaster Response Fund is used to supplement State Disaster Response Fund.
- These numbers are – **incorrectly – called damage and losses.**

Signs of Change

- Since 2001 more detailed assessments of disaster impact have been undertaken for R&R

.

- **The Gujarat earthquake in 2001,**
- adequate estimations were made of the value of damage or destruction in all affected sectors of social and economic activity;
- production losses were only partially estimated for some sectors, leaving out many of the social and infrastructure sectors.

Continued….

- **The 2008 Bihar floods, the Uttarakhand floods and of Cyclone Phailin in Odisha in 2013** – which were called
- "**Damage and needs assessments",** was carried out.
- However the scope of work was limited to the **estimation of the value of destroyed assets and of the corresponding needs for reconstruction.**
- Production losses and social sector changes in flows were not quantified.

Post-disaster assessment in India

The **weaknesses** of the existing system:

(i) not all affected population is included to receive assistance;

(ii) not all sectors of economic and social activity are included;

(iii) the assessment concentrates on relief assistance and only;

(iv) more often, only the government sector damages are assessed.

(v) The amount of assistance to be provided have remained at fixed levels for a number of years.

Where do we Stand Today

The current assessment practices in India do not provide adequate information that:

(i) may be used by the higher authorities to adopt adequate public policies for recovery and reconstruction, and that

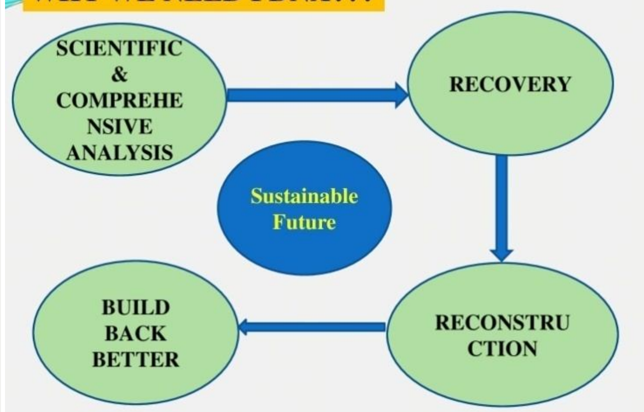
(ii) as a result the affected population faces longer periods of suffering to achieve recovery.

So we need reinforcement of the current set up of Disaster Relief Assistance in India

Where it goes wrong???

- Lack of Institutional Approach
- Initiatives were largely
  - Uncoordinated and Scattered
  - Adhoc and Incomplete
  - Experimental in nature, Lacked Continuity
- Data demanded Vs Date supplied
- Validation of data

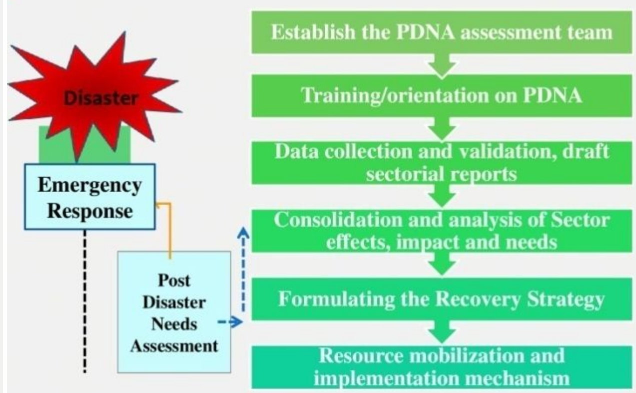
WHY WE NEED PDNA???



WHY CONDUCT PDNA

- To ***quantify the financial needs.***
- To ***define government priorities for intervention*** in different geographical areas, sectors and population groups.
- To ***create capacity of government to design post-disaster programs.***
- To provide ***basis for monitoring progress*** in implementing recovery and reconstruction programs.

REQUIREMENTS TO DO PDNA



OPERATIONAL STEPS

DISASTER

The Govt . decides PDNA

Agreement on the Assessment Team

Government assigns responsibility to Department/Agencies

Coordination discussion among the Assessment Team

Agreement is reached on the conduct of the PDNA

ASSESSMENT STEPS

1. **Collect and/or validate the baseline data.**
2. **Estimate & validate damages and losses.**
3. **Analyze the impacts of the damages and losses.**
4. **Identify the recovery strategies and reconstruction needs.**
5. **Draft the implementation plan of the identified programs and projects**
6. **Draft the post-disaster damages, losses and needs (PDNA) of the sector.**

Himachal Pradesh seeks ₹ 1,972 crore for calamity relief

All India | Indo-Asian News Service | Updated: November 26, 2013 19:22 IST

NEW DELHI: Himachal Pradesh Chief Minister Virbhadra Singh on Tuesday called on Prime Minister Manmohan Singh and requested him to provide financial assistance of ₹1,972.08

NEW DELHI, September

Updated: September 14, 2014 12:15 IST

Over Rs. 5,000 cr. loss to J&K due to floods: Assocham

Detailed memo of damages, relief package being readied: CS

12.5 lakh families affected due to worst ever flood

Posted on 29/09/2014 by Dailyexcelsior

SRINAGAR : Giving a detailed account of the damages suffered in the unprecedented flood, Chief Secretary, Mohammad Iqbal Khandey, Monday, said a detailed memorandum is being readied and after receiving approval of the Cabinet, it will be submitted to the Union Government.

TERMINOLOGY

- DAMAGES.
- LOSSES.
- NEEDS
- EFFECTS & IMPACTS.
- NEEDS.
- RECOVERY.
- RECONSTRUCTION.

DAMAGES

The loss which can be recovered in less than a year.

1. **Repair** of ***partially damaged*** structures, equipment other assets up to their pre-disaster condition.

2. **Replacement** of ***totally destroyed*** structures, equipment.

3. Cost of bringing back the **affected structures, equipment , machinery and other assets** up to their pre-disaster state.

LOSS

- Changes in economic (production) flows which can extend beyond the year the disaster occurred.

- Example:

1. Foregone income opportunities

Private:

- total loss of crops or reduction in farm output

Public

- Income losses from public facilities and firms like airports, ports, state-owned enterprises, etc.

RECOVERY

- These are ***shorter term needs.***
- Need to be taken care of at the ***earliest.***
- ***Emergency*** fund should be utilized.
- ***Prioritization then allocation***. and should be

RECONSTRUCTION

- Longer term needs.
- Focuses on the strategy of build back better.
- Assistance to be provided after PDNA.
- Should ensure sustainable construction.

DISASTER EFFECTS & IMPACTS:

They happen immediately after the disaster and have long term consequences classified as:

1. PERSONAL/HOUSEHOLD LEVEL

2.SECTOR LEVEL

3.MACROECONOMY LEVEL

4.CROSS-CUTTING LEVEL

NEEDS

- **Needs** – amount needed to bring back normalcy as was in pre disaster condition.

- ***1. Recovery needs*** – usually urgent short-term needs to restore pre-disaster conditions as soon as possible

2. Reconstruction needs – longer-term needs like
- new infrastructure like relocation of buildings, airports, houses etc.

Example of Estimation of Damages ,Loss & Needs

An internet café was affected:

- Building was destroyed. Cost of repair is estimated at $ **5,000**
- There is a computer that was totally destroyed
- Before disaster: Earns **$ 100 per day**
- Closed for **5 days** after disaster

Description of computer:

- Was bought 3 years ago for **$1,000**
- Useful life is **5 years** (not useable after 5 years)
- The replacement value of the computer when it was damaged was = **$ 400**

- **The internet café damage:**
  - Cost of repair of building: **$ 5,000**
  - Replacement of computer: **$ 400**
- **The Loss is:**
  - $ 100 income per day x 5 days closed = **$ 500**
- If you cannot buy a similar computer (**3 years old at $ 400**)

- If you cannot buy a similar computer (3 years old at $ 400)
- **The need is:**

a) New computer, which is the value of a brand new one, say maybe $1,200;

b) $ 5,000 for repair of building ; and

c) $ 500 for retrofitting or reinforcing the repair with iron bars as estimated by engineers

Tabular estimation of damages and loss

Items	Damages	Losses	Needs
Building repair	5,000		
Computer replacement	400		
Income		500	
New computer			1,200
Repair			5,000
Retrofitting (iron bars)			500
TOTAL	**5,400**	**500**	**6,700**
Applies to houses, buildings, schools, hospitals etc. where **structures**, their **contents** (equipment, etc.) and **income** are affected			

Differences between Current and PDNA methodology

Current methodology	PDNA methodology
• Unscientific. • Might ignore some sectors. • Quick. • Ignores SIA. • Ignores environmental damages.	• Scientific. • Holistic sector wise analysis. • Takes time for overall study. • SIA is an integral part. • Environmental damages are accounted for.

OUTCOME:RECOVERY & RECONSTRUCTION

- The purpose of **Post-Disaster Needs Assessment** is:
- To provide assistance for the financial requirements.
- To provide assistance for the social impact of disaster.
- To provide assistance for environmental restoration.
- To achieve normalcy in the life of affected persons.
- To formulate a sustainable longer term plan for R&R.

PDNA::
POST DISASTER NEEDS ASSESSMENT TODAY FOR A SUSTAINABLE,SAFE AND SECURED TOMORROW.

RESILIENCE

- Pathways to Resilience Process: Way Forward - *Mr Pradeep Mahapatra*
- Building Communities around Disaster Management – Demystifying Disaster Management - *Pinaki Dasgupta*
- Alternative Technologies as a Toolkit for Management of Rain Water Flooding in Machilipatnam Municipality - *Prof. Dr. P. Padmavathi, Ar.P.Pavan Kumar (Ph.D.),*
- Resilient Infrastructure for the Capital City Amaravathi - *Pothula Shiva Sai Kiran, Harshit Sosan Lakra*
- Effectiveness of Base Isolation Technique and Influence of Isolator System Parameters on Response of a Base Isolated Building - *Sunita Tolani and Dr. Ajay Sharma*
- Repair and Rehabilitation of Buildings: *Shri MKSharma, CE, CPWD.*
- Seismic / Cyclonic Retrofitting of Buildings: *D T K M Soni, CE, CPWD*
- Precautions required in Building Construction in Earthquake and Cyclone Prone Areas- *Shri Shailendra Sharma.*
- Precautions for Improving Wind / Cyclone Resistance of Buildings
- Building Community Disaster Resilience through Multi-Sectoral Collaboration at Local Level - *Jayashree Parida, Niharranjan Mishra*

PATHWAYS TO RESILIENCE PROCESS:
WAY FORWARD

Mr Pradeep Mahapatra,

Team Leader UDYAMA, Bhubaneswar, Odisha, India

People and agriculture are first that would lead to community resilience, preventing degradation, unsustainable farming system have caused gross social ecological imbalances, variability and change is another threat to life and livelihoods and has created panic for survival and sustainability unless there has initiatives at local level to meet the global issues

Global climate Community resilience has become one the challenges for everyone and has become of issues for policy makers, governments, non governments, humanitarian organizations, bilateral organizations and funding organizations.

With advancement of global climate change, Fear, Risks, Stress, Shocks, Trauma, Worries, Threats, Hazards, Conflicts, Drudgery, Imbalances, Speculations, vulnerabilities are getting accelerated due to recent climate changing chaos .more disasters like drought and floods, sea surge, coastal inundation will occur. Rainy Days will be lessened and volume of water will be more within a short span. Manifold vulnerabilities and health hazards will be also another emerging issues that can kill lives and loss of loss of infrastructures

Despite there are severe threats of floods cyclones, coastal erosion, inundation, heat wave, flash floods, distress migration and hunger, enormous opportunity are there to regenerate revive, and rejuvenate the fragmented livelihoods through consorted actions and community resilience practices & initiatives with regard to human adaptation and regional resilience capability.

The time has come to concerted action in mobilizing mainstream resources with value added initiatives that will complement and supplement the initiates of government, CSOs; institutions to carry forward broad based human adaptation initiatives.

Vulnerability the degree to which people are susceptible to the adverse impacts of climate change i.e level of resilience and capacity to cope of community. Persons living in a developing country faced 79 times greater risks of being affected by climate induced disaster .262 million people affected by climate disasters annually from 2000 to2004 over 98 percent were living in the developing world.

Reality Realization:

91% disasters in 2009 due to weather **Half of these disasters — mainly storms and floods — have taken place in Asia, a UN study says:**http://igovernment.in/site/91-disasters-2009-due-weather-36305

The Relevance of the Concept in the Odisha Context:

"Floods, Droughts, Cyclones, Earthquakes, Tornadoes, Heat waves, Village fire, Lightening, Distressed Migrations, Environmental Hazards, Foeticides, Ttrafficking, Extremists": What Next?

“If ever a concept called disaster tourism is to catch fancy of those bitten by wander bug, then Odisha certainly will be the number one destination”.

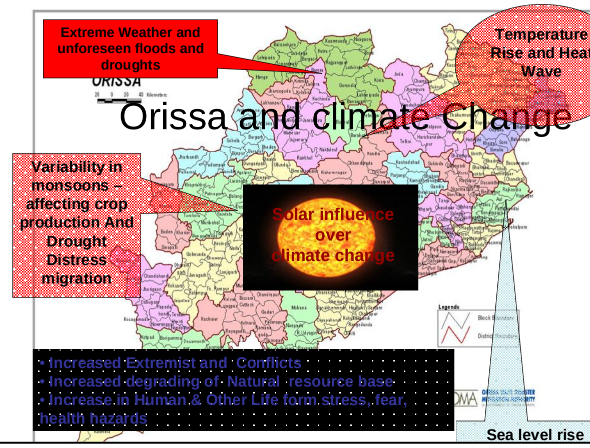
Odisha unfortunately is in the path way of depressions and cyclones formed in the Bay of Bengal during south west monsoon. With advance in global warming and climate change if sea storms acquire greater destructive power as is being forecast, the state will be required to bear the brunt of such storms which means all the gains of development will be washed away in flood/storms waters.

According to the state government’s Human Development Report 2004, property loss has been steadily growing every year over the past few decades.

Droughts and floods will be accelerated resulted in Food insecurity, water tress, starvation deaths, dreadful diseases, distress migration will be manifold.

The state has witnessed a fall in birth rate between 2002 and 2008. At the same time, the infant mortality rate (IMR) has gone up. According to the Population Foundation of India (PFI), crude birth rate has come down from23.2 in 2002 to 21.4 in 2008, while the state has second highest IMR in the country with 69 per 1,000 live births.

Even after the passage of 69 years of independence, people continue to struggle with the problems of deprivation and powerlessness. The extremity of the degree and implications of poverty is experienced by the situation that forces the people to live within a constant state of impoverishment, in circumstances where their most basic human rights, entitlements are need to rethink.



Living with Environmental Change: Our planet faces unprecedented change. If we continue on our current path, by the end of this century, or earlier, our environment will be in a state that modern humans have never experienced. In parts of the world, supplies of food and water will be at risk and flood defenses stretched

The intensity and frequency of droughts and floods appear to be increasing every year with declining vegetation and ground water availability followed by increasing of flash floods. There is media reporting that these regions are *slowly moving towards desertification.*. Thus, under the changing climatic situation (arising as a result of natural phenomena and or outcomes of human made developments), the relationship between ecology and sustenance has been badly affected

“Perpetual hunger, perennial drought, uneven rainfall, climatic variability, continuous crop failure, malnutrition, depletion of natural resource base, squeezed food basket, skewed land distribution, inadequate institutional linkages and infrastructure, inadequate bargaining power etc. count amongst the primary concerns of western/tribal districts in particular and Odisha in general.” Risk and vulnerability is getting compounded due to devastating natural, social, physical, economic and environmental capital, combined with poor political representation followed by nutritional and health hazards causing to disrupting the livelihoods that causes distress migration, child sale and women trafficking with rampant social, mental and physical abuse.

"The key findings presented in the Odisha review report clearly spell out that livelihoods, ecology and economics share a strong organic bondage. Under the changing climatic situation (arising as a result of natural phenomena and or outcomes of manmade developments), the relationship between the two has been badly affected causing disastrous harms to human lives, livelihoods and property.

A lot is being talked about the causes of disasters, technical know-how on disaster management and rehabilitation. But, developing understanding on existing coping mechanisms at the community level and then propagation of this understanding at a broader level has remained an area of neglect. Keeping this in view, it is highly important to integrate mainstream development programs for the lasting solution to human adaptation relating to livelihoods in rural and urban and Biodiversity Conservation as a process (access, avail, utilize the resources, implement& maintain) to vulnerability adaptation to climate change variability. Further, temperature hike in Nuapada, Titlagada, Sambalpur, Jharsuguda, Keonjhar, Jajpur, Angul and Bhubaneswar are considered the hottest places during summer especially mid-April to May. Floods, Droughts, Cyclones and Heat waves are many more accelerating. Hence, Rich State Odisha is in the backward category due to recurrent natural disasters. Equally distress migration, hunger is also very common in western and northern parts. Food insecurity, starvation has resulted distressed migration and trafficking and bring more dreadful diseases.

Climate variability contributes significantly to poverty and food insecurity. Proactive approaches to managing climate variability within vulnerable rural communities and among institutions operating at community, sub-national, and national levels is a crucial step towards achieving the Millennium Development Goal of eradicating extreme poverty and hunger.

Climate Change Issue in Odisha as an opportunity to accelerate Community Resilience Process and come up with a citizen action from Human Rights Perspective:

Since Climate Change and Poverty is global phenomena, in realty this has a greater impact at the local at community in relation to survival security, social security, economical security, environmental security and sustainability. Odisha is the hub of disasters.In this backdrop, utilizing ecologically sensitive alternative methods of income diversification (using water, land, people and adaptive methods of treatment and maintenance of resources) can help to achieve important prerequisites for reducing poverty , distress migration, economical viability and environmental sustainability, reducing the financial burden on government with an enterprise mode .

The proposal would make a sincere effort to summarize all ongoing developmental schemes and make aware the eligible communities with simplified and easily understood steps to access to, pool and leverage these schemes. Improved management of climate variability has appealing synergies with other interventions that target hunger and poverty, including production and productivity, gearing greening, soil fertility management, small-scale water management, markets, and extension and communication systems in minimizing the fear and worries with solid engagement of state and CSOs**.**

Further, Following are key areas need to address the human adaptation & resilience initiatives:

- Survival Security (addressing Poverty, health problems especially of women and child, absorption of distress migration, , Employment generation at community level)
- Social Security (access and avail to social security programs for all sections, village safety nets and productive assets creation integrating ongoing development programs, grooming community level institutions and community empowerment and entitlement process, inclusion of social exclusion, demand driven work generate for community infrastructures
- Financial security (Group initiatives, small business development initiatives, micro-linkages with intermediary institutions for vending, capacity building and economic activity)
- Environmental sustainability (energy plantations, nutrition plantations,water, land and forest resource restoration and rehabilitation, awareness generation for climate variability and change adaptation, inclusion of school children on environmental stabilization.
- Make environmentally sound programs and culturally acceptable, economically viable livelihood micro plans for their village

- Community be proactive to pursue with Govt and NGOs to converge available schemes broadly with social and employment guarantee schemes and allied sectors which covers almost all livelihood based activities
- Community capacity building and training to supervise the implementation of the program help quality job assurance and Fixing Responsibility and accountability.

Specific objectives;

- Links to the broader view of poverty and poverty alleviation that goes beyond just income poverty to include empowerment, capability and health etc.
- Highlights the crucial role of ' local context' (especially vulnerability context) – and how this influences the asset base, the selection of livelihood strategies, and the outcomes for households.
- Gives space to local perspectives - categorize the strategies that make up their livelihoods.
- Build on what exists - a multidimensional, integrated perspective that unites the concepts of economic development, reduced vulnerability and environmental sustainability

Following activities may be undertaken:

- Eco-Logical Development towards responsive development in harmony with nature & culture, life style
- Life cycle Based Community Livelihoods Resilience at Coastal, Rural and Tribal Hilly Regions
- Ecosystem based Model building on Micro-Water conservation, Sustainable Agriculture,biodiversity conservation, Crop Diversification,
- Inclusion of Women & children towards safe Sanitation, House Hold Nutrition and Hygiene, Environmental Education
- Life Skill Development, income diversification and alternate livelihoods of ultra-poor& disability
- Gearing Greening towards environmental sustainability
- Implementing& advocacy on Minimizing Adverse impact of Distress Migration at source and destination
- Citizen Action on climate Justice involving Women, Children and multi stakeholders
- Networking and mainstreaming DRR and Institution building,
- Result Based Management Training, Study & capacity building, collectivesGrooming

Strategy & Approach aimed at:

- Provide as a catalyst for efforts to support people in areas facing repeated disasters or Vulnerabilities
- Prepare for, plan to withstand and recover from stresses, shocks & drudgery
- Take in hand root causes of disasters, impacts and vulnerabilities with lasting solutions
- Adaptive Action Research and Innovation focused on the challenges and opportunities
- This program willconsistently to stem the rot and build back the societal networks that can rejuvenate the resource base. Searching alternative process to live with dignity and deal the Next Development

Challenges for a lasting solution to disaster resilient development & ecological sustainability.

This will have an impact:

- Minimizing threat on climatic variances and reducing threats to life & livelihoods
- Building community institutions & strengthening their capability to make more resilient
- Linkage establishment with mainstream and Increased community demand for implementation of schemes to include and execute economically and climatically viable activities as in micro plan
- Better social monitoring of the execution of schemes to rejuvenate ecological capital
- Motivate and sensitize community and policy holder for environmental sustainability focusing livelihoods

of vulnerable communities at risk

- Implementation of programs based on the gap towards self-mitigation/adaption process

Expected outcomes:

- The project is with best of our effort, would empower community to:

Access to information: Informed communities will be better equipped to take advantage of opportunities, access services, exercise their rights and entitlements, and hold state and non-state actors accountable.

Inclusion/participation: Opportunities for vulnerable and other excluded groups to participate in decision making are critical to ensure the usage of resources equitably and community priorities

Local organizational capacity: The process equips communities and CBOs to plan and work together to identify, prioritize and resolve issues relating to community resilience process.

This overall approach is aimed at empowering the vulnerable communities to participate, negotiate, change, and hold accountable the institutions that affect their well-being and improved capabilities in the long run.

Proposed areas for community resilience process - Selected Gram panchayats in coastal & tribal districts prone to vulnerability in terms of poverty and disasters affected due to climate aberrations.

♣

BUILDING COMMUNITIES AROUND DISASTER MANAGEMENT – *DEMYSTIFYING DISASTER MANAGEMENT*

Pinaki Dasgupta
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Abstract

The subject of disaster management has been deliberated upon several forums with different dimensions dealing with various phases viz. pre-disaster, during disaster and post disaster. Legislations are in place for management of disasters at central and state level. Several institutions provide education on disaster management. At school level, central board and few state boards have given comprehensive coverage of disaster management. There are formal and informal groups which are active in connecting communities, people from academics, industries and social networks. However, there are several grey areas sometimes overlooked. First, majority of the population due to a strong perception of it being a specialized field, are unable to grasp the essence. Secondly, organisations face challenges in building communities around disaster management. Third, there are significant gaps between thought process of stakeholders, such as academics and industry or corporates, social organisations and academics and the more significant divide between social organisations and industries. In addition to the above, disaster management is seldom given its place in social media, mainstream media and often perceived as more of a casual practice rather than taking it inherently in planning and daily lives. Further, for most of the industries, hotels and schools, disaster management is confined to only a select section. There is a lack of holistic planning. This is probably due to the fact that disaster management has remained a niche among communities, organisations and public in general. The Government also must allocate resources (both technical and financial) as a well knitted programme or scheme for widespread research and development, field trials, design and planning along with education well synchronized with infrastructural and industrial development. There is an urgent need to simplify it so that the importance of disaster preparedness reaches on ground in a steady manner in every sphere of life. Hence, communities need to be prepared to first be sensitized, trained and then assisted to build capacities for coping mechanisms. The paper attempts to identify resources which can be utilized in building communities around disaster management.

Key words: *Disaster Management, Community, Capacity, Demystifying, Stakeholders, Communication*

♣

ALTERNATIVE TECHNOLOGIES AS A TOOLKIT FOR MANAGEMENT OF RAIN WATER FLOODING IN MACHILIPATNAM MUNICIPALITY

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Ar. P. Pavan Kumar (Ph.D.),
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Introduction

The focus of the paper is on the necessity of *water sensitive urban planning* in the design of urban geography to alleviate natural disasters with affective and efficient use of alternate technologies.This paper predicts and provides necessary evidence of a disaster waiting to happen, which can never be gauged or read by the local citizens or Governing ULB's. The disaster caused by **"Soil Liquefaction"** is little known, the research so far conducted by the author has shown that there is a very high probability of soil liquefaction in Machilipatnam town. Findings of the research so far, shows that there is a danger of soil liquefaction in future for Machilipatnam town, because of its unique topographic feature and a manmade canal called "Shivan Samudra", which surrounds the town as shown in, Figure 1.

There are three vital parameters that cause Soil Liquefaction:

- Water logging resulting in heavy saturation of soil with water
- Loose soil / Granular soil
- Disturbance in soil crust for any reason like earth quake, construction activities etc. (http://geology.com/usgs/liquefaction/)

On an average earth quake of magnitude 5 hits Machilipatnam town once in every 5 years. Studies were conducted during the times when the town was totally flooded due to storms and overflow of both manmade and natural canals, which lead to stagnation of water throughout the town. Water logging, loose soil and earth quake are instrumental combination for liquefaction. Partial liquefaction of soil and structural implication can be seen in Figure No 2.

This study aims to show the risk of 'Soil Liquefaction' which leads to horrifying and harrowing disasters, which can be averted by proper urban planning and efficient use of alternative technologies in management of surface runoff and design proper drainage system.

At present as there are no multilevel buildings in Machilipatam areas, therefore vulnerability to risk of soil liquefaction is not yet seen. It is predicted that the next decade will see rapid growth in infrastructure and multilevel buildings due to formation of separate Andhra Pradesh which focuses some of its development in this region. If rain water management is not taken up at this stage, disaster through floods and soil liquefaction is a high possibility. Conventional methods to manage rain water flooding in Machilipatnam did not work for last 10 decades, due to the geographical features of Machilipatnam town and intrinsic flaws is designs and implementation.

Definition of Soil Liquefaction:

Definition of soil liquefaction is given by Sladen et.al. 1985 "Liquefaction is a phenomenon wherein a mass of soil loses a large percentage of its shear resistance, when subjected to monotonic, cyclic or shock loading, and flows in a manner resembling a liquid until the shear stresses acting on the mass are as low as the reduced shear resistance" (Alan F .Rauc chapter 2: soil liquefaction)

Hazards of Soil Liquefaction:

Soil liquefaction inflicts great damage to property and lives, since the ground is too unstable to withstand pressure, anything resting above the mush - a building, a bridge, a house, a pier, a runway, a nuclear power plant, an earth dam - may lean, tip over, split open, or sink several feet. (Kaplan, Alisha, May 2004, "Soil Liquefaction," The Mid-America Earthquake Center, University of Illinois, Accessed July 20, 2010)

Figure 1: Machilipatnam Town Surrounded by natural/manmade canals (Geographical Terrain is Molded Using Google Earth Image and 3D Max Software by Author)

Figure 1 is graphical representation showing after 10 minutes of rain, storm water gets collected and starts to flows in to Shivanasamudrathrough main storm water drains resulting in raising the level of water in the drain during monsoons. Figure 1 clearly shows the spillage over from the storm water drain into the low-lying areas due to back flow from Shivanasamudra when the water level in the drain reaches equivalent level of discharge from the storm water drain from Machilipatnam town. Water logging happens for weeks together causing heavy saturation of water in the soil.

Figure 2: Stagnated Water for 7days around a Dwelling Unit in Madulagudem, Machilipatnam (Picture Taken By Author)

Figure 2 shows fungus formation on the stagnated water around the dwelling unit clearly indicates the water logging is there for more that 7 days in Mandulagudem. It is very clear that storm water drains are not effective in the town. The change in levels of stagnation can be clearly understood by studying damages caused to the plinth of the dwelling unit in its entire span of life which is 10 years.

Conclusion

Soil Liquefaction is a hazard which can weaken the soiling suddenly thereby causing unforeseen damage to property and life.

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RESILIENT INFRASTRUCTURE FOR THE CAPITAL CITY AMARAVATHI

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Abstract

Historical region of Amaravathi is going to be the Riverfront Capital City for the state of Andhra Pradesh. The newest Capital in India which is going to be situated between Existing cities of Vijayawada and Guntur is being planned in an extent of 217 square kilometers. The masterplan takes the leverage of resources from river Krishna and large amount of Capital region falls under the flood risk zone. There are innumerable hurdles in developing Amaravathi into a World Class City and to develop it as an extensive "Water – Networked City". As our Cities are heading towards becoming smart, there is need to study the innovations and strategies to apply and adapt them to boost resilience and improve livability in our Cities. There is a need for resilient infrastructure to deal with the problems caused by climate change and its subsequent effects like urban flooding, variable temperatures, and draught and reduced visibility. This paper attempts to study the literature on resilient infrastructure systems and develop strategies for a resilient transportation infrastructure for New Capital City of Andhra Pradesh State. The study embraces the need to have resilient transportation infrastructure and how their strategies can help in developing Amaravathi as a Smart City. This study is part of the ongoing research at IIT Roorkee entitled, "Smart Strategies for Transportation development for the Greenfield Capital City – Amaravathi"

Keywords: *Amaravathi, resilience, infrastructure, transportation, development, disasters*

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Introduction

Disaster and their effects continue to affect millions of people annually (Guha-Sapir, et al., 2012). These disasters often disrupt the functionality of our cities by rendering our infrastructure unusable. In the age of rapid urbanization – the more we develop, the grater is the impact of each disaster on our cities and its infrastructure (Madhusudhan & Ganapathy, 2011). This creates a pressing need to redevelop our infrastructure under time and budget constraints. Post disaster scenarios are extremely complex and requires diverse groups of Agencies and organizations to coordinate under stress. We can how ever be prepared, minimize the impact and reduce the recovery time – Resilient Infrastructure.

The predominant understanding of the infrastructure has been based on the restricted view of our infrastructure as a combination of discreet sectors which contain physical assets and facilities. Over the last decade, the infrastructure of our Cities has evolved into a system which consists of networks of assets knowledge and institutions. But still in practice, there are pre-disaster vulnerabilities, which are often failed to be addressed in the construction of Infrastructure. There is an increasing need for our cities to manage and adapt to the effects of climate change, urban flooding and other disasters. "There is a need that we move our focus from a reactive on focusing on effective disaster response to a proactive one, through which we can develop an understanding of what, when and where infrastructure needs to be put in place and how to address the urban infrastructure to prevent or minimize the effect of a natural event" (UN - Habitat, 2015).

The new City lies southern side of the river Krishna and falls under flood prone zone. The city is prone to heat waves, flash floods and high climate variability. The existing city of Vijayawada will be the best case to study for understanding the disaster risk profile of the Capital city Amaravathi, as they reside on either sides of the river and share common threats.

Resilient infrastructure can be considered highly inter-dependable and this is highlighted when they are in crisis or disaster. To overcome the complicated issues, we need a resilient infrastructure which can survive after a crisis. A Greenfield development such as the new Capital City – Amaravathi can be an ideal platform to study, design and implement infrastructure which can be proactive, minimize the impact and reduce the recovery time.

The study can be categorized as these main parts. The section deals with the literature on resilient infrastructure and identifies the core properties of resilient infrastructure. The second section deal with context of Amaravathi and profile its disaster nature with the case of its neighboring city Vijayawada. The third section studies the literature of resilient transport infrastructure in the context of Amaravathi and delivers an approach for the development of the same.

Scope of the paper

This study is part of the ongoing dissertation research entitles, "Smart Strategies for Transportation development for the Greenfield Capital City – Amaravathi" at the Indian Institute of Technology Roorkee, under the department – Centre for Excellence in Transportation systems. This study aims to identify principle features of resilient infrastructure as a first step; then the study mainly focuses on applying these principles to generate recommendations for resilient infrastructure for any one sector – Transportation.

The term "resilience" is a vast concept. For the purpose of the paper, it refers to the events of climate change and its subsequent effects such as urban flooding and variable temperatures. The study focusses on the road transportation Infrastructure to explain the resilience strategies and excludes air, rail and maritime transportation.

- **Resilience**

Resilience is a broad concept, there are as many definitions of resilience as there are people defining it, but in all definitions resilience is connected to the concepts of recovery after physical stress. Also, according to Petit et al. (2012), we can agree that the resilience is the ability to:

- Absorb acceptable shock of deformation in a time of crisis;
- Recover the functionality of the system after a disaster or a sudden shock; and
- Operate appropriately even if some parts of the system fail.

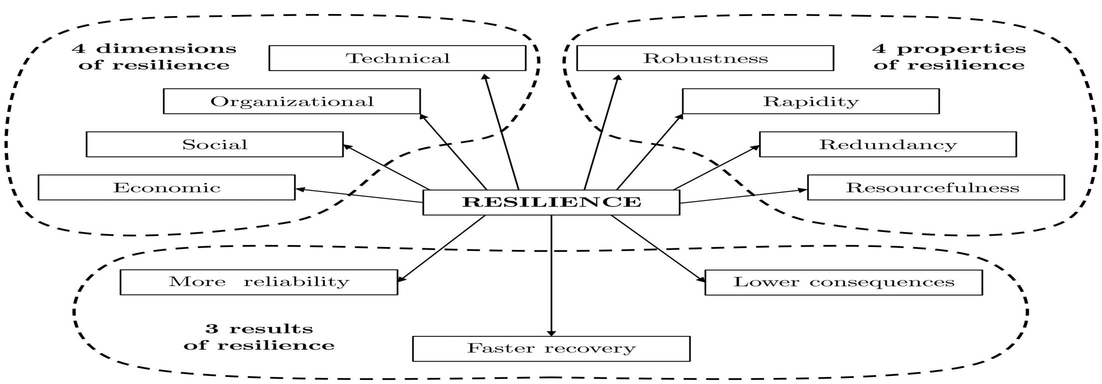


Figure 1. Aspects of resilience in the definition by Bruneau et al. (2003)

Some studies indicate that resilience is a practical attitude that looks at ways to strengthen the capacity of a system, to clearly regulate risks (Hollnagel, 2004). Resilience is often used to signify both flexibility and strength concepts. In other studies, resilience is also focus primarily on survival. The definition of resilience that is currently the most popular was proposed by Timmerman (1981): "In synthesis resilience is the ability of human communities to withstand external shocks or perturbations to their infrastructure and to recover from such perturbations" (Timmerman, 1981). Resilience is also understood as: "how fast the variables return towards their equilibrium following a perturbation" (Pimm, 1984). Resilience is a metric that quantifies the capability of a system to survive a disaster and to recover efficiently from the destruction made by such disaster. All these concepts of resilience are unified and a definition was proposed by the National Infrastructure Advisory Council (NIAC) as "the ability to reduce the magnitude and/or duration of the disruptive events" (NIAC, 2009). In case of civil infrastructure, "resilience is usually associated with the ability to deliver a certain service level even after occurrence of an extreme event, such as an earthquake, and to recover the desired functionality as fast possible" (Bocchini, et al., 2014).

In the past decade, several authors have defined resilience. Two general aspects can be observed from these definitions and all the concepts discussed above. First is the resistance to an unusual external shock and second is the ability to recover quickly. Later these aspects have evolved into much complex and comprehensive understanding of the term. Bruneau et al. (2003) provided a description that accounted for 11 aspects of resilience, see figure 1. He comprehensively explained resilience under 4 properties, 4 dimensions and 3 results which spanned across 11 aspects of resilience; technical, organizational, social, economic, more reliability, more recovery, lower consequences, resourcefulness, redundancy, rapidity and robustness.

- **Principles of Resilient Infrastructure**

Adverse natural and man-made disasters occurring over the last decade have highlighted the growing need for infrastructure systems that can cope with unexpected events and their impacts. The objectives behind developing resilient infrastructure can be multiple. The resilience of an infrastructure can be estimated over various timescales: primarily short-term and long-term resilience. Short-term resilience is the ability to cope with extreme weather events such as storms, floods or droughts; while the long-term resilience is the ability to cope with long-term changes in environmental conditions such as gradual climate change or soil deterioration at low costs.

According to Bruneau et al. (2003), in the case of urban communities and infrastructure, resilience has 4 dimensions namely; technical organizational, social and economic. A resilient infrastructure should also possess these properties; robustness, rapidity, redundancy and resourcefulness. According to various other studies by McDaniels et al. (2008), Jackson's (2010), Woods (2006), Mendonca &Wallace (2006) and Hollnagel et al. (2007), the principle features of resilient infrastructure are:

- **Robustness**is the ability to withstand a given level of stress without suffering degradation or loss of function
- **Redundancy** is the property that allows for alternative choices, decisions and substitutions when under pressure
- **Resourcefulness** is the ability to expertly get ready for, react to, and manage a disaster or disturbance as it occurs (NIAC, 2009)
- **Rapidity** indicates the capacity to meet priorities and achieve goals in a timely manner in order to contain losses and avoid future disruptions (Bruneau & et al., 2003)
- **Capacity** is the ability to withstand the "known" disturbances
- **Flexibility** is a situation in which the functionality of other parts will be saved in terms of changes in one part of a system

- **Tolerance** refers to the infrastructure which does not immediately lose all its abilities after a break, but will instead gradually degrade
- **Cohesiveness** is the inter element collaboration between the different sub-systems of infrastructure

- **Examples of Transportation Infrastructure failure**

Transportation is the lifeline of our Societies. Minor disturbances to transportation infrastructure can cause catastrophic impact on the ability of community, business and economy to recover from a disaster (Madhusudhan & Ganapathy, 2011). The need for resilient transport infrastructure have been a field of active study during the past decade.

When the Hurricane Katrina (costliest natural disaster in the history of United States) had a devastating impact on transportation network. “It was wake-up call for the world, making clear that climate change is real and that transportation infrastructure is not ready to cope with extreme weather conditions” (Garcia & Papi, 2015). Litman (2006), concluded after studying the Hurricanes Katrina and Rita in the US that evacuation plans worked well for motorist but failed to serve people who were dependent on public transport.

The roads tarnished when the Seoul, the capital city of Republic of Korea, received an enormous large amount of rain, 259.5 mm (Kwon, 2013). The largely flooded urban roads have restricted the emergency services and highlighted the smart city’s inability to cope with extreme conditions. The unintended situation was caused by inefficient rain water detention pockets and urban flood management techniques.

- **Case Study – Hurricane Sandy**

This section is an inference from an extensive report by Kaufman and et al. submitted to Rudin Centre of Transportation in 2012. Hurricane Sandy illustrated the strengths and weakness of New York’s transport infrastructure. The events before, during and after the Hurricane Sandy strengthened the importance of having numerous modes of transportation: subways, buses, bridges and tunnels, ferries as well as commuter rail systems in moving people in, through and out of the New York City and neighboring regions.

Figure 2. Capital Region development plan for Amaravathi as proposed by Surbana Consultants (2015)

The hurricane also highlighted the key investment areas to assure the viabilityof our transport Infrastructure:

- Increasing Multiple modes of transportation with priority on mass transit
- Using porous pavement for streets in flood prone areas
- Increase flexible modes of walking and cycling
- Alternates routes of commuting

While transportation slowdowns would have crippled other cities, New York was able to deliver alternative services, and those citizens who lived outside the severely damaged areas of the Rockaways, southern Brooklyn, and the south shore of Staten Island creatively adapted to conduct business, though under new constraints and conditions. The recent development in the city's bicycle infrastructure delivered an emergency choice for commuters in Brooklyn and Queens who were stuck at bus stops or struggled to find gas for their cars, resulting in 30,000 bike commuters on November 1. The Hurricane Sandy helped us understand the importance of alternate modes of transportation in events of crisis.

- **Amaravathi – The Greenfield Capital City**

Amaravathi is the Greenfield Capital City developed for the State of Andhra Pradesh after bifurcation. The capital region comprises of approximately 7,420 sq. km. of area spreading along both sides of river Krishna, while the capital City is developed on the banks of the river which spreads over 212 sq.km. (Surbana Consultants, 2015), see figure 2. The proposed capital is in close proximity to the existing city of Vijayawada on the southern side of the river Krishna, hence sharing common treats. The capital city is proposed to be developed as a World class city and is also participating in the 100 Smart Cities Mission by the Government of India. For the long run benefits of the City, there will be an immense pressure on development of its infrastructure.

- **Disaster Profile**

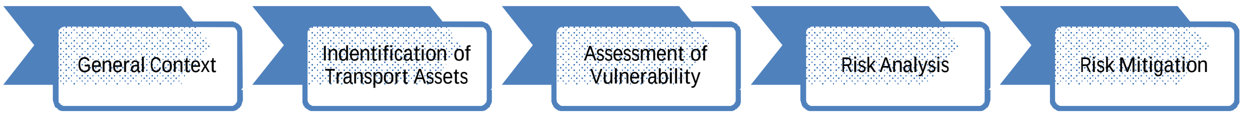
The state of Andhra Pradesh is exposed to cyclones, storm surges, floods and droughts majorly caused by climate changes, Capital City Amaravathi is no exception. The neighboring city Vijayawada is selected as one of the six cities in India for implementation of Climate risk Management Project on pilot basis under the framework of Urban Disaster Risk Reduction project of GOI – UNDP. The proposed Amaravathi city is very much dependent on geography with the river flowing through it, with tropical hot summers and humid, mild winters. It is a fact that the new city is prone to hydro-meteorological hazards flashfloods, storms and heat waves which derail the process of social – economic development. It is identified that the potential threats to the existing city of Vijayawada and probable threats to the new Capital City are caused by the increasing climate change and climate variability(UNDP, 2012). The city also falls under the earth quake hazard zone III.

- **Key Issues**

Table 1: Key issues to be addresses for resilient infrastructure for Amaravathi in comparison to existing city Vijayawada. Source: UNDP (2012), Surbana Consultants (2015), EPTRI (2011) and elaboration by author.

Proposed Amaravathi City	Existing City of Vijayawada
The city is proposed along the river bed of Krishna and prone to flash floods	The city has seen frequent flash floods to low lying areas along the river bed
The development along the highly fertile agricultural lands will result in decreased green	The city has undergone extreme hot summers increasing the deaths over heat waves

cover and increase impact of heat waves	and heat strokes
The city is proposed as a world class city projecting a population of 4.49 million by 2050. Future post disaster services should be considered in planning phase itself	Rapid urbanization and increased vehicle use has congested the city increasing variables for climate change and restricting post disaster services and evacuations



The infrastructure poses a double threats of urban flooding from overflowing river Krishna and monsoon rainfalls	City addresses clogged up roads and overflown drains for minor rainfalls and infrastructure cripples in monsoon seasons
The city lies under earthquake hazard zone III according to IS 1893: 2002 and experiences frequent minor tremors	The city and a surrounding radius of 150 km has a recorded history of 159 earthquakes till April, 2015
Heat waves are predicted to be more frequent in the coming years	Integrity of pavement is effected by extreme weather conditions

- **Strategies for Resilient Transport infrastructure for Amaravathi:** The upcoming city of Amaravathi is no exception to disaster failures, the city should present robust and flexible infrastructure to tackle the hydro-meteorological threats exhibited by the geography of the city. From the study it is evident that the dominant causes for the transport infrastructure failure for Amaravathi could be urban flooding and heat waves. The city should be able to cope with climate change and increase in frequency of natural events.

- **Approach for Amaravathi City's Resilient Transport Infrastructure:** The studied approach is an incremental process which set out to me implemented periodically as part of the Capital Region Development and core city development decision making process. The approach is a useful planning tool for both large scale and small scale transportation infrastructure projects, complementing a larger scale disaster and climate change adaptation scheme (Garcia & Papi, 2015).

- **General Context:** The first step in developing strategies for resilient transportation infrastructure is to identify context and physical scale of the transportation network. This step involves understanding the scale of the infrastructure and also the climate effects of the Amaravathi region. Identifying the Disaster profile of the region is one of the key aspects to deliver strategies in the context of the region.

- **Identification of Transport assets:** The second phase should be the identification of all the assets of proposed transportation infrastructure that could be endangered by the impacts of disaster profile discussed above. Some factors while characterizing endangered infrastructure include; location, traffic volume, reconstruction costs, type of structure, etc. (Garcia & Papi, 2015).

- **Assessment of Vulnerability:** This step is a product of interrelations between the above two steps and should be assessed in an iterative procedure. This process assess the identified critical assets in the process of their vulnerabilities through planning, construction, operation and maintenances phases of an infrastructure.

- **Risk Analysis:** Previous stage has determined the damage, depending on the potential disaster impact, for each type of infrastructure. The next step in the approach should entail a probabilistic model of risk triggered by type of disaster impact identified.

- **Risk Mitigation:** New policies are key tools in order to build resilient transport infrastructure. Having identified the general context, transport assets, vulnerabilities and risks, the last stage is to mitigate those disaster related risks through frameworks and policies.

- **Tackling urban floods:** Urban flooding is one of the major implications of climate change – unpredictable monsoons and overflow of water from river banks. As identified earlier, Amaravathi is prone to flash floods from river Krishna and urban floods from unpredictable monsoons. A prominent approach to tackle urban floods is to reduce the burden placed on flood control authorities by expanding permeable layers and a variety of spaces for the rainwater detention within a system of Integrated Flood Management system (IFM) (Sim, 2010).

According to Sim (2010), the most rational approach to and desired approach is to find public urban facilities and spaces of multi-purpose usage to detain water in highly urbanized areas. This is easier to incorporate in the city of Amaravathi, as it will be designed as water centric city. Public spaces along with water bodies can be developed at major grid locations of the city to detain water and also use permeable open spaces and street pavements to detain rainwater.

- **Tackling Heat Waves:** The existing city of Vijayawada and the new City Amaravathi are prone to heat waves. Heat waves have disrupted the transportation of Vijayawada by vehicle overheating, electrical system malfunction, and loss of pavement integrity and resulted in inefficient network. Tackling heatwaves is a long-term process and should adapt to future changes. One way is to plan urban transport with regard to comfort of non-motorized modes and public areas through planting, shading, and free air flow. Other approach is to reduce the urban heat islands effect by promoting efficient fuels and low carbon mobility."Shading of buildings, asphalt and other dark surfaces with trees can reduce the urban heat island effect. Tree planting requires adequate space, water, and maintenance, and the correct selection of trees" (CDPH, 2013). Both the approaches require a dominant shit from private transport modes to public and NMT.

- **Planning and Design Recommendations:** The upcoming city of Amaravathi should value diversity, flexibility and redundancy in its plan. A grid network accompanied with transit oriented development would develop a multi modal transport infrastructure. Which is sufficient to provide alternate route and modes to commute. Instead of depending on prescribed arterial roads, a grid network would disperse the traffic with providing multiple links to each destination.

We noticed that investing in diverse transportation modes would help in pre and post disaster management. This would develop into a contingency based planning approach which provides wide range of potential solutions. The implementation of these strategies can be justified by the order of most cost effective strategies justified at each point of time and additional strategies to deploy at need.

Design transportation facilities to withstand extreme conditions such as heat waves and urban flooding. Incorporate security planning (emergency lanes and routes) as part of transportation planning. Include Emergency Response as part of all transportation planning (local, regional, national, transit, etc.). Consider all the possible disasters and stresses on the transportation system, and consider the comprehensive possible range of possible solutions.

Boost Transportation Options, particularly for transportation choices and services that help provide basic access. Support development of diverse and competing transportation services, such as Ridesharing, Telework, Delivery Services, etc. Insure that transport planning take into account people with special needs (physical disabilities, low incomes, inability to speak the local language, etc.). Develop plans to provide basic access to persons with disabilities, and under unusual conditions. Develop operative ways to maintain information and communication systems among transportation system managers, staff and users under normal and extreme conditions. Develop ways to warn travelers of problems and let travelers know their transportation options. Maintain periodic transportation systems evaluation to provide early detection of possible problems and inefficiencies. Develop Comprehensive Planning that identifies the full impacts and vulnerabilities of a transport system.

Conclusion and Discussion

This study has preliminarily focused on the literature available on resilient infrastructure and pproaches to develop resilient transportation infrastructure. From the study it become evident that Amaravathi is prone to disasters caused by climate change such as flash floods, heat waves and storms. In order to achieve a resilient infrastructure a system must possess the discussed eight properties of resilient infrastructure. The resilient properties must reflect in the process of planning, design, construction, operation and maintenance of transport infrastructure of Amaravathi. The approach should be periodically updated to mend to the changing climatic events.

The approach for resilient transportation infrastructure is a periodic function rather than a onetime event. The approach is primarily designed for transport infrastructure, but can be adopted to other physical infrastructure assets with slight modifications. It is evident that increase in automobile are congesting the roads during emergency evacuations and it emphasizes the need for equitable transportation modes for the City of Amaravathi. It is also evident that city less dependent on motorized transport has performed well in pre and post disaster evacuations.

Understanding the disasters, climate changes and creating proactive infrastructure systems can address the potential impacts and avoid the damage, disruption in service and safety concerns for the upcoming Amaravathi City.A resilient Infrastructure approach can facilitate Amaravathi in growing as a sustainable development.

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EFFECTIVENESS OF BASE ISOLATION TECHNIQUE AND INFLUENCE OF ISOLATOR SYSTEM PARAMETERS ON RESPONSE OF A BASE ISOLATED BUILDING

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Abstract

Base isolation is a worldwide used technique for protecting structures, its nonstructural components and contents from the damaging effects of earthquake ground motion. This investigation concerns with the response comparison of a fixed base building with a base isolated building and parametric study of a base isolated building. The structural system considered for analysis is a three storey reinforced concrete building, which is idealized as a shear type building with one lateral degree of freedom at each floor level. The isolation systems considered for this study are Laminated Rubber bearing (LRB), Lead Rubber Bearing (N-Z bearing) and Friction Pendulum System (FPS). The response of fixed base building and of base isolated building is compared in terms of maximum top floor acceleration, inter-storey drift, maximum floor displacements and base shear. For parametric study important isolation system parameters considered are: (i) isolation time period, isolator damping for LRB; (ii) isolator yield strength, isolation time period, isolator damping for N-Z bearing and (iii) isolation time period, friction coefficient for FPS. It is found that base isolation technique is very effective in reducing seismic response of structure and isolation system parameters significantly influence the earthquake response of a base isolated structure.

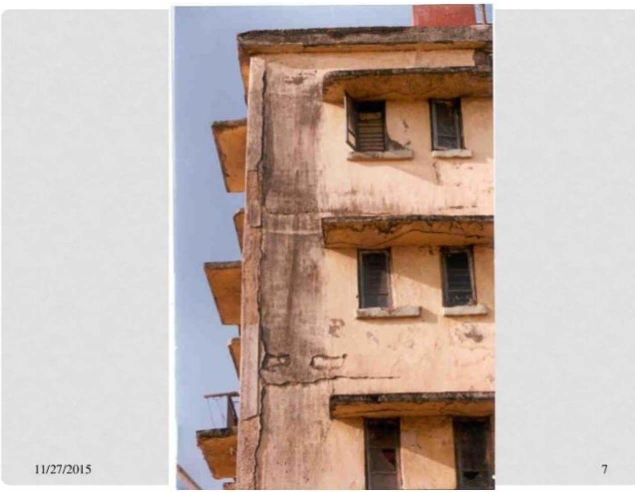
REPAIRS, REHABILITATION AND RETROFITTING

ANIL K SHARMA
FORMER SPL. DIRECTOR GENERAL, CPWD

PRESENTATION COVERS

- CORROSION DAMAGE
- SEISMIC DAMAGE
- CONDITION SURVEY & DOCUMENTATION
- REPAIR MATERIALS
- REPAIR & RETROFITTING METHODS
- SEISMIC DAMAGE RESTORATION
- SEISMIC RETROFITTING

CORROSION DAMAGE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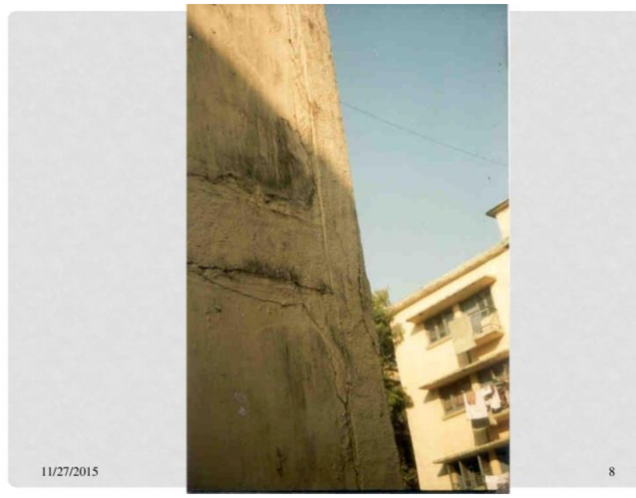
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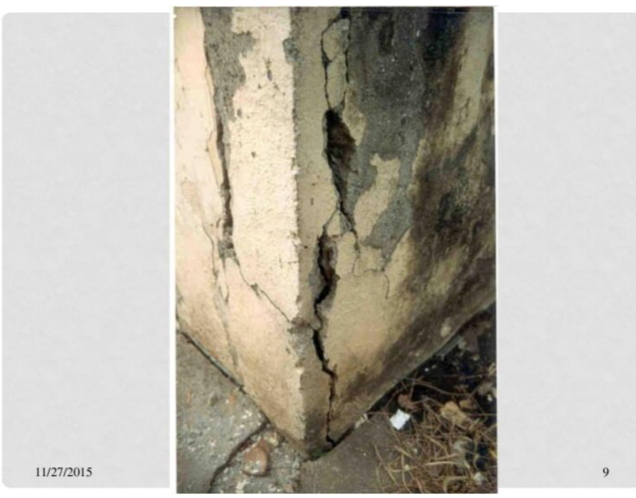
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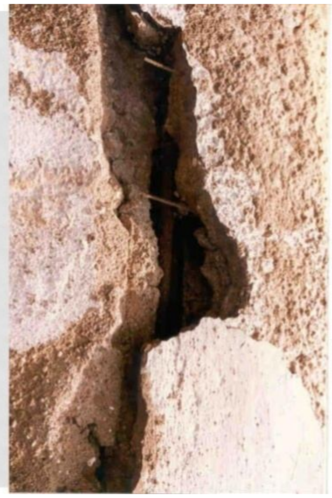

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11/27/2015 16

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232
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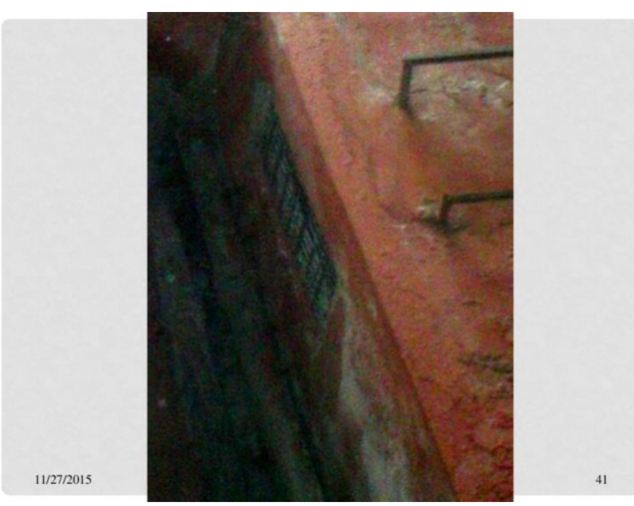
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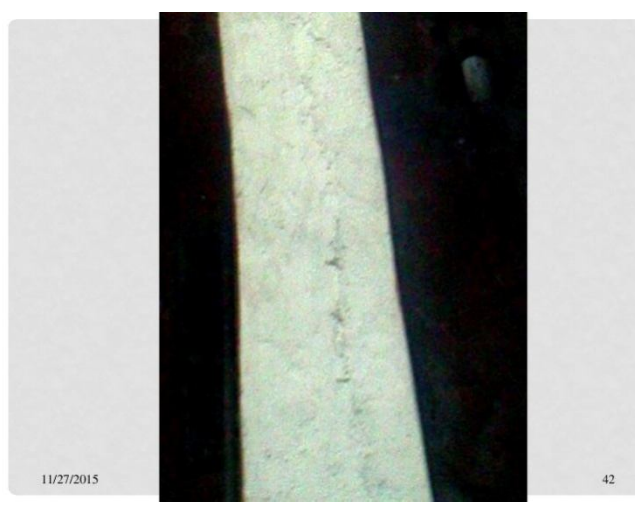
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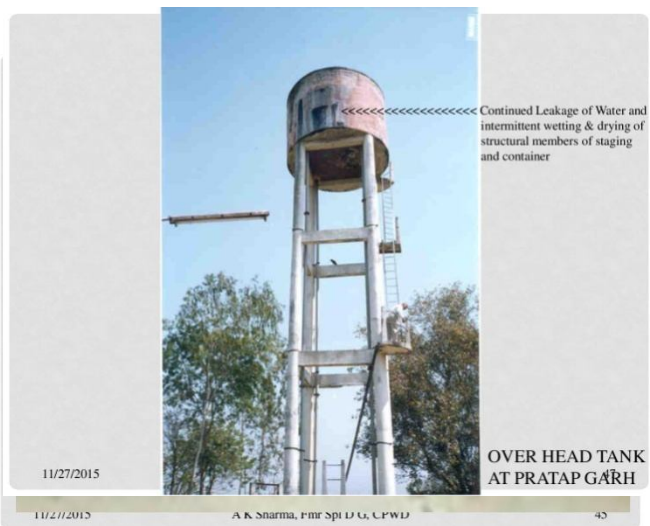
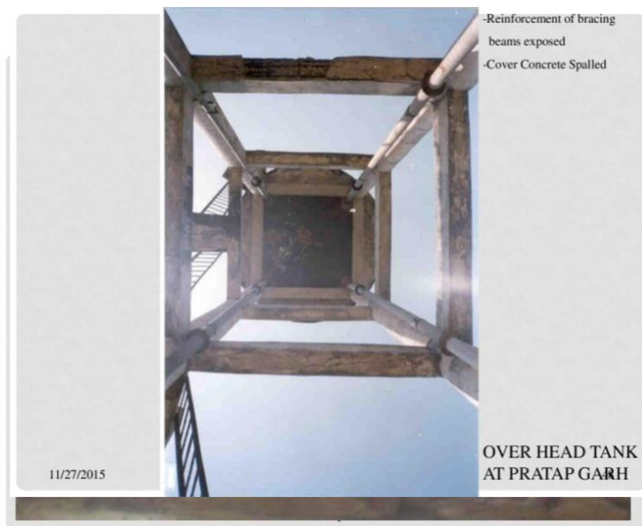
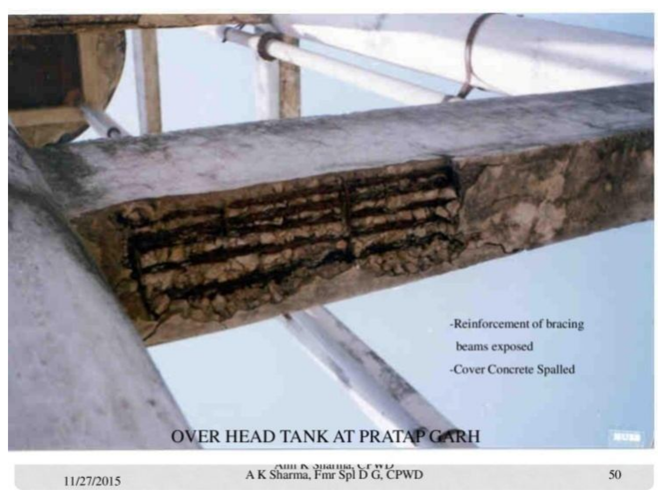
43


Continued Leakage of Water and intermittent wetting & drying of structural members of staging and container
OVER HEAD TANK AT PRATAP GARH
11/27/2015


-Reinforcement of bracing beams exposed
-Cover Concrete Spalled
OVER HEAD TANK AT PRATAP GARH
11/27/2015


-Reinforcement of bracing beams exposed
-Cover Concrete Spalled
OVER HEAD TANK AT PRATAP GARH
11/27/2015


-Reinforcement of bracing beams exposed
-Cover Concrete Spalled
OVER HEAD TANK AT PRATAP GARH
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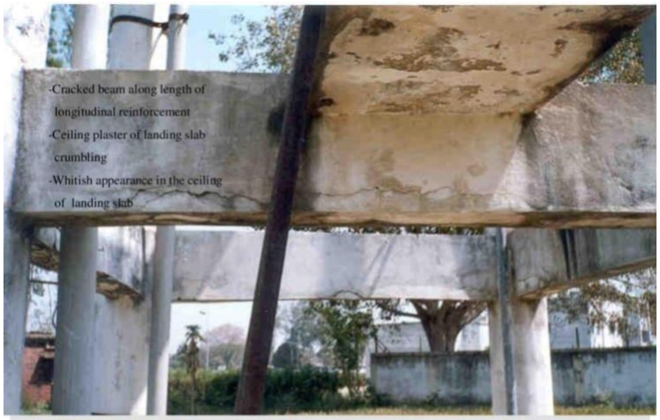
50



OVER HEAD TANK AT PRATAP GARH

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OVER HEAD TANK AT PRATAP GARH

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<<<<<<<<<<<<<<<<<<<<<<<<<< Micro Cracks in Columns at Beam-Column Junction allowing water and air to enter RCC freely and carbonate RCC to initiate corrosion of reinforcement.

Corrosion causes reinforcement to swell, widen crack and accelerate corrosion process.

OVER HEAD TANK AT PRATAP GARH

11/27/2015 53

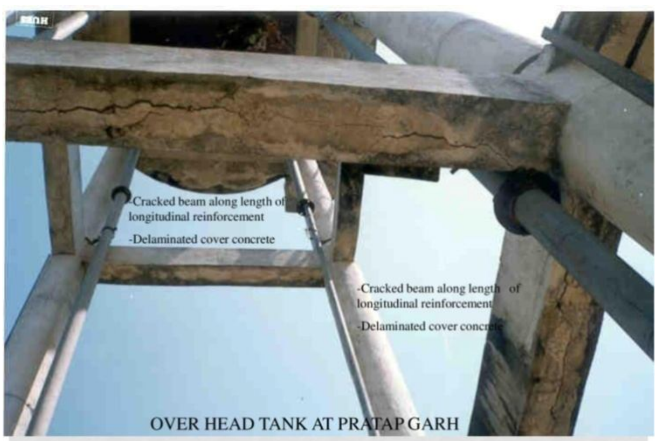
<<<<<<<<< Macro Cracks/ honey combed concrete in Columns allowing water and air to enter RCC freely and carbonate RCC to initiate corrosion of reinforcement.

Corrosion causes reinforcement to swell, widen crack, thus allows free access of air and water and accelerate corrosion process.

< Cracked beam along length of longitudinal reinforcement

OVER HEAD TANK AT PRATAP GARH

11/27/2015 54



OVER HEAD TANK AT PRATAP GARH

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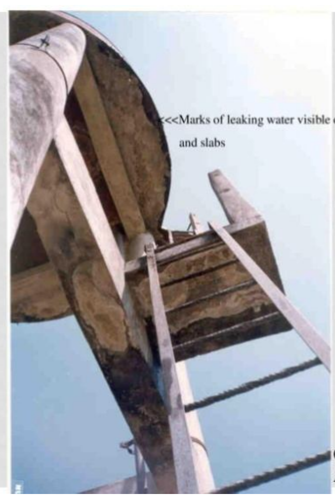

<<Marks of leaking water visible on soffit of beams and slabs

OVER HEAD TANK AT PRATAP GARH

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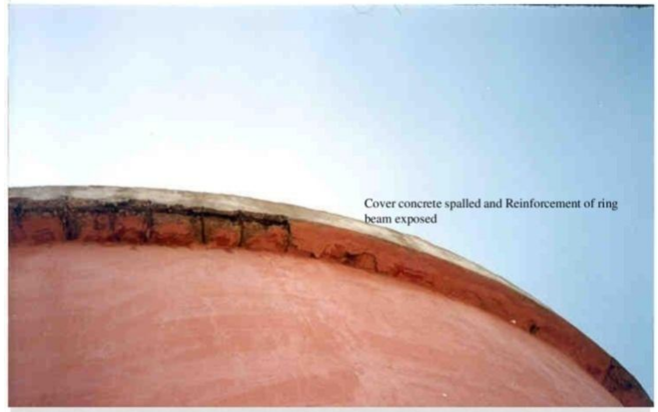
Cracks in exposed RCC surface and RCC columns

OVER HEAD TANK AT GOVT OF INDIA PRESS, FARIDABAD

11/27/2015 57



Cover concrete spalled and Reinforcement of ring beam exposed

PRESS COLONY AT FARIDABAD

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Reinforcement of waist slab exposed

Cover Concrete Spalled

Marks of leaking water visible on soffit of slab

PRESS COLONY AT FARIDABAD

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-Cracks in exposed RCC surface and RCC columns

-More damage near ground level due to capillary rise of water through pores of concrete with high capillary porosity

OVER HEAD TANK AT GOVT OF INDIA PRESS, FARIDABAD

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SEISMIC DAMAGE

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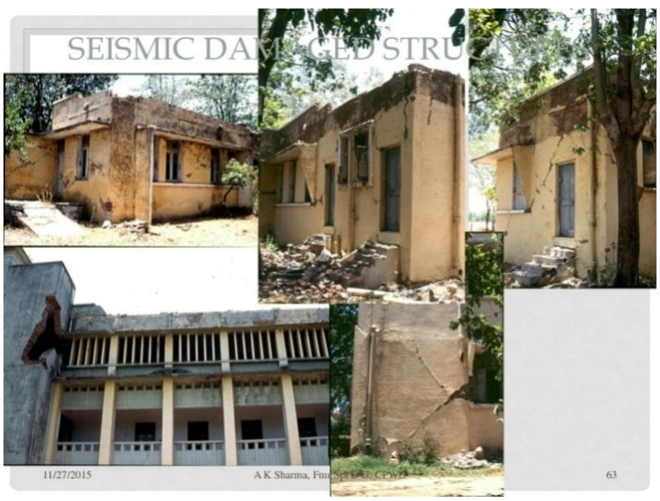
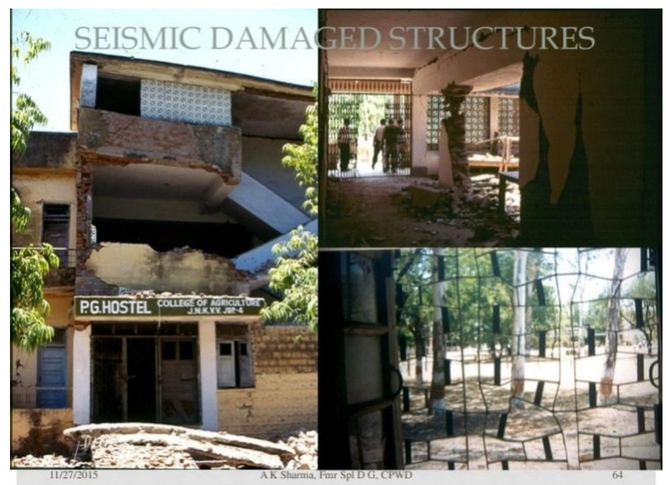
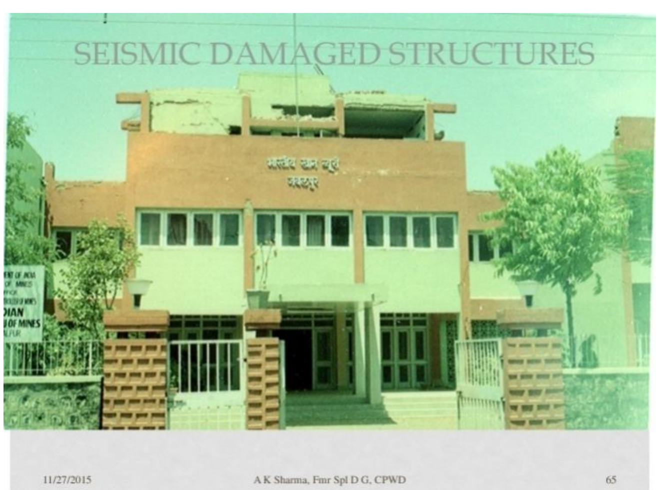
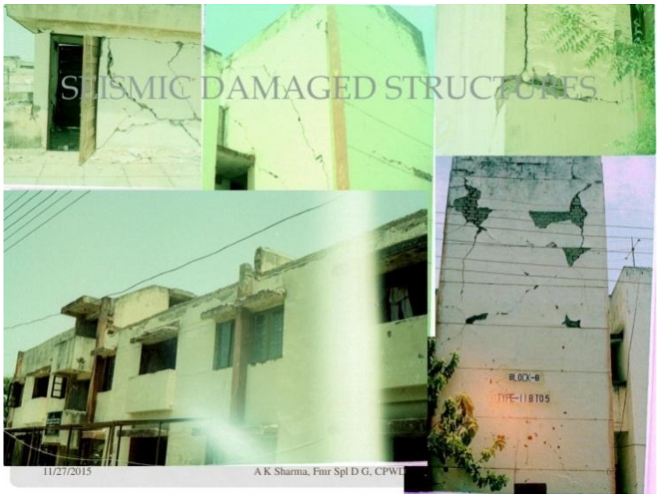






SEISMIC DAMAGED STRUCTURES



SEISMIC DAMAGED STRUCTURES

SEISMIC DAMAGED STRUCTURES

SEISMIC DAMAGED STRUCTURES

TYPE OF DAMAGE

- Damages could include both Structural and Non-Structural
- Non structural damage could include:
  - Plaster,
  - Panel/filler walls, parapets
  - Doors, windows, window glass panes etc
  - Dislocation of civil services like water supply, gas, drainage pipes and electrical conduits/wiring
  - Disturbed Roofing Tiles
  - Flooring at ground level, etc
- Structural damage could cover
  - Foundation system
  - Load bearing walls
  - RCC beams/columns
  - Roofing
  - Lintels over door/windows, etc

SEQUENCE OF OPERATIONS

- Removal of Hazardous Components
- Propping & Supporting, wherever required
- Condition Survey to Determine Rehabilitability
- Evaluate Damage to each Structural Component
- Restoration and strengthening
  - Appropriate Structural Repair Method
  - Non structural repairs covering civil & electrical items
- Finish the Repaired Structure

CONDITION SURVEY FOR DOCUMENTATION OF DAMAGE

STRUCTURAL DAMAGE ASSESSMENT

- Important to conduct 'Condition Survey'
  - Determining rehabilitability i/c part demolition
  - Whether building to be got vacated for repairs?
  - Detailed damage assessment and determining residual strength.
  - Details of temporary support arrangement to avoid further distress under normal loads

REPAIRS/ REHABILITATION/ RETROFITTING

- In New Building, the extra Cost of Seismic Resistant features is nominal (i.e. 2% to 5% of structure's cost)
- In Existing Building, the seismic retrofitting is costlier (i.e. 5 to 15% of structure's cost)
- Structural Repairs of Corrosion distressed structures are also costlier
- Replacement of structure is still more costly
- A Balanced View is required to be taken before deciding upon the various options

REPAIR/ RETROFITTING VIS-VIS RECONSTRUCTION

- As a thumb rule, repair/ strengthening is resorted, if its overall cost is less than half the cost of reconstruction
- Replacement/reconstruction is, generally avoided due to
  - Preservation of Historical Architecture
  - Maintaining functional social and cultural environment

REPAIR MATERIALS

SATISFACTORY REPAIR

1. Careful Diagnosis		1. Strength
2. Sound Materials	→	2. Durability
3. Thorough Preparation		3. Appearance
4. Proper Application		4. Economy

DESIRABLE PROPERTIES OF REPAIR MATERIALS

- As stated in scriptures:
- " A good rafoogar shall repair a torn garment with sound material of similar performance to that of the original"
- It means that a patch repair made with unshrunk fabric would soon pull away and cause a greater damage.

DESIRABLE PROPERTIES OF REPAIR MATERIALS

- Similar anology is applicable in selection of materials for repair of concrete
- Repair Material:
  - Pre-shrunk concrete/ Mortar
  - Non-shrink concrete/ Mortar
  - A material similar in properties as that of hardened concrete
- Repair materials selection
  - Local availability of materials
  - As per selected repair techniques to achieve best results

DESIRABLE PROPERTIES OF REPAIR MATERIALS

1. Non-shrink
2. Early setting/ hardening
3. Workability
4. Good Bond
5. Durable
6. Comparable Properties
7. Minimal or no curing
8. U V Resistant
9. Not to adversely affect alkalinity
10. Low air & water permeability
11. Aesthetically matching
12. Reasonable cost
13. Durable/ Non Bio-degradable
14. Non Hazardous/ Non-polluting

CLASSIFICATION OF REPAIR MATERIALS

- Based on its Application
  - Surface Preparation
  - Rust Removers / Converters
  - Passivators for Reinforcement Protection
  - Bonding Agents
  - Structural Repair Materials
  - Injection Grouts
  - Joint Sealants
  - Protective Surface Coatings

CLASSIFICATION OF REPAIR MATERIALS

- Based on its Contents
  - Cement Mortars and concretes [modified with admixtures/additives(non-polymeric)]
  - Polymers/latex modified Cement Mortars, Concretes and slurry
  - Epoxy Resins
  - Polyester Resins
  - Chemicals for Corrosion Inhibition, Rust Removing

CEMENT CONCRETE/MORTAR AS REPAIR MATERIAL

- Cement Concretes/Mortars are the natural Repair Materials for RCC structures **but not favoured** due to inherent undesirable properties like:
  - Drying shrinkage
  - Slow Setting
  - Low Workability
  - Prolonged Curing requirements
  - Permeability

CEMENT CONCRETE/MORTAR
AS REPAIR MATERIAL

- Concrete/Mortar have to be tailored to suit the specific repair requirement
- Properties needed to be modified using:
  - Admixtures
  - Special type of Cements

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CEMENT CONCRETE/MORTAR
AS REPAIR MATERIAL

- Role of Admixtures
  - Dosage
  - Plasticisers/Superplasticisers
    - *Plasticiser* - Water reducing 5% - 15%

      (Modified Lignosulphates (Retarding); Acids, Amides, Poly-sachcharides, other high molecular weight polymers; Hydroxy-Carboxylic Acid Derivative; Hydroxylated Polymers)
    - *Super-plasticiser*- Water reducing 15% -30%

      (Sulphonated Melamine-Formaldehyde Condensate; Sulphonated Nepthalene Formaldehyde Condensate)
  - Accelerators
    - Accelerates the setting time and causes early gain of strength
  - Retarders
    - Reduces the setting time and results in delayed workability
  - Water Proofing Compounds
    - Improves the impermeability

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CEMENT CONCRETE/MORTAR
AS REPAIR MATERIAL

- Role of Admixtures (….Contd)

  Expansion Producing

  Gas Forming

  Miscellenous
  - To arrest Alkali Aggregate Reaction
  - Improving physical properties of hardened concrete
  - Pigmenting requirements
  - Anti-Fungicidal properties

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CEMENT CONCRETE/MORTAR
AS REPAIR MATERIAL

- Role of Cement
  - Ordinary Portland Cement
    - 33, 43, 53 Grade Cements
  - Rapid Hardening Cements
  - Portland Slag Cements
  - Portland Pozzolana Cements
  - Shrinkage Compensating Cements
    - By incorporating Calcium Sulphoaluminate, Calcium Aluminate and Calcium Silicate or other phases

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CEMENT CONCRETE/MORTAR
AS REPAIR MATERIAL

- Role of Mineral Additives
  - Fly Ash
  - Silica Fumes
  - Rice Husk Ash
  - Ground Granulated Blast Furnace Slag
  - Metakaoline
- Role of Water Cement Ratio
  - Controls shrinkage, permeability, strength, etc

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POLYMERS IN CONCRETE REPAIR

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POLYMER MODIFIED MORTARS/ CONCRETES/ SLURRY AS REPAIR MATERIAL

- Materials are same as in normal cement concrete and cement mortar except with an additional ingradient being the polymer.
- Polymers are long molecules built of small units called monomers which are normally organic compounds.
- Conversion of monomers in to polymers is called Polymerisation.

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POLYMER MODIFIED MORTARS/ CONCRETES/ SLURRY AS REPAIR MATERIAL

- In Civil Engineering, polymers obtained from monomer at ambient temperature are important from practical point of view.
- The most popular polymers are Urethane, Acrylics, Styrene Butadiene Rubber, Vinyls and epoxies

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POLYMER MODIFIED MORTARS/ CONCRETES/ SLURRY AS REPAIR MATERIAL

1. Workability
2. Water Retention
3. Bleeding and Segregation
4. Strength
5. Stress-Strain relationship
6. Shrinkage
7. Durability and Non-degradability
8. Water Proof Quality
9. Adhesion or Bond Strength
10. Impact Resistance
11. Abrasion Resistance
12. Chemical Resistance
13. Temperature Effect

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POLYMER MODIFIED MORTARS/ CONCRETES/ Slurry As Repair Material

- Mix Proportions for Repair Mortars/ Concretes:
  - Cement Mortar's are generally used in the range from 1:2 to 1:3 cement:sand proportion.
  - Solid contents of polymer are added in proportion of 5 to 20% by weight of cement for mortars and 5 to 15 % by weight of cement for concretes
  - Water Cement ratios in range of 0.3 to 0.6 for mortars and 0.3 to 0.5 for concretes

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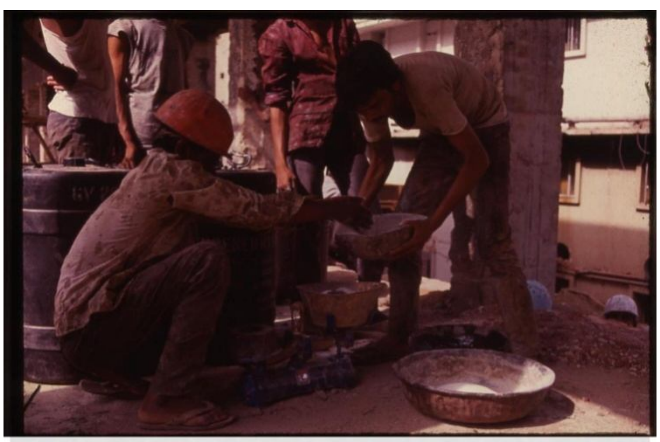

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POLYMER MODIFIED MORTARS/ CONCRETES/ SLURRY AS REPAIR MATERIAL

- **General Guidelines for use**
  - Speed and time of mixing should be such as to avoid unnecessary entrapment of air
  - Shorter working time than normal
  - Metallic equipments to be washed immediately
  - Before resurfacing, flooring and patching all loose/non durable material to be removed by sand blasting, wire brushing and blowing air
  - Surface so cleaned to be thoroughly wetted
  - Before application, surface to be saturated dry
  - Surface to be finished by trowelling 2-3 times only. Over trowelling not advisable
  - Working range of temperature 5 Deg C to 30 Deg C
  - Provide 15 mm joints at 3-4 metre intervals
  - Only moist curing for 1-3 days followed by air curing. Steam curing not recommended
  - Non-Toxic and safe for handling

POLYMER MODIFIED MORTARS/ CONCRETES/ SLURRY AS REPAIR MATERIAL

- **Fields of Application:**
  - **To make up the lost cover concrete or damaged concrete.**
  - **Ultra rapid hardening Polymer Modified Shotcrete System**
  - **Polymer Ferrocements**
  - **Anti-washout Underwater Concrete**
  - **Protective Anticorrosive and Waterproof Coatings**
  - **Bonding coatings over concrete and reinforcements.**

EPOXY, EPOXY MORTARS/ CONCRETE AS REPAIR MATERIAL

- **Epoxies are variant of Polymers, where polymerisation takes place when two materials called epoxy resin and hardener come in contact by thoroughly mixing in specified proportion.**
- **Epoxies exhibit excellent mechanical properties and resistant to chemicals**
- **Epoxy Resin:**
  - Basic epoxy resin used in civil construction is **D**i**G**lycidyl **E**ther of **B**isphenol-**A** (DGEBA) is condensation product of bisphenol-A and epichlorohydrin.
- **Epoxy Hardener** (Curing Agents)**:**
  - Aliphatic & aromatic amines and polyamides and their adducts form room temperature curing compositions

EPOXY, EPOXY MORTARS/ CONCRETE As Repair Material

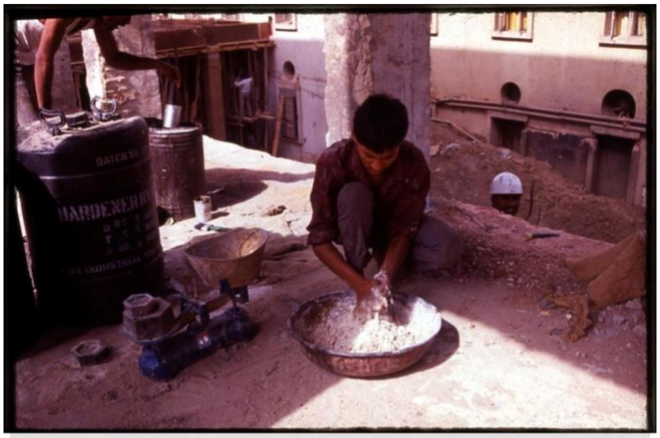
- **Modified Epoxy Systems**
  - Diluents
  - Coal Tar Epoxy Systems
  - Rubber Modified Epoxy Systems
  - Epoxy Phenolic Interpenetrating Polymer Network Systems
  - Epoxy Mortars and Concretes
  - Composite Fibre Systems

EPOXY, EPOXY MORTARS/ CONCRETE As Repair Material

- **Precautions to be taken**
  - Should not come in contact with skin
  - Equipments/utensils used for mixing to be immediately cleaned after use
  - Should not be used for application areas liable to get temperatures higher than 60-80 Deg Centigrade
  - Are not durable in UV Exposure conditions

EPOXY, EPOXY MORTARS/ CONCRETE As Repair Material

- **Fields of Application**
  - Anticorrosive coatings
  - Water proofing coatings
  - Protective Coatings
  - Bond Coats
  - Structural Repairs



REPAIR & RETROFITTING METHODS

PERFORMANCE REQUIREMENTS

- Durability
- Protection of steel reinforcement
- Bond with parent surface
- Dimensional stability
- Initial resistance to environmentally induced damage
- Ease of application
- Appearance

PRIORITISATION

- **A high priority should be assigned to ensure**
  - **Safety,**
  - **Durability &**
  - **Serviceability of the structure**

while carrying out repairs to structural defects and seismic retrofitting

REPAIR/ RETROFITTING METHODS

1. Injecting grout
2. Poured concrete
3. Dry packing
4. Plate Bonding
5. Resin injection
6. Concrete sealing compounds
7. Surface impregnation
8. Silica fume concrete
9. Ferro-cement
10. Dry Pack/Epoxy Bonded Dry Pack
11. Fibre Wrap Technique
12. Protective Seal Coats
13. Thin Polymer Overlays
14. Chemical & Electrochemical Methods
    - Cathodic Protection
    - Chloride Removal
    - Re-Alkalisation

REPAIR/ RETROFITTING METHODS

15. RCC Jacketing
16. Pre-placed aggregate concrete (PAC)
17. Shotcrete
    1. *dry mix*
    2. wet-mix
18. Concrete replacement
19. Epoxy bonded
    1. Epoxy mortar
    2. Epoxy bonded concrete
20. Polymer concrete system

PROPPING AND SUPPORTING

- To provide relief in stress and strains of Structural members which are deteriorated, overstressed required to be repaired or strengthened by transfer of dead and live loads safely through an alternate system to the foundation medium

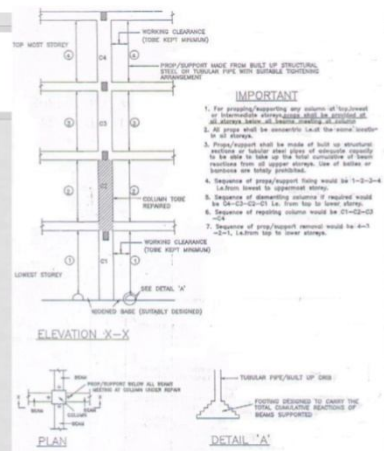


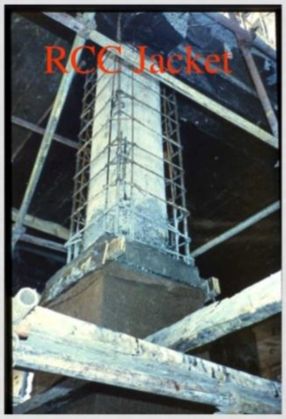
FIG.1 TYPICAL ARRANGEMENT FOR PROPPING & SUPPORTING A COLUMN TO RELIEVE IT FROM LOAD

SURFACE PREPARATION FOR CORROSION DAMAGE

- Purpose to remove weak, loose or carbonated concrete from the structure using mechanical and chemical means
    - Unsound Weak concrete to be removed by Chiselling to the required depth
    - The depth of chiselling to be governed by carbonation depth or the cover thickness plus the dia of rebar
    - Remove concrete all around the rebar creating a minimum air gap equal to 1.5 times diameter of rebar or nominal aggregate size plus 6 mm
    - Sandblast the surface with coarse sand and oil free air blast
    - Use alkaline rust remover to remove rust not removed by mechanical means

REPAIR SEQUENCE FOR CORROSION DAMAGED & SPALLED COVER CONCRETE

1. Surface Preparation
    - Loose and carbonated concrete removal all-around reinforcement
2. Fix Shear Connectors, if required
3. Apply bonding layer over Substrate concrete
4. Apply Passivating Coat over Steel Reinforcement
5. Apply repair – Cement based repairs or
    – Resin based repairs, or
    – Sprayed concrete (shotcrete)



RCC Jacketing

- Purpose
  - To provide a thin walled RCC element structurally bonded to the substrate of an existing stress-relieved structural member either to increase its structural size & strength or to restore the reduced structural size due to chipping

CONCRETING OF LAST LIFT IN EXISTING COLUMN

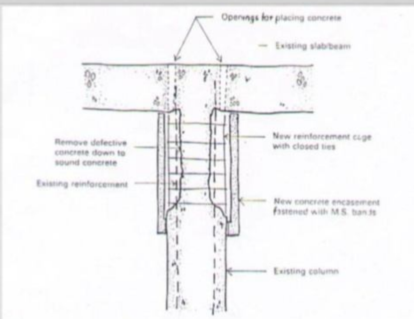


Figure 7.13 Use of cc ~~rete collars for strengthening compression concrete member

SHOTCRETING

- Purpose- Application of repair concrete of specified mix proportions by spraying it under pressure in layers over of prepared surface
  - Dry Mix Process
  - Wet Mix Process

SHOTCRETE PROCESS

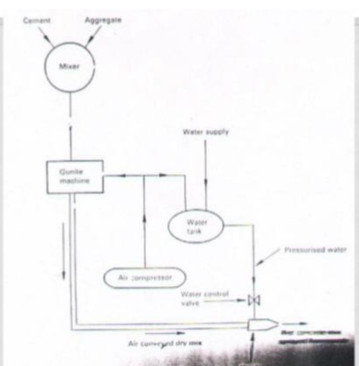
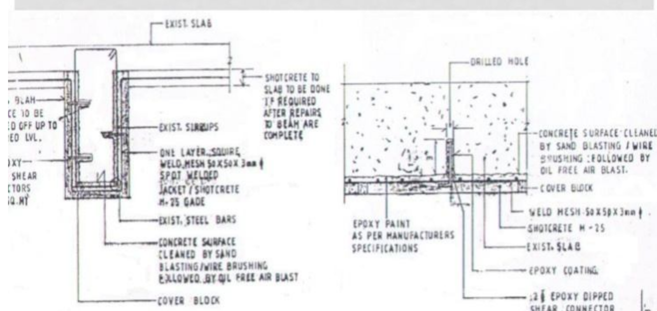


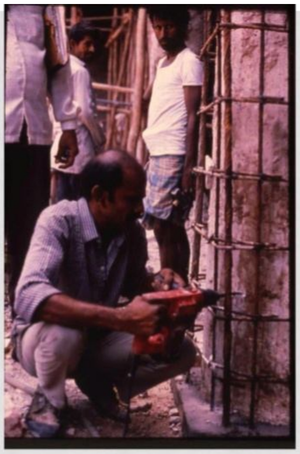
Figure 7.4 Diagrammatic representation of the gunite process.

SHOTCRETE JACKETING



JACKETING / SHOTCRETING DETAILS FOR BEAMS

SHOTCRETING DETAILS FOR SLABS



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SHOTCRETE-SHUTTERIG

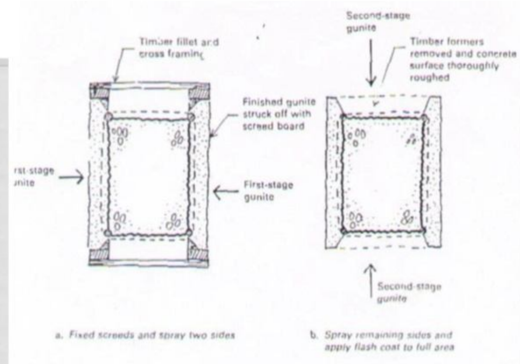

Figure 7.5 Typical two-stage column repair by guniting

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CONCRETE OVERLAY

- Purpose
  - To provide specified additional thickness of RCC over an existing stress-relieved RCC slab/bee, bonded structurally to the substrate either to increase the structural thickness and/or additional reinforcement to enhance the load carrying capacity or to restore the reduced thickness of RCC slab due to removed weak and/or carbonated concrete

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CONCRETE REPLACEMENT

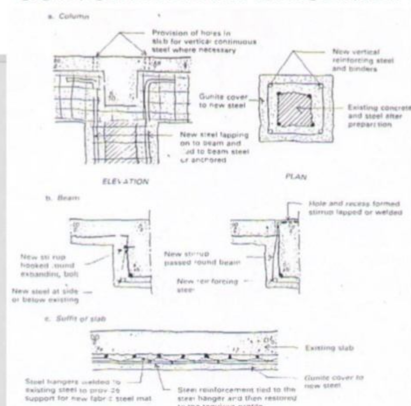

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Figure 7.16 Reinstatement of fire-damaged concrete members

LETTER BOX FORMWORK

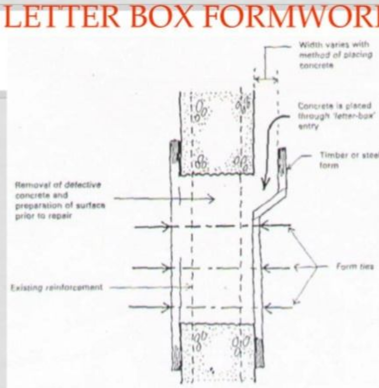

Figure 7.6 Letter-box formwork for wall or column repairs

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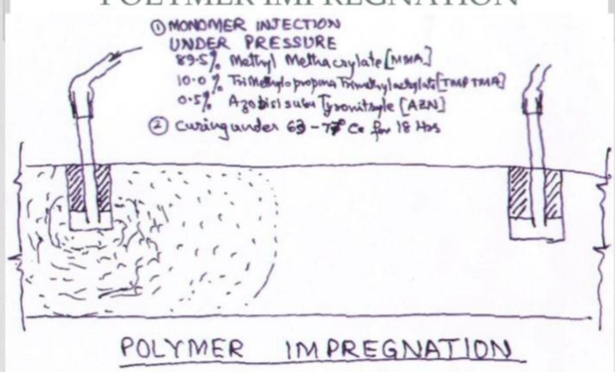
INJECTION TYPE POST CONSTRUCTION WATER PROOFING

- Purpose
  - To seal pores of existing concrete structures against ingress of water and moisture by pressure injection of pore sealing compounds through nipples fixed for the purpose

MICRO CAPILLARY STRUCTURE

POLYMER IMPREGNATION



CONCRETE SURFACE WATER PROOFING

PRE-PLACED AGGREGATE CONCRETE

- Purpose
  - To carry out structural strengthening by non-shrink concrete by injecting flowable cement mortar in prepacked stone aggregate in a shuttering mould through a nozzle slowly withdrawn from the lower most level keeping it inserted in the mortar.

PRE-PLACED AGGREGATE CONCRETE

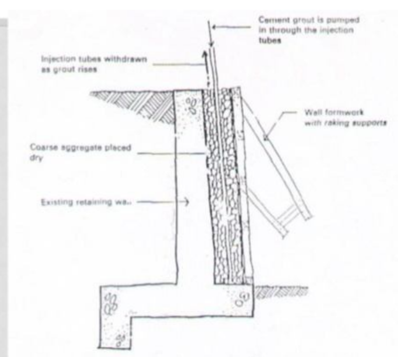


Figure Prepacked aggregate/concrete repair to retaining wall

STEEL PLATE BONDING

- Strengthening/upgradation by mecnenically connecting MS Plates by bolting and gluing to the surface with exoxy to substantially increase strength, stiffiness, ductility and stability of RCC elements

PLATE BONDING

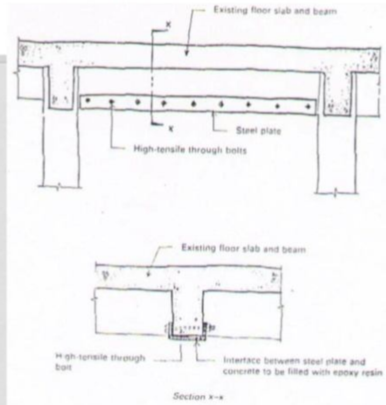


Figure 7.14 Beam strengthening with steel plates

EXTERNAL PRE-STRESSING

- To provide additional load carrying capacity of a structural member by an external pre-stress to resist additional loads or relieve the distressed structural member and avoid its failure.

EXTERNAL PRESTRESS

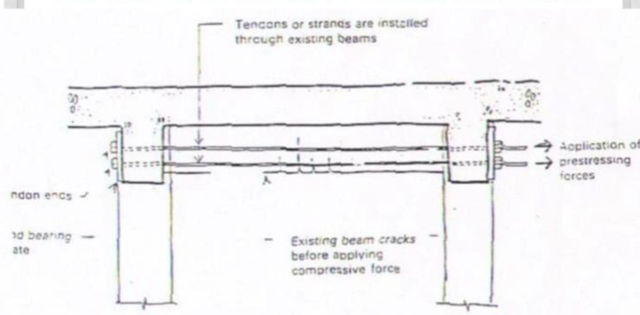


Figure 7.12 Application of external prestressing for tensile cracks

SEISMIC DAMAGE RESTORATION

STRUCTURAL REPAIRS & STRENGTHENING

- **Structural Repair/strengthening of cracked members may consist of**
  - **Removal and rebuilding portions of cracked masonry walls and piers using richer mortar**
  - **Injecting non-shrink cement mortar, cement slurry, epoxy in to cracks in walls.**
  - **Addition of reinforcing mesh on both faces of cracked wall fixed with spikes /bolts and covering with micro-concrete or cement mortar**
  - **Cracked RCC elements could be repaired by**
    - **Epoxy grouting**
    - **Polymer modified non-shrink cement grout**
    - **Epoxy or polymer modified mortar application**
    - **Shotcreting**
    - **Jacketing, etc**

RESTORATION OF ORIGINAL STRENGTH
(CRAKS IN UNREINFORCED MASONRY)

- Fine cracks in load bearing unreinforced concrete and masonry walls reduce their resistance appreciably
- Hence, all cracks, may be very fine, must be located and marked carefully
- Critical cracks to be fully repaired by injecting strong cement or epoxy grout or by external bandage

RESTORATION OF ORIGINAL STRENGTH
(CRAKS IN UNREINFORCED MASONRY)

- MINOR CRACKS (Width 0.5 to 5 mm)
  - Restoration of tensile strength is done by pressure injection of epoxy/non-shrink cement grout
    - Smaller the crack, higher the injection pressure
    - Smaller the crack, closer the spacing of nipples
    - Nipple spacing: Not more than thickness of member
    - Pulverised fines should be cleaned by air/water
    - Applicable even for beams, columns in RCC, walls and flooring units in masonry

RESTORATION OF ORIGINAL STRENGTH

- MAJOR CRACKS (Width more than 5 mm)
  - Restoration of tensile strength is done other than by pressure injection as under:
    - Verticality be checked to decide its reconstruction
    - Pulverised fines is cleaned by air/water and replaced with quick setting expansive mortar
    - If necessary, shear/flexural reinforcement, covered with mortar, is provided to further strengthen
    - In walls, Steel mesh could be provided on outside of surface, nailed/bolted and covered with micro-concrete, plaster or shotcrete

RESTORATION OF ORIGINAL STRENGTH

- Yielded/Buckled Reinforcement
  - Replace old with new steel by butt/lap welding
  - Additional stirrup ties are added in damaged portion before concreting
  - In some cases, anchoring additional steel in existing concrete is done to provide anchorage
    - A hole larger than bar is drilled
    - Hole is filled with epoxy or expanding high strength cement grout
    - Bar is pushed in and held till grout sets

SEISMIC RETROFITTING

SEISMIC RETROFITTING

- Upgradation of a structure by making up structural inadequacies by appropriate strengthening technique, to resist earthquake loads in conformity with the prevalent codes of practice, is called Seismic Retrofitting

SEISMIC RETROFITTING

- **Seismic Retrofitting could involve one or more of following**
  - Increasing the lateral strength in one or both directions to coincide centre of mass with centre of stiffness in both directions
  - Providing proper connections to different structural and non structural components to ensure composite structural behaviour
  - Eliminating such features that weaken or produce concentration of stresses in structure
  - Avoiding possibility of brittle mode of failure

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SEISMIC RETROFITTING

- **Unsymmetrical Buildings**
  - **Purpose:** Centre of mass to be made coincident with centre of stiffness
  - **How to achieve:**
    - By inserting new masonry or reinforced concrete walls or buttresses to act as vertical resisting elements
    - Insertion cross walls for transverse support to very long walls
    - Connection of new wall unit with old wall unit has to be an appropriate structural connection

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SEISMIC RETROFITTING

- **ROOF:**
  - Slates & Roofing tiles be replaced with CGI or Asbestos Sheets
  - Brittle materials in false Ceiling be replaced with non-brittle ones
  - Roof truss be braced by welding/clamping Diagonal bracing in vertical as well as horizontal planes
  - Anchorage at supports be improved

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SEISMIC RETROFITTING

- **Existing Walls:**
  - Lateral strength of buildings can be improved by increasing strength and stiffness of cracked or uncracked walls
    - By injection grouting
    - By addition of vertical reinforced concrete covering
    - By prestressing wall unit

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SEISMIC RETROFITTING

- **Achieving Integral Box Action:** causes improvement in overall strength and stability of bearing wall buildings
  - By use of prestressing
  - By providing horizontal bands
  - By providing vertical bars at proper locations
  - By installation of tie rods at springing level, Lintel above the crown of arched openings or connecting bottom flanges of I-girders with MS flat by bolting or welding

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REFERENCES

IS 1893

IS 4326

IS 13827

IS 13828

IS 13920

IS 13935

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EXTERNAL/ INTERNAL
RETROFIT BY K-FRAME
151


STRUCTURAL MEMBER OF RETROFIT
AT MAIN DOOR ENTRANCE
11/27/2015
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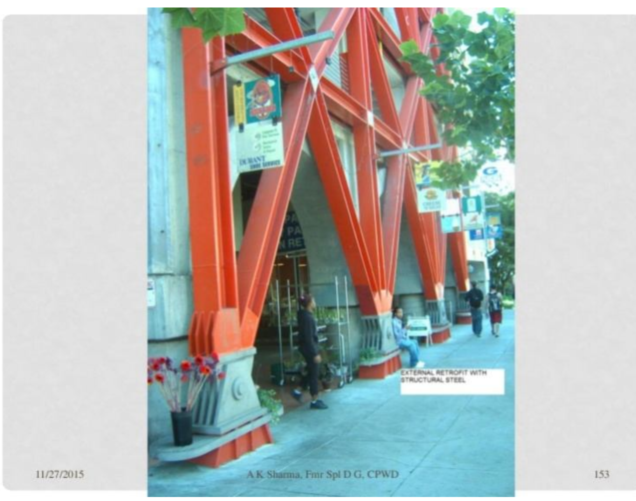
152


EXTERNAL RETROFIT WITH
STRUCTURAL STEEL
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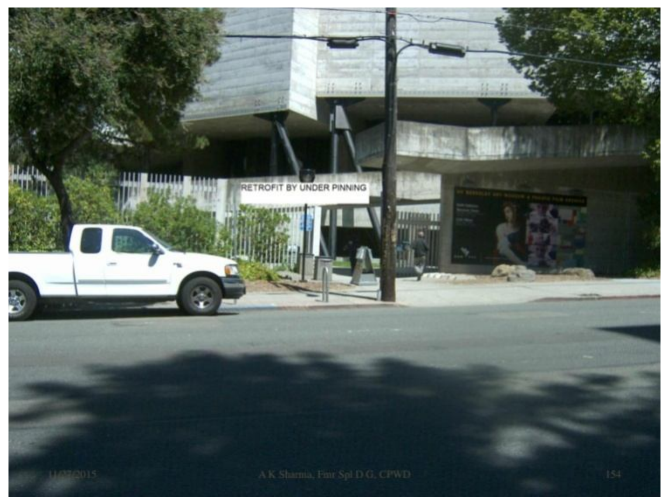
153


RETROFIT BY UNDER PINNING
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154


RAKER UNDER PINNED
SUPPORTS TO TAKE
VERTICAL & HORIZONTAL
LOADS
11/27/2015
155


RETROFITTED
BUILDING
11/27/2015
156


11/27/2015
157


11/27/2015
158


11/27/2015


CONNECTING BEAMS WITH COUNTERFORT
RETROFITTING WITH COUNTERFORT WALL
160


11/27/2015
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161


ONE WAY


11/27/2015


EXTERNAL
RETROFIT
EXTERNAL RETROFIT
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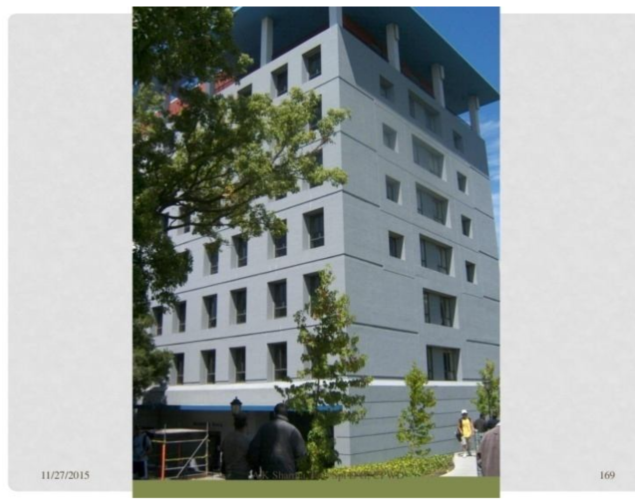
164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169


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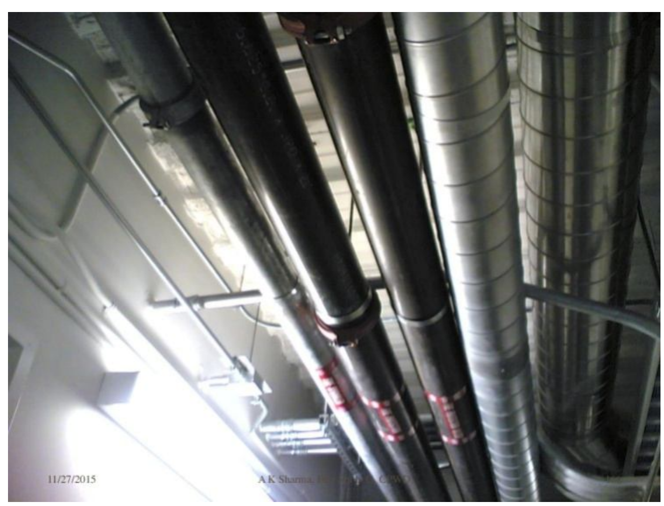
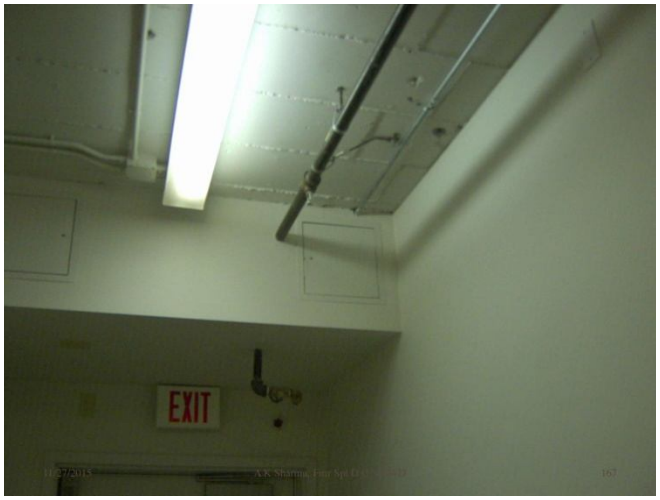
A K Sharma, Fmr Spl D G, CPWD
165


11/27/2015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11/27/2015

SEISMIC/CYLCONIC RETROFITTING OF BUILDINGS

SEISMIC/CYCLONIC RETROFITTING OF BUILDINGS

DR. K.M. SONI
CHIEF ENGINEER
WEST ZONE I, CPWD, MUMBAI

EARTHQUAKES

- EARTHQUAKES DO NOT KILL BUT IT IS THE BUILDINGS WHICH KILL
- NEARLY 5,00,000 EARTHQUAKES OCCUR EVERY YEAR
- ABOUT 1,00,000 ARE FELT
- Minor earthquakes occur nearly constantly around the world in places like California and Alaska in the U.S., as well as in Mexico, Guatemala, Chile, Peru, Indonesia, Iran, China, Pakistan, Portugal, Turkey, New Zealand, Greece, Italy, India and Japan, but earthquakes can occur almost anywhere.

CASUALTIES

- LARGE NUMBER OF CASUALTIES OCCUR IN DEVEOPING COUNTRIES. REASONS MAY BE;
  - INADEQUATE DESIGN
  - POOR CONSTRUCTION AND MAINTENANCE
  - LACK OF RESOURCES
  - INADEQUATE KNOWLEDGE
  - INADEQUATE AWARENESS
  - INADEQUATE TRAINING
  - INADEQUATE SAFETY IMPLEMENTATION

TANGSHAN, CHINA, 27.7.1976;
DEATHS-242,769; MAG. 7.5

HAITI'S E/Q, 12.1.2010; DEATHS-3,16,000; MAGNITUDE:7

SUMATRA E/Q, 26.12.2004
DEATHS;2,27,898
MAG. 9.1

Haiyuan, china
e/q 16.12.1920
Deaths; 2,00,000
Mag. 7.8

9

Kanto, e/q, Japan; 1.9.1923
Deaths-1,42,800
Magnitude: 7.9

10

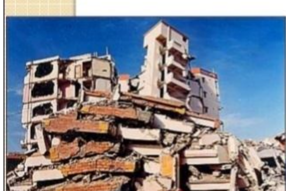
Pakistan e/q, 18.10.2005
Deaths; 86000
Mag-7.6

11

Iran e/q, 20.6.1990
Deaths-50,000
Mag. 7.4

12

Gujarat e/q, 26.1.2001
Deaths-20,085, Mag. 7.6



Latur, india e/q 29.3.1993
Deaths – 9748
Mag. 6.2

NEPAL EARTHQUAKE

2015, Magnitude: 7.9, deaths over 5000

15

16

17

AFGHANISTAN EARTHQUAKE

26th October, 2015

18

19

CAUSES OF FAILURE OF MASONRY BUILDINGS

- POOR QUALITY OF MORTAR
- IRREGULARITY IN PLANE AND VERTICAL DIRECTION
- NO PROVISION OF BANDS
- NO THOROUGH STONES
- HEAVY MASS CONCENTRATION AT ROOF LEVEL
- UNSYMMETRICAL BUILDINGS AND FULL OPENINGS
- UNCONFINED WALL CORNERS
- INADEQUATELY DESIGNED CANTILEVER ELEMENTS

20
20

CAUSES OF FAILURE OF RCC BUILDINGS

- SOFT STOREY (ONE IN WHICH LATERAL STIFFNESS IS LESS THAN 70% OF THAT IN THE STOREY IMMEDIATELY ABOVE OR LESS THAN 80% OF THE COMBINED STIFFNESS OF THREE STOREYS ABOVE)
- POOR DETAILING OF BEAM COLUMN JUNCTIONS
- PROVISION OF FLOATING COLUMNS
- PLAN AND MASS IRREGULARITY
- INADEQUATE FOUNDATION
- POUNDING OF BUILDINGS
- INADEQUATE DESIGN AND DETAILING
- INADEQUATE CONNECTVITY LIKE ISOLATED STAIRCASES AND WATER TANKS NOT PROPERLY ANCHORED

24

25

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33

NORMALLY STRUCTURES REQUIRING REPAIR AND REHABILITATION ARE MORE SUSCEPTIBLE TO DAMAGE, HENCE REPAIR AND REHABILITATION IS VERY IMPORTANT

34

34

SELECTION OF MATERIALS FOR REHABILITATION/ RETROFITTING

- TECHNICAL REQUIREMENTS
- COST
- AVAILABILITY
- EXPERT'S ADVICE
- IMPORTANCE OF THE STRUCTURE
- BALANCE LIFE OF THE STRUCTURE
- TOXICITY OF THE MATERIAL
- AESTHETIC CONSIDERATION

39

REHABILITATION METHODS

- SAND BLASTING FOR REMOVAL OF CORROSION
- BINDING/ADDING OF ADDITIONAL REINFORCEMENT
- WELDING
- ANCHORING TO THE EXISTING MEMBERS THROUGH SHEAR KEYS OR ANCHORS
- SHOTCRETING
- PLATE BONDING
- JACKETING
- FIBRE WRAPPING
- UNDERPINNING

40

RETROFITTING

- PLATE BONDING
- FIBRE WRAP TECHNIQUES THROUGH GLASS FIBRES/CARBON FIBRES
- RCC JACKETING

42

MASONRY STRUCTURES

44

45

46

47

48

SEISMIC STRENGTHENING/ RETROFITTING

- THE TECHNIQUE TO UPGRADE THE STRUCTURE FOR EARTHQUAKE RESISTANCE TO THE LEVEL OF PRESENT DAY CODAL REQUIREMENTS HAVING ORIGINAL STRUCTURAL INADEQUACY OR INADEQUACY DUE TO MATERIAL DEGRADATION OVER TIME OR DUE TO ALTERATIONS CARRIED OUT DURING ITS USE OVER THE YEARS

51

IS CODES

- CODES
  - IS 13935 (JUNE 2009) – GUIDELINES FOR REPAIR, RESTORATION, CONDITION ASSESSMENT AND SEISMIC STRENGTHEING OF MASONRY BUILDINGS
  - DRAFT CODE WITH COMMENTARY ON SEISMIC EVALUATION AND STREGTHENING OF EXISTING BUILDINGS FOR RCC STRUTURES

53

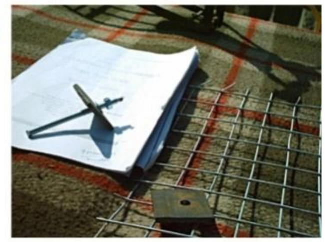
GENERAL PROVISIONS REQUIRED IN MASONRY BUILDINGS

- PLINTH BAND
- LINTEL BAND
- ROOF SLAB/ROOF BAND
- CORNER REINFORCEMENT
- BRICK WORK IN CEMENT MORTAR OF 1:6
- RESTRICTED OPENINGS
- ADEQUATE FOUNDATION

54

SELECTION OF MATERIALS AND TECHNIQUES FOR RETROFITTING

- CEMENT
- STEEL
  - BOLTS, RODS, ANGLES, BEAMS, CHANNELS, EXPANDED METAL, WELDED WIRE FABRIC
- ADMIXTURES TO IMPROVE NON-SHRINKAGE (GROUTS CONSISING POLYMER, NON-SHRINK CEMENT AND SPECIAL SANDS), BOND (EPOXY RESINS) ETC.



SEQUENCE OF RETROFITTING

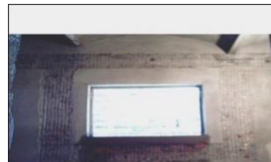
- REPAIR/REHABILITATION
- ALL CRACKS SHOULD BE FULLY REPAIRED
  - PRESSURE INJECTION OF NON-SHRINK CEMENT POLYMER GROUT FOR 0.5 TO 5 MM CRACKS
  - REPAIR BY EXPANSIVE CEMENT MORTAR, QUICK SETTING CEMENT, ADDL. SHEAR OR FLEXURAL REINFORCEMENT, STEEL MESH, STEEL RODS

REPAIR/STRENGTHENING OF WALLS

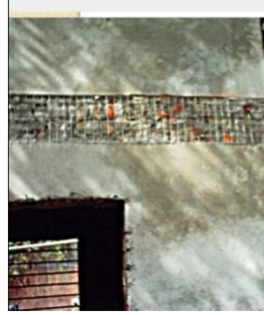
- BY GROUTING (CEMENT WATER MIXTURE OR POLYMERIC MORTAR)
- BY ADDITION OF VERTICAL REINFORCEMENT CONCRETE COVERINGS ON THE TWO SIDES OF THE WALL
- BY PRESTRESSING WALL

HORIZONTAL SEISMIC BELTS

- TO BE PROVIDED
  - ON ALL WALLS
  - ON BOTH THE FACES
  - JUST ABOVE THE LINTEL
  - BELOW ROOF
  - BELOW FLOOR
  - IN CASE OF RCC SLAB ROOF BELT NOT REQUIRED
  - NOT REQUIRED AT PLINTH LEVEL UNLESS PLINTH HEIGHT IS MORE THAN 900 MM



ON ALL WALLS
ON BOTH THE FACES
ABOVE LINTEL



SEISMIC BELTS AROUND DOOR/WINDOW OPENINGS

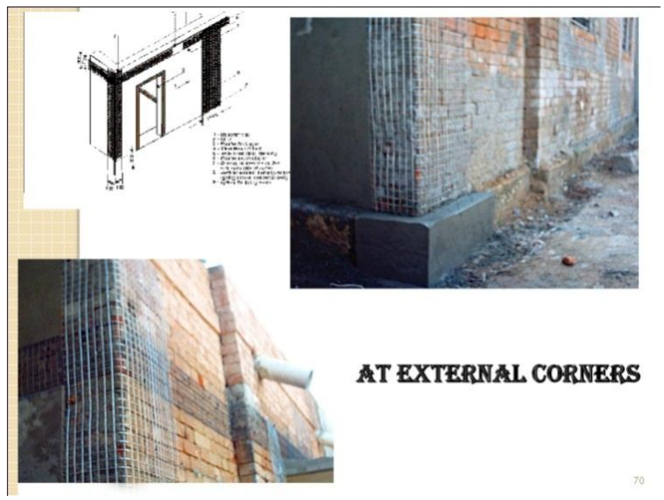
- IN CATEGORY "D" AND "E" BUILDINGS
- MESH OF GAUGE 10 WITH 8 WIRES IN VERTICAL DIRECTION SPACED AT 25 MM IN A BELT WIDTH OF 200MM OR
- GAUGE 13 WITH 10 WIRES IN VERTICAL DIRECTION SPACED AT 25 MM IN A BELT WIDTH OF 250MM (IN CAT. C BUILDINGS ALSO)

64

VERTICAL SEISMIC BELTS AT CORNERS

- AT THE CORNERS OF ROOMS
- JUNCTIONS OF THE WALLS
- WIDTH ON EACH SIDE OF THE CORNER TO BE KEPT 25 MM EXTRA TO THE WIDTH OF THE MESH
- REIFORCEMENT TO BE STARTED BELOW 300 MM BELOW PLINTH LEVEL

69



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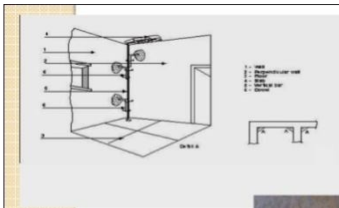


VERTICAL REINFORCEMENT AT INSIDE CORNER

74

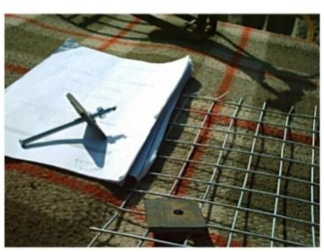
75

ROOFS CONSISTING OF STEEL JOISTS FLAT OR SEGMENTAL ARCHES MUST HAVE HORIZONTAL TIES HOLDING THE JOISTS HORIZONTALLY IN EACH ARCH SPAN SO AS TO PREVENT SPREADING OF JOISTS

76

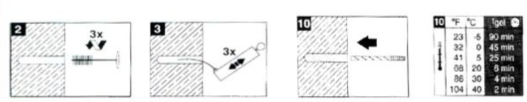
ANCHORS

- MECHANICAL ANCHORS
- CHEMICAL ANCHORS



77

PROCEDURE OF ANCHORING



78

SPECIFICATIONS FOR HORIZONTAL SEISMIC BELT

Length of wall	Cat. B			Cat. C			Cat. D			Cat. E		
m	Gauge	N	H	Gauge	N	H	Gauge	N	H	Gauge	N	H
≤ 5.0	g 14	9	250	g 13	9	250	g 12	9	250	g 10	10	280
6.0	g 13	9	250	g 12	9	250	g 10	10	280	g 10	14	380
7.0	g 12	9	250	g 10	10	280	g 10	14	380	g 10	18	460
8.0	g 10	9	250	g 10	14	380	g 10	18	460	g 10	23	580

1. Gauges: g10=3.25 mm, g11=2.95 mm, g12=2.64 mm, g13=2.34 mm, g14=2.03 mm
2. N = Number of made longitudinal wires in the belt at spacing of 25 mm.
3. H = Height of belt on wall in micro-concrete, mm.
4. The transverse wires in the mesh could be spaced upto 150 mm.
5. The mesh should be galvanized to save from corrosion.

SPEC. FOR VERITICAL REINFORCEMENT

No. of Storeys	Storeys	Cat. B			Cat. C			Cat. D			Cat. E		
		Single Bar, mm	Mesh (g10)		Single Bar, mm	Mesh (g10)		Single Bar, mm	Mesh (g10)		Single Bar, mm	Mesh (g10)	
			N	B		N	B		N	B		N	B
One	One	-	-	-	-	-	-	10	10	300	12	14	400
Two	Top	-	-	-	-	-	-	10	10	300	12	14	400
	Bottom	-	-	-	-	-	-	12	14	400	16		
Three	Top	-	-	-	10	10	300	10	10	300	12	14	400
	Middle	-	-	-	10	10	300	12	14	400	16	25	650
	Bottom	-	-	-	12	14	400	12	14	400	16	25	650

1. Gauge 10 (3.25 mm dia) galvanized mesh with 25 mm spacing of wires shall be used.
2. Single bar, if used, shall be HSD or TOR type. If two bars are used at a T-junction, the diameter can be taken as follows. For One of 10 or 12 mm take 2 of 8 mm, and for One of 16 mm take 2 of 12 mm.
3. N = Number of longitudinal wires in the mesh.
4. B = Width of the micro concrete belt, half on each wall meeting at the corner or T-junction.
5. The transverse wires in the mesh could be at a spacing up to 150 mm.

80

81

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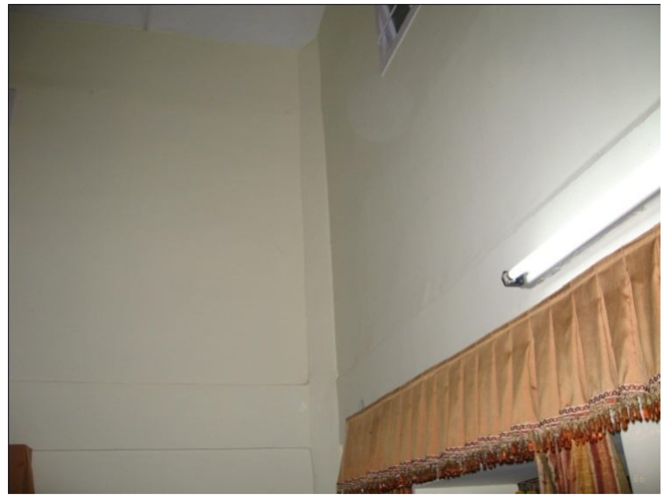

ADDITIONAL STEPS

- Repair and rehabilitation to be carried out prior to retrofitting.
- At the external corners, on each face of the wall, the width of the mesh for corner reinforcement may be kept as minimum 250 mm on each wall so that it covers minimum one brick.
- The mesh reinforcement at the corners may be kept minimum 300 mm below ground level

88

•On the internal cross walls since stiffening is available, horizontal seismic belt can be restricted just to have anchoring effect on cross wall. In the present case this was limited to 600 mm.

89

Contd.

- Mesh reinforcement used should be galvanized steel and anti rusting paint should be applied on the cut points to prevent corrosion.
- MS washers used on wire mesh should be painted with anti corrosive paint. In the present case, M.S. washers of size 50X50X5 mm were used to anchor the mesh reinforcement.
- Since it was not possible to provide roof belt of mesh of required width in central portion due to segmental arch construction and ventilators provided near the top portion, MS flat belt was provided.

90

•The anchors are to be inserted into the hole after the grout is inserted within gel time, which is given 4 minutes for temperature of 30 degree Celsius and 6 minutes for 20 degree Celsius for the anchors and chemical grout used from Hilti India Private Limited.

91

•In the inside corner reinforcement, a prefabricated MS piece was used having two holes, one used for inserting into the bar which can be adjusted at any position and other end used for inserting anchor. Chemical anchoring was done thereafter. Anchoring on wire mesh should be in staggered (zig-zag) manner.

92

TRAINING, SKILL UPGRADATION AND COMPETENCE DEVELOPMENT

- STAKEHOLDERS
  - POLICY MAKERS
  - TRAINERS
  - PARTICIPANTS
  - IMPLEMENTERS

93
93

Item 1

- Providing and fixing 250 mm wide or required size seismic belt for retrofitting with 12 gauge (2.64 mm dia) galvanized iron welded mesh with 25 mm spacing of wire on walls at required height (inside and out side the building) fixed in position with headed nails at required distance complete as per direction of Engineer-in-charge. (Cut end of wire mesh to be painted with NitoZinc Primer)

94

Item 2

- Providing and fixing stainless steel anchors of 8 mm dia (HAS-EM8 x 80 / 14) of HILTI or equivalent on GI wire mesh at required distance in staggered position i/c drilling of 10 mm dia hole with HILTI hammer drill machine TE-6S or equivalent and cleaning of hole by brush and blow out pump. Anchors shall be fixed by resin and hardener pack of HILTI make HY-150/330/2R or equivalent (35 holes per tube of 330 ml) chemical. Mesh will be fixed with MS washer of size 50x50x5 mm painted with NitoZinc primer (FOSROC) on top of the mesh with anchor screwed with nut complete as per direction of Engineer- in- charge.

95

Item 3

- Painting on galvanized iron / steel work such as M.S. angle, flat, cold twisted bars with Protective / Bond coats i.e NitoZinc (FOSROC) primer of approved brand and manufacture as per direction of Engineer-in-charge.(Surface area of steel work shall be measured for payment)

96

Item 4

- Providing and Fixing steel reinforcement bar 10 mm dia for seismic strengthening of building at inside corner i/c fixing with M.S. cleat 50x50x6 mm size having 2 holes. The reinforcement bar shall pass through one hole and other hole shall be used for anchoring into brick / CC wall.

(The payment for steel reinforcement, Anchor & grouting at floor and roof shall be paid for separately)

97

Item 5

- Providing and fixing seismic band for seismic strengthening of size 50x5 mm flat iron section at required level including making necessary holes not more than 75 cm apart and keeping in position with nails and finally fixing with Anchors (Payments for Anchors & its fixing shall be made separately).

98

Item 6

- 28 mm thick Acrylic modified cement mortar/micro concrete band at required level with mix 1:1:2 (1 cement : 1 coarse sand : 2 graded stone aggregate 6 mm & down nominal size) in two coats admixed with polymer modified compound (Armourcrete / Tapecrete) @ 10% of cement (by weight) used area and including slurry coat of Acrylic cement @ 2.2 kg / sqm mixed with polymer modified compound (Armourcrete/ Tapecrete) @ 10% of cement used and finished smooth complete (top layer will be of 12 mm plaster).

99

SEISMIC RETROFITTING OF BUILDINGS

Dr K M Soni
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Abstract

Construction of houses depends upon many factors, one of them being economic status of the owner. To construct an economic structure, sometimes safety during disasters is not taken care of, mostly by those who do not take consultancy from the structural experts. Such structures may exist all over the world, but are more in developing countries where construction of house is still a dream for many. Many of such structures have been constructed in India also without any structural or proper structural design. In addition to this, there are many structures constructed with poor quality and poor detailing, in terms of materials, workmanship and design. Such structures require retrofitting though a costly affair but due to cost considerations, owners do not undertake retrofitting. During disasters such structures fail and lead to large casualties.

When building structures collapse or show severe distress after disasters, they require large resources in reconstruction and thus retrofitting before disasters is still economic in such cases. Since a large number of such structures exist particularly in rural, semi urban and urban areas, this is high time that retrofitting is carried out on large scale, both in government and private sectors. Such retrofitting may require awareness generation among owners of such habitats, financial assistance either from governments or banks, capacity building for identification and carrying out work and technical advice from engineers, NGOs, local bodies and the governments.

Seismic retrofitting of few load bearing structures was carried out in Delhi. Retrofitting details are discussed in the paper.

♣

Introduction

Earthquakes in India are common in many parts of the country. Recent earthquake was on 26th October 2015 whose epicentre was in Afghanistan of magnitude 7.7 on Richter scale which affected Afghanistan, Pakistan and northern parts of India. In 2015 itself so far northern India has experienced many earthquakes such as one mentioned above and earthquakes of Dibrugarh (Assam) of 5.6 magnitude on Richter scale of June 28, of northern and north eastern India of magnitude 7.3 of May 12, and aftershocks of magnitude of 6.7 and 6.6 of April 26 and April 25 of earthquake came on April 25 in north and north eastern part of the country of magnitude 7.8 whose epicentre was in Nepal. Maximum casualties were in Nepal earthquake estimated to be more than 8900 in these earthquakes.

It is said that earthquakes do not kill but men made structures mostly buildings kill the people. It is a fact that safe structures made or retrofitted in developed countries do not lead to large casualties as found in developing countries. Such casualties are also from un-designed buildings particularly load bearing structures constructed from brick or stone masonry. Therefore, there is a need to retrofit brick and stone masonry structures on large scale.

In case of cyclones, it is the wind which is responsible for the disaster and then followed by rains and flooding. Cyclones may affect the structure completely by blowing it off from the foundation or part of the structure particularly roofing and roofing members including other light weight members like doors and windows. Thus, detailing, fixing and specifications of building components are important. In existing structures, such detailing needs to be provided through retrofitting.

Decision on Repair, Rehabilitation and Retrofitting

Normally one thinks for retrofitting after the disaster. Such retrofitting is very costly as retrofitting has to be clubbed with repair and rehabilitation. Repair and rehabilitation cost may itself become very high and thus total cost of repair, rehabilitation and retrofitting may be very high and non feasible. Better way of retrofitting is before it is affected by the disaster so that not only damage is minimised but casualties also. This type of retrofitting is also economic. Normally cost of retrofitting depends upon the quality of the design, construction, maintenance, and aging of the structure. A structure having design deficiencies requires retrofitting as per latest codes. As per the guidelines for repair, restoration, condition assessment and seismic strengthening of masonry building[1] "As a thumb rule, if the cost of repair and seismic strengthening is less than about 30% of the reconstruction cost, the retrofitting is adopted". This cost may be only 5 – 10% of cost of reproduction of a building if only seismic members are to be provided but repair and rehabilitation is also to be carried out, it may lead to a very high cost. In case of poor quality construction, rate of distress is very high and cost of repair, rehabilitation and retrofitting is also very high. Also, such structures cannot be brought to the level of required quality level. For example, if the joints of brickwork have not been filled up properly, any rehabilitation work such as grouting may not fill up all the hollow joints.

After the disasters, when structures are under severe distress, it becomes economic to go for reconstruction except some special structures like heritage structures which are to be preserved. Also there may be compelling circumstances when retrofitting becomes essential like non availability of buildings for the users for a long period, immediate requirement of habitats, and litigation etc. Some public buildings like hospitals, schools and other administrative buildings which suffer minor damage are repaired and rehabilitated and seismic or cyclone retrofitting is simultaneously carried out as per latest codes and guidelines.

Structural Evaluation

For retrofitting of any structure including RCC whether showing distress or otherwise, structural evaluation is carried out through condition survey and non destructive testing. Condition survey is carried out at four stages through preliminary inspection, planning, detailed visual inspection, and field and laboratory testing. Non destructive testing includes tests for in situ compressive strength like rebound hammer test, ultrasonic pulse velocity test, Windsor probe test, pull out test, core tests and load tests. Tests for chemical attack include carbonation tests, chloride test and sulphate test. Corrosion potential assessment can be made from cover meter/Profo meter, half cell method, and resistivity meter. Normally a series of tests or a combination of tests or all tests are carried out based on condition assessment and importance of the structure. Though interpretation of tests is important and to be carried out by the experts, testing procedure is equally or more important as incorrect testing procedure may provide incorrect results.

Structural evaluation and physical verification of site details and of the buildings provide the basis for the methods and materials to be chosen for retrofitting. It is to be understood that a proper sequencing is to be followed in repair, rehabilitation and retrofitting.

Materials for Repair And Rehabilitation

Selection of materials for repair and rehabilitation depends upon many factors such as;

- Technical requirements
- Cost
- Availability
- Expert's advice
- Importance of the structure

- Balance life of the structure
- Toxicity
- Aesthetic requirements

Technical requirements of materials used for repair may include their shrinkage properties, compatibility to base materials, setting and hardening properties, workability, bond strength, thermal expansion properties, mechanical strength, curing requirements, permeability, and durability. Most of the materials used for repair are cements, admixtures, polymer modified mortars/concrete, aggregates, polymers, epoxies, resins, grouts, plasticizers, steel in the form of reinforcement, sections, nuts/bolts, wire mesh, metallic sheets, glass fibre sheets, carbon fibre sheets, geo-synthetics in the same form or in modified form.

Rehabilitation and Retrofitting Methods

Repair, rehabilitation and retrofitting methods[2] are to be planned carefully and to be followed in the required sequence. Structural repairs are to be carried out first and thereafter retrofitting works for seismic requirements and then repair of non structural members. In the last, repair and rehabilitation of architectural components should be taken up. Such a sequence is followed as repair of non structural members initially may cover up structural cracks or members requiring structural strengthening.

Weak protective surfaces and materials like concrete, plaster, water proofing materials, and corroded steel are to be removed first. Repair is thereafter to be carried out by ensuring design requirements, compatibility of materials and also other factors mentioned earlier. Repair should also be compatible to design requirements. For example, if a lintel is to be repaired, it should be compatible to seismic retrofitting, if being carried out. For repair of all distressed structures, no standard method and materials may be listed as it depends upon structure to structure.

During rehabilitation of distressed structures and retrofitting, following methods may be carried out;

- Sand blasting to remove rust or corrosion
- Binding/adding additional reinforcement
- Binding of wire mesh
- Welding
- Anchoring to the existing members through shear keys or anchors
- Shotcreting
- Plate bonding
- Jacketing
- Fibre wrapping
- Underpinning

One should take decision judiciously on the method of rehabilitation or replacement of structural members. For example, a slab will always cost more in rehabilitation compared to replacement. Slab may require sand blasting to remove rust of the reinforcement, anti rusting coat, additional reinforcement, binding coat, welding, anchoring or shear key and shotcreting. Shotcreting itself is costlier than concreting of new slab, hence rehabilitation becomes very costly. Thus, it should be examined whether slab replacement is feasible. In case of roof, other factors like water supply system, water proofing etc are also to be considered. Sometimes, repair and rehabilitation is to be carried out in a roof slab, without disturbing water supply system to other residents, hence replacement is not feasible even if it economic. Many times, heavy "I" beams are provided to support distressed slab and wire mesh is inserted above the "I" beams (Fig. 1). Such system provides a feeling of unsafe structure. Also, there becomes a large distance between I beams, and wire mesh itself may sag after few years. Hence, it is recommended that angle sections should be provided at the ends and T sections in between in shorter direction (Fig. 2) and wire mesh provided on top. Thereafter shotcreting can be done. Small sections at closer intervals do not allow wire mesh to sag due to small spans between beams and in future, it becomes easy to repair small portion if needed. Small portions of slabs may be rehabilitated by tying additional reinforcement but tying should be proper else welding should be preferred with the existing reinforcement. In case, wire mesh is needed, it may also be anchored in existing slab by providing washers made of MS flats in case welding is not carried out. Mere binding additional reinforcement to the existing reinforcement with binding wire does not serve purpose for long as binding wire gets corroded after some time and thereafter there is no monolithic action between existing reinforcement and additional reinforcement.

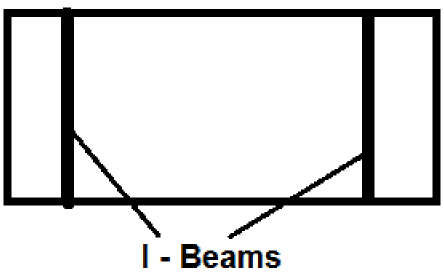

Figure 1: "I" Beams provided in distresses slab

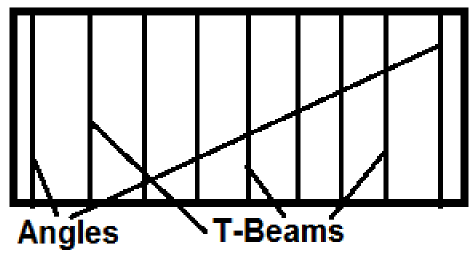

Figure 2: angles and small T sections

Beams cannot be replaced easily hence they are rehabilitated. Additional reinforcement binding has to be ensured as additional reinforcement is part of the design to take up the loads. Welding though costly ensures monolithic action of additional reinforcement with existing reinforcement. in case of jacketing of columns, two precautions are to be ensured one enlarging the foundation as per the requirements of new columns and other monolithic action of existing reinforcement and additional reinforcement through welding or anchoring and providing additional bent up bars[3] (Fig. 3) or shear keys. In case of non monolithic action, cracks will appear between existing section and additionally jacketed section after some time.

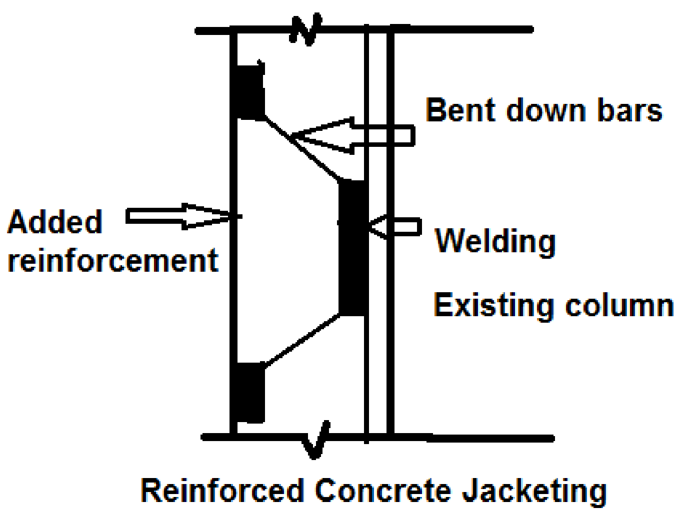

Figure 3: Rehabilitation through jacketing in a column

Thus, main procedure to any rehabilitation work is removal of loose materials and rusting, providing protective layer, bonding coat between old and new surface, providing steel members/welding/anchoring/shear keys to ensure monolithic action between old and new reinforcement and concrete work. Two surfaces may be joined through welding, anchoring, providing shear key, adhesives or bonding coat according to the surfaces and materials used in rehabilitation work.

Retrofitting is also done through plate bonding, and fibre wrap techniques. Materials used in plate may vary according to the requirements such as metallic, glass fibre or carbon fibre. Fibre wrappers are wrapped around the structural members after repair and rehabilitation of distressed members and may be of different materials such as carbon fibres, glass fibres etc.

Seismic Retrofitting of Masonry Structures

Seismic retrofitting can be defined as the modification of existing structures to make them seismic resistant during ground motion due to earthquakes. Main purpose of seismic retrofitting is to provide or upgrade seismic resistance in a building, having original structural inadequacy or damaged during earthquake.

Materials for Repair and Retrofitting

Most common materials required in repair and retrofitting are cement, steel, grouts, sand, aggregate, admixtures and epoxy resins/mortars. Some methods and techniques employed for retrofitting may require special materials like fibre reinforced plastics such as carbon fibre reinforced polymer sheets and adhesives. Steel may be required in many forms like reinforcement bars, bolts, angles, beams, channels, expanded metal, anchors and welded wire fabric. Wire mesh is very economic compared to fibre reinforced plastics but advantage of using fibre reinforced plastic sheets is that they have very small thickness which does not lead to projection of band.

Materials to fill up cracks may include cement mortar/micro concrete/shotcrete or non shrinkage grouts consisting polymers, non - shrink cement and special sands. Advantage of using non shrink grouts is that they have better adhesion as well imparts higher tensile strength but the quality of the grouts has to be ensured. Shotcrete should be applied cautiously as it may add weight to the structure and needs architectural adaptability. Also it has to be ensured that there is no corrosion in the reinforcement. For checking the corrosion in the reinforcement, cracked cover/concrete must be removed thoroughly. In case, any corrosion is noticed, residual area of the reinforcement has to be examined and action to be taken to restore it. Sand blasting may be required to remove the corrosion. In case, corrosion is left in the reinforcement, cracks may develop after some time of shotcreting, depending upon the extent of corrosion and porosity in the structural members. In case, shotcrete is applied without removing cracked concrete and corrosion, there will be no bonding to the parent concrete imparting strength to the members and whole shotcrete along with some part of the parent concrete may come down. Decision of shotcreting needs to be taken after comparing the cost of shotcreting with replacement cost of the member like slab and its allied parts and difficulty in carrying out replacement. Normally shotcreting costs more than the cost of replacement but other factors like site difficulty in carrying out reconstruction and requirements of reconstructing/relocating water tanks if a roof slab, water proofing works etc. and time to carry out replacement force engineers to adopt this technique.

Repair of minor and medium cracks up to 0.50mm may be carried out by pressure injection of non-shrink cement polymer grouts. In case of major and multiple cracks, a decision may be taken to replace the member/portion if feasible else some cost effective technique or steel mesh may be used with micro concrete/plaster for repair. In case deficiencies of structural members have been taken care and strengthening has been done, cracks may also need to be stitched with steel bars/wire mesh bonded properly with the wall. Stitching of two walls should be done with bars placed at an angle of 45 degree to the horizontal plane in a cross way. Diagonal cracks should be stitched in a plane perpendicular to the crack. Thereafter cement grouts may be used for filling the cracks and drilled portions.

Assessment of Retrofitting

As per the guidelines given in draft IS 19935[1], categorization of buildings is the first step. Buildings have been classified in B, C, D and E category depending upon the location of the building in the seismic zone II, III, IV or V (Table 1). An importance factor of 1.5 has been mentioned for the important buildings as defined in IS 1893 (part I). Old masonry buildings having more than 50 years of age are classified as one category lower. Similarly a provision has been made for the masonry buildings having weak mortar than cement mortar given in IS 4326 or having mud mortar, the requirements of retrofitting are determined by raising the building category.

Table 1: Building categories for use with IS 4326 & 13928 (Source draft IS 13935, June 2006)

Building Use	**Building Category in Seismic Zone**			
	II	**III**	**IV**	**V**
Ordinary	B	C	D	E
Important (I=1.5)	C	D	E	E

Requirements of Seismic Retrofitting of Masonry Structures

The following are the requirements of seismic provisions:

- Plinth band
- Lintel band
- Roof band
- Reinforcement around openings
- Corner reinforcement
- Safe foundation

Above provisions are required to achieve integral box action as it provides seismic resistance during earthquakes or ground motion. Seismic retrofitting is required when one or more provisions do not exist in the building. In an existing building, it is not easy to provide bands. If bores are made horizontally along the wall and reinforcement inserted and concrete pumped in the bore, procedure is difficult and expensive. Therefore, a simpler procedure needs to be adopted. Simple procedure may be to provide belts in place of bands from outside and anchor them in the wall. Procedure is something like a belt fastened on a trouser which holds it on waist and provides integral action with the body to prevent falling down even during running. But it must be remembered that fastening is important in a belt otherwise it would not be able to hold the trouser so also in the seismic belt else structure will not be able to hold the belt during ground motion. Belts are required as a substitute of plinth band, lintel band, roof band, corner reinforcement and reinforcement around opening. RCC slab acts as a roof band, hence in case of RCC slab, roof band at roof level/seismic belt is not required.

Seismic belts at plinth level, lintel level and roof level are horizontal belts. Seismic belt is not necessary at plinth level, unless the plinth height is more than 900mm. Also, if the height of eave level above the top of door is less than 900mm, only the eave level belt may be provided and lintel level belt may be omitted as per the draft guidelines of IS13935. However, it is suggested[4] that lintel level belt may be provided and at eave level, a belt with MS flat may be provided. Seismic belt at lintel level is to be provided on all walls and on both the faces just above lintels of door and window openings (Fig. 4).

Figure 4: Seismic belt at lintel level **Figure 5:** Seismic belt around opening

Similarly other seismic belts are to be provided at appropriate levels. It is felt that on the walls having no openings, seismic belt may not be required as the wall itself has a stiffening effect. Therefore, seismic belt up to a distance of 600mm to 900mm may be provided and thereafter a false band may be made in the cement mortar. The size (H) in mm, number of longitudinal wires (N) in the belts, and gauge of wire (g) depends upon the length of wall and category of building and are given in Table 2.

Table 2: Mesh reinforcement in seismic belts in various building categories (Source draft IS 13935, June 2006)

Length of wall	**Cat. B**			**Cat. C**			**Cat. D**			**Cat. E**		
M												
< or = 5.0	4		50	3		50	2		50	0	0	80
6.0	3		50	2		50	0	0	80	0	4	80
7.0	2		50	0	0	80	0	4	80	0	8	60
8.0	0		50	0	4	80	0	8	60	0	3	80

Around the openings, belt is required to be provided covering jamb area on both sides of an opening (Fig. 5). Mesh of gauge 10 with 8 wires in vertical direction spaced at 25mm in a belt width of 200mm or mesh of gauge 13 with wires @ 25mm in a belt width of 250mm may be used in category D & E buildings and mesh of gauge 13 with 10 wires in vertical direction spaced at 25mm in a belt width of 250mm in category C buildings.

Figure 6: Seismic belt at outer corner **Figure 7:** Inside corner reinforcement

Vertical reinforcement is required at the corners of rooms and junction of walls. The width of this belt on each side of the corner has to be kept 25mm extra to the width of the mesh. The reinforcing seismic belt at outer corners can be provided with wire mesh (Fig. 6) starting from 300mm below ground level/plinth level and continued into the roof level horizontal belt. A vertical bar inside rooms can be provided consisting TMT bar starting from 750mm below the ground floor going up to the roof slab, passing through each middle floor through holes made in the slab (Fig. 7). The reinforcement should be connected with the wall through L shaped dowels properly embedded or fixed with chemical anchors. Details of mesh reinforcement and vertical bars are given in Table 3 in which B is the width of the micro concrete belt in mm, half on each wall meeting at the corner or T junction.

Table 3: Vertical bar/mesh reinforcement in vertical belts at corners (source draft IS 13935, June 2006)

No. of storey	**storey**	**Categor y C**		**Category D**		**Categor y E**	
		S	**M**	**S**	**M**	**S**	**M**

		ingle bar, mm	esh (g10)		ingle bar, mm	esh (g10)		ingle bar, mm	esh (g10)	
1	One	-			1 0	0	00	1 2	4	00
2	Top	-			1 0	0	00	1 2	4	00
	Bottom	-			1 2	4	00	1 6	5	50
3	Top	1 0	0	00	1 0	0	00	1 2	4	00
	Middle	1 0	0	00	1 2	4	00	1 6	5	50
	Bottom	1 2	4	00	1 2	4	00	1 6	5	50

The reinforcement of the outer seismic belts can be covered with 1:1.5:3 micro concrete and reinforcement inside the room with 1:3 cement mortars.

Roofs consisting of steel joists flats or segmental arches may be provided horizontal ties (Fig. 8) holding the joists horizontally in each arch span so as to prevent the spreading of joists. This can be done by welding.

Figure 8: Ties in segmental arch construction

Strengthening of foundation may be required which can be provided by introducing new load bearing members including foundations to relieve already loaded members through jacking operations, improving the drainage of the area to prevent saturation of foundation soil to obviate any problems of liquefaction, providing apron around the building to prevent soaking of foundation directly and draining off the water or by adding strong elements in the form of reinforced concrete strips attached to the existing foundation part of the building.

Anchoring

Proper anchoring is most important in retrofitting as it makes seismic belts integrated part of the structure. Two types of anchors are available as mechanical anchors and chemical anchors. Mechanical anchors are recommended for RCC while in brickwork only chemical anchors (Fig. 9) should be used as mechanical anchors may break the brick and may not provide sufficient pull resistance. In chemical anchoring, a hole is first drilled in the wall and then cleaned with a cleaner by blowing air inside the hole from a pump. Chemical having resin and hardener is then inserted inside the hole and then stainless steel anchor inserted into the hole. After self curing period, the anchoring is complete. Anchors are small in diameter than the openings of the wire mesh and thus to anchor wire mesh, washers are required to be used with nuts to fasten the wire mesh. These washers can also be made from mild steel flats and painted before use.

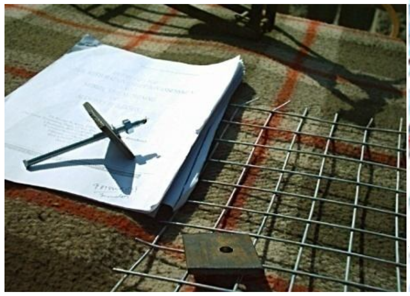


Figure 9: A chemical anchor, washer and wire mesh Figure 10: Anchoring

In two of the projects, HY 50/310 chemical was used with stainless steel anchors of Hilti make having 8mm diameter and a resistance of 110 kN against direct pull. The anchors were used in a staggered manner at a distance of 600mm as shown in Fig. 10.

Precautions

The following precautions may be taken during retrofitting process:

- Repair and restoration work may be carried out before seismic retrofitting or simultaneously carried out.
- No structural member should be cut for retrofitting like cutting of lintel for placing the seismic band. Horizontal seismic band should be placed just above the lintel.
- Only galvanized steel wire mesh should be used to avoid corrosion and cut ends of the wire mesh should be painted with corrosion resistance paint since there remains no galvanization on cut ends of the wires.
- MS washers should be painted with anti corrosive paint before use.
- Anchoring should not be disturbed before curing time. Curing time is normally 4 to 6 minutes as per the atmospheric temperature.
- Since micro concrete is used over seismic belts, cement plaster over the band or putty may be used so that the bands are uniform and aesthetic.

An external view of a bungalow after retrofitting is shown in Fig. 11 and interior of another bungalow in Fig. 12.


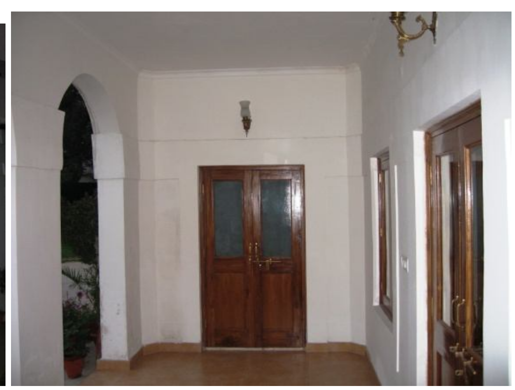

Figure 11: External view of completed work Figure12: Interior view of completed work

Conclusions

There are large number of un-engineered and engineered structures constructed without seismic provisions or inadequate provisions leading to distress and collapse during earthquakes. Such structures cannot be demolished due to high cost involved in reconstruction and non availability of assets hence there is a need to retrofit them to save structures and human lives. Retrofitting is simple and can be implemented without much difficulty. There is a need to develop simple and user friendly guidelines for municipalities, individuals, engineers, architects and contractors. Repair, rehabilitation and seismic retrofitting techniques are discussed briefly in the paper with case studies.

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1. IS 13935 (June 2006). Guidelines for Repair, Restoration, Condition Assessment and Seismic Strengthening of Masonry Buildings (Draft second revision).
2. Soni, K M (2015). Rehabilitation and retrofitting of buildings. Civil engineering & construction review, Vol. 28(5), pp 46-51.
3. Rai, D C (2005), Draft code with commentary on seismic evaluation and strengthening of existing buildings, IIT Kanpur.
4. Soni, K M & Khatri, N K (2006). Retrofitting of a brick masonry bungalow in Lutyen's zone. New Building Materials & Construction World, Vol. 12(4), pp 140-148.

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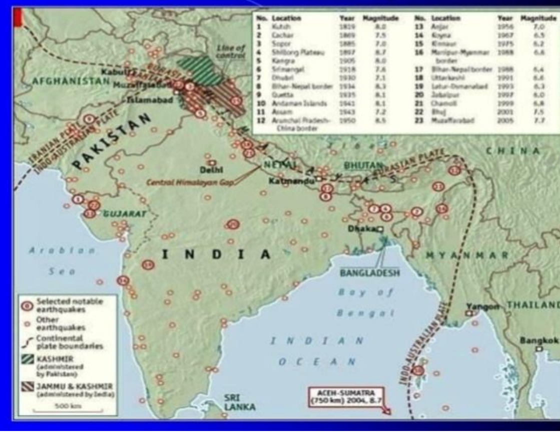
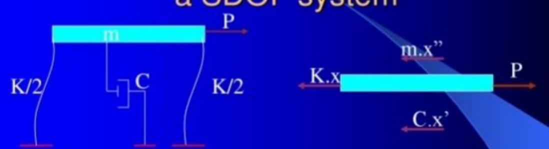
PRECAUTIONS FOR ENSURING BETTER SEISMIC RESISTANCE

- *Shailendra Sharma*
- *CE, CPWD, Hyderabad*

Major Indian Earthquakes



Modelling a Single storeyed Frame as a SDOF system

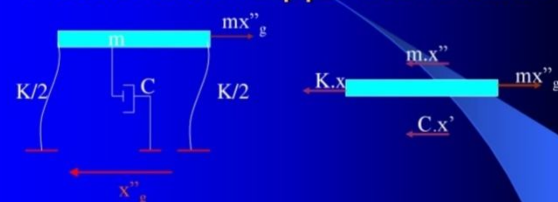


The single storey frame is shown in Fig. with the maximum of the frame mass assumed concentrated in the infinitely stiff beam/slab. The only significant motion considered is the lateral displacement of the mass. The eqn. of motion can then be written as:

$$m\ddot{x}(t) + c\dot{x}(t) + kx(t) = p(t) \qquad (1.1)$$

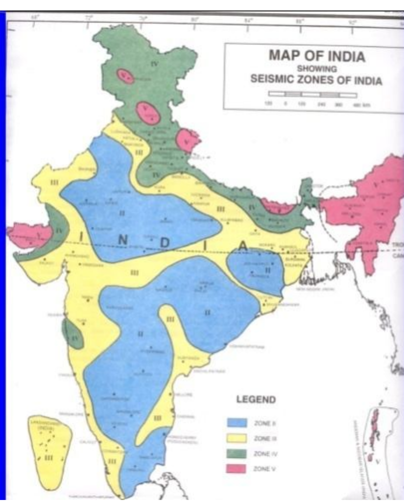
Where **mx"(t)** is the inertial (inelastic) force, **cx'(t)** is damping force and **kx(t)** is elastic force.

Modelling a Single storeyed Frame with Support Excitation



$$m\ddot{x}(t) + c\dot{x}(t) + kx(t) = m\ddot{x}_g(t) \qquad (1.2)$$

In case of external force being ground movement due to seismic excitation, the time dependent force p(t) is replaced by the term $mx''_g(t)$ on the R.H.S. of the equation.



NEW MAP

Performance Criteria for EQ Design of Structure

- The structure should resist earthquakes of minor intensity without damage. A structure would be expected to resist such frequent but minor shocks within its elastic range of stresses.
- The structure should resist moderate earthquakes with minor structural and some non-structural damages. With proper design and construction, it is expected that structural damage due to majority of earthquake will be limited to repairable damages.
- The structure should resist the major catastrophic earthquake (once-in-life earthquake) without collapse, as the principal concern is to assure life safety.
- **NO COLLAPSE DESIGN**

Ensure Ductility in Structural Design

- Ductility is the ability of building to bend, sway and deform. It is the ability of a structure to undergo large plastic deformations, after yielding, without collapse, or significant loss of strength.
- Larger the available ductility factor of a structural element, larger is the safety margin of the element against an earthquake.
- Steel reinforcement with proper detailing as per IS: 13920 - 1993 ensures ductile behaviour of structure

11/27/2015 7

USE OF BRITTLE MATERIAL & DETAILING

BHUJ EARTHQUAKE

Use of brittle materials (unreinforced masonry) and poor detailing has resulted in massive damage in past earthquakes

MUZAFFARABAD EARTHQUAKE

DAMAGE DUE TO NON-DUCTILE DESIGN/ DETAILING

9

NON-DUCTILE DESIGN/ DETAILING

0

Ensure No-Collapse Design

- The basic principles behind good reinforced concrete design are to achieve "No-collapse-design":

1) Beams should fail before columns. ("Strong Column Weak Beam")

2) Premature failure of beam-column joints should be prevented.

3) Capacity of all brittle modes of failures (shear & axial load capacity) should be higher than ductile modes of failures so that ultimately ductile rather than brittle failure should be obtained. This is called "Capacity-design".

11/27/2015 11

Ensuring Ductility in RCC Structures through Confinement

- It has been proven experimentally that the strength as well as ductility of concrete increases substantially under a state of triaxial compression.
- Transverse reinforcement prevents lateral swelling of a compression member and effectively creates a condition equivalent to hydrostatic compression. Such concrete is called confined concrete.
- The stress- strain curve for concrete subject to various types of confinement is shown next.

11/27/2015 12

Effect of Confinement on Concrete

It can be seen from the plots below that transverse reinforcement improves somewhat the first part of the stress- strain curve (in the elastic region) but more importantly, it has increasingly significant effect as maximum strength is approached and in the inelastic region beyond. So, confinement gives both advantages:

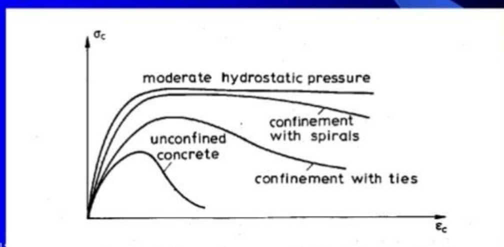


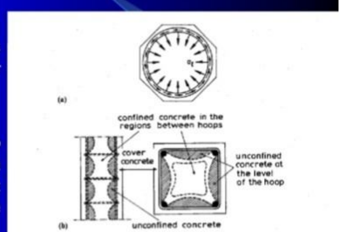
Figure 7.19 Stress–strain diagrams for concrete subjected to various types of confinemet

Ductility – confinement of concrete

- The increased concrete strength due to confinement compensates for reductions in effective concrete area due to spalling under Earthquake loading. (Spalling (failure of the cover concrete) in a RCC element occurs when the compressive strains in the cover concrete exceed about 0.40%.)
- **The most important effect of the confinement due to transverse reinforcement is that the slope of the descending branch of the stress-strain curve is reduced.** Therefore, the maximum usable strain becomes much higher than the 0.35% normally accepted by codes for flexural design. In other words, **confinement increases the ductility** of concrete members.

Circular & Rectangular Stirrups

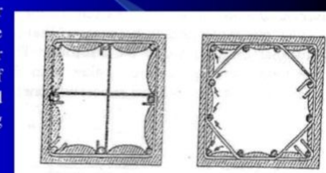
- Confinement by circular spirals is more effective than square or rectangular hoops.
- Circular spirals are subjected to hoop tension, creating an uninterrupted confinement pressure along the whole circumference as shown in Fig.



Common types of confinement: (a) with circular spiral; (b) with rectangular hoops.

Combination of Stirrups – More Uniform Confinement

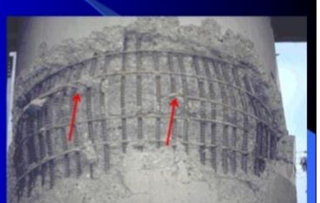
- On the other hand, square or rectangular hoops can produce substantial pressure only at their corners. Lateral expansion of core concrete causes outward deflection of hoop legs, leaving zones without confinement.



- Using combinations of rectangular hoops improves confinement.
- FOR SEISMIC RESISTANCE USE DUCTILE DETAILING AS PRESCRIBED IN IS:13920- 1993

Anchorage of Stirrup Ends is Essential

- It is very important that the legs of the stirrup are not pulled out during earthquake as it would lose confining capacity. That is why the 135 degree bend and 10 dia extension of hoop is so important in stirrup detailing for seismic design. (IS:13920)
- Note in the photo that as the links have not been anchored sufficiently, they have simply been pulled apart allowing the vertical bars to bulge under EQ loading (Kobe 1995).



Failure of Column due to lack of Confinement

- The photograph shows a column from an office building which has failed in shear due to the shaking of an earthquake. (Kobe 1995)
- Where the links have failed, the vertical reinforcement bars have buckled because the effective length of the longitudinal reinforcement bars has been increased.

NON-DUCTILE DESIGN/ DETAILING

Good Building Configuration

- There is no alternative to good planning & design
- Initial Decisions on a Project's Structural Concepts can Determine its ultimate Seismic Resistance for Better or Worse
- Once A bad Structural System is adopted it becomes difficult/ expensive to make the structure seismically safe
- Architect and Engineer should work as a team, not in isolated compartments.

Attributes to perform well in a earthquake

- **Simple and regular configuration**
- **Adequate lateral strength**
- **Adequate stiffness**
- **Adequate ductility**

11/27/2015 21

Provide Regular Configuration

- **Buildings having simple regular configuration suffer less damage than buildings with irregular configuration.**
- **Regular Configuration**
  - Simple regular geometry
  - Uniformly distributed mass and stiffness in plan and elevation

11/27/2015 22

Good Seismic Design

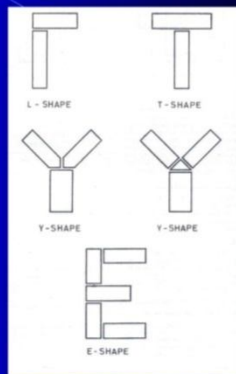
Features	***Beneficial Effect***
Ductile Detailing	Reserve Energy to prevent collapse
No-Collapse Design	Strong Col- Weak Beam, Redundancy (Rigid Connections)and capacity design ensure that structure tolerates failure of some members
Symmetrical Plan Shape	Reduces Torsion
Seismic Resistance along Both Axes	Balance Resistance in all directions
Seismic Resisting Elements at Perimeter	Maximizes Torsional resistance
Equal Floor Height/ Stiffness	Equalises Column/ wall stiffness
Uniform Section & Elevation	Avoids Stress Concentration

Relevant BIS Standards

- IS4326-1993 : Earthquake Resistant Design and construction for buildings – code of practice
- IS 1893-2002 : Criteria for earthquake resistant design of structures
- IS 13920-1993 : Ductile detailing of RC structures subjected to seismic forces – code of practice
- IS 456-2000 : Code of practice for plain and reinforced concrete

Typical Plan- Shapes of Building With Separation Sections (IS: 4326)

- Large Buildings with plan shapes like L, T, Y or E etc. Should preferably be separated into rectangular blocks by providing appropriate separation sections.
- At separation sections, complete separation of parts should be made except below plinth. The plinth beams and foundations may be continuous.



11/27/2015 25

Plan Irregularities IS:1893-Table 4

- Torsion Irregularity
- Re-entrant Corners
- Diaphragm Discontinuity
- Out-of-plane offsets
- Non-parallel systems
  - Buildings with plan irregularities, as defined in IS:1893-Table 4 (as per 7.1), are not allowed to be modeled for dynamic analysis by the method given in 7.8.4.5 (Lumped Mass Model) of code and detailed 3D analyis is required.

11/27/2015 26

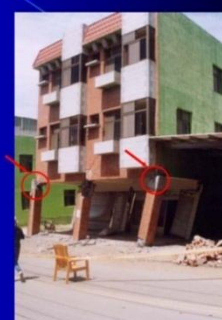
Vertical Irregularities- IS:1893-Table 5

- Stiffness irregularity – soft storey
- Mass irregularity
- Geometric irregularity
- In-plane discontinuity
- Discontinuity in capacity (lateral strength) i.e. weak storey

11/27/2015 27

Vertical Irregularities Soft Story

- **Stiffness irregularity – Soft Storey**
  - A soft storey is one in which the lateral stiffness is less than 70 percent of that in the next upper storey
  - or less than 80 percent of the average lateral stiffness of the three storeys above.



11/27/2015 28

Vertical Irregularities Soft Story

- **Stiffness irregularity – Extreme Soft Storey**
  - An extreme soft storey is one in which the lateral stiffness is less than 60 percent of that in the storey above
  - or less than 70 percent of the average stiffness of the three storeys above, e.g., buildings on STILTS will fall under this category.

11/27/2015 29

Summarising

- No substitute to good planning & design
- Structures designed and constructed as per BIS codes for Earthquake resistant design have withstood earthquakes of Bihar, Uttarkashi, Latur, Jabalpur and Gujarat
- In Gujarat earthquake, none of the CPWD buildings suffered major damage

Precautions for Improving Wind/Cyclone Resistance of Buildings

Precautions for Improving Wind/ Cyclone Resistance of Buildings

Shailendra Sharma
Chief Engineer, CPWD
Hyderabad

Action of Wind Forces

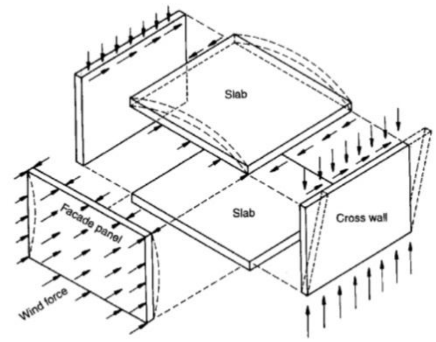
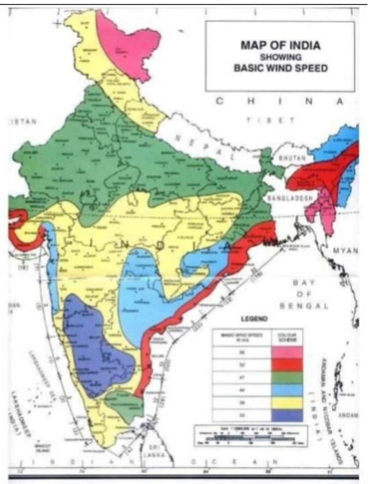


Fig. 6.1 The action of wind forces on a building. Wind force is resisted by the facade panel owing to bending, and transferred via floor slabs to the cross or shear wall and finally to the ground. (Structural Clay Products Ltd.)

Wind Load

- IS:875- Part 3
- Basic wind speed Map(based on 50 year return period)



Designing for Wind Load IS:875- Part 3

- Equivalent static load method for steady wind load is ok for short and heavy structures
- Gust factor method considering drag on structures for flexible structures
- In case of tall structures with unsymmetrical geometry, designs are to be checked for torsional effects

Wind Load

- Depends on
  - Risk level of the Structure being designed
  - Terrain roughness, Height and Size of structure
  - Local Topography

Wind Load

- Design wind speed

$$V_z = V_b\, k_1\, k_2\, k_3$$

  - V_z = design wind speed at any height z in m/s
  - V_b = basic wind speed in m/s (from Wind Map)
  - k_1 = Risk Coefficient (importance factor) : 1.00 for Ordinary buildings to 1.08 for Important Buildings
  - k_2 = Terrain, Height and Structure Size factor: e.g. for Buildings upto 10m height & Category-A :varies from 1.05 at seacoast to 0.80 in Built up City area
  - k_3 = Topography factor: Larger for ridges, Smaller for valleys due to deceleration of wind

Wind Load

- Design wind pressure

$$p_z = 0.6\, V_z^2$$

Where,
Design Wind Velocity V_z is in m/s
Design Wind Pressure p_z is in N/m^2

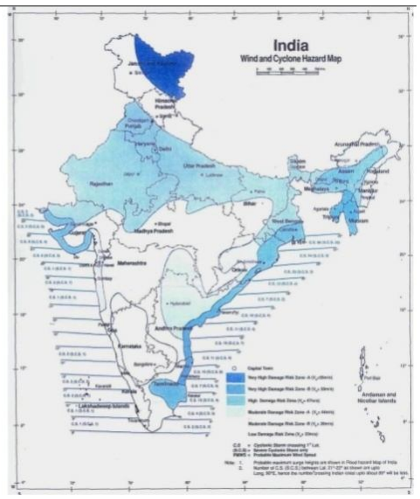
It is known that in certain events, the wind gusts can appreciably exceed the specified wind speeds by as much as 40-55% but for design of structures (except those considered very important), V_z only is used

TOWERS & MASTS

COLLAPSED LATTICE TOWERS - HUDHUD CYCLONE- Oct 2014

- Dynamically sensitive structures such as transmission line towers, chimney stacks, steel water tanks etc. should be designed following dynamic design procedure in IS:875-Part 3

Wind & Cyclone Hazard Map of India



Planning for Better Wind Resistance - **Site Selection**

- Cyclonic storms in coastal areas approach from sea but wind direction with reference to building remains random
- Avoid construction along ridges. Valleys experience lower wind speeds

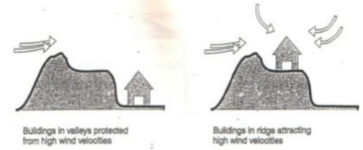
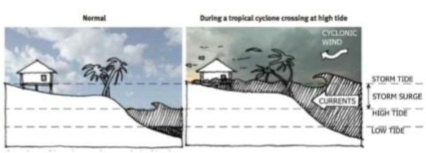


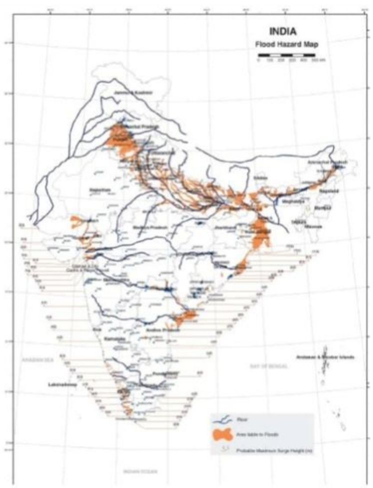
fig 6
Appropriate location of buildings in hilly terrains

- Storm tides accompany cyclonic storms. When close to coast, choose a site above likely inundation level.



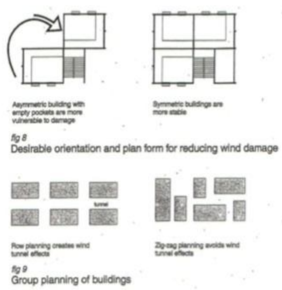
- Otherwise construct on stilts and with knee bracings above maximum storm surge level. This allows free passage to floating debris in surge.

Flood Hazard Map of India



Building Configuration

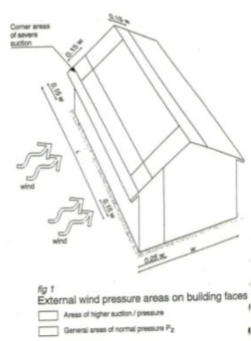
- Cyclonic winds can blow from any direction. **Building must have resistance in both directions.**
- So a **Symmetric, Circular or Polygonal plan shape works better** for wind resistance
- **Compact plan-forms** work better than an Asymmetric plan with many empty pockets that are more prone to damage



Doppler Weather Radar on top of Kailasagiri Hill, Vizag

Vulnerable areas in Roofing

- Roof projections, Roof corners and wall corners experience high suction pressure
- Large openings only on one side of bldg. can further cause high internal pressure ($0.7p_z$)
- Opening may be caused by façade failure too, causing progressive failure !



ROOF SHEETING- Industrial Buildings

LOSS OF CORRUGATED, METAL ROOF SHEETS

ROOF SHEETING

LOSS OF CORRUGATED, METAL ROOF SHEETS

ROOF SHEETING

LOSS OF CORRUGATED, METAL ROOF SHEETS

Industrial/ Metal Roofs

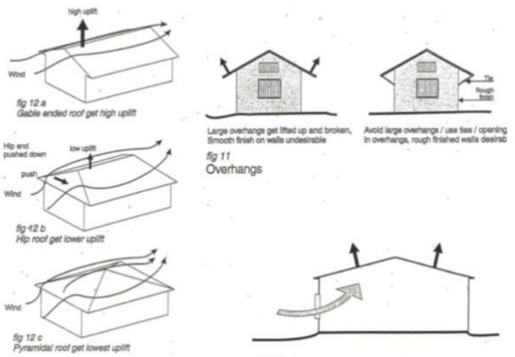


fig.12
Effects of roof architecture on uplift forces

fig 13
Unclosed openings on windward side create high positive pressure inside aiding uplift

TYPES OF ROOF SHEETING FAILURES

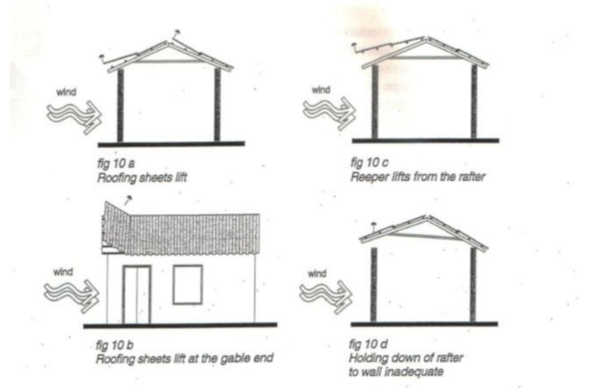


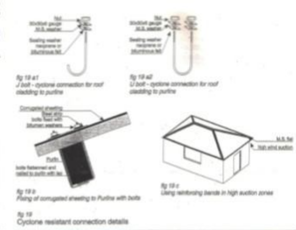
fig 10
Types of roof damage due to wind

Connections for Cladding

- Local pressure coefficient given in IS:875 –Part 3 to be used for design of connections of cladding to truss structure particularly near corners and roof edges.
- U-bolts instead of J-Bolts may be used for Cyclone resistant connections.

Connections for Cladding

- Otherwise Reduced spacing of J-Bolts at ¾ of that recommended in IS:800 should be provided for Cyclone resistant connections.
- A steel strap may be provided along at least the edges and ridges to fix cladding with the purlins to avoid punching through the sheet



Connections for Cladding

- Roof truss in turn should be properly anchored with anchor bolts and base plate in RCC lintel band / beam /column OR masonry wall below
- Purlins should be properly anchored at gable end.

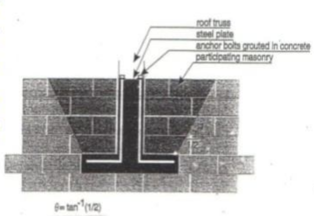


fig 21
Anchoring of roof framing in masonry

Roof Bracings to be provided in Industrial Buildings

- Adequate diagonal or knee bracing should be provided at rafter and eaves level. At least at the two ends of building.
- If number of bays is >5, additional bracing to be provided in every fourth bay

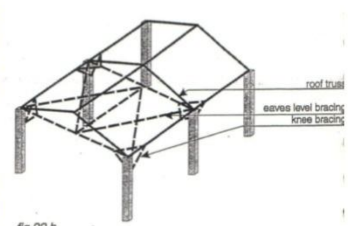


fig 22 b
Eaves level knee bracing

Roof Bracings to be provided in Industrial Buildings

- To reduce vibration/flutter, cross bracings to be connected/ welded at crossings and bracing connections at the ends be with at least two bolts/ welds.

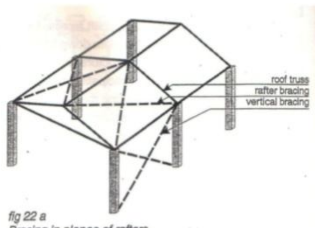
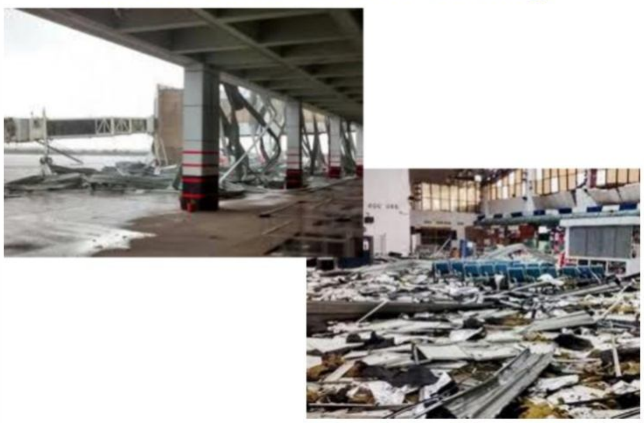


fig 22 a
Bracing in planes of rafters

Glass Panelling

- One of the most damaging effects of strong winds is seen in extensive failure of glass panes due to high local wind pressure or debris impact.
- Broken glass on windward side further increases internal pressure abnormally causing progressive failure including a roof failure. Vizag airport is a case in point.

Avoid Glass Curtain Walling



Avoid Glass Curtain Walling !

- Avoid glass curtain walls
- Keep Roof Projections preferably upto 500mm only required for rain protection. Or Tie-down

Lessons to Learn

- In Cyclone prone areas **slope of Pitched roof** should be in the range of **22- 30 degrees**. Flatter slopes than this create larger uplift due to **Aerofoil Effect**.

- **Large openings in facade covered in glass curtain walls** may be easily damaged by wind or debris, creating additional positive pressure from below, further adding to the suction and causing **Progressive Failure**

Avoid Glass Curtain Walling !

- Avoid glass curtain walls
- Keep Roof Projections preferably upto 500mm only required for rain protection. Or Tie-down

Glass Panelling

- Use smaller panel size of glass.
- Glass can be strengthened by using sandwich PVB film glass panels. This also reduces glass vibration by increasing damping.
- Provide metallic mesh outside glass panels. It protects glass against flying debris impact.
- Locking arrangement of door & window shutters should be sturdy and frames should be securely fixed to walls using hold fasts to resist local wind pressures

PASSPORT OFFICE BUILDING

Foundations

- Foundations of structures should be heavy enough and sufficiently deep/anchored.
- Flooding and tidal surge upto 10- 15 km inshore may cause soil saturation reducing the bearing capacity.

TOO SMALL FOUNDATION FOR LIGHT WEIGHT BUILDING, UPLIFTED & PULLED COMPLETELY OUT OF THE GROUND

Foundations

- Power supply should ideally be underground to reduce load/ damage due to falling branches, to power/ lighting poles.
- Else foundation block should extend high enough above ground so that natural frequency is more than 1.5 Hz

Power & Communication Failure poses major problem in post-cyclone scenario

Foundations

- Protection works of raised ground and depth of foundation should be decided accordingly taking into account the possibility of scour.
- In hilly terrain, on terraces, provide minimum edge distance of 1.5 times fndn. Depth upto the edge of terrace. Rest foundation on firm natural strata.

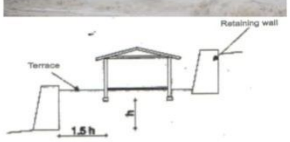


fig 17
Recommended edge distance of foundations in hilly regions

KEEP EDGE DISTANCE OF FOUNDATION FOR BUILDING ON TERRACES IN HILLY TERRAIN

Strengthening of Masonry Walls

- In Cyclone prone areas (V_b >50 m/s), for strengthening of masonry walls, it may be necessary to provide **RCC Lintel bands, Roof bands and Gable bands** as prescribed in IS:4326 for seismic resistance.
- For **retrofitting, ferro-cement plating** may be done all around the exterior perimeter of wall between lintel and roof level.
- Buttresses @ 5m spacing may be provided in long walls to reduce unsupported length.
- Openings in walls should be small and not close to edges/ immediately below roof.
- For compound walls also, RCC bands be given.

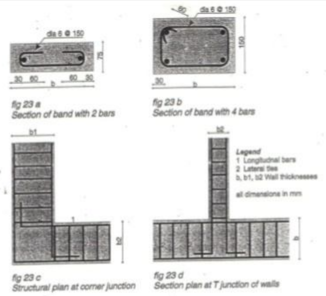


Table 2 : Recommended Longitudinal Steel in R.C. Bands
(High Strength Deformed Bars, Fe415)

Span	Design Wind Speed, m/s							
	>55		50-55		44-49		33-44	
m	No. of Bars	Dia. mm	No. of Bars	Dia. mm	No. of Bars	Dia. mm	No. of Bars	Dia. mm
5 or less	2	10	2	8	2	8	Nil	-
6	2	12	2	10	2	8	Nil	-
7	4	10	2	12	2	10	2	8
8	4	12	4	10	2	12	2	10

Summarising

- Site Selection
- Proper Building Configuration
- Proper Design
- Proper Building Materials
- Bracings in Steel Structure
- RCC Bands in Masonry
- Strong Connections, esp. Near the Edges
- Strong & Well anchored Foundations

CPWD in the Service of Nation for 161 Years

BUILDING COMMUNITY DISASTER RESILIENCE THROUGH MULTI-SECTORAL COLLABORATION AT LOCAL LEVEL

Jayashree Parida, Niharranjan Mishra

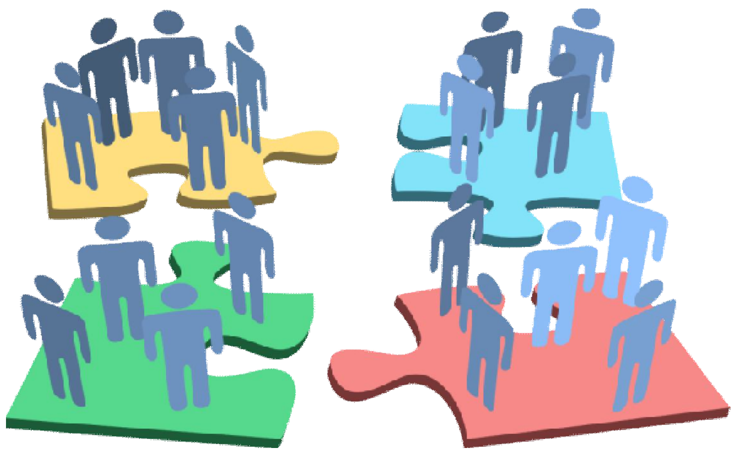
Abstract

Effective and meaningful collaboration among the stakeholders: Government, Non-governmental Organizations (NGOs), Local governance, and also the community are imperative to attain the goals of disaster resilience of a community. Building disaster resilience, particularly for people living in developing countries, is essential for ensuring sustainable development and the protection of development gains made so far for any community, region or nation at risk from disasters. Multi-Sectoral collaboration among all stake holders could improve the ability of a community to mitigate, prepare for, respond to, and recover from natural or human-caused disasters. Disaster risk can be reduced by strengthening resilience: the ability of communities to resist, cope with and recover from shocks. According to the World Bank, for building disaster resilience, five areas should be focussed: a) Risk identification, b) Risk reduction, c) Preparedness, d) Financial Protection and e) Resilient reconstruction. However, the study is an attempt to identify the organizational relationship among all stakeholders in disaster resilience programmes particularly at district and panchayat level. In this paper, the study was carried out in Balasore and Kendrapara districts of Odisha, India which are more prone to disasters like floods. Respondents were the Government officials, local panchayat leaders, NGOs and also the community engaged in disaster management directly or indirectly were interviewed in order to have broader views and opinions on policy matters, problems and potentials and to evaluate their roles in that particular area. Open and close- ended questions were used for this purpose. A SWOT analysis was used to focus on the strengths and weaknesses of collaboration in relation to efficiency, capacity building, quality and accountability. The study found that the effective collaboration is lacking among all stakeholders at local level. Majority of the respondents from NGOs were not satisfied with the existing mechanism of collaboration because of more control and authority over NGOs. There is irregularity of interaction between Government officials, NGOs and panchayat leaders which makes the collaboration weak. It is recommended that mutual respect, trust, transparency and accountability should be present among all the stakeholders.

Keywords: *Capacity Building, Disaster Resilience, Multi-Sectoral Collaboration.*

♣

STAKEHOLDERS



- Role of National Service Scheme (NSS) in Disaster Management – *Dr. Prashant Amrutkar*

ROLE OF NATIONAL SERVICE SCHEME (NSS) IN DISASTER MANAGEMENT

Dr. Prashant Amrutkar
Associate Professor, Department of Political Science, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra, India

Abstract

In India, National Service Scheme (NSS)is committed to providing assistance, among other things, in critical sectors like health, education, water supply and sanitation, shelter and infrastructure, restoration of livelihoods, food security and nutrition and environment. In this sense, it plays a crucial in this country where there isa pronounced vulnerability to the natural and man-made disasters.Launched in 1969,NSS is run under the Ministry of Youth Affairs & Sports, Government of India. College and university students comprise the NSS cadre across the country.

Roots of volunteerism and social service run deep in India, receiving special attention during the freedom struggle with theGandhian idea ofShramdaan. In recent times, NSS has strengthened this idea by undertaking to provide humanitarian assistance to disaster-affected people wherever such calamities have occurred. Role of NSS is specifically worth mentioning in Killari, a place in Marathwada region in Maharashtra, where a colossal quake struck in 1993, claiming about 10,000 lives and destroying properties across fifty-two villages around Latur and Osmanabad districts.The NSS volunteers did an exemplary job in the affected region. The present research works proposes to evaluatethe role and the emergent impact of NSS volunteerism in complementing relief operations duringKillari earthquake.

The present study seeks to test three hypotheses. First, potential of youth power is very important in disaster management. Second, volunteers of NSS have been playing a significant role in providing humanitarian assistance to disaster-affected people. Third, role of NSS has started changing from providing post-disaster relief to strengthening pre-disaster preparedness.

This research work will use primary and secondary data to analyse the role of NSS in disaster management. Random sampling will be done in six most affected villages of Latur and Osmanabad. The research will also employ qualitative as well as quantitative methods for the purpose.

Key words: *NSS, disaster management, Shramadan, volunteerism*

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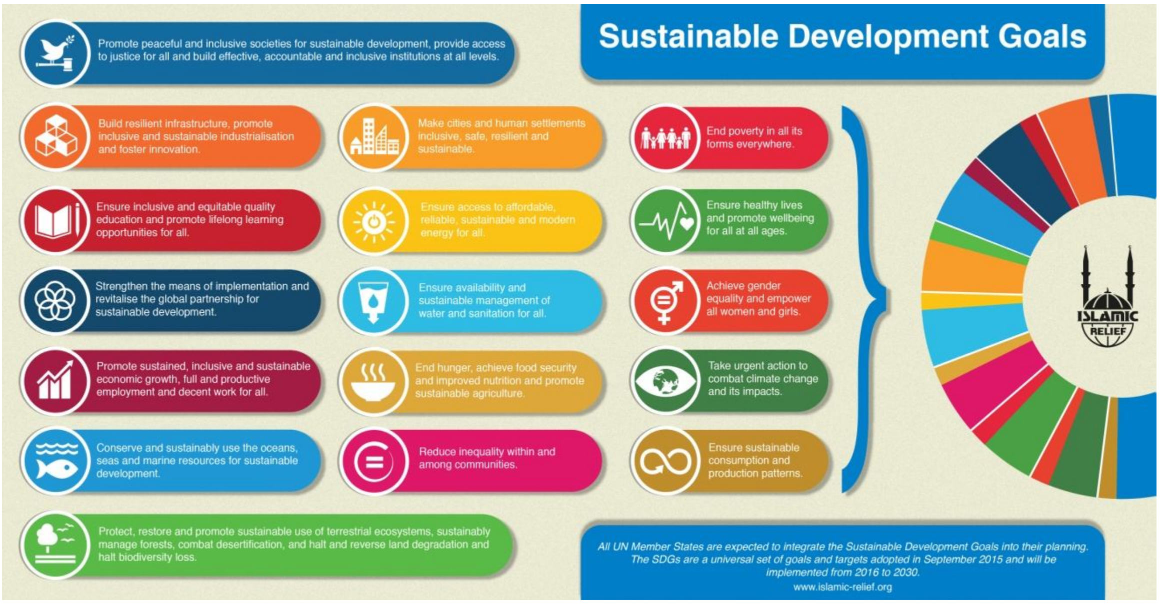
SUSTAINABLE DEVELOPMENT GOALS



- Cultural Discourse of Space: An alternative on Sustainable Development

  - Dr. Ritu Sharma.
- Sustainability and Survivability: Exploring the Nexus Between Disaster Management and Sustainable Development - *Manika Kamthan*

CULTURAL DISCOURSE OF SPACE:
AN ALTERNATIVE ON SUSTAINABLE DEVELOPMENT

Dr. Ritu Sharma
Kamla Nehru College, University of Delhi

Abstract

The increase of environmental damage due to human activities resulted in the emergence of environmental discourse as a public and political phenomenon. Therefore, environment problems are constructed through the intervention of certain activities in the society. Nature-based conflicts have intensified in terms of destruction as an offshoot of development in the recent times. They revolve around competing claims over forests, land, water, fisheries, and have generated a new movement struggling for the rights of victims of ecological degradation. However, there is a close affinity between the locality and its context-as in indigenous ways to preserve the environment for future generation. There is an urgent need to enable dependent populations the required knowledge, skills and meanings, in order to preserve the resources. As in everyday lives- we ignore the significant context and its influence, 'so much depends on the context' (Clifford and Valentine, 2003:127). Hence, an investigation needs to be done in relation to communities vis-à-vis space. What is the appropriate context of relationship and how is it useful in extracting the better use of environmental resources viz land, water and air? Taking clues from many countries dominating their cultural practices in terms of religious, cultural and political laws influencing their way of life.

♣

SUSTAINABLITY AND SURVIVABILITY: EXPLORING THE NEXUS BETWEEN DISASTER MANAGEMENT AND SUSTAINABLE DEVELOPMENT

MANIKA KAMTHAN

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Abstract

The disciplines of environmental management, disaster management and sustainable development share a lot in common like concepts, issues, processes and concerns. Yet they are seldom put in the same academic domain. This paper seeks to explore the nexus between sustainability and survivability. The disaster management mainly deals with recovery and post disaster reconstruction. The concept of disaster needs to be located in the domain of environmental management and sustainable development. The environmental degradation is undoubtedly one of the primary causes of natural disasters. However, when disaster management guidelines are formulated the environmental management is squarely ignored. As a result of which the concepts of sustainability and survivability are separated which otherwise are closely linked.

This paper argues that justice and equity issues in the disaster management can only be addressed when substantial effort is put in assuring sustainable development, which is possible only through effective environmental management. It is usually argued that poor or vulnerable sections of the population of the developing countries are both the cause and victims of the environmental degradation. Ms. Indira Gandhi while speaking in the Stockholm Conference on Human Environment in 1972 said, "On the one hand the rich look askance at our continuing poverty- on the other, they warn us against their own methods. We do not wish to impoverish the environment any further and yet we cannot for a moment forget the grim poverty of large numbers of people. Are not poverty and need the greatest polluters?" The things have not changed much since 1972. The development and prosperity of one class of the society is still the deprivation of other class. Various development projects put forward the unattended questions of rehabilitation of indigenous people, environmental hazards which ultimately result into natural or manmade disasters. The Uttarakhand flood in 2013 and the more recent Pune landslide are the glaring examples of natural disasters which were really propelled by unsustainable development and human activities. This paper seeks to explore the intertwined issues of environmental management, disaster management and sustainable development with the objective to make a point that they should be addressed simultaneously. The water tight compartmentalization of them leads to disasters which are unmanageable and grave in nature. The paper has adopted qualitative research method based on secondary source in the form of reports, government data, books, research articles etc. It concludes by identifying areas where environmental management, disaster management and sustainable development can and should interact more positively to support long-term recovery and reconstruction.

Keywords: *environment, disaster, management, sustainable development, equity etc.*

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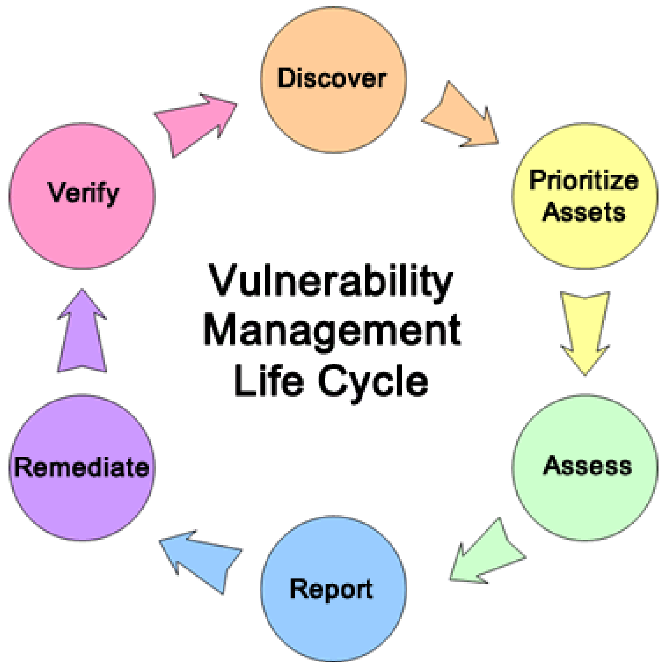
VULNERABILITY



- Disaster Vulnerability a National Mayhem: An International Grief - *Gajadhar Choudhary*
- Development and Vulnerabilities: A case from Sahyadri Mountain - *Shailendra Rai and Omkar Khare*
- Defining Vulnerability from the flood prone area: A case study at Village Shival, Bairiya Tehsil, Ballia (UP) -*Shishir Kumar Yadav*
- Social Vulnerability to Disaster and Need for Social Policy: A Study of 2015 Flood in West Bengal - *Dr. Rabindranath Bhattacharyya*
- Remembering Durkheim: A Sociological Perspective on Disaster Risk Reduction- *Sanghamitra Nath*
- Disaster and Social Vulnerability- Experiences of Dalits in India -*Binod Kumar*
- Most vulnerable social elements of natural disaster in Bangladesh: Surviving pattern and search for a new paradigm - *Nazmul Huda*

DISASTER VULNERABILITY A NATIONAL MAYHEM: AN INTERNATIONAL GRIEF

Gajadhar Choudhary
Research Scholar (MITIGATOR)

Abstract

Natural Disasters and Calamities throw up major challenges for national governments in many countries of the Asian region. Earthquakes, floods, cyclones, epidemics, tsunami, and landslides have become of common occurrence in the region, repeatedly taking a heavy toll of life and property. Asia experienced in 2009 a largest share as reported in natural disaster occurrence (40.3%), which was accounted for 38.5% as reported in total economic damages (US$ 41.3 billion). Natural disasters took a turn in 2010, caused US$ 123.9 billion of economic damages. Out of total 385 disaster recorded in 2010, Twenty-two were in China, Sixteen in India and Fourteen in Philippines.

The world economic vulnerability was only 54 billion US$ in the year 1980, became 63 billion US$ in 1990, 210 billion US$ in 2011 and finally to 300 billion US$ in 2015. Expected future disaster losses, climate change US $ 100 billion, by 2050, 40% of the global population will be living in the river basins in Africa and Asia. Global average annual loss is estimated to increase up to US$ 415 billion by 2030. Asia has average economic damage in the 1990 was 12 billion US$. According to the report, says India's average annual economic loss due to disasters is estimated to be $9.8 billion in 2015. This includes more than $7 billion loss on account of floods. State Andhra Pradesh has (2 billion US$) average annually. The Economic vulnerabilities exacerbate the impact of a disaster and make the process of recovery and rehabilitation very high opportunity costs. Developing Countries in Asia start losses 2-15% GDP annually. Global risk investment required US$ 6 trillion yearly for 15 years, Asia and India to evaluate Information to disaster, Infrastructure to risk and Incentives to community for future disasterrisk reduction, investment up to 2.4 US$ trillion average annually for 15 years (2015-2030).

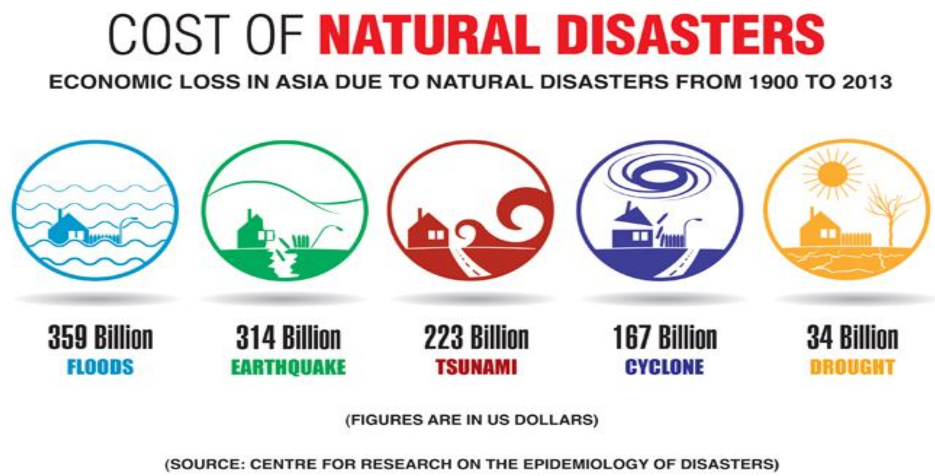
Key Words: *Economic Vulnerability, Information, Infrastructure, Incentive*

Introduction

Economic losses from disasters such as earthquakes, tsunamis, cyclones and flooding are now reaching an average of US$250 billion to US$300 billion each year. Future losses (expected annual losses) are now estimated at US$314 billion in the built environment alone. This is the amount that countries should set aside each year to cover future disaster losses. The mortality and economic loss associated with extending risks (minor but recurrent disaster risks) in low and middle-income countries are trending up in the last decade, losses due to extensive risk in 85 countries and territories were equivalent to a total of US$ 94 billion.

World Economic Disaster for last 2000 to 2012 (12) Years.

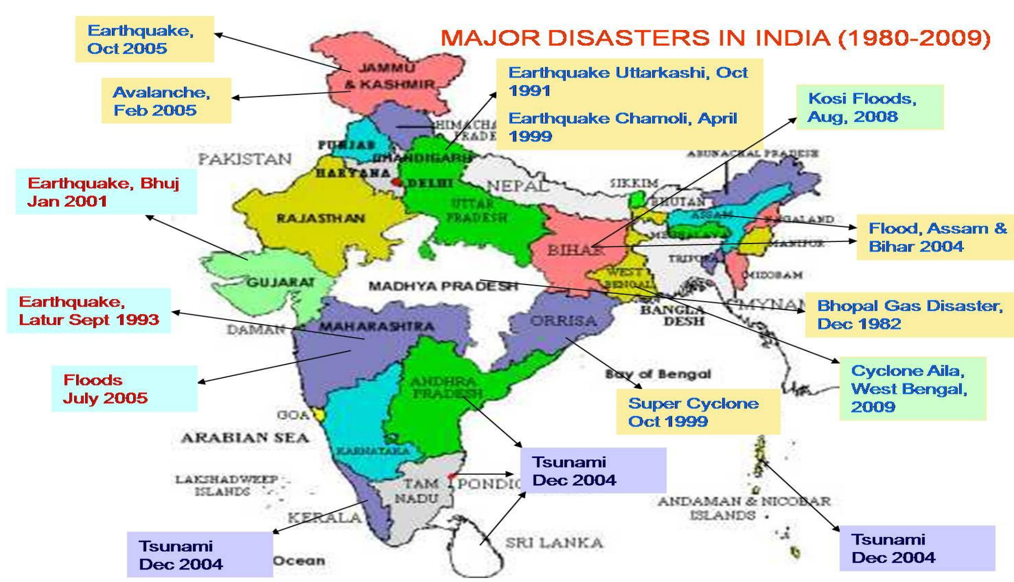
Asia is the most disaster-prone region in the world and has borne brunt of the physical and economic damages of natural disasters. Since 1900, drought has killed 9,663,389people, floods 6,794, 307, earthquakes 1,559,558, cyclones 1,242,150, and tsunami 261,915 people.



Economic Losses of Asia for 113 years (1900 to 2013)

India out of total geographical area of 33 lakhs (3.3 million) sq km, about 60% of the landmass is prone to earthquakes of various intensities; over 40 million hectares is prone to floods; about 8% of the total area is prone to cyclones and about 68% of the area is susceptible to drought. Of the 36 states (36) States/Union territories in the country, twenty-two (23) are disaster prone.

A new United Nations global assessment report on disaster risk, released last week, says India's average annual economic loss due to disasters is estimated to be $9.8 billion. This includes more than $7 billion loss on account of floods. The global assessment report (GAR) 2015, produced by the UN Office for Disaster Risk Reduction (UNISDR), has urged countries, particularly in Asia, to treat this as a wake-up call and make adequate investment in disaster risk reduction (DRR) or it will hinder their development. "The report is a wake-up call for countries to increase their commitment to invest in smart solutions to strengthen resilience to disasters.



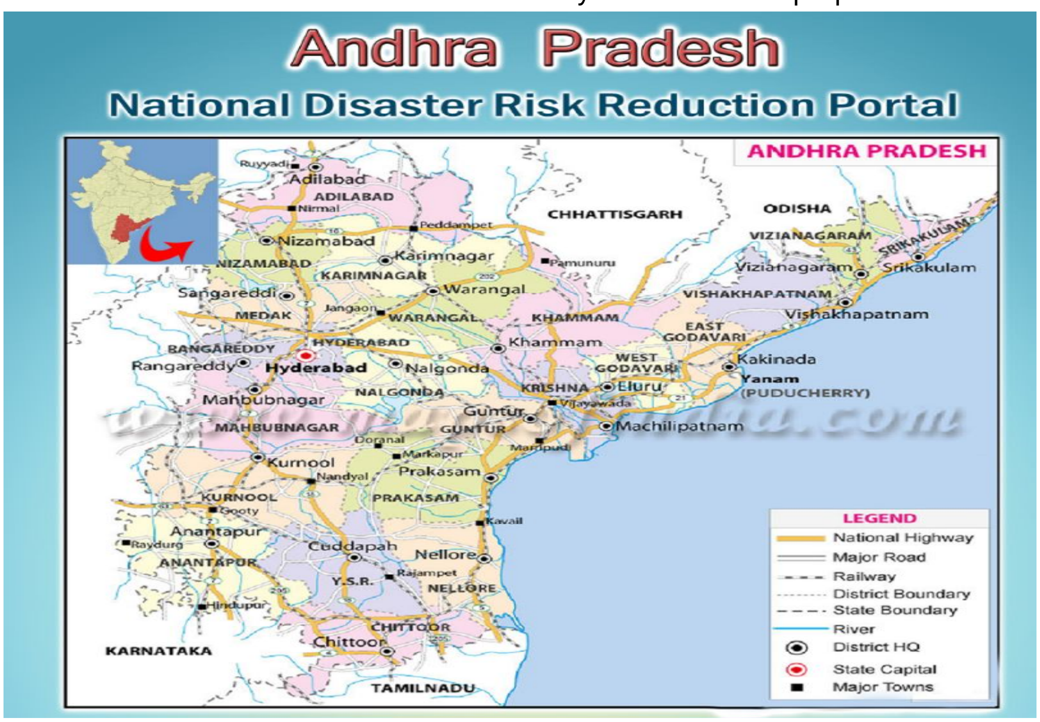
India has projected a $1 trillion investment in infrastructure in the next five years and unless adequate steps are taken to make them resilient to floods and other natural calamities, the investment runs the risk of going waste.

A Thomson Reuters Foundation report said about 4.8 million Indians are hit by disasters each year at present, but by 2030 that could rise to about 19 million, if India could not invest for DRR. India has more of its annual GDP exposed to river flooding each year, on average, than any other country. Its current $14.3 billion exposure could increase to about $154 billion by 2030," the report said, quoting a flood analyzer developed by the World Resources Institute (WRI).

By 2050, it is estimated that 40% of the global population will be living in river basins that experience severe water stress, particularly in Africa and Asia.In the Caribbean basin, climate change will contribute an additional US$1.4bn to theexpected annual losses from cyclone wind damage alone.

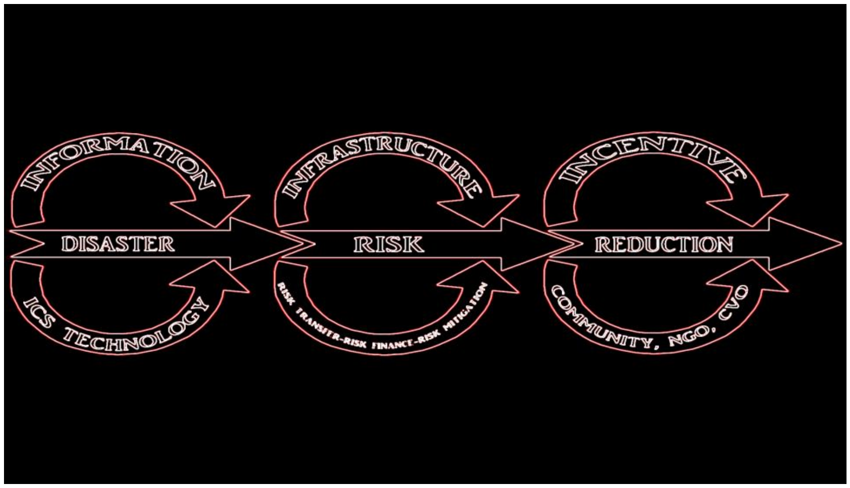
Andhra Pradesh is one of the most vulnerable states in India to multiple natural disasters like cyclones, heavy rains and floods, including drought in view of its widespread and peculiar geographical location. The State has a vast coast line of about 1,030 km, which is the second largest in the country, next to the western coastal State of Gujarat. Andhra Pradesh has the longest coast line on the Eastern coast of India. Andhra Pradesh is exposed to cyclones, storm surges, floods and droughts. A moderate to severe intensity cyclone can be expected to make landfall every two to three years. About 44 percent of the state is vulnerable to tropical storms and related hazards. In India, the cyclones develop in the pre-monsoon (April to May) and post-monsoon seasons (October to December), but most of them tend to form in the month of November Cyclones on the east coast originate in the Bay of Bengal, the Andaman Sea or the South China Sea.

The Cyclone "Nilam" brought heavy rains resulting in floods during the period from 29.10.2012 to 06.11.2012 and affected 19 districts of the state with heavy tolls of lives and properties.



Coastal belts of Andhra Pradesh vulnerable to Coastal Cyclones and Floods

After through studies and observations of Global Assessment Report, 2015 at Sendai(Japan) and World Disaster Report, 2015, more focus has been made to 'Manage Risk' rather than 'Manage Disasters' as well as advancement of human technologies. Manage disaster successfully observed in case of Cyclone Phailin in Orissa, but can't manage risk (damage) scenario. Now it has become more evident to follow (I^3) measures for future DRR. Information to Disasters by Information-Communication-Space Technology, Infrastructure to Risk by Risk Transfer, Risk Finance and Risk Mitigation and lastly Incentive to Community by applying local and indigenous knowledge for savings lives and livelihoods with the help of NGO & CVO.



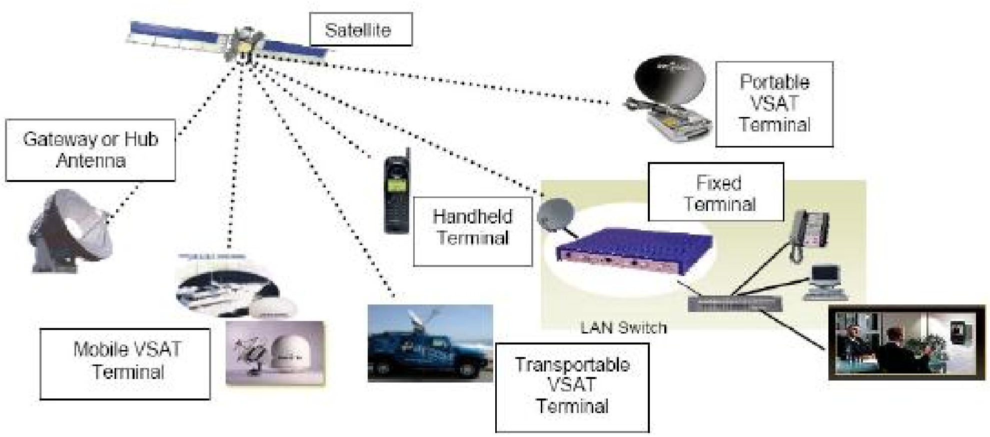
New (I^3) Mantra for Global Resilient and Sustainable DRR-MITIGATOR

Information to Disasters

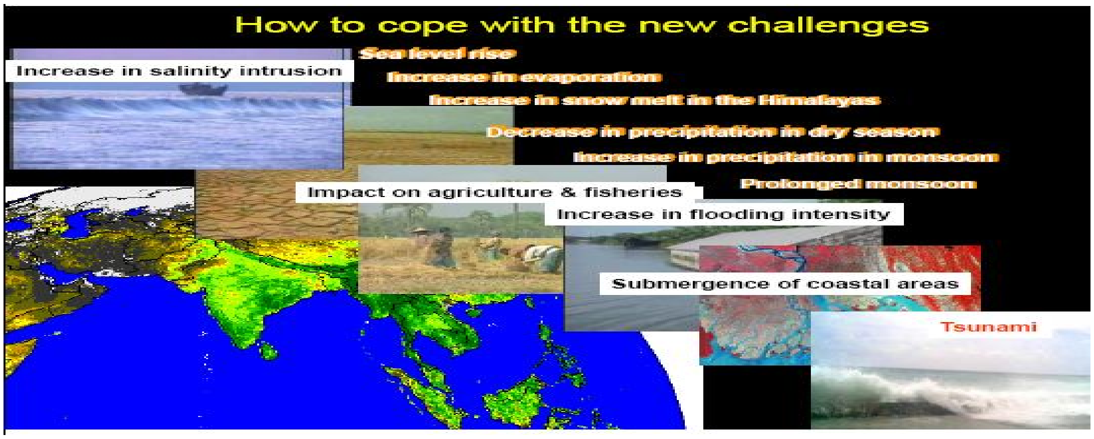
Early Warning, Early Action: Disaster Preparedness and Mitigation

Disaster advances in Asia would require strong disaster-resilient community with Information, Communication and Space Technology (ICST) to reduce disaster losses. The developing countries to be able to incorporate the routine use of space technology-based solutions.

Topology of Space Technology for DRR



Most of the Cyclone–prone countries of the Asia-pacific region have made considerable investments in modernizing Early Warning Systems. In 2014 a progressive experience of Cyclone/Typhoon has been followed. There are Meteorological, Hydrological and disaster risk reduction components that need to be integrated fully into early warning products and services. Advance weather satellite, radars, and observational network have contributed significantly to enhance the meteorological components; more efforts are required to reach the information in real time, real place/person in a local language that leads to local knowledge for saving local people's lives.

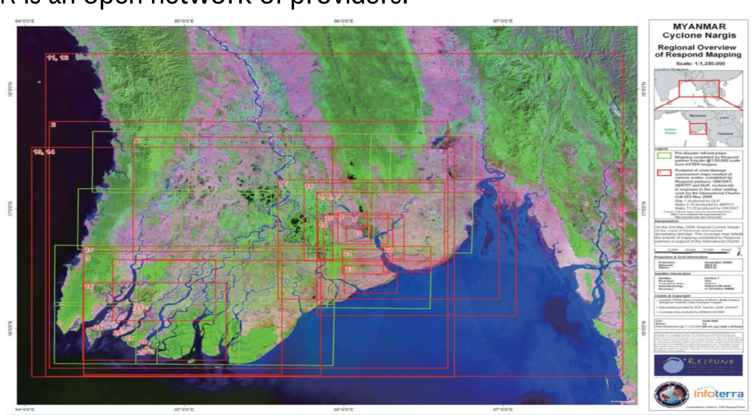


Asia is more Vulnerable to New Challenges

The ESCAT/WMO Typhoon Committee (TC), which services 14 members' countries, and the WMO/ESCAP Panel on Tropical Cyclone (PTC), which assist eight member countries in the Bay of Bengal and Arabian Sea have worked towards improving early warning capacity for typhoon and tropical cyclones.

Recent technological innovations in each observation satellite, weather radar, storm-surge, and cyclone reduction modeling. This modeling has been possible significantly enhance the accuracy of cyclone path tracking with severity estimated, landfall prediction. A twin track strategy for regional cooperation, one would enhance the capacity of early warning products and services by balancing meteorological, hydrological and disaster risk reduction components and track two focus on end-to-end early warning and response in terms of reaching out to the 'last mile' of the community at risk, particularly in low profile with high risk countries.

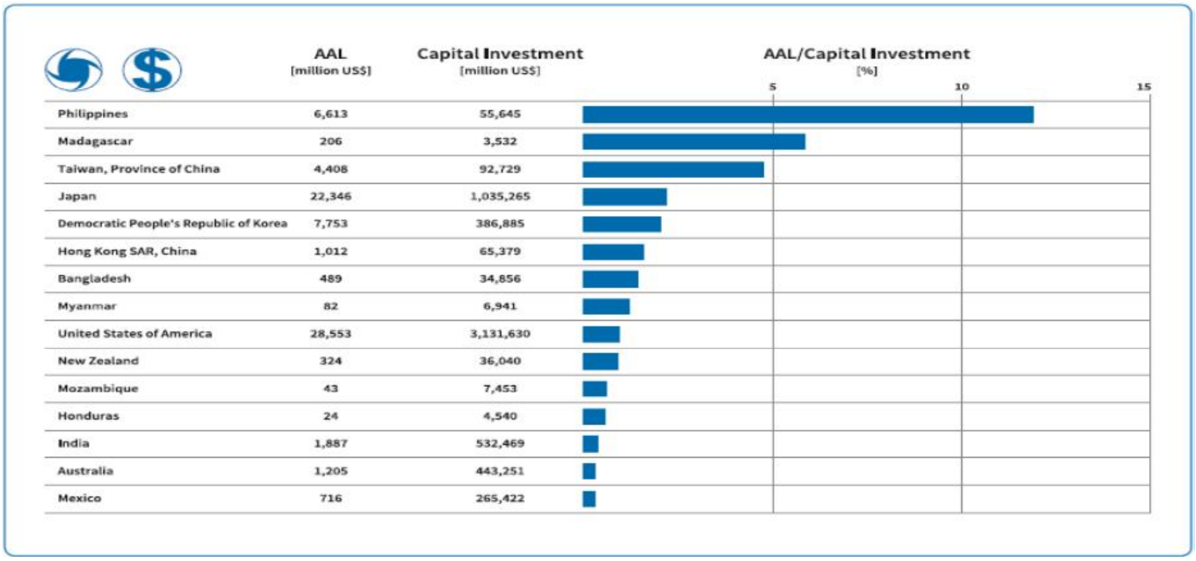
The super-cyclone that impacted the State of Orissa, India on 29 and 30 October 1999 killed 9,843 people. Sixteen years later, in October 2013, no more than 47 died when the equally powerful Cyclone 'Phailin' swept through the same area. Despite much progress, gaps remain integration of comprehensive risk information into hazard warning information is still weak, and it is still rare for alerts to provide information on the level of risk and possible actions beyond evacuation alerts.(UN-SPIDER) is a gateway to space information for disaster management support and serves as a bridge between the disaster management and space communities (UNOOSA, 2010). Promoted by the UN Office for Outer Space Affairs (UNOOSA), this will ensure that all countries and international and regional organizations can use all types of space-based information. UN-SPIDER is an open network of providers.



UN –Spider for Track & Impacts measuring Space Affair Technology

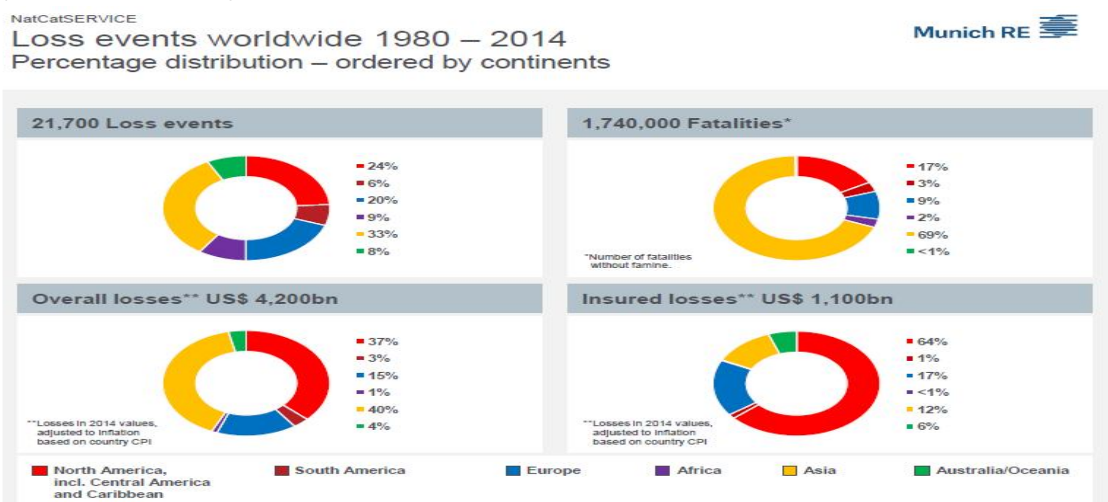
The development and implementation of early warning systems has been repeatedly cited as one of the areas where the most progress has been made within the HFA (WMO, 2011, 2014a; UNISDR, 2013b, 2011b). Success stories from Bangladesh, Chile, India, the Philippines and other countries show that timely and effective warning and communication coupled with risk information and a prepared population significantly reduces mortality.

Early Warning Developing15 Countries investment towards Early Warning for DRR



Infrastructure to Risk

Making infrastructure disaster-resilient encompasses structural and nonstructural measures. Structural ones include flood control systems, protective embankments, seawall rehabilitation, and retrofitting of buildings. Nonstructural measures refer to risk transfer, risk finance, risk-sensitive planning, hazard mapping and ecosystem-based management.



Non-Structural Measures

Recently India's economic vulnerability has reached to 9.8 US$ billion. India can transfer disaster risks of 10 billion US$ annual losses to only making a risk premium of 350 Cr annually to Insurance companies.

Structural Measures

Recent Sendai Framework Convention at Japan announced the program ‘Words into Action- Vulnerability into Resiliency to keep poverty at bay. Making infrastructure resilient to natural disasters is a daunting challenge. Resilience refers to a system's ability to anticipate, absorb, and recover from a hazardous event in a efficient time bound framework Hazards of nature - floods, earthquakes, cyclones/typhoons, landslides and climate change - pose growing risks to development. Damaged roads after a strong earthquake can hamper the swift transport of people to safer areas, provision of life-saving medicines and supplies to hospitals, and timely distribution of emergency relief. Severe Cyclone Aila in 2009, washed away 435 km embankment and 5.5 million house got damaged in Sunderbans, North & South 24 Parganas of West Bengal.

Housing: Shelters built using disaster-resistant construction techniques are not only safer, but they also provided decision-makers with an option for future construction choices. In India, the Maharashtra Emergency Earthquake Project promoted simple earthquake-resistant features based on building regulations that villagers could understand and apply. Retrofitting of all mud-stone/brick/bamboo made schools into a disaster resilient building for safety of students. All schools of Nepal and hilly states are in progress with the World Bank, ADB, UNISDR and other Internationals organizations. In flood-prone areas, raising houses above flood levels by putting them on pillars or using higher foundation. Bangladesh and India has also built 30 and more on progress in Sunderbans & Sagar Islands, multi-storied cyclone shelters in coastal regions, providing refuge from storm surges for coastal inhabitants (Mitigator, 2015). In Southern India after the 2004 tsunami, World Vision built tsunami extendable houses with earthquake-resistant structural cores that allowed building another floor without compromising the strength of the structure.

Roads: Road is very vital to keep food and relief materials in a channel. In Timor-Leste, measures to reduce the risk to roads of erosion from extreme waves included constructing earth levee banks with rip-rap protection and installing larger drains and additional culverts to accommodate heavier runoff (Asian Development Bank [ADB] 2010b).

Energy: Engineering measures to improve resilience include more robust designs, safe temperature and humidity limits for power generation plants and their components, higher wind and seismic stresses, multiple transmission routes, and system improvements to improve supply-side efficiency. Retrofitting high-risk power infrastructure was identified as a means of protecting against storms, flooding, and increased temperature and salinity (ADB 2012).

Water Supply and Sanitation. After disaster, access to hygienic water and sanitation facilities is vital for helping communities cope with disasters. Providing elevated tube-wells and flood-proof latrines has ensured year-round safe water and hygienic sanitation in the flood-prone districts of Sundarbans, Bogra, Gaibandha and Sirajganj (Department for International Development and Practical Action Bangladesh 2010). Where impounding reservoirs exist, as in Khulna, Bangladesh, increasing the size of the impounding reservoir or relocating the water intake point further upstream was a measure to boost the resilience of the water-supply systems.

Dikes: Six hundred cities of the world are vulnerable to coastal disasters**.** In Japan, dikes are necessary for protection against ordinary tsunamis. The 2011 tsunami, however, exceeded expectations, leading to the collapse of 190 of 300 kilometers of dikes in the Tohoku region. Nonetheless, these dikes decreased the force of the tsunami and, in some areas, delayed its arrival inland. Japan is now placing heavier emphasis on designing and managing systems that mitigate damage to the greatest extent possible including prevention of overflow of Tokyo’s major waterways and rivers during disasters (GFDRR and World Bank 2012). Indian Sunderbans 435 km dikes washed away and total areas become victims of saline flood waters. Nearly two million hectares of crops land remains uncultivated for next three years from 2009 to 2012.

Investing in disaster risk reduction makes financial sense

According to the report, an annual global investment of $6 billion in disaster risk management strategies would generate total benefits in terms of risk reduction of $360 billion. This is equivalent to a 20 per cent reduction of new and additional annual economic losses.

Investment required US$6 trillion per year for the next 15 years, but only 0.1% (US$ 6 billion) avail yet for DRR purposes. India Govt. has promised to invest 1 trillion in DRR investment for 5 years (200 billion per year).

Incentives to Community: A Disaster Resilient Community at Sunderbans (AILA)

Communities engagement during severe cyclone Aila intrusion in Villages

Community is the pillar upon which technology makes inventions and patent thereafter. Technology is the principle means by which individual and community access and manage resources. Sustainable-Resilient Technology makes the Community great and adjustable with the surroundings for development. The Community cannot move without technology. It becomes non-mobile and stagnant without its all-round development unless technology helps to gear it up. Investing 100 billion US$ yearly climate resilient fund to community motivated project can help reaching part of UN sustainable goals to MDGs and by 2030to eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 (100/per day) and nobody will hunger after 15 years.

Future Climate & Resilient Infrastructure Fund for Poverty Eradication

Double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment , ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality. Quality education, affordable drinking water for all, modern energy services (enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology).

Affordable Energy Services for all by 2030

Access for all to adequate, safe and affordable housing and basic services and upgrade slums, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons in communities. Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries, integrate climate change measures into national policies, strategies and planning, improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

Impacts of climate change in Asia-Pacific

The 2015 Global Assessment Report on Disaster Risk Reduction (GAR15), Making Development Sustainable: The Future of Disaster Risk Management, Building the Resilience of Nations and Communities to Disasters (HFA).The substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and societies.

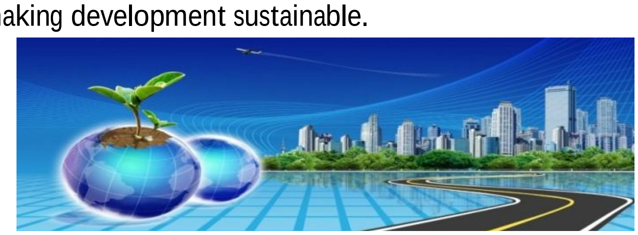
Focus Changes in Global Assessment Report:

GAR09, *Risk and Poverty in a Changing Climate*

GAR11, *Revealing Risk, Redefining Development*

GAR13, *From Shared Risk to Shared Value; The Business Case for Disaster Risk Reduction,* thefocus shifted once again, this time from publicpolicies and investment to the largely unexplored nexus between private investment and disaster risk.

GAR15, focuses why disaster risk reduction needs to move from managing disasters to managing risks if it is to contribute to making development sustainable.



MITIGATOR

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DEVELOPMENTAND VULNERABILITIES:
A CASE FROM SAHYADRI MOUNTAIN

Shailendra Rai and Omkar Khare

Abstract

The paper discusses about the existing institutional perceptional vulnerability to assess the risk and uncertainty of the area to which risk is existing. On 30th July, 2014 Malin Landslide caused by a heavy rainfall killed at least 134 people. Many more Malin are waiting to happen as hills continue to be exploited for mining, wind farms, tourism projects and unscientific farming like Padkai Yojana encouraged by State Agricultural Department which would have triggered the landslide. Malin is an eco-sensitive area as stated in Western Ghats Ecology Expert Panel Report headed by Madhav Gadgil. Human intervention with nature is not a new thing, forest gets cleared for agricultural practices but when greed overtook need it have a devastating impact. Risk is known to everyone but still people are living with risk. To understand the risk based choices Risk Matrix is prepared considering various vulnerabilities. The primary data involves field visits, interaction with government officials and Participatory Rural Appraisal Method has been used to engage the community in every part of the process. The paper talks about the existing resident risk and vulnerability. The paper also discusses about the resilience and adaptation strategies which can be adopted at village level.

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Introduction

Deccan trap province is one of the largest volcanic provinces in the world. They are multiple layers of basalt which are about 2000 meters thick and spread over 500,000 km sq. This was formed as a result of a massive series of volcanic eruptions. These eruptions started about 66.250 million years ago, i.e. at the end of cretaceous period. These eruptions occurred in the Western Ghats region (near Mumbai). The original area covered by the lava flow is estimated to be about 1.5 million km sq (which is approximately of the size of modern India). The current size is a result of continuous weathering and erosion of the rock. Weathering is the process which alters the rock chemically and physically, due to various chemical reaction and physical movements. This region has two types of soils; the black alluvium soil and the red clayey soil, both the types of are products of the weathering. The red laterite soil is a product of chemical process thatoccurs on basalt with various minerals. The area under study is a part of Deccan traps. Ambegaon is located in the north of Pune District. This is a region which has high rainfall. Due to the high rainfall, the weathering rate is relatively higher. Landslides are not new to this area, minor landslides, rock flows have been witnessed by the villagers. The Malin landslide, 2014 was a hazard that turned into a disaster. The hazards overlapped a settlement of the Malin gaon than, which caused about 146 deaths and a lot of property loss. The Ambegaon Taluka consists of multiple villages the area under study is located around Dimbhe dam reservoir.

The people here are mainly tribal, they belong to the Mahadev koli, another tribe found here is the Katkari tribe, which are very few in numbers and have become socially marginal. Traditionally these people have been farming and fishing. They would generally fish seasonally in the river and would take up agricultural activities in the other part of the year. The main crop takes is Paddy and Ragi. There are few other crops which the villagers have adapted lately. The region is hilly and the agricultural practices that are undertaken are largely on the slopes of the hills. As a result of which the community has been cutting the slopes and using it for agriculture. The community has a unique system in which they the villagers help each other to make the land cultivable. Villagers would come together and make retention walls using locally available basalt boulders. As a result, the effort was divided, and work would be faster. This system is locally known as 'padkai'. Lately due to global developmental process people have started migrating tothe nearby cities like Mumbai and Pune.

This area was highlighted when a massive landslide struck the Malin village leading to 146 deaths, loss of about 80 houses, a 70 feet tall temple, large number of cattle and a lot of distress amongst the people who were left behind. The causes of the landslide were studied by the Geological survey of India. They listed multiple factors, which included heavy rains, artificially diversion of the natural drainage system, weathering of the rocks, cracks on the hill where the village was. The indicators of the landslides were also listed by GSI, incidence like oozing of water from the mud flooring of the houses, jamming up of the doors and windows, water forming newer drainages at micro level, etc.

The Rock types found on the site of Malin Landslide is all basalt, the basalt is accompanied by red clayey soil. The condition of the basalt can be divided into three based on the degree of weathering. Type A, which is the compact basalt and it does not break easily, it needs to be broken by a hammer, Type B, which is semi weathered basalt and can be shattered if dropped on the ground of about 1.15 meter, Type C, are those which are completely weathered and can be shattered with hands. It is an uncommon phenomenon to find a wide range of weathered basalts on the same place. This varied amount of weathering may be the root cause of the disaster. The type C rock will also trigger the movement of the type A rock causing the land mass to flow under the influence of gravity.

The report by Madhav Gadgil on this area also blames the slope cutting as a factor for increase in the landslides. On further enquiry, it was clear that it was not simply the slope cutting that was responsible. The slope cutting has been occurring since a few hundred years according to the villagers. The newer change that is observed by the villagers is the out-migration factor. The out migration of at least one family member to Mumbai or Pune has made more availability of money to the people in these villages. As a result of which the people started using earth movers to flatten the slopes. As far as this was done by hand the slope structure was not altered to a certain limit, but the use of mechanized techniques disturbs the slope and makes it unstable. This could be treated as a reason of the slope failure and a cause of the landslides. In addition to this the road making activities that have taken place in the last fifteen to twenty years in the area, have also used a lot of earthmovers to cut out the hills. Toe cutting is seen at most of the places adjoining the road. This was a part of the developmental activity, care could have been taken in the first place and retaining walls should have been placed in order to mitigate the rock fall on the roads, hence damaging them. Use of earthmovers not only destabilizes the slope but also makes lets smaller openings andlets the water flow inside the rocks, this speeds up the weathering process (both physically and chemically) this weaken the bond within the rock and loosens it, hence causing a landslide or a rock fall.

The other reason for loosening of the rocks is the soil erosion that is occurring due reduction in the forest. A very prominent observation by the villagers is the entry of a foreign plant species in the forest. The Dimbhe Dam was constructed about 35 years ago, villagers around that time, post the dam construction a new shrub was observed in the forests. The local name is 'Tantani' botanically it is called Lantana Camara, this plant is reportedly known to absorb the nutrient and other resources from the soil and not allow the other plants to grow or survive (Prasad 2006). This plant has reduced the forest cover in the area, as a result of which the soil has been eroded, soil acts as a mortar and holds the rocks, due to erosion this soil cover is gone making the rocksloose and causing rock fall and/or landslides. There is little evidence where the villagers accept that they have also been party to deforestation about 30 years back where they were given money in return of the teak wood and the mango wood. Most of the villagers are open about it, but the people from the government are reluctant to talk about this fact.

It is now observed that all the conditions are present in all the neighboring villages, making them vulnerable to landslide. In the following section the details of other villages will be explored and the situation will be analyzed.

LANDSLIDE ON THE FRONT HILL OF KALWADI

HOUSE SHIFTED TO OTHER AREA DUE to Fear

VULNERABILITY ANALYSIS

Physical Dimension: Physical Dimension pertain to the built environment- housing, water, sanitation, electricity, land tenure status, solid waste management, roads and scope of early warning and evacuation. Majority of the houses have metered individual electricity connection but the electricity bill is generalized not on the basis of units consumed. Drinking water source is not available inside the house it may be within the premises or community source is used. Irrigation facilities are available only for those who can pay for it, the economically marginal section of the community does not have any access to irrigation except for the community open wells, which are controlled by the village panchayat. Sanitation facilities are not up to the mark; availability of latrines is not accompanied by water and hence open defecation is preferred.

Houses found are pucca (made of bricks with cement), semi pucca (bricks and mud) and kuchcha (mud), majority of the houses are single floor houses with a mezzanine to store grains and other resources. The land share is very less and tribes like Katkari don't have any land, they work as landless laborers and do fishing (sponsored by Saswat, an NGO).

The general setting of the villages here is typically a central Gaothan, surrounded by Wadis every wadi is far away and not all the wadis are connected to the central village by a tar road, in the village Jambori, the roads have been built about 10 years back and lack of maintenance has damaged the road not allowing the state transport buses to reach the furtherest Wadi that is 8 km away from the central village, this leaves the villagers to with no option but to walk to the central village for school, shopping of the basic requirements, etc. In another village called Borghar, the furthest wadi (Kaal Wadi) is about 13 km away and there is not road that connects the wadi, there is a mud path that had been formed from the middle of the forest over the slope to reach the wadi, there is a primary school in the wadi which spares the young children to walk 13 km. children above fifth grade need to walf to the central village to attain school. Another village, Phulavde has its furthest wadi only 7 km away, but it's on the top of another hill, the road is under construction to the since more than 5 years, but its slow and the hill is being cut to make it. There are no retention walls planned even when toe cutting is happening at a large scale. This will cause vulnerability in the future, as the curved-out portion may slide down during the monsoons. A simple mitigation measure can be used while constructing the road, the rock which is curved out in order to construct the road, can be used for the construction of retentation walls to the same road which can be the most effective mitigation measure. Such walls are constructed on the national highway which is a about 100 kilometers away from the village.

All the three villages mentioned above have more physical vulnerability that just the road, Jambori and Borghar have witnessed cracks into the ground, villagers are afraid of these cracks, as they feel this may cause a land slide. The cracks occur due to access amount of water and pressure on the land. It is observed in Jambori and borghar that these cracks are parallel to the toe cutting that has occurred for formation of the road. This could be mitigated by simple retentation walls in vulnerable areas. On the other hand a unique basaltic feature is seen in Phulavde, columnar joints[2] are seen over a wadi, there are about 50 houses located right under the joints, joints are generally stable structures but due to deforestation the soil cover above the joints have been washed away, this exposed the joints to the direct climate action, (extreme heat in summers followed by exposure to water in the monsoons) as a result of this the joints have loosened and now smaller boulders have started collapsing into the wadi shot-creting or putting up a mesh to hold the rocks may help here.

Efficient and timely disaster warning and evacuation can play a crucial role in avoiding casualties in disaster situation these areas never seem to get disaster warnings through the local administration. This is so especially during the rainy season. There are no efforts to identify and relocate the vulnerable pockets in the city. As discussed earlier, evacuation would be a herculean task considering the complexity and narrowness of the road network.

Economic Dimension: The primary source of income is agriculture; it is primarily a self-sustenance mechanism and not for commercial purposes. This is because every farmer owns less land. Largely only one crop is taken during the monsoons by the entire community, during non-monsoons season the work as daily wage laborer with irregular pattern the fields of the rich farmers who can afford to have irrigation facilities or go to Dimbhe and Ghodegaon for work and they are paid Rs.150-200 per day with one time food in afternoon. There is no alternative source of livelihood; some of them have cows, buffalo and goat. In times of need, they get loan from SHGs and from family members. The economic status needs to be strengthened because it affects ones coping capacity.

People in Phulavde are relatively rich than most of the other surrounding villages. But there is a lot of economic divide within the village, this village has a patpedhi (a local bank) which shows that people here have enough money to make larger savings. Villagers can also take loans for their needs. On the other hand, in other villages like Jambori, Asane, Malin, Borghar, etc. there are no Patpedhis. They have SHGs as mentioned above. Bharmal Community is currently the dominating community in the village phulavde, and others work on their fields in non-monsoonseasons, the patpedhi is run by this community, most of the panchayat members are also from this community. As this community is economically strong, it is seen that they are dominating every aspect of the village dynamics. There is a high concern for youth unemployment across all the villages. Due to availability to school and easy access to the central villagers the youth does not prefer to continue in the traditional agriculture and fishing activities. Also, there are no diverse livelihoods options like dairy farming, poultry farming, etc. due to scarcity of water. This leads to out migration of the educated youth and work in nearby towns like Dimble, Ghodegaon, Chakan or cities like Mumbai and Pune. Ironically sometimes the youh is forced to work as daily wage workers in these places.

The following is the livelihood profile of the village Borghar. This reflects the general trend in livelihood of all the villages.

Livelihoods

S. No.	Types	Total
	Primary Occupation	
1.	Agriculture	300
2.	Agricultural labor	50
3.	Animal related business	15
4.	Fisheries	10 Families
5.	Brick Klin	12
6.	Fruits, flowers, plants, etc.	2 Families
	Secondary Occupation	
1.	Small Business	2
2.	Construction	5
3.	Transport	4
	Tertiary Occupation	
1.	Government employees	25
2.	Private employees	35
3.	Others	30

Human Dimension

Human dimension covers education, health status, and community assets. Majority of wadis inBorghar have primary schools and Aaganwadi. They have mid-day meal schemes running in Aaganwadi and almost all children are enrolled in Aaganwadi. They have a health sub centre but they have less stock of medicines and the less availability of doctor. Generally, for deliveries they have to go to Adiware PHC which is 8 kms away from the central village by hiring private vehicle which is very costly. There is no Ambulance is any of the villages in this area. Ambulances may be managed the quality of the roads that cross the villages like Phulavde, Borghar, Asane, Malin will not allow the ambulance to reach the medical emergency on time.

Health Infrastructure (status of all the PHCs and Sub centers)

S.No.	Government and Private	Total
1.	Doctors	1
2.	Medical shop	0
3.	Primary health Sub-Centre	1
4.	Primary Health Centre	0
5.	OPD	0
6.	X-ray	0
7.	Pathology laboratory	0
8.	Surgery	0
9.	Blood Bank	0
10.	Vetenary Centre	0

Sanitation (situation of all the villages except Malin, as Malin is the only place with a Crematorium)

S.No.	Facilities	Status
1.	Community toilets	No
2.	Community Bathroom	No
3.	Drainage system (closed/open)	Yes
4.	Solid waste management vehicle	No
5.	Human resource for solid waste management	No
6.	Crematorium	No

Water Infrastructure (Borghar)

S.No.	Government	Status
1.	Dams	0
2.	Wells	10
3.	Taps	1 (Gaothan)
4.	Borewell/Tubewell	1
5.	Handpump	10
6.	Water tanker	0
Private		
1.	Wells	2
2.	Tubewell/Borewell	0
3.	Handpump	0

Education (Borghar)

S.No.	Educational Institutes	Total rooms	No.of Teachers	No. of Students	No.of Safe Roof	Yes/No
1.	College	0	-	-	-	-
2.	Higher Secondary School	0	-	-	-	-
3.	Medium School	01	6	10	156	Yes
4.	Primary school	09	20	18	135	Yes
5.	Aaganwadi	09	09	09	125	Yes

Social Dimension

Social dimension covers knowledge and awareness, social conflicts and community involvement. Internal disputes and struggles divert people's energy and resources and social networks will remain poor during crisis or emergency situation. Although there is no conflict in the village and social capital is quite good. They work in each other fields in times of need. They have 23 SHGs running in a village, Bachat gadh like Savitri Bai Mahila Bachat gadh in Darewadi and Rukmani Bachat gadh in Borghar. They are a group of 10 or 11 people and they have a meeting on Sunday and they deposit Rs.20 and they have a provision of penalty of Rs.2 if they don't deposit money on meeting. There is very less knowledge and awareness about many schemes and no proper implementation of it but Gram panchayat.

Other Facilities

S.No.	Facilities	Status	Total
1.	Community Centre	Yes	1
2.	Cooperative society	No	-
3.	Social work Mandal	Yes	1
4.	Dairy cooperative	Yes	2
5.	Police station	No	-
6.	Petrol pump	No	-
7.	Kerosene Depot	No	-
8.	Gas agency	No	-
9.	Ration shop	Yes	1

In Phulavde it is largely seen that people have undertaken the 'Varkari'[3] sect. As indicated before the Dominant community of the Bharmals have all taken resort to the Varkari sect and hence the village culture has altered accordingly. As an influence of this the people here call themselves has 'Hindu' Mahadevkolis , tribes were originally out of the Hindu spectrum of caste, but this is an effect of saffronisation that has slowly occurred in the past 80 years. As a result of this the village has a religious community center where there is food for all every fortnight which can be used during a disaster situation as a community center for all. The villages like Jambori, Malin, Asane all have one temple which acts as a place for socializing of men, women and children, as temple is a place which culturally holds importance in everyone's life. People in different villages have different rituals that they follow.

Varkari (meaning "a pilgrim") is a sampradaya (religious movement) within the bhakti spiritual tradition of Hinduism, geographically associated with the Indian states of Maharashtra and northern Karnataka.Varkaris worship Vitthal (also known as Vithoba), the presiding deity of Pandharpur, regarded as a form of Krishna. Saints and gurus of the bhakti movement associated with the Varkaris include Jñāneśvar, Namdev, Chokhamela, Eknath, and Tukaram, all of whom are accorded the title of Sant.

Ecological Dimension

The Phulavde, Borghar, Asane, Jambori, Adiwre, Malin are all forest areas in which tribal have their own lands. The deforestation rate is very high and there is hardly any dense forest area. The trees have been cut at an enormous rate for leveling land on the mountains for agriculture. The earth movers have been used for leveling and also for construction of roads which leads to erosion of mountains, making it prone to landslides. The forests are also reduced as the fire wood also comes from the forest, though this is a traditional way that these tribes have been using for cooking since centuries in accordance with preserving the forest. But the requirement of firewood has increased due to increase in population and hence it is harming the environment lately. These tribes used to have a concept of sacred groves, (locally called devrai[4],which translated to God's forest) but today Rajpur is the only village where the sacred groves are still there exist. This clearly shows that the ecosystem is deteriorating. Due to deforestation, the soil erosion rate increases and due to the loss of soil the bed rock gets exposed and fracturing occurs easily, this may lead to rock fall or landslides.

Another major reason for the reduction in the forest is the invasion of the plant Lantana Camara, which does not let the other plants in the surrounding area. All these factors have added up and lead to depletion of the forests in the region.

Here, other hazards- water scarcity and agricultural runoff

Risk Matrix

PRIORITY	HAZARD & RISK INDEX
1	(Risk Index: 24) OTHER, OTHER
2	(Risk Index: 20) LANDSLIDE, DEBRIS FLOW or SUBSIDENC
3	(Risk Index: 16) FIRE - INTERFACE & WILDFIRE
4	(Risk Index: 15) CRITICAL FACILITY FAILURE
5	(Risk Index: 12) EPIDEMIC - HUMAN
6	(Risk Index: 9) EPIDEMIC - ANIMAL
7	(Risk Index: 4) EARTHQUAKE
8	(Risk Index: 3) INFRASTRUCTURE FAILURE

Risk Priority List

frequency

	Very Low	Low	High	Very High	
6				(Risk Index: 24) OTHER, OTHER	Frequent or very likely
5			(Risk Index: 15) CRITICAL FACILITY FAILURE	(Risk Index: 20) LANDSLIDE, DEBRIS FLOW or SUBSIDENCE	Moderate or likely
4			(Risk Index: 12) EPIDEMIC - HUMAN	(Risk Index: 16) FIRE - INTERFACE & WILDFIRE	Occasional, slight chance
3	(Risk Index: 3) INFRASTRUCTURE FAILURE		(Risk Index: 9) EPIDEMIC - ANIMAL		Unlikely, improbable
2					Highly unlikely (rare event)
1	OTHER HAZARDS?			(Risk Index: 4) EARTHQUAKE	Very rare event
	1	2	3	4	

severity

Linking Disaster Risk Reduction with Development

Mainstreaming disaster management into the development planning process essentially means looking critically at each activity that is being planned, not only from the perspective of reducing the disaster vulnerability of that activity, but also from the perspective of minimizing that activity's potential contribution to the hazard.

Every development plan in the state would require incorporating elements of impact assessment, risk reduction, and adoption the 'do no harm' approach. The measures such as urban planning and zoning, up gradation of building codes their enforcement, adoption of disaster resilient housing designs and flood proofing, response preparedness planning, insurance, establishment of early warning systems generating community awareness, creating technical competence and promoting research among engineers, architects, health experts will be taken on priority.

Mainstreaming DRR into ongoing Flagship Programmes

Sr. No.	Name of the Programme	Department / Sector	Proposed Strategies for DRR Integration into the Flagship Programmes
1	**Indira Awas Yojana**	Rural Development	i. Inclusion of such measures like application of Hazard resistant design in construction of IAYhouses, appropriate sitting of IAY housing in guideline of IAY ii. Development of model design for IAY houses which could be easily referred to by DRDAs at district level and used for community awareness depending on the geographical location. iii. Capacity Building of Rural/Local masons on safe construction. iv. Capacity Building of PRIs. v. Community Awareness. vi. Capacity Building Programmes for DRDA officials on Disaster Risk Reduction issues.
2	**Mahatma Gandhi National Employment Guarantee scheme**	Rural Development	i. Utilization of MGNREGS funds to reduce the vulnerability of Panchayat vis-à-vis. natural hazards such as landslide, drought, forest fire, cloud burst, flash floods, earthquake etc. ii. Giving priority to those works which reduce the vulnerability of area over the works which enhances the vulnerability of the area to natural hazards. iii. Identified works are available which take into

			account the hazard profile and offer continuous employment opportunities in the event of disasters to ensure livelihood security in the event of disasters. iii. Works which reduce disaster risk are given priority in plans-such as local mitigation works etc. iv. Any other implement able suggestion within the ambit of the scheme.
3	**Pradhan Mantri Gram Sadak Yojana**	PWD	i. The Master Plan for rural roads, the district rural road plan and identification of core network under the planning process of this scheme should, which the overall guidelines of its preparation, explicitly address the disaster risk reduction concerns and accord priority to connect the vulnerable habitations. ii. The technical guidelines should explicitly provide for suitable protection and inclusion of disaster risk Concerns explicitly -while provision of cross drainage, slope stabilization, protection works are already included, in multi-hazard and especially flood and landslide prone areas fair weather roads need to be upgraded on a priority basis. iii. The maintenance guidelines are modified to ensure that in case of disasters these roads get provision for restoration to ensure all weather connectivity
4	**Sarva Siksha Abhiyaan**	Education	i. Development of a Policy paper of school safety. ii. Introducing school safety as a part of the guidelines of SSA which is currently focusing on inclusive development. iii. Developing model structurally safe designs for schools. iv. Introducing School Safety in the Teacher's Training Curriculum. v. Training of Rural Engineers appointed under SSA Scheme as well as the SSA State Coordinators. vi. Training of masons in rural areas. vii. Construction of Technology Demonstration Units. viii. Community Awareness.

5	**National Rural Health Mission**	Health and family welfare	i. Ensure that the village Health Plan and the District health plan explicitly address the disaster risk reduction concerns in the vulnerable habitations and the vulnerable districts and the disaster management plan as per DM Act 2005 takes links itself to the District and village Healthplans. ii. Provide training to the ASHA workers on disaster health preparedness and response. iii. Strengthening of Disease Health Surveillance System in rural areas. iv. Ensuring structural safety of the CHC/PHC and other health care service delivery centers in rural areas. v. Training of doctors and hospital staffs on mass casualty management and emergency medicine. vi. Community awareness on disaster management.

Disasters are basically unresolved problem of development. Development can increase vulnerability. Development can reduce vulnerability. The outcome rests on developmental choices. The seeds of disasters are often sown in development patterns poor land use planning, environmental management and lack of regulatory mechanisms. It is due to this reason that despite having almost similar exposures disaster has greater impact on humans in developing or low developed countries than the developed countries. Therefore, disaster risk can best be addressed through integrating into the developmental planning, programmes and processes.

Some of the key sectors where integration of DRR can be done are as follows

- **Public Infrastructure**
    i. Incorporate disaster risk impact assessment as a part of the planning process before the construction starts.
    ii. Site analysis and risk sensitive land-use planning (either avoid development in hazard prone areas or adopt treatment and mitigation measures).
    iii. Strengthen compliance to the various provisions of the codes - set up hazard safety cell for advice and monitoring.
    iv. Disaster resistant technologies mandatory in case of all construction using public/corporate funds.
    v. Training and capacity building of the department and functionaries.

- **Health Sector**
    i. Ensure hospitals and health facilities are not located in hazard-prone areas.
    ii. Analyze the internal and external vulnerabilities of existing health care facilities during emergencies.
    iii. Retrofitting of the critical hospitals.
    iv. Prepare and implement hospital preparedness plan.
    v. Training of doctors on mass casualty management, trauma care and emergency medicine.
    vi. Raining of health workers on emergency preparedness and response.
    vii. Strengthening of disease surveillance system.

- **MGNREGAS - Scope of work - Some illustrations**
  i) Water conservation and water harvesting;
  ii) Drought proofing, including forestation and tree plantation;
  iii) Irrigation canals, including micro and minor irrigation works;
  iv) Plantation and horticulture;
  v) Renovation of traditional water bodies, including de-silting of tanks;
  vi) Land development;
  vii) Flood-control and protection works, including drainage in water logged areas; and
  viii) Rural connectivity to provide all weather access.

Animal Care: Animals both domestic as well as wild are exposed to the effects of natural and man-made disasters. The department of Animal & Husbandry would devise appropriate measures to protect animals and find means to shelter and feed them during disasters and their aftermath, through a community effort, to the extent possible. It is pertinent to note that many communities have shown compassion to animals during disasters, and these efforts need to be formalized in the preparedness plans including Carcass Disposal Management Plan by the Departments of Animal Husbandry at the village level.

Needs of Special Vulnerable Groups: When addressing the preparedness and relief requirements of the disaster victims, focus would be placed on the special needs of the vulnerable population that is, children, women, aged and the disabled. Socio-cultural needs would be accounted for in all phases of disaster management planning. A specific strategy for addressing the risk reduction needs of these vulnerable groups will be developed by every line department. Representation of department of Social Justice and Empowerment has been made in the specified committees constituted to ensure that issues related to special vulnerable groups is taken care of under different phases of the state disaster management planning.

Ecosystem Approach in Disaster Risk Reduction

An ecosystem based Disater Risk Reduction is required at each step of a disaster management cycle. The term "sustainable ecosystems" or healthy ecosystems, implies that ecosystems are largely intact and functioning, and that resource use, or demand for ecosystem services, does not exceed supply in consideration of future generations (Sudmeier-Rieux and Ash, 2009). A sustainable ecosystem reduces vulnerability to hazard by supporting livelihood which acts as a physical buffer. To reduce the impact of hazard so that it doesn't become a disaster, we must have a good plan, risk reduction methods or strategies and sustainable development. The western ghats are also eco sensitive zones according to Gadgil's report. The environmental degradation can be seen in this area and this has also been reported by the villagers. The reasons behind this degradation are as follows.

- **Deforestation:** There used to be dense forest in this area many years before. But with rapid increase in population and peoples' demand, people were bound to cut the trees for getting firewood as fuel and for generating more agricultural land. Later on, government implemented a scheme called "Padkai Scheme" in which government used to provide agricultural land by cutting trees and slopes of hilly area by bringing Earth movers. These machines were also used for construction of road. So, these are the main reason which has led to deforestation. Also, there are less wild animals left, as their home doesn't exist anymore its getting depleted.

- **Overgrazing:** Just because of deforestation less amount of forest coverage is available and hence animals are likely to graze on smaller area. Therefore, environment depletion is also caused by overgrazing.

- **Heavy rainfall:** This area used to face heavy rainfall in monsoons because of its geographical conditions. Heavy rainfall has lead to the soil erosion and hence very less fertile land is left.

- **Bunds construction:** People of Borghar are mainly engaged in agriculture. Majority of them sow paddy and for paddy cultivation plenty of water is needed. So, for this purpose they have constructed bunds in their fields. Bunds loosen the soil and it increases the chances of landslide and land degradation as well.

- **Borghar versus Bhimashankar:** Bhimashenkar is a reserve forest where still dense forest exists. But in Borghar the land belongs to tribal. So, they use these lands as they require and whenever they require. There is no restriction or regulation present to restrict this action. The lack of regulation can also be said as one of the reason for environmental degradation.

Conclusion

Development is a right of every citizen of India. This must not be stopped in the areas wherethe ecology is fragile. One must respect the limitations that mankind has in facing the wrath ofnature, but at the same time it must be one cannot forget the wise use of technology. In the area studied it is clearly observed that the use of technology is lacking. Simple available technology which is used to construct safety measures for the national highways can be used to mitigate the risk of landslides in these regions. Is it appropriate to say that the government would invest only in the spaces used by larger population and neglect the smaller and vulnerable population? One need to understand that human life must be considered more than the cost involved.

Social exclusion generally referred to caste, religion, creed but development is not included in it although we talk about inclusive development. Inclusive Development is necessary for removing poverty which is one f the MDG but only development will not lead to removing poverty because these development leads to man-made disasters like Uttrakhand floods, Malin landslide. There are around 64 schemes running by state government but people are not aware of it. For instance, in Borghar state government is giving free pipes for transferring water from dams but it's of no use for people living at top of the hill.

The money that is received by Malin (about 12 million Rupees) after the landslide it is quite evident that if risk reduction measures were in place and the early alarms were used for evacuation by the local administration the money required would have been exponentially less. The cost of the implementing the risk reduction methods would be must less than the cost of post disaster response, recovery and rehabilitation. Investment in Disaster Risk Reduction is a hence economically as well as socially better option than investing in post disaster situation. Participatory approach is the key for sustainability practices and for long term planning and development.

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DEFINING VULNERABILITY FROM THE FLOOD PRONE AREA:
A CASE STUDY AT VILLAGE SHIVAL, BAIRIYA TEHSIL, BALLIA (UP)

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Abstract

The vulnerability of any physical, structural or socio-economic systems to a natural hazard is its probability of being damaged, destroyed or lost (Birkmann, 2008, p.1; Pistrika & Tsakiris, 2007, p.5). Vulnerability, in the disaster context, is a persons or groups "capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard" (Mohammed et al., 2011, p.16; Cançado et al., 2008, p.8; Neumayer & Plumper, 2007, p.3; Fothergill & Peek, 2004, p.90). Vulnerability, as defined by inadequate capability, is linked to a specific group(s) of people or population. These people are perceived as vulnerable and thus it is difficult to protect them from a disaster. Degree of vulnerability is defined by factors such as socio-economic status, differences in wealth, occupation, caste, ethnicity, gender, disability, health status, age, immigration status (legal or illegal), the nature and extent of social networks, and so on (Mohammed et al., 2011, p.36; Birkmann, 2008, p.3; Khunwishit, 2007; Fothergill & Peek, 2004, p.90; Wisner et al., 1994). Vulnerable populations are more affected by the same disaster when compared to non-vulnerable populations. Moreover, among vulnerable population, the impacts of disasters vary depending on how vulnerable a person is.

Flood is defined as an overflow of water from river or other bodies of water due to excessive rainfall or other inputs of water. It is the most common occurring natural disaster that affects human and its surrounding environment (Hewitt, 1997). The frequency of floods in India is more than half of the total number of floods occurring in Asia in each decade (Parasuraman & Unnikrishnan, 2000). According to the Rashtriya Barh Ayog (National Commission on Flood), the area prone to floods in India is 40.0 million hectares. According to the estimates, the average area annually affected by floods is 7.52 million hectares out of which the agricultural area is 3.52 million hectares. Assam, U.P. and Bihar are among the most flood prone states in the country (Jain, Agarwal, & Singh, 2007).

The objective of the study is to examine vulnerability to the floods in India. It also tends to explore how vulnerability varies across caste, class and gender in the Indian settings. The study has been based upon the primary study carried out in the village Shival, Bairiya block of Ballia (Uttar Pradesh). Observation, interview and schedule were the major tools of data collection.

The village Shival is a major flood prone village and is fraught with recurrent floods. The findings of the study reveal that the vulnerability is highly dynamic and varies across caste, class and gender in India. It has been found that the lower castes such as Nais or Kurmis were economically not well off and were thus highly vulnerable group in the village. Higher castes and the Yadavs are economically well off and their vulnerability is downplayed by two factors. Firstly, they own major land resources in the village as well as they have access to flood relief materials easily. Further, women who are already marginalized (deprived of any material possessions) are the worst sufferers. There were no special provisions for women such as gender wise compensation and all the flood relief compensation is male prerogative which is some time spent in liquor or gambling.

Keywords: *Disaster, floods, hazards, livelihood, vulnerability.*

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SOCIAL VULNERABILITY TO DISASTER AND NEED FOR SOCIAL POLICY: *A STUDY OF 2015 FLOOD IN WEST BENGAL*

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Abstract

Social loss of a disaster is less responded in any administrative initiative. One of the major reasons for that is lack of consensus about the indicators of social vulnerability and their correlations. But from common people's perception, it is very much comprehensive that different sections of society – women, children, ethnic tribes and socially backward classes – face challenges of different dimensions in the same disaster even when they remain in the same economic strata. In fact in a disaster situation extremity in age obstructs the movement or ethnicity poses cultural challenge or language barrier in a post disaster situation. Women face different sorts of physiological as well as familial challenges, which men do not face. But the situation of a disaster or a post-disaster is often responded with a uniform and general administrative initiative. The recent flood and its aftermath in West Bengal that occurred due to excessive rain from a depression triggered by Komen in the last week of July and discharge of water by the DVC from its reservoir in the first week of August, has affected nearly 52 lakh people of 12 districts taking toll of 59 lives (The Indian Express, Kolkata, 4.8.2015).West Bengal StateGovernment has taken administrative initiatives for post disaster recovery of all sections of people in a general and uniform manner. This paper aims to explore theneed for specific social policies to respond to the social vulnerabilities of different sections of people in post flood recovery initiative.

Hypothesis and Objectives

In an amorphous manner, all these sections of a society build different communities – which on the one hand contain conglomerations of individuals, subject to various administrative decisions and on the other hand contain autonomous individual actors looking for influencing the decisions of the administrative system in pursuance of their own interests. For social accountability, administrative initiatives should take into account social vulnerability of various sections of the society and formulate the policies for post disaster recovery responding to those vulnerabilities. In post flood (2015) situation in West Bengal, administration has been managing the crisis with certain policies. In this context, this paper aims to find out: i) How do the communities in flood hit Burdwan district perceive their vulnerability? ii) Given the situation, can there be any social vulnerability measurement in West Bengal? iii) To what extent administrative policies have responded to the social vulnerabilities of different sections of these flood victims in West Bengal? iv) Does social vulnerability lead to further marginalization in a post disaster situation?

Theoretical Framework

Andrew Maskrey in his book Disaster Mitigation: A Community Based Approach writes, "Natural hazard and natural disaster are two very different terms which are frequently confused and used interchangeably. Earthquake, flood, and cyclone come to be synonymous with disaster but, although natural hazards like earthquakes can be highly destructive, they do not necessarily cause disaster. … Natural disasters are generally considered as a coincidence between natural hazards (such as flood, cyclone, earthquake and drought) and conditions of vulnerability. There is a high risk of disaster when one or more natural hazards occur in a vulnerable situation: RISK = VULNERABILITY + HAZARD" (1989, Oxfam: Oxford, p. 1). Normally the policy makers emphasize upon the second part i.e. how to reduce the risk of hazard since the policy planners have scanty knowledge in specifying the characteristics of a group those make them vulnerable to hazard. This leads to over-generalization of a concrete disaster or post-disaster situation.

Research Method

The target group of this study is flood hit people in Barddhaman district in West Bengal. The study will be based on i) various media reports. ii) For a closer observation study will take up 50 individuals from different vulnerable groups of one worst hit administrative block in Barddhaman district on the basis of structured questionnaire to identify the impact of the policy interventions by the administration on their lifestyles. iii) The study also attempts to take up focused interviews of the key personnel of administration (specially district administration) in this regard.

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REMEMBERING DURKHEIM:
A SOCIOLOGICAL PERSPECTIVE ON DISASTER RISK REDUCTION

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Abstract

In India, annual hydro-meteorological disasters necessitate disaster risk reduction (DRR) as a valorized objective. Inter-sectoral coordination, during peaceful and crisis times, among government line departments and ministries becomes a pre-requisite. During a recent field study of public administration in natural disasters, it was found inter-sectoral coordination was highly skewed at three junctures: in different levels of bureaucracy, across different departments and ministries, and state-wise. Consequently, this contributed to disaster risks and weak resilience to disasters.

Inter-sectoral coordination may be read sociologically. A functional complex modern society depends on synergy among distinct line departments and ministries. This kind of synergy resonate Durkheim's concept of 'organic solidarity' which advocates congregation of separate bureaucracies in the hope to converge disparate plans and actions. Convergence, therefore, facilitates mainstreaming DRR in all institutions of governance.

This paper explores the role of 'organic solidarity' in order to overcome inter-sectoral coordination skewness and encourage convergence of capacities.

Keywords: *Synergy, Convergence, Organic Solidarity, Capacities, Disaster Risk Reduction*

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DISASTER AND SOCIAL VULNERABILITY
- *EXPERIENCES OF DALITS IN INDIA*

Binod Kumar

Abstract

'Disasters' do not occur in vacuum, it is not sealed off from the existing individual and community realities. Hence, disaster has different meanings for different sets of people. Current meaning of disaster has been shaped by different set of realities and is context specific. Much of the mitigation and preventive efforts in disaster policy are woven around this specific meaning given to 'disasters' in a country. Where modern disasters are potential injustices; past injustices are increasing the vulnerability of people. Although different groups of people (like children, women, senior citizens etc) within the same caste group have differential experience of same disaster, however studies show that disasters have impacted different castes differently. A holistic approach to the understanding of disasters emerges when we look hazard, vulnerability and social vulnerability together. This approach of looking at disaster emphasises on study of vulnerability to hazard and variable capacity of different castes to mitigate the impact of disaster. On account of greater social vulnerability, lower castes and other marginalized groups have high possibility of loss of life and property in the event of disaster. In this context, central idea of the paper revolves around the case of double jeopardy as perpetrated to Dalits in case of disaster in India.

In current context, it is important that disaster is not to be looked upon as natural phenomena, rather as a function of development. Sometimes disaster is caused by insufficient development of means to avoid crisis and sometime aspect of development itself become the reason for crisis. The vulnerability approach to disaster reduction goes beyond the concern of being exposed to disastrous event and takes people's socio-economic status, attitude, knowledge and physical and mental wellbeing into consideration. In this backdrop, the paper highlights the plight of Dalits in disaster. Paper uses case study method to support its argument. It has also been demonstrated that vulnerability can be counterbalanced by resilience. However, resilience could only be attained when society is structurally equal and resources are accessible to all segments of society. On this backdrop, paper tries to explain the role of social vulnerability in disaster among Dalits.

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MOST VULNERABLE SOCIAL ELEMENTS OF NATURAL DISASTER IN BANGLADESH: *SURVIVING PATTERN AND SEARCH FOR A NEW PARADIGM*

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Abstract

This paper reviews some important and selected studies regarding 'social vulnerabilities of natural disasters' and 'social impacts of natural disasters' aiming to explore (a) identifying existing vulnerable social elements of natural disaster related to Bangladeshi society; (b) detecting the extent of these elements and (c) to develop a new framework for policy makers to take necessary action to most vulnerable social elements before natural disasters in Bangladesh. Paper reveals that socio-political, socio-economic, socio-cultural, socio-demographical and socio-psychological issues create risk. The study predicts that accessibility or availability or presence or high level or satisfactory of the most vulnerable social elements can reduce vulnerability of natural disaster in Bangladesh. A new social vulnerability framework, counting mostly vulnerable social elements, can guide policy maker to help people before disaster happen.

Key Word: Social Elements, Natural Disaster, Risk, Framework.

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Introduction

The terms 'vulnerable' and vulnerability have been turning up more and more frequently beginning in the 1980s in writing about disaster. Alternatively, the researcher uses these terms as resilience, marginality, susceptibility, adaptability, fragility and risk [1]. The meaning of vulnerable as an adjective presented by Oxford English Dictionary is in danger or in peril or in jeopardy or at risk or endangered or unsafe or unprotected [2] that clearly indicates a noun vulnerability that is made up of the characteristics of a person or group and their situation that influence their capacity to anticipate, to cope with, resist and recover from the impact of a natural hazard [3]. However, the scientific use of 'vulnerability' has its roots in geography and natural hazards research but this term is now a central concept in a variety of other research contexts such as ecology, public health, poverty and development, secure livelihoods and famine, sustainability science, land change, and climate impacts and adaptation [4]. Overgeneralization and some confusing uses of vulnerability take many forms as well [5].

In this regard, social vulnerability is defined as the susceptibility of social groups to the impacts of hazards, as well as their resiliency, or ability to adequately recover from them and a social dynamic rooted in gender, class, race, culture, nationality, age, and other power relationships [6]. Again, human factors are just as important a determinant of a disaster, as nature and to examine predisaster socioeconomic characteristics of a person or group is called 'social vulnerability' [7]. But there is a general consensus within the social science community about some of the major factors that influence social vulnerability. These include: lack of access to resources (including information, knowledge, and technology); limited access to political power and representation; social capital, including social networks and connections; beliefs and customs; building stock and age; frail and physically limited individuals; and type and density of infrastructure and lifelines [8]. Thus, social scientists needs to continue to seek practical ways to incorporate local technical knowledge, insight, skills, desires, and needs into the management of disaster situations, so that local people and institutions might be affirmed in identifying problems and offering solutions towards the management of their own situation, and that local capacities may be strengthened to resist future emergencies [9].With a total area of land 1, 47,570 square kilometer and a population of about 150 million, Bangladesh territory is one of the largest deltas in the world. It is a low lying country and covers with a network of rivers and canals forming a maze of interconnecting channel. Bangladesh mostly comprises floodplain areas with scattered hills in the eastern and northern parts. The northern part is in the Himalayan valleys and the southern part in the cost of Bay of Bengal. Bangladesh is recognized as worst victim of global climate change effects without being responsible for its underlying causes. The country manifests all the direct and indirect effects of climate change such as, global warming and sea level rise. As a result human, human health has to bear enormous costs. With a hot and rainy summer and dry winter, the climate of the country is tropical. Bangladesh has the highest population-density compared to any other country in the world with 1015 living per square kilometer and the country has an agrarian economy although the contribution of agriculture to GDP has been decreasing over recent years [10]. Moreover, the country has been suffering from various difficulties; population problem, poverty, hunger and food insecurity.

After the World Climate Conference-3 (WCC-3) in Geneva, Switzerland, 2009, the name of Bangladesh came into first rank as a vulnerable country. Recent reports of UN and WB and numerous researches also indicate 'Bangladesh' as the most vulnerable country in the world. Generally Bangladesh has a risk of a variety of natural hazards like storm, cyclone, tornedo, nor'wester (kal-baishakhi), storm surge and tidal bore, flood, river bank erosion, costal erosion, landslide, arsenic, earthquake and drought

Table-1: Top 10 Natural Disasters in Bangladesh (Sorted by Numbers of People Killed and Affected)

Disaster	Date	Killed	Disaster	Date	Affected
Famine	1943	1,900,000	Flood	22-Jul-1987	73,000,000
Epidemic	1918	393,000	Flood	Aug-1988	73,000,000
Wind Storm	12-Nov-1970	300,000	Flood	Jul-1974	38,000,000
Wind Storm	30-Apr-1991	138,866	Flood	May-1984	30,000,000
Wind Storm	Oct-1942	61,000	Drought	5-Jul-1983	20,000,000
Wind Storm	11-May-1965	36,000	Flood	Jul-1968	15,889,616
Flood	Jul-1974	28,700	Wind Storm	11-May-1965	15,600,000
Wind Storm	Jun-1965	12,047	Wind Storm	30-Apr-1991	15,438,849
Wind Storm	28-May-1963	11,500	Flood	8-Jul-1998	15,000,050
Wind Storm	9-May-1961	11,000	Flood	15-Jun-1995	12,656,006

Source: International Disaster Database, GoB. [11]

Natural disasters have caused the greatest loss of life in Bangladesh over the last decade than in any other country of the world, according to the Global Climate Risk Index (CRI), 2010, an average of 8,241 people died each year in 244 instances of extreme weather conditions in Bangladesh with cost of damage $2,189 million a year and loss of GDP 1.81 percent. Bangladesh's 1970 Bhola cyclone is the fourth worst natural disaster in recorded history and it was also the world's most deadly tropical cyclone. The cyclone killed 500,000 people and devastated many offshore islands. In 1991, at least 138,000 people were killed and 10 million made homeless following a cyclone in the Chittagong district [12]. But the most dangerous natural disaster happened in Bangladesh was on 15 November 2007. Cyclone Sidr struck the south west coast of Bangladesh with winds up to 240 kilometers per hour. The number of deaths caused by Sidr was estimated at 3,406, with 55,000 people sustaining physical injuries. It also affected extensive agricultural production losses and destruction of physical assets, totaling near US$ 1.1 billion [13].

The findings related to impact of climate change in Bangladesh indeed indicate severe social, economic and environmental damages and losses as the country has a vulnerable social position. The social inequality based on gender, geographical position, poverty, income, occupation and caste creates vulnerability among the people of Bangladesh. Thus, any of the natural disasters may loss huge damage of life, property and wealth of the people. As Camille Raillon described that like many other countries, Bangladesh is situated in a high-risk region, prone to natural and/or climate disasters, which are occurring with increasing frequency and intensity. The impact of climate change is currently only being felt in terms of negative effects, leading many to fear the worst for the security and survival of people, both in the short and long term, in certain regions of the world. This sounds the alarm for potential humanitarian crises in both rural and urban areas, the scale of which is as yet impossible to predict accurately. Access to vital resources, such as water, food and space are increasingly under threat by changes in climate (reduced drinking water resources, loss of land to flooding caused by rising sea-levels, arable land under threat from soil salinity or recurring drought, etc). Today (and looking to the future) the main question for humanitarians is how to reduce the risk of disasters and therefore indirectly lessen potential tension between individuals and communities, in this high-risk area [14].

Thus, it is obvious to search a 'new framework of most vulnerable social elements' which will reduce the losses of societal people. As the previous studies provide frameworks of mixed (social, political, economic and environmental) vulnerability of the people ignoring the most vulnerable social elements need for Bangladesh society. This paper aims to identify existing vulnerable social elements applicable for Bangladeshi society; to detect extent (most, moderate, somehow and no) of vulnerability of those elements and to develop a new framework for policy makers to take necessary action to most vulnerable social elements before natural disaster.

Vulnerability Analysis of Natural Disaster

The article reviews eight journal papers and one research report on vulnerability analysis of natural hazards/disasters. Cutter along with several researchers showed some pragmatic factors that influence social vulnerability of natural disaster at different studies. The Cutter's broad issues of social vulnerability related to natural disaster are 'lack of access to resources', 'limited access to decision making', 'beliefs and customs', 'Building stock and age', 'lack of social capital', 'frail and physically limited individuals', 'weakness in infrastructure and lifelines', 'population shifts', 'increased mobility'. Again cutter revealed some broader aspects of resilience like 'social resilience' ,'economic resilience', 'institutional resilience', 'infrastructure resilience' and 'community capital'. Garrett Dolan and Dmitry Messen (2012) identified several social elements of vulnerability as an emergency managing tool. Those elements are age, disability, illiteracy, education, gender, household composition, income level, poverty, religion, race, ethnicity, language, mass media access, social networks, and location of house and so on. And the rest of the studies, like the first four in table -2, revealed that somehow socio-historical, socio-anthropological, socio-political, socio-economic, socio-cultural, socio-demographical and socio-psychological elements might make people vulnerable at the time of natural disasters in society [table -2]. The table also shorts most relevant social elements of vulnerability to natural disaster. Those elements are commonly matched to socio-economic and socio-demographic elements of the existing society.

Table-2: Elements of Vulnerability and Most Relevant Social Elements of Vulnerability to Natural Disaster.

SNO	Name of the author/authors	Elements of vulnerability	Most relevant social elements of vulnerability
1	Susan L. Cutter, Bryan J. Boruff and W Lynn Shirley (2003) [15]	Income, political power, prestige, gender, race, ethnicity, age, employment, residence pattern, residential property, family structure, personal wealth	Employment, prestige, race, ethnicity, family structure.
2	Susan L. Cutter, Christopher G. Burton and Christopher T. Emrich (2010) [16]	Educational quality, age, transportation access, communication capacity, language competency, special needs, health	Educational quality, age, transportation access, communication capacity, language competency, employment, previous

		coverage, housing capita, employment, business size, health access, mitigation, flood coverage, municipal services, political fragmentation, previous disaster experience, social connectivity, housing type, shelter capacity, evacuation potential, housing age, sheltering needs, recovery, place attachment, political engagement, religion, civic involvement, advocacy, innovation,	disaster experience, social connectivity, political engagement, religion and civic involvement.
3	Susan L. Cutter, Lindsey Barnes, Melissa Berry, Christopher Burton, Elijah Evans, Eric Tate and Jennifer Webb (2008) [17]	Age, race, class, gender, occupation, social networks, social embeddedness, community value-cohesion, faith based organizations, employment, value of property, wealth generation, participation in hazard reduction programs, counseling services, quality of life, alcoholism.	Age, race, class, gender, occupation, social networks, social embeddedness, community value-cohesion, faith based organizations, employment, participation in hazard reduction programs, counseling services, quality of life, alcoholism.
4	Garrett Dolan and Dmitry Messen (2012) [18]	Age, culture, disability, illiteracy, education, gender, household composition, income level, politics, poverty, religion, race, ethnicity, language, mass media access, social networks, per-capita income, population growth rate, location of house.	Age, disability, illiteracy, education, gender, household composition, income level, poverty, religion, race, ethnicity, language, mass media access, social networks, location of house.
5	Sapam Ranabir Singh, Mohammad Reza Eghdami and Sarbjeet Singh (2014) [19]	Poverty, occupation, caste, ethnicity, exclusion, marginalization, inequalities, living area, gender, class, power-relation, employment, income, savings, education, housing type, infrastructure, lifeline, tenure type, built environment, family structure, medical services, information, knowledge and technology, political power, social networks, beliefs, custom, disability, housing, population density, age or seniority.	Poverty, occupation, caste, ethnicity, exclusion, marginalization, inequalities, living area, gender, class, power-relation, employment, income, education, housing type, family structure, information, knowledge and technology, political power, social networks, beliefs, custom, disability, age or seniority.
6	Wisher, Ben, Dr. and Henry R. Luce (1993) [20]	Class, gender, age, ethnicity, disability	Class, gender, age, ethnicity, disability
7	W. Neil Adger and P. Mick Kelly (1999) [21]	Poverty, inequality, institutional adaptation	Poverty, inequality, institutional adaptation
8	A. Fekete (2009) [22]	Age, occupation, income, gender, social welfare residents, residents per doctor, population per settlement, residents per hospital bed, living space per person, persons per house, new comer and re-habilitation center per population.	Age, occupation, income, gender, social welfare residents, population per settlement, living space per person, persons per house.
9	Tapsell, S; McCarthy, S; Faulkner, H &	Potential for loss of life, bereavement, injury, ill-health, way of	Way of life knowledge, skills, talent, experience specific, local 'folk',

	Alexander, M (2010) [23] *based on adapted framework	life knowledge, skills, talent, experience specific, local 'folk', knowledge/awareness of hazards and hazardous event producing processes, indigenous, cultural, responses to hazards, obligations and expectations, informal potential, norms and effective sanctions, authority relations, appropriable social organisations, intentional organisations, adaptability, language and ethnicity bonds, religious bonds, other cohesiveness, collective memories of disaster, environmental ethics homes, public facilities, schools, colleges, hospitals, fire stations, other public infrastructure, social welfare wealth (personal, collective), income inequality, age composition, gender, family structure, occupation, employment, disability, risk perception, access to political power	knowledge/awareness of hazards and hazardous events, indigenous, responses to hazards, obligations and expectations, norms and effective sanctions, authority relations, appropriable social organisations, language and ethnicity bonds, religious bonds, other cohesiveness, collective memories of disaster, income inequality, age composition, gender, family structure, occupation, employment, disability, risk perception and access to political power

Existing Vulnerability Approaches and Frameworks of Natural Disaster

Tapsell, S et al. (2010) identified 19 indices or approaches for assessing social vulnerability of natural hazards. The approaches are 1.Predictive indicators of vulnerability, 2.Index to evaluate socio-economic vulnerability to drought, 3.Hurricane Disaster Risk Index (HDRI), 4.Cutter's Social Vulnerability Index (SoVI), 5.Social vulnerability profiling (SVP), 6.Earthquake Disaster Risk Index (EDRI), 7.Local Flood Vulnerability Index, 8.Social and Infrastructure Flood Vulnerability Index (SIFVI), 9.Social Flood Vulnerability Index (SFVI), 10.Community vulnerability index (the Cities Project), 11.Neighbourhood social vulnerability, 12.Social vulnerability index, 13.Socio-Economic Indexes for Areas (SEIFA), 14.Community vulnerability framework and index of socioeconomic dimensions to the hazard of mountain pine beetle, 15.Draft Coastal Resiliency Index: A Community Assessment, 16.Pressure and Release model (PAR) and Access model, 17.Social Vulnerability Index (SVI) and Social and Infrastructure Flood Vulnerability Index (SIFVI), 18.Social-cognitive model, 19.Household Vulnerability Index. The assessment of these multi-disciplinary approaches went through individual level, household level, neighborhood level, community level, local level, city level, municipality level, metropolitan level, regional level, national level, country comparison level and even world level analysis of social vulnerability of natural hazards. Author also gathered the key variables used to measure social vulnerability related to natural hazard as well [24]. However, certain limitations of these approaches are (a) the approaches are not entirely 'social vulnerability approaches' rather multi-disciplinary approaches; (b) generalization of these approaches was based on mainly developed country's primary/secondary data (c) the most vulnerable social elements of these approaches were used only to complement of other broader issues rather producing domination.

Apparently, concept of vulnerability has been changing since its' initiation. Figure –1 shows the changing trends of the concept clearly that while the traditional engineering perspective of vulnerability focused primarily on physical aspects, the current debate regarding vulnerability clearly underlines the necessity to take into account various themes and parameters that shape and drive vulnerability, such as physical, economic, social, environmental and institutional characteristics. Some approaches also stress the necessity to integrate additional global drivers that have an impact on vulnerability, such as globalization and climate change. This implies that the focus of attention has shifted from a primarily physical structure analysis to a broad interdisciplinary analysis of the multidimensional concept of vulnerability [25]. Again, figure-2 demonstrates a 'diamond analogy: one illustration for conceptualizing the multifaceted nature of vulnerability'. Where the susceptibility to, or potential loss of, indigenous beliefs, customs, related artifacts and ways of life refers to the 'cultural' facet. This may include cultural independence and the superimposition of ideas and concepts from external sources. The 'institutional' facet broadens the focus to institutional arrangements and the potential consequences of the critical shortcomings of institutions and institutional arrangements. In its most extreme case the breakdown of national governance could be an outcome signified in part by corruption [26]. And social facet might extend to social factors associated with vulnerability. It is obvious that the concept of vulnerability demands a multi-disciplinary approach of study. And thus, the social elements regarding vulnerability remain a part of the central idea. Though, the central idea of vulnerability denotes people's societal settings and elements.

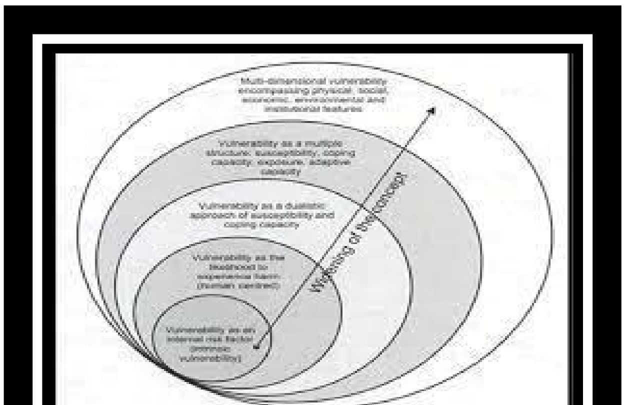

Figure-1: Birkmann's Key Spheres Of The Concept Of Vulnerability [27]

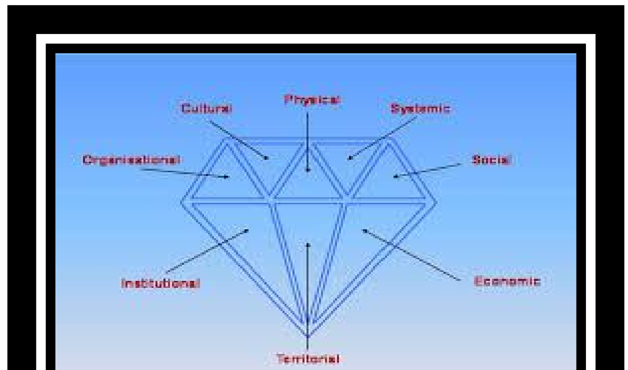

Figure-2: Parker's Diamond Analogy: One Illustration For Conceptualizing The Multifaceted Nature Of Vulnerability [28]

Dunning (2009) attempts to locate social vulnerability analysis in an emerging conceptual framework for flood risk management in the USA to help improve the understanding of social vulnerabilities and consequences, however the framework could be equally applied to other natural hazards. The framework describes who is likely to be most vulnerable to threats, the kinds of consequences that can be expected for vulnerable populations, as well as the resilience of populations (i.e. influences on how rapidly and completely they are likely to recover [29]. In his framework, Dunning set up a cycling process of social vulnerability analysis in a risk framework. Firstly, policy maker think about establish a decision context and then they can go for identify the risks. After identifying the risk, the next step will be 'analysis the risks' and then 'evaluate the risks'. Finally, the institutional set up can make a 'risk management decision' (figure-3).

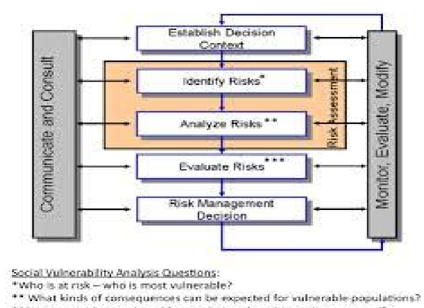

Figure-3: Dunning's Social Vulnerability Analysis In A Risk Framework [30]

Another framework at figure-3 describes the Wisner et al.'s (2004) pressure and release (PAR) model which condensed some pressure to assess the progression of vulnerability. Overall, the PAR model is an important approach and one of the best known conceptual frameworks worldwide that focuses on vulnerability and its underlying driving forces. It is particularly useful in addressing the release phase and the root causes that contribute to disaster situations. On the other hand, the approach underlines the fact that the real effort to reduce vulnerability and risk involves changing political and economic systems, since they are viewed as root causes of, for example, dynamic pressures such as rapid urbanisation or rapid population change. This conceptual framework puts a heavy emphasis on the national and global levels, although many dynamic pressures and unsafe conditions might also be determined by local conditions [31]. The model illustrates limited access to power; structure and resources are the root causes of vulnerability. It also claims political and economic system as well. The model further identified some dynamic pressures; lack of knowledge, training, investments and some macro forces of social, environmental and demographic issues. Only the elements represent social condition is the elements of unsafe condition like, location, livelihood, group, institution (figure-4).

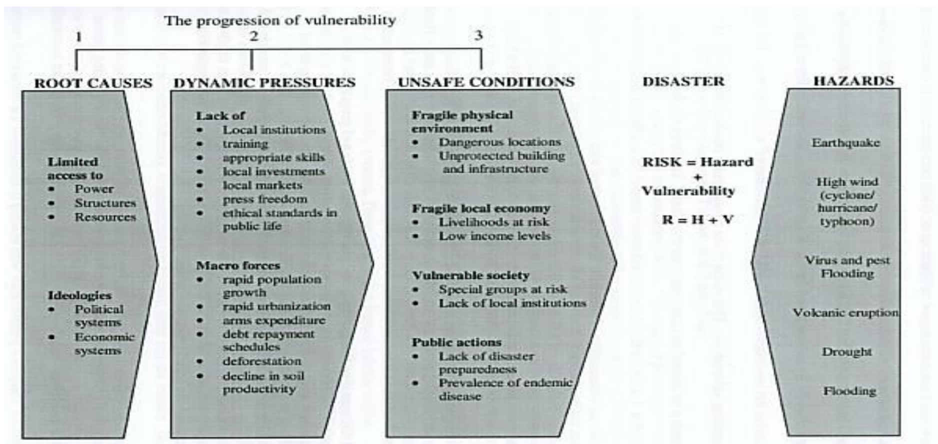

Figure-4: Wisner's Pressure and Release (Par) Model: The Progression of Vulnerability [32]

Pulling together the various perspectives and scales Parker et al. (2009) represented an approach providing a description of the three element categories in the framework. It is immediately apparent that a mixing of different measures and scales is taking place. Apart from introducing difficulties in undertaking vulnerability analysis, a broad catch-all framework as characterized here can be in danger of masking more complex relationships between concepts and attributes represented within categories. Relationships may not be linear or even discrete. Nevertheless, it provides a starting point for unpacking the complex attributes and processes influencing social vulnerability [33]. But the potential limitation of the framework is that several studies has already shown more extended elements of personal capital, social capital, quality and security, economic factors affecting recovery and capacity, social factors.

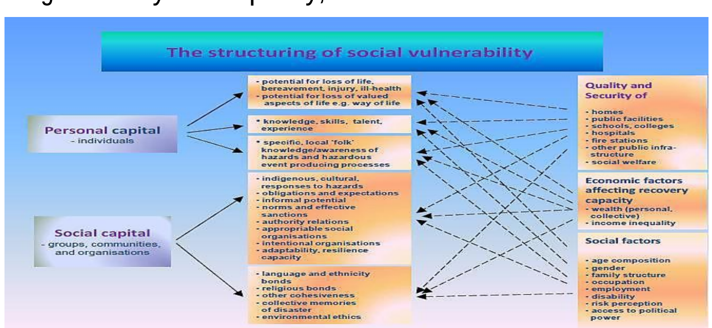

Figure-5: Adapted Framework for Approaching Social Vulnerability (Parker Et Al. 2009) [34]

Several studies, related natural disaster using different approaches tried to demonstrate the vulnerability analyses in Bangladesh. K. M. Maniruzzaman, Atsuyuki Okabe & Yasushi Asami (2001) showed a 'Geographic Information System (GIS)' base approach, preliminary development for a prototype 'Response Estimation System for Cyclones Under Emergency (RESCUE)'. Wind speed and surge models are incorporated into the system to predict natural disaster [35]. Dwijendra Lal Mallick Dwijendra Lal Mallick et al. (2005) identified, the governmental agencies in Bangladesh, working with natural disaster management, are shifting from disaster management towards disaster preparedness [36]. Mizan R. Khan and M. Ashiqur Rahman (2006) identified that the Government of Bangladesh has already established a multilayered institutional mechanism for disaster management, with formal recognition of the role of various stakeholders. Despite the presence of some strength, such as long experience in disaster response and recovery, the people's resilience, and donor support, the current management strategies suffer from a host of policy and institutional weaknesses. Most prominent is the absence of a functioning partnership among the stakeholders within these formal set-ups. What is lacking is the development and embodiment of a culture of collective decision-making in planning, in resource sharing, and in implementing disaster management policies and programs in an integrated and transparent way [37]. Keiko Ikeda (2009) recognized the proper gender roles can reduce vulnerability at the time of natural disaster. As women and men have different experiences in disaster, gender concerns should be fully addressed by the community and integrated in the action they take up to reduce disaster risks in Bangladesh [38]. Like K. M Maniruzzaman et al., Ashraf M. Dewan et al. (2006) also suggested to implement GIS sensor to predict food in Bangladesh. They only address an additional engineering elements; 'Remote Sensing'. [39]. Interestingly, Waziul Alam Choudhury, Firoz Ahmed Quraishi & Ziaul Haque (2006), emphasized to respond properly to a serious type of disaster like a cyclone or a tornado or recurrent devastating flood to gain mental health and to reduce physiological disorder as well. Furthermore, he argued that the disaster mental health team should be aware of the socio-economic status, local culture, tradition, language and local livelihood patterns. Integration of the team with the network of various governmental and non-governmental organizations is essential to provide mental health services effectively [40]. S.K. Singh (2010) praised the Cyclone Preparedness Program (CPP) of Bangladeshi Government and tried to use a huge telecommunication network throughout the cyclone zones to reduce people's vulnerability [41]. Shahzad Firoz (2010) used Sillitoe's local knowledge to reduce vulnerability. It's a rare study to analyze the concept of local knowledge in disaster management system in Bangladesh. He also pointed out the most commonly used terms 'indigenous' and 'local' knowledge, notions can be found such as 'rural people's knowledge', 'peasants' knowledge', 'farmers' knowledge', 'folk knowledge', 'indigenous technical knowledge', 'traditional environmental knowledge', 'indigenous agricultural knowledge', 'Ethnoscience' and 'traditional knowledge' [42]. M. A. Kashem (2006) found that most of the flood affected people had demanded 'shelter'. 'relief' and 'disaster preparedness' related information. And they had relied on friends, Union Parishad Chairman, NGO workers and neighbors to collect information rather using any type of mass media [43].

The social vulnerability analysis of natural disaster remained multidisciplinary approach of explanation. It is an attempt to conceptualize the social vulnerability on the basis of social elements only. Broadly, socio-economic, socio-demographical, socio-cultural, socio-political and socio-psychological issues determine the vulnerability of the people in Bangladesh. Each issue has several social elements like socio-economic issues incorporate with income, employment, occupation, investment, debts, land ownership, wealth, knowledge of risk reduction, skills, training and level of poverty. Again, socio-demographical issues include age, sex, education, no. of child, no. of person per family, living space per head, location of house, life expectancy, access to mass media, migration and building density. A broader issue, socio-cultural, also contain race, ethnicity, minority, family structure, community roles, religious bonds, member of social network, use of technology, types of using transportation, housing pattern, food habit, level of conformity, level of obedience, experience of disaster, community support and customs. Furthermore, socio-political issues include political engagement, leadership level and access to power. And lastly socio-psychological issues comprise illness, disability, mental position, distance of shelter center, neighborhood pattern and emotion. The level of vulnerability might low if the social elements will be accessibility or availability or presence or high level or satisfactory and vice versa (figure-6).

A similar prediction was done by Terry Cannon (2008). He argued that the basic building block in determining a person's vulnerable is how satisfactory their livelihood is (and how resistant it may be to hazards). A person's wellbeing and self-protection are closely determined by the strength of their livelihood. He added if Social protection is properly in place, will mean again that people can more quickly become operational after a hazard strike, restoring their livelihoods, making good the damage, and providing the resources needed for relief and recovery [44].

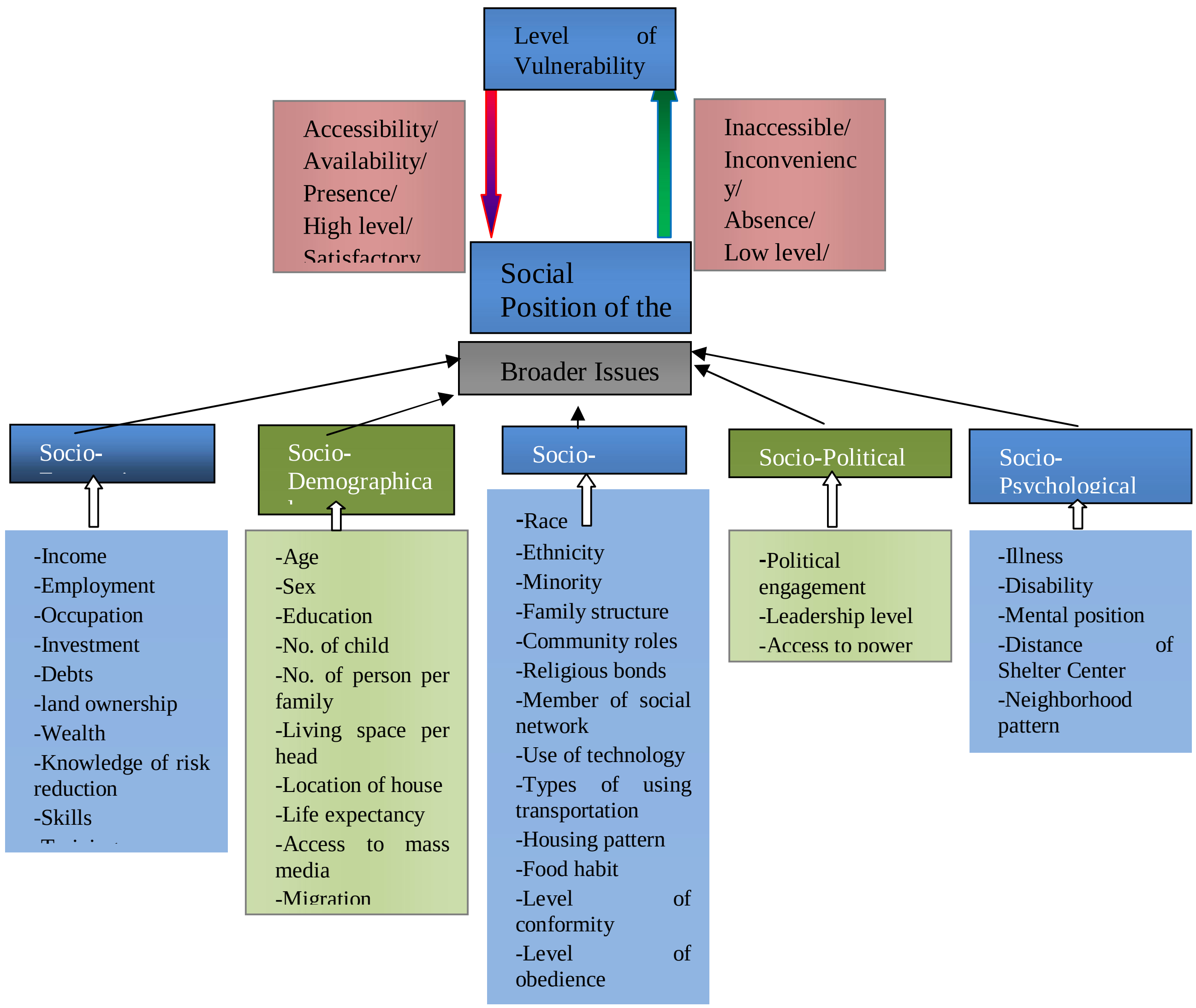

Figure-6: Elements of Social Vulnerability of Natural Disaster in Bangladesh

Conclusion

Attempting to validate a social vulnerability index meets several constraints. First, it is difficult to find empirical evidence about social vulnerability itself. Social vulnerability is often hidden, complex and nested in various human aspects and contingencies bound to different levels of society. Second, vulnerability as a concept is conceived in at least two major ways. On the one hand, it is perceived as a holistic and generic concept, encompassing many complex interrelations. On the other hand, it is seen as a more single-dimensional concept, focusing on one specific item to a specific hazard. Depending on each conceptualization, vulnerability is better apt for experimental tests. Third, social vulnerability is difficult to estimate for methodological reasons. Indicators and indices are indirect numerical surrogates of real phenomena. Quantitative assessments of qualitative phenomena are subject to generalizations in order to achieve computation and comparability [45]. Though, social vulnerability is a valuable construct, because it allows emergency planners to focus their attention on the factors that make people susceptible to harm, as opposed to the physical variables of the potential natural hazard. It also enables the planners to see how vulnerability is socially expressed and as a result, it provides a frame of reference for addressing solutions [46]. The present study depending upon secondary data of natural disaster tries to explore existing vulnerable social elements in Bangladeshi society and to develop a new framework for policy makers to take necessary action to most vulnerable social elements before disaster. It might be acceptable that accessibility or availability or presence or high level or satisfactory of the most vulnerable social elements can reduce vulnerability of natural disaster in Bangladesh. The current research suggests exploring an individual's social vulnerability score on the basis of these social elements.

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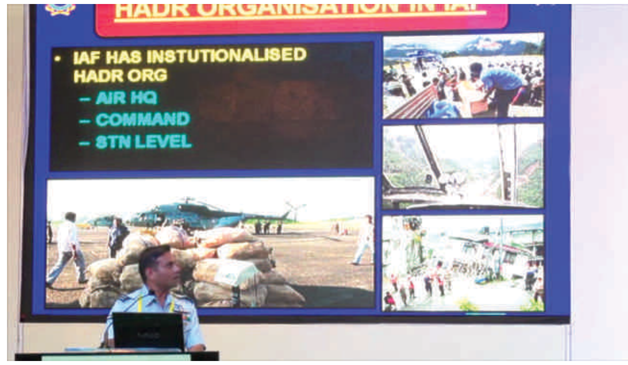
Open Sessions

Photo Gallery



Open Sessions

Photo Gallery

Open Sessions

Photo Gallery

Open Sessions

Photo Gallery

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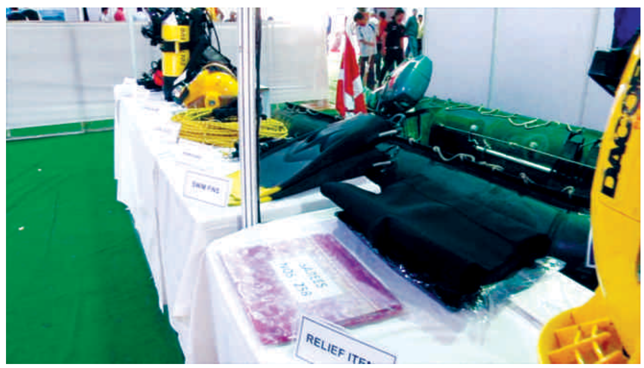
Photo Gallery

Cultural Photo Gallery

Exhibition Photo Gallery



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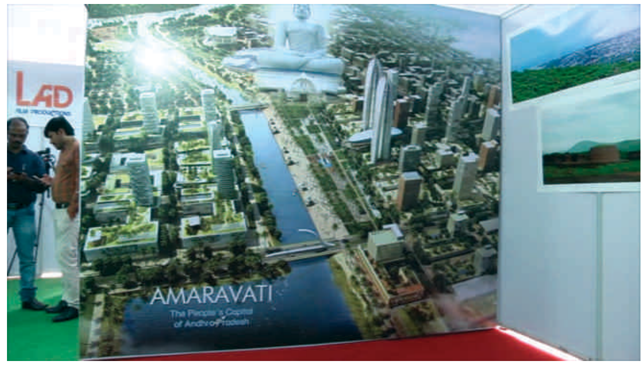

LIST OF INTERNATIONAL DELIGATES

S.NO	COUNTRY	DELEGATES	DESIGNATION
1	AFGHANISTAN	**Zolfaqar Karimi Baloch**	*Director of International Environmental Relations*
		Eng. Ab. Wadood Ghorbandi	*Director of Plant Protection & Quarantine*
2	AUSTRALIA	**Prof. Ken Coghill**	*Monash University, Melbourne*
		Dr. Channaveer Rm	*Social Work Discipline, Australia Catholic University, Brisbane, Australia*
		Brett Aimers	*Adjunct Associate Professor,Discipline of Public Health and Tropical Medicine, James Cook University,Townsville*
3	BANGKOK	**Dr. Indrajit Pal**	*Asian Institute of Technology*
		Abhinav Wallia	*Asian Institute of Technology*
4	BANGLADESH	**Dr Mahfuzul Haque**	*CEO, PRC.bd,Dhaka, Bangladesh*
		Prof. Md. Akbaruddin Ahmad	*Ex- VC . Dhaka,*
		Dr. Shahnaz Huda	*Professor Department of Law, University of Dhaka*
		Md. Anwar Hossain	*Professor, Department of Social Work, Jagannath University, Dhaka*
		Ashmayar Nabi Asif	*University of Dhaka*
		Mr. Nazmul Huda	*Lecturer, Department of Humanities,Bangladesh University of Engineering and Technology Dhaka-1000, Bangladesh*
		Mst. Marzina Begum, Phd	*Associate Professor,Department of Public Administration,Rajshahi University Rajshahi-6205*
		Md.Zahir Ahmed	*Chairman of Policy Research Centre.bd and Vice Chancellor of DarulIhsan University. & Research Associate, Policy Research Centre.bd and Social Activist.*
		Wahida Musarrat Anita, Senior Assistant Secretary	*Ministry of Environment and Forests*

		Dr. M Shamsur Rahman	*Ex- Professor, Department of Public Administration, Rajshahi University, Bangladesh and also Ex-Vice chancellor, Jatiya Kabi Kazi Nazrul Islam University, Mymensingh, Bangladesh*
		Ms. Farjana Ahmed Moon	*Subidbazar, Sylhet*
		Mr. Badrul Islam	*Subidbazar, Sylhet*
		Professor Dr. Nasim Banu	*Subidbazar, Sylhet*
		Md. Mustafa Zaman	*Department of Disaster Management,*
		Md. Shafiqul Bari	*Professor, Dept. of Agroforestry and Environment*
5	**BRAZIL**	**Richard Almeida Da Silva**	*Rio de Janeiro*
		Waleska Fortini	*The TAM Transportes Aereos Meridionais Avenda*
6	**BRAZZAVILLE CONGO**	**Monsieur Henri Djombo,**	*Minister of Economy Forest and Sustainable Development*
		Alexis Minga	*Advisor with Sustainable development and the Climate change*
		Jean Ignace Tendelet	*Chief executive officer of Sustainable development*
		Edmond Makimouha	*Coordinator, Focal Point Reduction Risks of Disasters*
		Christian Bossembe	*Attaches to the Cabinet of the Minister*
		Honourable Blaise Ambeto	*Deputy, Member ofthe Commission Lega l affairs and Administrative to the National Parliament*
7	**CANADA**	**Mr. Alexander Ferworn**	*Professor, Graduate Programs Director, Associate Chair - School of Computer Science Director*
		David Begg	*Ryerson University*
8	**China**	**Dr. Tu Wonghong**	
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		Yan Cui	*Lecturer, School of Law, Shandong University, Weihai, China*
9	**Cuban**	**Mrs. V. Sunderrajan**	*Embassy of Cuban*
10	**Gambia, West Africa**	**Bibhuti Bhusan Gadanayak**	*DRR & CCA Specialist, NDMA-UNDP*
11	**Geneva**	**Werani Zabula**	*Intergovernmental Panel on Climate Change (IPCC), Geneva*
12	**Germany**	**Mr. Stephan Struck**	*Advisor (Police Affairs), Embassy of the Federal*
13	**Ghana**	**Sir Kofi Portuphy**	*NADMO*
14	**Grenada**	**Ms Aria St.Louis**	*Permanent Secretary, Ministry of Agriculture, Lands, Forestry, Fisheries and Environment*
		Mrs. M. Jessamy	
15	**Guatemala**	**Leslie Melisa Ojeda Cabrera**	*Technical Advisor National CHM and BCH Portales*
16	**Guinea**	**Colonel Aboubacar Oularé**	*Adviser to the Minister of the Environment Manager of Water and Forests, Biodiversity Member of the World Commission on Protected Areas Chairman of the Regional Network of Marine Protected Areas in West Africa (RAMPAO) BP 761 Conakry*
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17	**Honduras**	**Lenin O'connor**	*Republic of Honduras*
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25	**Mauritius**	**Mr. J. Goburdhun**	*Head of Mission ,High Commissioner*
26	**Mongolia**	**Tsogtsaikhan Purev**	*Director, Ministry of Environment and Green Development,*
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		Karl P. Campos	*PHILLIPINES*
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		Emilia P. Pacoy	*University of South-eastern Philippines, Obrero Campus, Davao City*

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		Prof. Huong Ha	*New Castle Univ.*
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		Richard M. Walden	*Operations USA, President & CFO, Los Angeles*

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7	**Mr. V. THIRUGNANAM**	*PE(CIVIL), BHAVINI*	Chennai
8	**Mr. DEEPAK MATHUR**	*SOID(CIVIL), BHAVINI*	Chennai
9	**Mr. VENKATAKRISHNAN**	*SOID(CIVIL), BHAVINI,*	Chennai
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14	**Mr. Psc Rao**	*Roster Member,Red R India*	Pune
15	**Dr R.S. Purushothaman**	*PROFESSOR & HEAD-TNAU*	Chennai
16	**Dr. M.S ANEESA RANI**	*PROFESSOR & HEAD-TNAU*	Chennai
17	**Mr. Sunil Kumar**	*Joint Secretary, Bihar State Disaster Management Authority.*	Patna, Bihar
18	**Alla Sathya Dev**	*STUDENT/NGO QUOTA*	Hyderabad
19	**Mr. S P Sahu**	*Chief Safety Officer, SOUTHERN RAILWAY*	Hyderabad
20	**Mr. Venkar Rao**	*Deputy Chief Safety Officer(MECHANICAL),S.RAILWAY*	Hyderabad
21	**Mr. G. Muralidhar**	*Traffic Inspector Safety, SOUTHERN RAILWAY*	Hyderabad
22	**Mr. A. Pradeep Kumar**	*Senior Divisional Mechanical Engineer, S.RAILWAY*	Vijayawada, Andhra Pradesh
23	**Mr. M. Prasad**	*Senior Divisional Safety Officer, SOUTHERN RAILWAY*	Vijayawada, Andhra

			Pradesh
24	**Mr. Amit Goel**	*Chief Bridge Engineer, SOUTHERN RAILWAY*	Hyderabad
25	**Mr. Amarendra**	*Chief Rolling Stock Engineer, SOUTHERN RAILWAY*	Hyderabad
26	**Dr. Prasad**	*Chief Health Director, SOUTHERN RAILWAY*	Hyderabad
27	**Mr. Vara Prasad**	*Senior Divisional Safety Officer,SOUTHERN RAILWAY*	Hyderabad
28	**Mr. Srinivas Reddy**	*Senior Divisional Mechanical Engineer, S.RAILWAY*	Hyderabad
29	**Mr. Pankaj Sharma**	*Madhya Pradesh State Electronics Development Corporation*	Bhopal
30	**Mr. PRASHANT BARSING**	*FPM-Operations Management,IIM*	Lucknow
31	**Mrs. K. SASIKALA**	*Senior Technical Officer, Wind Engineering Lab, CSIR-Structural Engineering Research Centre,*	Chennai
32	**Mr. AJAY KUMAR**	*BIHAR STATE ADMINISTRATION & RURAL DEVELOPMENT*	Bihar
33	**Mr. KAUL SINGH THAKUR**	*HON'BLE MINISTER OF HEALTH, REVENUE & LAW*	Himachal Pradesh
34	**Dr. Lalrokima Chenkual**	*Head Faculty,Disaster Management Centre,GOVERNMENT OF MIZORAM*	Mizoram
35	**Dr. Abhijit Sarma**	*Additional Superintendent & Nodal Officer, Disaster Management, Gauhati Medical College, Guwahati*	Assam
36	**Deputy RELIEF COMMISSIONER**	*REVENUE & DISASTER MANAGEMENT Dept.(SPECIAL RELIEF) BHUBANESHWAR*	Odisha
37	**Dr. A. SENTHIL VEL**	*Asst.PROJECT DIRECTOR, MINISTRY OF FOREST & ENVIRONMENT*	New Delhi
38	**Dr. RAMESH RAMACHANDRAN**	*DIRECTOR NCSCM, MINISTRY OF FOREST & ENVIRONMENT*	Chennai
39	**Dr. S. BOSE**	*Asst.DIRECTOR, CLIMATE CHANGE DIVISION, MINISTRY OF FOREST & ENVIRONMENT*	New Delhi
40	**Mr. Sagat Shaunik**	*Research Scholar,The Indian Institute of Technology, Bombay*	Mumbai
41	**Ms. ANJU SHARMA. IAS**	*CHIEF EXECUTIVE OFFICER, GSDMA*	Gujarat
42	**Dr. KAMLESH UPADHYAY**	*Ass.PROFESSOR, BJ MEDICAL COLLEGE*	Gujarat
43	**Mr. NISARG DAVE**	*Dy.DIRECTOR, GSDMA*	Gujarat
44	**Mr. SUMEDH PATIL**	*Dy.DIRECTOR, GSDMA*	Gujarat

45	**Mr. PIYUSH RAMTEKE**	*SECTOR MANAGER,GSDMA*	Gujarat
46	**Mr. MIKIHLESH MISHRA. IAS**	*DIRECTOR-LAND RECORDS, GOVT.OF BIHAR*	Bihar
47	**Mr. SASHIBHUSHAN TIWARI. IAS**	*DIRECTOR-LAND ACQUISTION, GOVT.OF BIHAR*	Bihar
48	**Ms. Prasanna Kumar Wundavalli**	*Professor Climate and Disaster Management, Dr MCR HRD Institute*	Hyderabad
49	**Ms. Yamini Meduri**	*Research Associate, Viganana Jyothi Institute of Management, Bachupally*	Hyderabad
50	**Dr. N.JAYARAJU**	*Dept of Geology,Yogi Vemana University,KADAPA-*	Kadapa
51	**Mr Shakeel Intaz**	*Dy Chief Engineer (Prod-Gas)- Oil India Ltd*	Mumbai
52	**P G V Ramana Reddy**	*Vice President – Consulting & Technical Services,Avineon India Pvt. Ltd*	Hyderabad
53	**Dr. Ch Murali Krishna**	*MS (Ortho)., MBA, GREEN TRUST OF INDIA,*	Nellore
54	**Mr. M. K. R KIRAN**	*EXECUTIVE ENGINEER, MINISTRY OF ROAD TRANSPORT & HIGHWAY*	Hyderabad
55	**Ms. Neelima Satyam,**	*B2-104,Vindhya-C2,Gachibowli,.*	Hyderabad
56	**Ms. Sanjana Chaliha**	*HR Manager- Oil India Ltd*	Mumbai
57	**Prof. NIRANJAN SAHOO**	*Xavier Institute of Social Service*	RANCHI
58	**Mr. Soumyadeep Baksi**	*Assistant Professor,Department of Health Safety & Environment*	Dehradun
59	**Shri Amitava Sabui**	*Jt. GM, Rifle factory Ishapore,*	West Bengal
60	**Shri Pavan Kumar**	*WM, Rifle factory Ishapore,*	West Bengal
61	**Shri. N. S BHAGGI**	*MGGS(OPERATIONS), NORTHERN COMMAND*	Punjab
62	**Mr. SAMIR KUMAR IAS**	*DIRECTOR, DISASTER MANAGEMENT*	Punjab
63	**Mr. P.K SINHA IPS**	*INSPECTOR GENERAL POLICE*	Punjab
64	**Mr. HARMANJIT SINGH**	*COMMANDANT, HOME GUARD, CIVIL DEFENCE*	Punjab
65	**Mr. AMREEK SINGH**	*SCIENTIST "F", SNOW & AVALANCHE STUDY ESTABLISHMENT, CHANDHIGARH*	Punjab
66	**Mr. ROSHAN TAMANG**	*SCIENTIST "B", SNOW & AVALANCHE STUDY ESTABLISHMENT*	Punjab
67	**Mr. Lakshay Taneja**	*Research Scholar,Mechanical Engineering Department,Indian Institute of Technology- Delhi*	New Delhi
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69	**Mr. K C Gupta**	*DGM(Mining), NMDC*	Hyderabad
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152	**Mr. D. ROYCHOWDHURY**	*SE, CPWD, MINISTRY OF URBAN DEVELOPMENT*	New Delhi

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155	**Shri C. N. Suresh**	*SE*	Vijayawada, Andhra Pradesh
156	**Shri Anand Kamal Pandey**	*EE NSC Project*	Hyderabad
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158	**C RNanda**	*SE*	Bilaspur
159	**Nem Chandra**	*SE (P)*	Gandhinagar
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201	**INDIAN NAVY**		
202	**INDIAN NAVY**		

203	**INDIAN NAVY**		
204	**INDIAN NAVY**		
205	**INDIAN NAVY**		
206	**INDIAN NAVY**		
207	**INDIAN NAVY**		
208	**INDIAN NAVY**		
209	**AIR VICE MARSHALL A S BUTOLA, VM VSM**	*INDIAN AIR FORCE(12 Nos)*	Airforce Base
210	**AIR COMMODORE A S PATHANIA, VSM**		
211	**AIR COMMODORE B V UPADHYAY, VM--AIR II**		
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213	**GROUP CAPTAIN Debadutta PATRO**		
214	**GROUP CAPTAIN KULWINDER SINGH**		
215	**GROUP CAPTAIN K S SAINI**		
216	**GROUP CAPTAIN O S MALHI**		
217	**WING COMMANDER P SURENDRAN**		
218	**WING COMMANDER RB SINGH**		
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299	**Yellabothu Teja**	*Children from Andhra Pradesh*	
300	**Arambakkam Kartika**	*Children from Andhra Pradesh*	
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304	**N Keerthi**	*Facilitator*	
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306	**Devi Nagarjuna**	*Children from Andhra Pradesh*	
307	**K.Durga Naga sai**	*Children from Andhra Pradesh*	
308	**B.Kurpa**	*Children from Andhra Pradesh*	
309	**R.Raju**	*Children from Andhra Pradesh*	
310	**R.Doraswamy Raju**	*Children from Andhra Pradesh*	
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313	**Mrs Padmaja**	*Facilitator*	
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315	**Sangita Kumari**	*Children from UNICEF Team*	
316	**Rohit Kumar**	*Children from UNICEF Team*	
317	**Sweety Kumari**	*Children from UNICEF Team*	
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321	**Mamata Mai**	*Save the Children (Odisha)*	
322	**Anupama Sahani**	*Save the Children (Odisha)*	
323	**Lipuna Patra**	*Save the Children (Odisha)*	
324	**Manoranjan Mohanty**	*Save the Children (Odisha)*	
325	**Mamata Rout**	*Facilitator*	
326	**Biraja Prasad pati**	*Facilitator*	
327	**Mufti Riyaz**	*Facilitator*	
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329	**Kaminiprabha Dhakad**	*Children from Child Fund India Team*	
330	**Laxmi Talia**	*Children from Child Fund India Team*	
331	**Chandra Pujari**	*Children from Child Fund India Team*	
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333	**Kamraj Desianayak**	*Facilitator*	
334	**Rama Rao Dammala**	*Facilitator*	
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336	**Md Rafique**	*Children from World Vision India Team*	
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S.No	Government of India
1	Ministry of Environment Forest And Climate Change
2	Ministry of Civil Aviation
3	Ministry of Urban Development
4	Ministry of Defence
	Indian Army
	Indian Navy
	Indian Air Force
5	Ministry of Road Transport and Highways
6	Ministry of Railways
7	Ministry of Water Resources

LIST OF STATE GOVERNMENTS

S.No	State Governments
1	Government of Assam
2	Government of Bihar
3	Government of Goa
4	Government of Gujarat
5	Government of Himachal Pradesh
6	Government of Jharkhand
7	Government of Karnataka
8	Government of Kerala
9	Government of Madhya pradesh
10	Government of Mizoram
11	Government of Odisha
12	Government of Punjab
13	Government of Uttar pradesh
14	Government of Uttarkand
15	Government of Telangana

LIST OF STATE GOVERNMENTS DELIGATES			
S.NO	**STATE**	**DESIGNATION**	**NAME**
1	**Gujarat**	Chief Executive Officer, GSDMA	**Ms. Anju Sharma. IAS**
		Asst. Professor, BJ Medical college	**Dr. Kamlesh Upadhyay**
		Dy. Director, GSDMA	**Mr. Nisarg Dave**
		Dy. Director, GSDMA	**Mr. Sumedh Patil**
		Sector Manager, GSDMA	**Mr. Piyush Ramteke**
2	**Uttar pradesh**	Revenue & Disaster Management Department	**Mr. Narendra Tiwari**
3	**Bihar**	Director, Land records,	**Mr. Mikihlesh Mishra. IAS**
		Director, Land Acquistion	**Mr. Sashibhushan Tiwari. IAS**
		Bihar State Administration & Rural Development	**Mr. Ajay Kumar**
		Joint Secretary, Bihar State Disaster Management Authority.	**Mr. Sunil Kumar**
4	**Karnataka**	Karnataka State Natural Disaster Monitoring Centre	**Mr. G S Srinivasa Reddy**
5	**Assam**	Additional Superintendent & Nodal Officer, Disaster Management, Gauhati Medical College, Guwahati	**Dr. Abhijit Sarma**
6	**Uttarkand**	Superintendent of Police	*******
		Deputy General of Police	*******
		Assistant Professor, Department of Health Safety & Environment, Dehradun	**Mr. Soumyadeep Baksi**
7	**Goa**	South Goa District, Margao	**The Collector**
		Fire & Emergency Services, Panaji	**Mr. Ashok Menon IAS**
8	**Himachal pradesh**	Hon'ble Minister of Health, Revenue & Law	**Mr. Kaul Singh Thakur**
9	**Madhya pradesh**	Dy. Director, BHOPAL	**Dr. Chhaya Joshi**
		Madhya Pradesh State Electronics Development Corporation	**Mr. Pankaj Sharma**
10	**Mizoram**	Head Faculty, Disaster Management Centre	**Dr. Lalrokima Chenkual**
11	**Odisha**	Revenue & Disaster Management Department. (Special Relief)	**Deputy Relief Commissioner**
		****	**Officer**
		****	**Officer**
12	**Punjab**	Director, Disaster Management	**Mr. Samir Kumar IPS**

		Inspector General Police	**Mr. P.K Sinha IPS**
		Commandant, Home Guard, Civil Defence	**Mr. Harmanjit Singh**
13	**Telangana**	Superintending Engineer, SDSO	**Mr. P. Srinivas Rao**
		Executive Engineer, SDSO	**Mr. S. Srinivasulu**
		Deputy Executive Engineer, SDSO	**Mrs. M. Gouthamishilpa**
14	**Kerala**	Travancore Cochin Chemicals Ltd	**Mr. S. Harishchandran**
			Mr. Rahul Menon
15	**Jharkhand.**	Dy. Director of Mines Safety, Ministry of Labour & Employment,	**Mr. Aftab Ahmad**

LIST OF SUPPORTING ORGANISATIONS		
S.No	**NAME**	**CITY/STATE**
1	National Disaster Management Authority(NDMA)	New Delhi
2	UNICEF INDIA	Delhi
3	Oxfam India	Kolkata
4	Coal India ltd	Kolkata
5	Kerala Tourism Development Corporation(KTDC)	Kerala
6	Cairn India	Gurgaon
7	Kamineni Hospitals	Hyderabad
8	Hindustan Shipyard Limited (HSL)	Visakhapatnam
9	Jawaharlal Nehru University (JNU)	New Delhi
10	Network of Asia Pacific Schools and Institutes of Public Administration and Governance (NAPSIPAG)	New Delhi
11	Indian National Centre for Ocean Information Services (INCOIS)	Hyderabad
12	Andhra University	Visakhapatnam
13	Gitam University	Visakhapatnam
14	Vignan University	Visakhapatnam
15	Save the Children	Hyderabad
16	University of Hyderabad	Hyderabad
17	Association of Indian Universities	New Delhi
18	Electronics Corporation of India Limited (ECIL)	Hyderabad
19	The International Emergency Management Society (TIEMS)	Beijing
20	Society of Emergency Medicine India (SEMI)	Hyderabad
21	Uttar Pradesh State Disaster Management Authority	Lucknow
22	Geo Climate Risk solution	New Delhi
23	Ridge Events and Media	Thiruvananthapuram
24	Institution for Disasters, Emergency & Accidents (IDEA)	New Delhi

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Envisioning a Disaster Resilient Society

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