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Editorial Note

Interrelationship between enviroment and disasters are becoming more evident from some of the recent disasters like Uttarakhand Floods, Kashmir Floods and so on. The impacts of disasters have human as well as environmental dimensions. Environmental conditions exacerbate the impact of a disaster and disasters have impact on the environment. Deforestation, poor land-use planning, forest management and agricultural practices etc can exacerbate the negative environmental impacts of extreme weather leading to landslides, flooding, silting and ground/surface water contamination and so on. Climate Change is posing new challenges by increasing the frequency and intensity of hazards, vulnerability of people and ecosystems and also by reducing capacity of the people to cope with and recover from disasters.

NIDM through "Disaster and Development" Journal bridges gaps between the researchers and practitioners by providing readers with up-to-date information regarding the evolving nature of the research in the field of disaster risk reduction. Recognizing the inherent links between disaster and development, particularly sustainable development, the current issue of the journal is on environment and disasters with special focus on Climate Change Adaptation. This issue has eleven peer reviewed research papers contributed by academicians, scientists, researchers and practitioners on climate change adaptation, mainstreaming climate change adaptation and disaster risk reduction in developmental planning, disasters and displacement issues, chemical disasters, monitoring and mapping for drought, landslides, forest fire management, river basin management and cross cutting issues like empowerment of PRI for disaster preparedness and risk reduction and social support in disaster coping and mitigation.

Our sincere thanks to authors who have contributed papers, and the members of the editorial advisory board and reviewers, editors of the journal for their outstanding work. We welcome your valuable comments and contributions for the future issues of the journal.

(Satendra)

Integrating Climate Change Adaptation and Disaster Resilience: Issues for Sundarbans

– Ranajit Jana[1], Subhakanta Mohapatra[2] and Anil K. Gupta[3]

Abstract

Climate change has been one of the major threats in the recent decades. It is a significant and lasting change in the statistical distribution of weather pattern over long periods of time and one of the greatest environmental, social and economic threats. According to the IPCC, Sundarbans, a dynamic delta is mostly affected and is vulnerable to climate change and natural disasters. Sundarbans delta is the largest single block of tidal mangrove forest in the world and UNESCO world heritage site covering two third parts in Bangladesh and one third part in India. This paper discusses the climate change adaptation with disaster resilience issues in the Sundarbans (India). The coastal communities of

Sundarbans are adapting to different issues such as sea level rise, cyclone, storm surges, coastal erosion, salt water intrusion etc. These extreme events are the great challenges to people living on this delta. In the Sundarbans delta, the above chall1enges have affected the physical, human, financial, social and natural capital. Not only these but also agriculture, fishing, forestry, tourism, infrastructure, trading and health are under risk of insecurities due to climate change and natural disaster. The present paper examines the critical issues and challenges of Sundarban's environment and its communities with respect to impact of climate change and disasters in view of disaster resilience and climate change adaptation.

Keywords: *Sundarbans, climate change, disaster resilience, adaptation.*

Introduction

Climate change has been a global problem in the last few decades and it is an issue integrally linked to the achievement of sustainable development, involving a much broader set of conceptual and institutional linkages, domestically and internationally

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in the late 1980s and early 1990s (Depledge & Yamin, 2009). At the heart of the existing climate change regime is a divide between developed and developing countries (Ghosh and Woods, 2009). Climate, the totality of weather conditions over a given area, is variable. Although it is not as fickle as weather, it fluctuates globally as well as locally in irregular pulsations (Landsberg, 1997). It is caused by the different factors that including oceanic processes, variations in solar radiation received by Earth, plate tectonics, volcanic eruptions and human-induced alterations. Scientists are working actively to point out the past and future climate by using observations and theoretical models.

Climate change as a global challenge has evolved through a series of stages in the last few decades which are divided into different eras which are characterised by the scientific evidence, public perceptions, responses and engagement of different groups to address the problem (Huq and Toulmin, 2006). There are different impacts of climate change in different places in the world such as North America, South America, Europe, Africa and Asia. Not only there in the continents but also thousands of islands which are low-lying have problems which are very specific to them, and the problems of climate change are the most severe for the low-lying islands, but for those that are volcanic have unique challenges in terms of transportation, and in terms of access (Chand, 2011). In India, since the industrial revolution, climate change has started endangering biodiversity, human health and food and fresh water supplies, coastal and low lying system, impacting people due to low adaptive capacities. The Sundarbans is a world heritage site and becoming increasingly vulnerable to climate change and disasters in the world (IPCC, 2007). Each island has its uniqueness and that uniqueness needs to be nurtured and strengthened through sustainable policies and will examine the specific issues and problems that islands face in sustainable tourism development (Sheldon, 2005). Deltas, which occupy less than 2 percent of the world's coastline, vary in shape and size in relation to the quantity and type of sediment supplied by rivers and the ability of oceanic processes to rework and redistribute them (Coleman and Wright, 1971).

Disasters generally have a negative impact on the environment. In a direct way, it can physically damage the environment in proportion to its intensity. In an indirect way, it might put additional anthropogenic pressure on the natural resources caused by the loss of usual livelihood of the affected people. However in the case of Sundarbans, the impact of the disaster was not so much on the environment but much more on the livelihood of the people, and especially the poor (Ghosh, 2010). Adaptation measures embedded within climate change policies could, by design, try to reduce vulnerabilities and risks by enhancing the adaptive capacity of communities and

economies. This would be consistent with sustainability goals. Researchers and practitioners should not equate vulnerability to poverty, though, and they should not consider adaptation and adaptive capacity in isolation. Brooks et al. (2005) conclude that efforts to promote adaptive capacity should incorporate aspects of education, health and governance and thereby extend the context beyond a particular stress (such as climate change) to include factors that are critical in a broader development context. Many people have worked on Sundarbans Delta from different angles such as some of the people has shown how the climate change has affected the perspective view on climate change livelihood of the people. Some of the people has described about the disaster resilience. But this is different from other studies because this is an Integrating study where we highlighted the key issues and challenges of Sundarbans Delta. The study aimed at understanding the impacts of climate change on the Sundarbans environment for suggesting an integrated strategy for Climatic resilience and Disaster Risk Reduction. The key objectives of the study are-

- To indentify and analyse the impacts of Climate change on livelihood and disaster impacts in the Sundarbans delta.
- To identify the issues and challenges with the current situation of Sundarbans Delta.
- To strategise to protect the ecosystems/natural resource base from the impacts of climate change and natural disasters while providing for human needs.

Study Area

Sundarbans is the largest delta in the world formed at the Ganges-Brahmaputra river system. The Indian Sundarbans is situated in between latitude 21° 32'-22° 40'N and longitude 88° 22'- 89°0'E in the north east coast of India occupy 9630 square kilometer and surrounded by Raimangal river in the East, Hooghly river in the West, Dampier Hodges line in the North and Bay of Bengal in the South. There are 56 islands of various sizes in Sundarbans and these are separated from each other by a network of tidal channels and creeks, some of which act as pathways for both freshwater discharge from upland and to and fro movement of flood and ebb. The world's largest Heritage Site awarded by UNESCO in 1997, the Sundarbans is an archipelago of several hundred islands, spread across 9,630 sq km in India and 16,370 sq km in Bangladesh. On the Indian side, it extends over two districts: 13 blocks in South 24 Parganas and six in North 24 Parganas. The Sundarbans delta has taken its current shape over the past 300 years. The islands are low, marshy, alluvial plains that are still in the process of being formed through siltation and powerful tidal currents,

a continuous process of erosion and accretion. As new land is added to the existing mass, some parts are eroded away as part of a natural cycle.

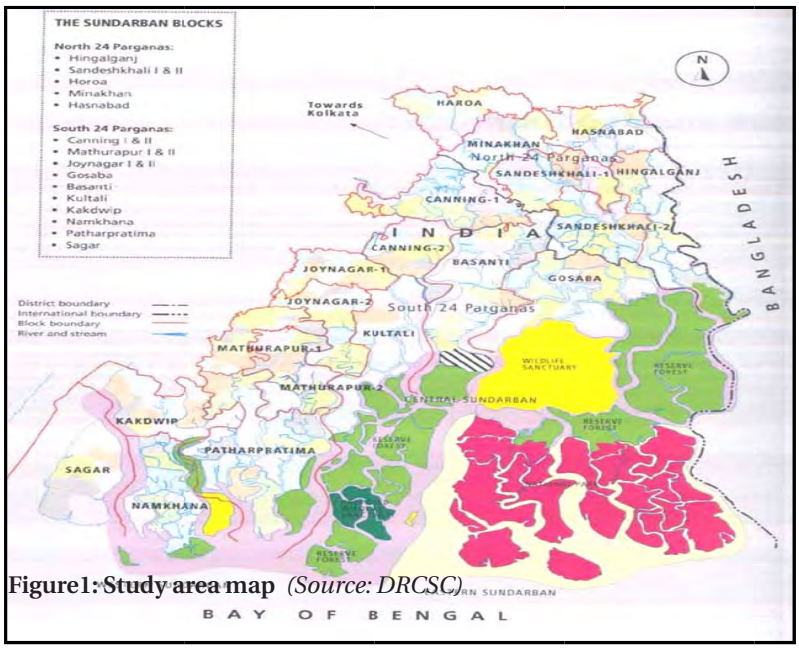

Figure 1: Study area map *(Source: DRCSC)*

The Sundarbans delta is intersected by a complex network of tidal waterways, mudflats and small islands of salt-tolerant mangrove forests, and presents an excellent example of ongoing ecological processes. Not only is the Sunderban ecosystem of enormous value to mankind, millions of people are generating their livelihood from the resources of the region. Some of the activities include agriculture, fishing, woodcutting, honey-collection etc. However, the Sundarban, its flora, fauna, and the people who depend upon it are in danger. The area covered by the mangrove forests has halved in the last two decades. Many of the species of flora and fauna are endangered. The Sundarbans has been celebrated in numerous Bengali language and Indian English novels, songs, and film. The Bengali folk epic *Manasamangal* mentions Netidhopani and has some passages set in the Sundarbans during the heroine Behula's quest to bring her husband Lakhindar back to life. Sundarbans being a part of West Bengal, the people follow Bengali culture; since it is a total forest area tribal lifestyle is followed. The state is well-known for its superb arts and crafts made of silk, ivory, shola, conchshell, dhokra and beautiful clay models. Also worth-mentioning are Baluchari saris and the famous woollen carpets, blankets as well as knitted garments. The average maximum and minimum temperature is 34°C and 20°C respectively. Rainfall is heavy

with humidity as high as 80% as it is close to the Bay of Bengal. The monsoon lasts from mid-June to mid-September. Prevailing wind is from the north and north-east from October to mid-March and south-west westerlies prevail from mid-March to September. Storms which sometimes develop into cyclones are common during the months of May and October. Sundarbans where a highly vulnerable system would be a system that is very sensitive to modest changes in climate, where the sensitivity includes the potential for substantial harmful effects, and for which the ability to adapt is severely constrained.

Data Sources and Methodology

The present study was conducted based on primary and secondary data sources. The household survey was based on semi-structured questionnaire that encompassed a large set of queries on households' experience with climate shocks in general and cyclone Aila in particular, impact on household economic conditions, adopted coping mechanisms, health and morbidity status, treatment seeking behaviour, health expenditure and health shocks, migration history of the de-facto household members and detailed information on presently out-migrated members. Village level information was collected using an in-depth interview guidelines. This encompasses probe on the impact of Aila on village infrastructure such as transportation and communication facilities, civic amenities, productivity of lands, breach of embankment & repair etc. These issues of livelihood and migration of villagers, overall health status of population as an aftermath of Aila, utilization of services for health and nutrition, understanding of environmental vulnerability at the community level and strategies undertaken by the community for mitigation and adaptation against future climate shocks. Villages were taken to elicit their perception about the human-animal conflicts and different aspects of the problem and its probable solution.

The Sundarbans delta is increasingly becoming vulnerable to climate change. It is high time the government policies are formulated giving much needed emphasis to the menace," said Chandra Bhushan, deputy director, Centre for Science and Environment (CSE). An increase in the salinity of land and its erosion has drastically lowered agriculture productivity of the area. Fishing, which is an important occupation here, has also been hit with the fish migrating to cooler waters, said Aditya Ghosh of CSE, elaborating on the ill effects of climate change. "Our disaster management is reactive. We wait for disasters to hit and then we go for rescue and rehabilitation. But the need is for a proactive system which can give sufficient prior information about a disaster so that we can prepare ourselves," Ghosh said. Increased risk of high tidal inundation, salinity, cyclonic storm / tidal surges for the livelihoods of the local people, land infrastructure etc. lead to direct loss of agricultural land, pond and other community assets and human settlement. Disasters in Sundarbans have already

aggrevated by climate change, importantly through increased salinity and extreme weather events like tropical cyclones.

Results and Discussion

Climate change issues for Sundarbans

Most of the islands in the Sundarbans are low lying, even the mainland does not have any sharp elevation near the seafront. This means the rise in sea level has a direct impact on the people living there. Two type of impact are there: firstly land is lost to the sea which decreases landholdings and puts more pressure on agriculture. Secondly, the land lost to the sea is difficult to reclaim for agriculture in the near future, since salinity destroys the productivity of the soil. The loss of land due to the rise of the sea level is but one factor in the decreasing size of the Sundarbans landmass. The other is the constant erosion of embankments built to stop the seas from invading islands. This is again a recurrent theme throughout the islands of the Sundarbans where there is a constant battle between man and sea to stop large chunks of land being dragged away, and islands, once capable of supporting hundreds of people, now lie uninhabited. Although land erosion affects everyone in the Sundarbans, the table below depicts the land loss in the 10 most vulnerable Islands in the last decade, where Jambudwip is the most vulnerable island with approximately 20.19% land loss.

Table 1: Land Loss in 10 most vulnerable Island in eight years of the last decade

S. No.	Islands	2001 (In sq km)	2009 (In sq km)	Loss (In sq km)	% Loss
1	Dakshin Surrender-nagar	44.336	42.015	2.324	5.23
2	Sagar	244.434	239.091	5.343	2.18
3	Namkhana	150.155	145.488	4.667	3.1
4	Moushuni	28.283	28.283	0.64	2.28
5	Ghoramara	5.339	4.564	0.774	14.52
6	Dalhousie	36.084	34.28	1.904	5.26
7	Dhanchi	67.101	62.201	4.9	7.3
8	Bulchery	26.915	23.287	3.628	13.45
9	Bhangaduani	31.316	26.159	5.157	16.44
10	Jambudwip	6.242	4.979	1.263	20.19
Cumulative Land loss for ten Islands				30.6	

Source: Hazra, et. al. 2010

Cyclone Aila of 2009 was the most dramatic of the climatic disasters to have recently

hit the Indian Sundarbans. Residents say that the storm incidences are on the rise over the years, both in frequency and in intensity. Although the months of July to October were always the season for storms, the storms now come more often, and do much more damage than before. The people of the Sundarbans feel much more vulnerable, and they have little to protect them when these storms strike.

Livelihood Challenges in Sundarbans

Sundarbans population lives within the mainland and their livelihood pattern are similar to the rest of the rural population in both the districts of North and South 24 Parganas. It is the island villagers whose way of living and entitlements are considerably different from that of their mainland counterparts. The livelihood options in these remote islands are indeed very limited till date. Typically in the delta region rain-fed, single-crop agriculture and fishing are the two main sources of livelihood. For the blocks bordering the reserve forest, during agricultural lean season, substantial part of the population depends on forest and river resources. Traditional methods of cultivation have been put at risk, and today the farmer in the Sundarbans does not know what to grow when. The most puzzling part of the rainfall changes cited by the people indicates that most of the rains do not come in the monsoons. Rainfall has shifted to the post-monsoon period. There is widespread agreement that rainfall patterns are changing over the Sundarbans. Almost all of those interviewed agreed that rainfall has decreased during a certain phase of the season, and the pattern of rainfall has changed, making conventional cultivation of crops difficult for farmers. Climate change-induced salinity intrusion is likely to affect the productivity of the Sundarbans. A significant decrease in regeneration and growth is noticed with an increase in salinity (Siddique et. al., 2001). The germination of seedlings and metabolic activities are dependent on salinity. Salinity reduces the productivity growth of the mangrove timbers (Siddique et. al., 2001; McLeod& Salm, 2006). Salinity intrusion causes change in fish composition and shifting of fishing zone. These changes in productivity ultimately affect other livelihood capitals.

After agriculture, fishing is the most common means of livelihood in the Sundarbans. In the interviews conducted, most fishermen complained of lower volumes of fish caught. Although the reasons attributed to this are many, including the entry of deep sea trawlers which sometimes violate territorial waters, there is a feeling among the fishermen in the Sundarbans that the quality of water has also changed. Not only that but also the forest cover area also changing day by day, according to the 1990 to 2000 study. Until 1770, the total area of the Sundarbans in India and Bangladesh combined was 36,000 sq km. In 2000, it was 25,000 sq km. The Indian part consisted of 9,630 sq km out of which 4,264 sq km constituted reserve forests. This was made up of 2,168 sq km of mangrove forest and 2,096 sq km of tidal river.

This means that an area of around 5,366 sq km has been cleared of forest and used for human settlements since 1770.

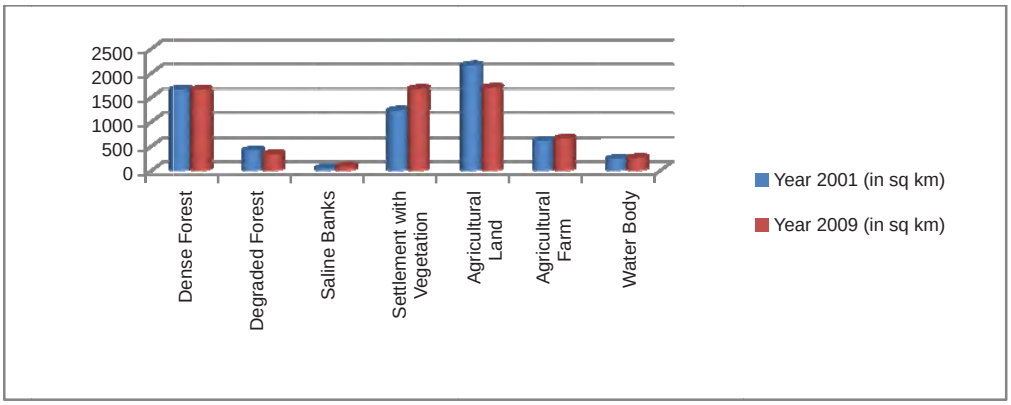

Figure 2: Landuse patterns and landcover changes in Sundarbans between 2001and 2009 Source: (Hazra, et. al. 2010).

Disaster risks – hazards and vulnerability in Sundarbans context

Climate change-related hazards have a catastrophic impact in the coastal area which is subjected to intensive human use. These areas are highly vulnerable to both natural and man-made hazards and disasters like coastal flooding, cyclones, storm surges, erosion, salinity, arsenic contamination, pollution, etc. Disasters related to climatologically disturbance impact natural and human system, either directly or in synergy with other determinants, and alter the productivity, diversity and functions of many ecosystems and livelihoods (Hossain, 2009). Vulnerability is the inability to resist a hazard or to respond when a disaster has occurred. For instance, people who live in plains are more vulnerable to floods than people who live higher up. In actual fact, vulnerability depends on several factors, such as people's age and state of health, local environmental and sanitary conditions, as well as on the quality and state of local buildings and their location with respect to any hazards. Vulnerability is an essential part of hazards and risk research and refers to the susceptibility of people, communities or regions to natural or technological hazards (Kumpulainen, 2006). There are three dimensions of vulnerability: economic, social and ecological (ESPON Hazards project 2004, Schmidt-Thomé, 2005).

Vulnerability is defined as the extent to which a natural or social system is susceptible to sustaining damage from climate change; it is also a function of the sensitivity of a system to changes in climate (the degree to which a system will respond to a given

change in climate, including beneficial and harmful effects), adaptive capacity (the degree to which adjustments in practices, processes, or structures can moderate or off set the potential for damage or take advantage of opportunities created by a given change in climate), and the degree of exposure of the system to climatic hazards. Under this framework, a highly vulnerable system would be one that is very sensitive to modest changes in climate, where the sensitivity includes the potential for substantial harmful effects, and for which the ability to adapt is severely constrained. Resilience is the flip side of vulnerability—a resilient system or population is not sensitive to climate variability and change and has the capacity to adapt (Schneider, et. al. 2000).

Conclusion and Recommendations

From the above analysis it is clear that intensity of both damage and frequency of climate change disasters is increasing over the time with enhanced vulnerability of communities though they are undertaking some coping strategies. It is important to incorporate information on climate change and its impacts of long-term predictions and local knowledge about trends and changes experienced by the communities, NGOs and Government. Government departments and NGOs can enable the community to take part in disaster risk reduction. Government efforts during emergency condition are valuable as they provide accommodation and relief facilities (Sarker and Hossain, 2012). Impact of climate change on Sundarbans mangrove is already being felt and the Sundarbans ecosystem is changing. Change in Sundarbans mangrove system and poverty are making the livelihood tough since dependence on Sundarbans is becoming highly vulnerable. Bangladesh Government has banned felling down of living tree and limited the harvesting season in response to changing state of Sundarbans. Sea level rise and associated salinity intrusion will further hamper the productivity of Sundarbans. That will reduce the resilience of the livelihoods dependent on Sundarbans. The adaptation and capacity building strategy has basically three types aspects: to develop a better understanding of current and future climate challenges, to develop and implement pilot adaptation strategies at selected sites, to regenerate mangrove patches, construction of a disaster relief shelter, and installation of early warning system and establishment of effective disaster-response mechanism and e-introduction of salt-tolerant paddy and pisciculture.

Following are the lists of activities are recommended to reduce climate vulnerability and build resilience of the vulnerable communities in the Indian Sundarbans such as the Climate Adaptation Centre (MCAC) should work actively and introduction of salt tolerant paddy and fish varieties re-introduced. Early warning system and disaster response teams need to work more actively and warning should reach to inside of the rural area. Environmental management is crucial for island sustainability, given the

challenges to the island's ecosystems. Environmental management includes recovery from natural disasters to which islands are so vulnerable (Meheux and Parker, 2004). Funds for conservation and disaster management are needed and can be gained through taxation, visitor fees or other mechanisms (Shah, 2002). Long term planning, developed with comprehensive community inputs is becoming an important foundation for tourism on islands. A study of tourism in the Canary Islands showed that when these two growth patterns were out of balance the industry is not healthy (Gil, 2003). Through all our activities we are trying to convey the message of great climate risk to the Sundarbans eco-region and its inhabitants. Often, we are asked about climate adaptation strategies for the Sundarbans in light of predicted future changes. In trying to answer such a question we are increasingly realising that what we are currently doing is essentially "buying time" for the people of the Sundarbans. Climate adaptation for a place like the Sundarbans beset with development challenges emanating from inadequate infrastructure, lack of period-appropriate education, health, and modern energy services needs not only a robust methodology for vulnerability assessment but also a future looking basket of options for the people in the Sundarbans delta.

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A Model Integrating Flood Disaster Resilience into Developmental Plans for Adaptation to Climate Change: A Case Study from Northern India

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Abstract

India is prone to several hydro-meteorological disasters, viz. floods, cyclone, drought and disease epidemics, known to have been aggravated under the impact of climate change. Disaster Management Plan at District level (DDMP) prepared as per statutory requirement, seldom envisaged risk mitigation or role of developmental activities, and remained a contingency coordination charter, due to lack of orientation to consider climatic scenarios and consequences relevant to development and disaster preparedness. Flood vulnerability of land and people in North India remained un-attenuated with resultant disaster situations almost every year due to uncertain and frequent climate hazards in the Districts like Gorakhpur in Uttar Pradesh. A pilot action research was undertaken by the team comprising of NIDM, GEAG and ISET (US), in collaboration with District Disaster Management Authority during 2012-13, to understand prevailing and emerging risks in the light of climatic projections, and their relevance to department-wise developmental activities and plans. The process involved series of workshops, consultations and shared leanings, which led to improved and climate resilient developmental plans at district level, and finally a climate-sensitive and adaptive DDMP as a model. A Training Manual based on Gorakhpur model of CCA-DRR integration at district level, and a Delhi declaration on 'Resilient Housing' (2014) were other outcomes. This paper discusses the approach and process, enabling factors and outcome, comparing with other approaches and pathways of integrating CCA and DRR at different levels.

Keywords: *Climate projections, Flood vulnerability, District plans, Disaster Management Plan.*

Introduction

India, like other countries of the region, has its land and inhabiting people vulnerable to a range of hydro-meteorological disasters, effects of which supersede any other

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category of disasters, for example, earthquakes or industrial mishaps. Northern India, chronically facing floods and drought proneness, witnesses scientifically and statistically evident impacts of climate change. Episodes of flood disaster are usually an annual feature in areas like Gorakhpur. Floods associate with emergencies for water, sanitation and medical response, besides temporarily evacuating, relocating and relief to flood affected populations. Disaster management in India has been 'relief- and response- centric' till past decade with, however, focus shifting to disaster mitigation-preparedness (DPR) in early 2000s, and now toward 'long-term DRR' integrating component of Climate Change Adaptation. Disaster Management Act 2005 (Chapter 4) mandates setting up of district level District Disaster Management Authority and preparation of District Disaster Management Plans. Hyogo Framework of Action (HFA) 2005-15, and following Bangkok Declaration on Disaster Risk Reduction (DRR) in Asia & Pacific, in the backdrop of Sustainable Development Goals (SDGs) strongly advocate mainstream Disaster Risk Reduction and Climate change adaptation into local development processes.

'Multi-hazard' disaster management plans to deal with prevailing disaster risks and emerging risks (evolving) due to changing climate conditions attained special emphasis in India's National Policy on Disaster Management 2009 (NDMA, 2009). However, the Disaster Management Plan developed at district level as a statutory requirement (as per DM Act), hardly focuses on risk mitigation or role of developmental activities, but rather remained a contingency coordination charter. Lack of orientation of key professionals to consider climatic scenarios and consequences relevant to development and disaster preparedness was a critical challenge. Considering the gaps and importance of mainstreaming DRR and Climate Change Adaptation (CCA) in developmental planning process at district level a pilot action research study was undertaken in Gorakhpur district by NIDM, ISET-US and GEAG during 2012-13 with the support of Climate Development Knowledge Network (CDKN), and in collaboration with District Disaster Management Authority.

The Climate Resilience Framework (CRF) developed initially for resilient urban areas (developed by ISET) has been referred to in drawing the vulnerability analysis approach in the present study as well (Figure 1).

This study aimed to understand prevailing and emerging risks in the light of climatic projections, and their relevance to department-wise developmental activities and plans. The process involved detailed literature review, analysis of existing data on disasters and climatic factors and review of existing plans. This was followed by a series of workshops, consultations and Shared Learning Dialogues (SLDs), which led to the development of improved and climate resilient developmental plans at district level (GEAG, NIDM & ISET, 2013). This served DDMA to come out with a climate sensitive model DDMP for Gorakhpur District (DDMA, Gorakhpur, 2013).

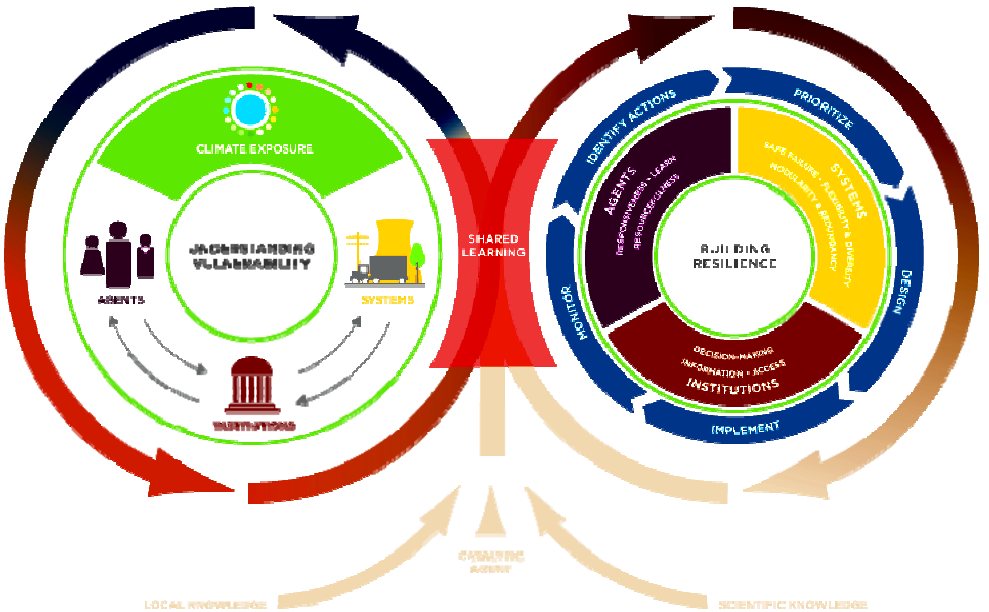


Figure: Climate Resilience Framework (Source: ISET International. http://i-s-e-t.org/projects/crf.html)

Study Area Description

Gorakhpur is one of the flood prone districts situated in the eastern corner of Uttar Pradesh. It lies between Lat. 26°13´N and 27°29´N and Long. 83°05´ and 83°56´. The district has 3,321 sq km geographical area and is located in the '*Terai Belt*'. It has cup-shaped topography that increases the risk of flood during monsoon season. Approx 70% population is living in rural area dominated by the agriculture as the main occupation (Wajih et al., 2010). Presence of several rivers in the Gorakhpur district increases the risk of flooding. Rapti river covered the largest part of Gorakhpur and it has tendency of overflow during the monsoon season. Gorakhpur has a population of 4,436,275 with 51.43% male and 48.56% females. Population density in the district is 1,336 per sq. km.

Approach and Methodology

Aim of the study was to understand prevailing and emerging risks in the light of climatic projections, and induce the component of Climate Change Adaptation and DRR in preparation of climate-sensitive department-wise developmental plans and District Disaster Management Plan. Key objectives were following:

To understand existing and emerging risk of disasters in the district with special focus on floods under changing climatic conditions,

- To understand systemic factors within the flood-prone Gorakhpur district which can exacerbate vulnerability and hamper resilience against flood disasters, and
- To understand specific policy innovations that could help bridge the vertical gap between integrated national policy framework and local contexts and the horizontal gap between actions within sectoral development programme to integrate DRR and CCA practice in departmental plans. This involved:
  - (a) Analysis of exiting departmental plans and district DM plans and identification of the gaps, and
  - (b) Identification of pathways of integration and inducing CCA-DRR in developmental plans, through inclusion of measures (short-term and long-term) into Departmental plans.

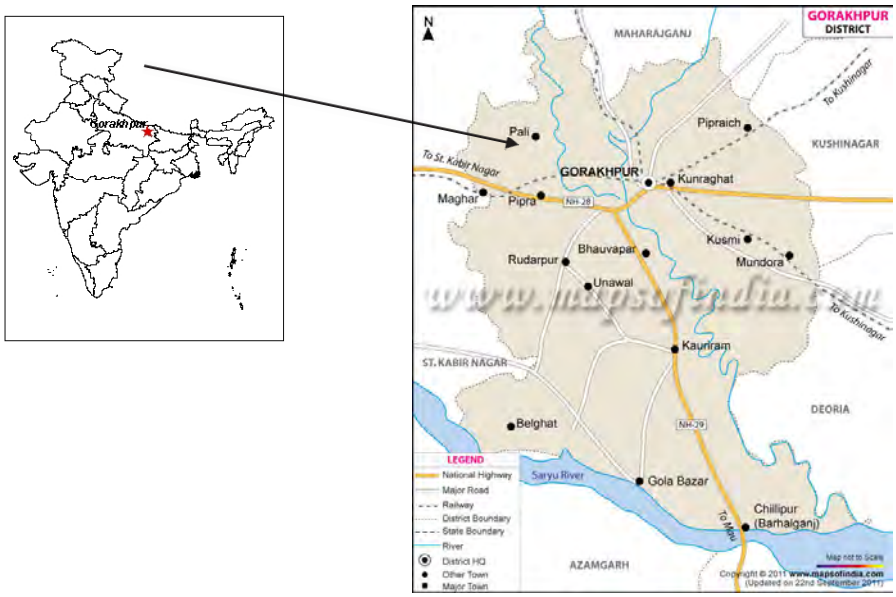


Figure 2: Location of Gorakhpur in India

- The study was an action research and approach was "Practice to Policy" orientation. Data on various hazards, disasters and climatic factors were analysed based on the available scientific datasets. Remote Sensing data and GIS were used extensively in mapping and analysis. Downscaling Climate Change Projections for Gorakhpur and Extreme Event Analysis were also carried out. A detailed downscaling of Climate Projections was carried out for Gorakhpur's rainfall in 2050's. Subsequently, to capture changes in extreme precipitation events Intensity-Duration-Frequency (IDF) curves were developed for key duration and intensities (Opitz-Stapleton, 2013).

The process diagram of the study is given as figure 3. Outcome of the study also included a training manual on mainstreaming CCA-DRR integration and policy intervention in the form of State level Government Orders (GOs) and a 'Delhi Declaration on Resilient Housing', besides a Model of climate resilient District Disaster Management Plan (crDDMP). Key agencies involved in the process were following:

- Research Institution (NGO) – Gorakhpur Environmental Action Group,
- Institute of Social & Environment Transition (ISET), US – an International Research Organisation,

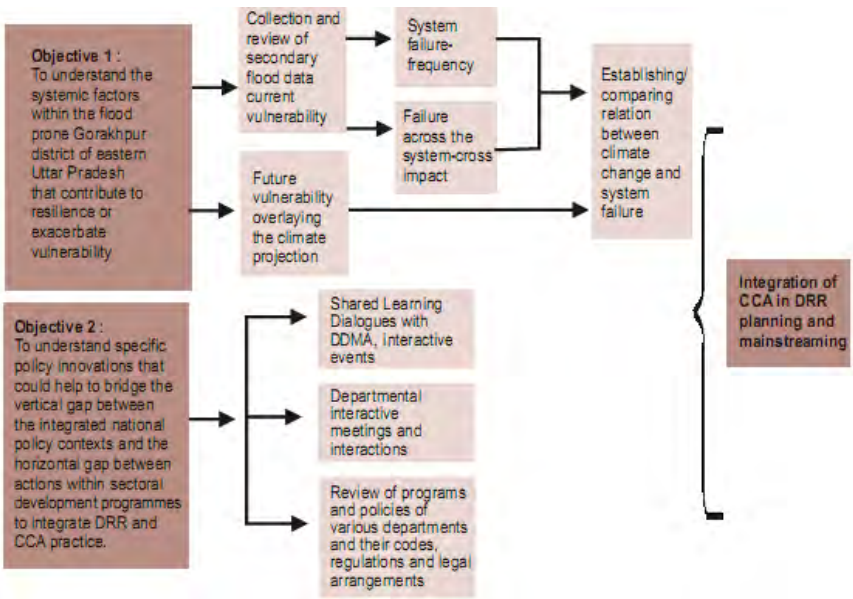
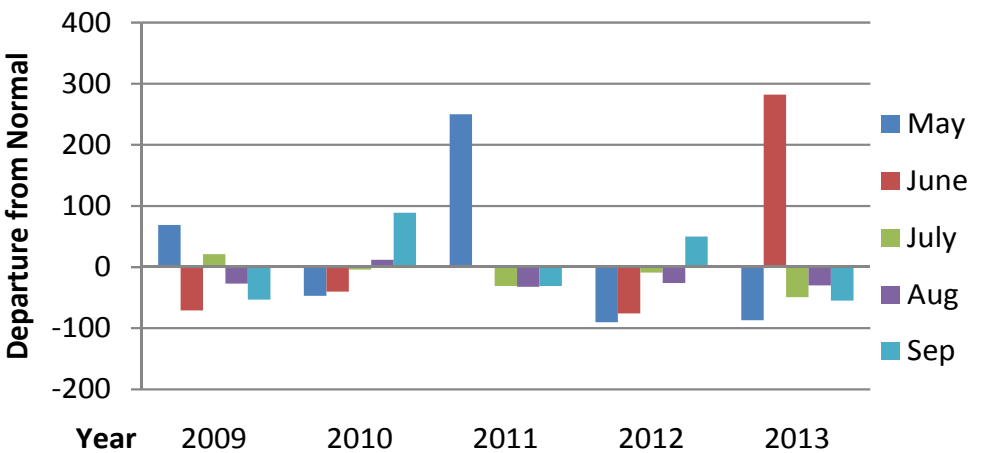


Figure 3: Methodology flowchart detailing the steps towards integrating CCA DRR in developmental planning (Source: GEAG, NIDM & ISET, 2013)

- National Institute of Disaster Management (NIDM) – apex institute of Government of India on disaster management capacity development, research and training,
- District Disaster Management Authority (DDMA) – statutory agency constituted as per Disaster Management Act 2005, at district level, and
- District Departments, like Nagar Vikas (Urban Development) - Local Bodies, Jal Nigam; Department of Environment & Forest, Dairy Development, Revenue, Fisheries, Horticulture, Remote Sensing Application Centre, Health, State Disaster Management Authority, Rural Development, State Institute of Health & Family Welfare, Animal Husbandry, etc.

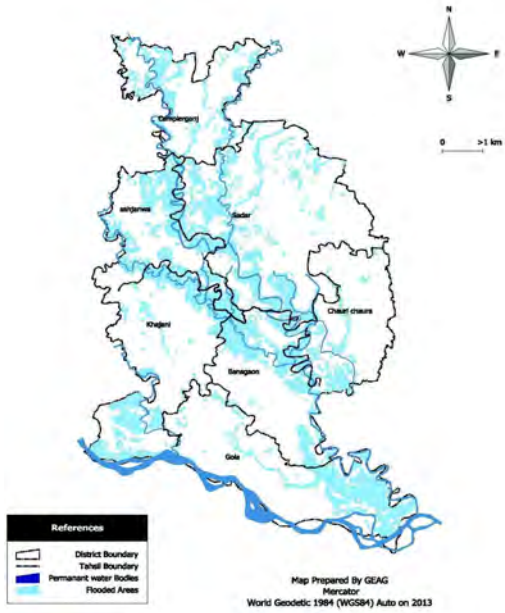
Results and Discussion

Unplanned urbanisation coupled with poor land use planning and encroachment in the river channels increased the flood risk (Arya et al., 2012). Gorakhpur is experiencing climatic variability, which is quite evident from the monsoon rainfall. Number of rainy days in the season is decreasing and 80% of the rainfall was received in the months of May 2011 and June 2013. Gorakhpur is now experiencing perennial flood challenges.



(Source: IMD, Govt. of India)

Figure 4: Departure from Normal Rainfall (May-September) 2009-2013



(Source: GEAG)

Figure 5: Gorakhpur district Flood-Prone Area

Downscaling Climatic Projections

Global circulation models (GCMs) project how the climate might change, given changes to these human-controlled factors, which are accounted for as representative concentration pathways (RCPs) in the IPCC 5th Assessment models (van Vuuren et al., 2011). Because no single model can project exact changes to an area's climate, it is necessary to use projections from multiple GCMs, each driven by a couple of RCPs, to capture the possible range and trend of changes. Furthermore, climate is a description of an area's average weather over a period of time, typically 30 years. Therefore, climate change analysis involves comparing the statistics of an area's particular weather as projected for a period in the future that is at least 30 years long, with a period of historical climate of the same length.

With these two caveats, ISET obtained the daily precipitation data (simulated historical and projected future) from the CMIP5 Multi-Model Ensemble Database (http://pcmdi9.llnl.gov/esgf-web-fe/). The ensemble set of projected daily rainfall was formed using projections from 9 GCMs, each running the RCP 4.5, for a total of 9 ensemble members against which to compare future rainfall with past rainfall. Simulated historical rainfall by the GCMs covered the period 1961–2005, whereas future projected rainfall spanned 2006–2055. At the time of data access from the

CMIP5 Database (November 2012), only projections from RCP 4.5 were available, precluding the use of other RCPs for comparison.

A 'super' historical daily rainfall dataset for Gorakhpur was compiled and interpolated from a number of data sources due to the incompleteness of available records. Additional historical data covering the period of 1961–2005 were accessed from the APHRODITE project database (Yatagai et al., 2012) to validate and supplement gaps in the sparse station records. The data were cleaned and underwent several quality control checks that are standard for meteorological and climatological analysis.

Six out of the nine GCMs were able to reasonably replicate the seasonality of Gorakhpur's rainfall, as well as the median and standard deviation (the first and second moments) of monthly rainfall totals. Hence, these 6 models were used for Climate Projections downscaling.

Possible Changes to Gorakhpur's Extreme Rainfall by 2050s

In the future, according to a range of a combination of different climate models and emission scenarios, the intensity and frequency characteristics of rainfall events for Gorakhpur are likely to change. For 24-hour and longer duration events of all return periods, all of the models project a potential increase in precipitation intensity. That all models are in agreement about the direction of the change in trend (increasing) provides some measure of confidence in the projections.

Table 1: Percentage change in rainfall intensity for 24-hour duration events between multi-model projected (2006-2055) and historically observed (1961-2005) events for Gorakhpur

	Return Period (in years)			
Model	**2**	**10**	**20**	**50**
HadGEM2	9.6%	4.3%	3.4%	2.2%
NCAR-CCSM4	10.0%	19.1%	20.1%	22.5%
BCC-CSM1.1M	20.4%	23.4%	24.1%	24.8%

Table 2: Percentage change in rainfall intensity for events of select durations (1, 12 and 24 hours) for select return periods (2, 10 and 50 years).

Duration (hrs)	Return Period (Years)		
	2	**10**	**50**
1	11 to 18%	-12 to 52%	-22 to 68%
12	10 to 17%	1 to 30%	-4 to 33%
24	10 to 20%	4 to 23%	2 to 25%

Percent changes are derived from comparing IDF curves from multiple GCMs for the future (2006-2050) with historical IDF curves (1961-2005).

There is greater uncertainty (larger spread in the model projections and/or unclear direction of increasing or decreasing intensity) in how climate change might alter short duration events—those lasting less than 12 hours—than in events lasting longer than 12 hours as shown in (Table 1 and 2). Some of this uncertainty is due to gaps in the historical observation records that affected the statistical distributions and will improve with time through efforts such as GEAG's automatic weather station, and coordination with the local Indian Meteorological Department office. Other sources of uncertainty are due to natural climate variability (not influenced by climate change), the differences between GCMs in how they model interactions between the land, ocean, and atmosphere to influence climate, and the fact that no-one really knows what the world's population, energy use, greenhouse gas emissions, and land-use will look like in 2050. This is why it is important to use projections from multiple models, and build cities smartly to reduce natural hazard risks.

Scientific analysis was coupled with Social Science methods. Shared Learning Dialogues (SLDs) were a central component in the research approach. Different techniques of shared learning bring together knowledge from different disciplines with that held by individuals and organisations in communities, the government, and other sectors.

Shared learning involves structured one-to-one and small group interactions that elicit insights from participants and build their understanding of the views of others and their implications. Many of the techniques are similar to those used in participatory research, but they stand out for their ability to build new knowledge and common understanding. Shared learning processes move research away from outsider-driven, top-down, extractive information gathering towards participatory, bottom-up, and inclusive knowledge generation.

Process of Integration of CCA –DRR in Departmental Plans and DDMP

Analysis of Vulnerability

Data and documents related to the hazard and disaster profile, climatic conditions etc. were collated and analysed. Spatio-temporal analysis of floods, location of water logging sites, rainfall and flood level data etc. were carried out. Special focus was given on analysing the systemic vulnerability in the area. Various data and documents related to flood damage, relief distribution, disaster response planning were collected. Several Government Orders from the DDMA were collected and thoroughly analysed to identify gaps at departmental level. Along with the observation of shared learning

dialogues, identified points were used to prepare guiding documents or departments for preparing effective plan.

Series of Dialogues

Project Launching Dialogue

In July 2012, a project launching dialogue was organised by GEAG and DDMA at DDMA office to share the project purpose, implementation plan and expected outcomes with the concerned line departments; 54 government officials from various departments participated in the workshop and expressed their viewpoints on the process. On behalf of District Magistrate, Additional District Magistrate-Finance Revenue (ADM-FR) chaired the workshop and facilitated the discussion. Representatives from NIDM, ISET and GEAG were present in the workshop. Key outcomes of the workshop were (i) nomination of ADM-FR as Nodal officer for anchoring the project from DDMA Gorakhpur (ii) placing of a representative from NIDM and GEAG in DDMA to manage the project and coordinate with various departments (iii) formation of Project Steering Committee at district level (iv) progress review meeting to be held quarterly (v) provision of separate meetings at all departments from time to time to make department wise preparedness and response plan for District.

Departmental Shared Learning Dialogue

The Shared Learning Dialogue was organised by DDMA and GEAG under the title - Climate Change - District Disaster Management and Reduction Management Workshop to prepare Guidelines with different Departments: Problems & Opportunities. Details of department wise identified gaps and recommendations are listed in Table 3.

State Level Sharing at Top Policy level and State Disaster Management Authority (SDMA)

This process, thus, was shared with the Minister of Revenue and Relief Commissioner of Uttar Pradesh in a state level dialogue in Lucknow where process and outcomes were presented before them. ADM-FR from 24 districts were also present during the sharing. The prime purpose of sharing the process was not only to make them aware of it but also getting the process recognised at state level so that it can be scaled up at larger level though SDMA in other districts. As a result, Relief Commissioner instructed district representatives to follow the process undertaken in Gorakhpur in DDMP preparation.

Table 3: Department-wise identified gaps and recommendations

Department	Gaps Identified	Recommendations to Departments
Rural Development/ Distt. Administration	• Lack of adequate human resources • Lack of information on fund disbursal to the beneficiaries under the disaster relief fund • Non-utilisation of funds due to lack of information on disaster management relief fund	• Development programmes should be designed keeping in mind the local disaster threats and disaster reduction should be an integral part of the development programmes • Coordination between governmental planning and development projects should be established • MGNREGA scheme should be utilised for cleaning of rivers and removal of silt. Several other developmental works can be done through MGNREGA funds.
Health Department	• Connecting road to PHCs/CHCs gets damaged during rainy season-Long duration power cuts creates problems in attending the patients in the PHCs/CHCs • Women employees feel unsafe working in the late evening hours in the centres because there is no adequate arrangement of lights on the roads • Caution before floods are not given due to which adequate preparations are not made • Most of the health centres get water logged due to heavy rain	• In the construction of PHCs/CHCs, it is important to include flood resistant techniques along with earthquake resistant techniques • Training on DO's and DONT's at times of disaster should be organised for the members of Village Health and Sanitation Committee
Education	• School premises is often used for shelter and relief centres during flood disaster • Lack of knowledge in students regarding basic disaster preparedness and safety • Many of the schools are not located at elevated land	• In the construction of schools, it is important to include flood-resistant techniques along with earthquake-resistant techniques • Site selection for construction of schools should be done at a safe and elevated place • In the school campus, the Mark-ll hand pumps should have proper water outlet arrangements • Information and awareness on use and management of fire extinguishers installed in the schools should be given not only to the teachers but also to accountants and employees of other departments • Mock programmes in the schools should be organised on relief and management of disasters; the schools should not be used as disaster relief camps or for storage of food grains. This adversely affects education

Agriculture/ Agriculture Protection Department	• Crops get affected due to untimely rains, extreme cold and hot temperatures • The situation of agriculture go-downs at the block level are not good due to which flood water enters the godowns and causes damage to the chemicals stored there • Water logging in the crop fields causes problems in controlling pests, insects and diseases. Also, application of pesticides in water logged areas causes water pollution • Problems in storage of crops • Soil structure gets affected and amount of silt increases. Floods negatively affect crop cycles	• Works related to land levelling and construction of farm bunds for the conservation of soil can be done under the MGNREGA programme • Promotion of vermin compost and Nadep compost structures under MGNREGA programme • Effective coordination should be established between soil conservation department, agriculture department and agriculture protection department • There is a need to bring about awareness among farmers from the flood-affected areas to use flood resilient varieties of crops
Animal Husbandry	• Infertility problem in animals due to extreme temperatures • Non-availability of fodder because of water logging • Shelter problem for animals during rains and water logging - Water logging leads to diseases • Animals suffer because of unavailability of medicines at veterinary hospitals	• Pre-flood vaccination of animals • Shelter and fodder for animals should be the part of relief package • Ensure availability of medicines at village level
Jal Nigam	• Most of India Mark-ll pumps are not functional during disaster in India • Funds for installing hand pumps at elevated lands are not sufficient • The plan for establishing sewerage system for the city of Gorakhpur is ready but due to non-allocation of funds, the work has not yet started • For every scheme, there should be adequate number of regular staff to carry out the tasks	• The India Mark-ll hand pumps should be installed at a high elevated and safe place with the support of Panchayats • In construction of buildings, problem of flood should be kept in mind • Renovation of water sources to enable access to water for everybody in the village and ward • The Panchayat (local body) should get the defunct hand pumps repaired in time • For the implementation of schemes, the funds should be made available before the actual work on the ground starts • System of quick communication, decision and implementation should be established in order to manage disasters effectively

Panchayati Raj Department	• Lack of resources for repair of destroyed public properties • Lack of active involvement in planning and implementation process • Capacity building of Pradhans and other members are not done at local level • Lack of infrastructures and other facilities	• Assessment of flood and other disasters in local areas should be done according to which provision for funds should be made for the maintenance of Panchayat bhawan and other public buildings • Awareness should be brought among villagers to keep their village surroundings clean and usage of individual, school, Anganwadi and community toilets should be promoted • Awareness campaigns can be done by using motivation groups, nukkad natak, media, etc. • For the repair of India Mark hand pumps for drinking water, funds under Panchayati Raj, 13th Finance Commission should be increased • Assessment of damage caused to public properties should be done and accordingly the demand for renovation/repair of these properties should be made. This should be implemented at the Gram Panchayat level for which adequate funds should be allocated
Flood Division and Drainage Division	• Less number of work supervisors in the departments • The embankments get cracked in summer season due to high temperatures. Situation becomes even worse if this is immediately followed by heavy rains • Pressure on the embankments increases when all of a sudden, water increases in the rivers which are on the way to Nepal • Lack of support and cooperation from Tehsil and local government	• As per the State Disaster Response Fund (SDRF) guidelines, the embankments should be re-established within 45 days. It becomes very difficult to get the work completed within this deadline • It is important to activate the flood protection committees
Saryu Canal Division	• Heavy rains rupture the branch-lets of canals which hampers irrigation facilities - Depletion in the groundwater levels due to which the discharge from tube wells is decreased • Low electricity voltage because of which the tube wells get defunct in the Kharif season, the pipelines are destroyed at some places by the farmers	• Construction and re-establishment-related works are done during a fixed time. Considering the geographical and environmental situation of an area, it is important to place bans and restrictions on cultivation of water-intensive crops such as peppermint, etc. • Diversity in cropping systems should be strictly implemented • The structural designs of various infrastructures which are related to canals are done as per the orders of respective departments. These infrastructures should also be made earthquake-proof and flood-resistant • As a mechanism to adapt to drought and flood situations, various rivers should be joined so that they prevent floods and help in increasing the groundwater table levels • It is important to have convergence between various departments and Panchayats in order to prevent encroachment

Second Round of Dialogues with Departments

Second round interaction was held with all the department to facilitate the planning and document preparation. Fifteen dialogues were organised with the departments under the guidance of district magistrate and ADM-FR. As a result of these dialogues, various points related to climate change were integrated in department level plan. Further these plans were integrated in district plan document.

Trainings on CCA and DRR

Training programme on *CCA and DRR* was organised to build capacity of young researchers and scholars from reputed institutions promoting DRR and CCA by seeking contribution to and sharing development of the knowledge. The Training provided an opportunity to young people to discuss and understand climate change and the need for risk reduction and adaptation

Guideline Preparation and Planning at Department Level

A guideline was prepared for all departments based on the various Government Orders and sectoral workshops experiences. This guideline was circulated along with government planning format. Even District Nodal Officer-Disaster Management provided every required support to the project as he had already realised the gaps in the government planning and potential changes out of this project. He has significantly acknowledged research team's effort in developing DDMP, which is now in printed and ready-to-use form. DDMA Gorakhpur has adopted Mahewa Ward of Gorakhpur city as model ward for participatory resilience planning. Mahewa ward is GEAG's intervention model of people-centred climate resilience plan.

Conclusion

Integration of scientific analyses of existing and emerging risks under changing climatic conditions was carried out under this study. This study integrated both the scientific methods and social science methods viz. Participatory Assessments and Shared Learning Dialogues. SLDs helped in identifying the gaps and also the possible corrective actions. Such interactions between the departments helped in reducing the horizontal gaps by engaging departments in making the plans integrating CCA and DRR issues. This led to improved understanding of three corners: Communication, Coordination and Convergence within organisation, right from planning to implementation level. This climate-sensitive departmental plans indeed led to the development of District Disaster Management Plan with inclusion of climate change issue. A new paradigm in planning process and content in DDMP, will possibly contribute to state and national planning framework in context of DRR and CCA considering climate change adaptation issue.

Acknowledgements

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Climate Change & Environment Risks in Balasore District, Odisha : Issues for Capacity Building

– Achraya Shyam Sundar[1] and Sukanta Patra[2]

Abstract

The menace of climate change is haunting people all over the world. Both developed and developing countries are affected in the process. Balasore district of the state of Odisha is a fertile and productive area. Agriculture is the lifeline of the district. However, the danger of climate change is going to affect the lifeline of the district. The area no doubt is prone to multiple disasters like floods, cyclones etc. But the intensity and magnitude of the disaster is going to increase as a result of future climate change. The anthropogenic factor like environmental degradation due to felling of trees, deforestation which in turn is the result of steep increase in population, rapid urbanisation and industrialisation is a matter of serious concern. Added to this there is fear of desertification in the district. Not that the nature only is creating havoc and showing its fury but the ill planning of the authorities is also a contributing factor. A series of floods caused due to the faulty planning of NH-60 have proved this point beyond doubt. In such a scenario the disaster mitigation and adaptation strategies by the people at the grass roots, the governmental structure and the NGOs is highly essential. Their combined effort can provide a ray of hope in the midst of the gloom caused due to natural and human-induced disasters. The long term goal of sustainable development can also not be glossed over.

Keywords: *Adaptation, Bio-Shield, Capacity Building, Climate Change & Mitigation.*

Introduction

Climate change is a global phenomenon. It has been assuming menacing problem day by day. There is growing concern over the possible impacts of climate change internationally yet it has been a major concern especially for the developing countries which suffer most of the natural disaster related-deaths occurring each year and also face much larger economic losses than the developed countries in terms of percentage of Gross National Product (GDP). According to an estimate during the

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period from 1950 to 2001 about 6 lakhs disaster-related deaths took place around the world, out of which 1 percent were in developed countries and 99 percent were in developing countries. But the situation was quite different before 1950 when 30 percent of the total deaths took place in developed countries and 70 percent were in developing countries (Ahmad, 2003). Developed countries which have modern early warning systems and effective mitigation programme are able to reduce the impact of natural hazards whereas the developing countries with less preparedness and inadequate mitigation efforts suffer more from natural hazards (Kumar, 2012). At global level, there has been considerable concern over mounting human deaths and economic losses caused by the occurrence of natural disasters and despite substantial scientific and material progress having been made. According to a survey, despite the development of science and technology, the frequency of disasters is increasing alarmingly. Since 1960, the people affected due to disasters are growing at the rate of 6 percent (Baksi, 2008). The situation will be exacerbated due to climate change in future. Climate change too will disproportionately affect the developing countries and poor persons in all countries. It has been projected in a report called 'Global Natural Disaster Occurrence & Impact-1998-2008' in the database of Centre for Research on Epidemiology of Disaster (CRED-EM-DAT) that by the year 2015, an average over 375 million people per year are likely to be affected by climate-related disasters. This is over 50 percent more than the average number of people who have been affected during the last decade (CRED, Undated). Another research finding predicts that by the year 2025, about 80 percent of the world population will live in developing countries and up to 60 percent of them will be highly vulnerable to floods, severe storms and earthquakes (Cunny, 1994). The case is more frightening in case of India in general and Odisha in particular. The state of Odisha is vulnerable to multiple disasters. The sub-tropical littoral location makes the state susceptible to tropical cyclones, storm surges and tsunami. The river system with heavy load of silt having very little carrying capacity results in frequent floods. The large part of the state comes under earthquake Zone-II. However, the Brahmani-Mahanadi graven and their deltaic areas fall under earthquake Zone-III. This area covers 43 out of 103 Urban Local Bodies (ULBs) of the state (OSDMA, Undated). The western part of the state is prone to drought and sometimes the erratic behaviour of monsoon causes drought situation in the eastern part also. It has been noticed that the state of Odisha has been experiencing frequent disasters with varying magnitudes in the recent years (Behera et. al. 2002). The tornado of 1998, super cyclone of 1999, widespread drought during 2000, recurring floods in 2001, 2005, 2007 and 2008, the cyclone 'Phailin' and devastating flood in its aftermath in 2013 have taken a heavy toll of lives, stanched away livelihoods, rendered many homeless and damaged infrastructures.

Methodology

Empirical method has been adopted to collect data from the people subjected to some of the earlier major disasters in the district. At first the existing literature was perused to enhance knowledge about disasters and their management. The Census of India, documents available with NABARD, OSDMA and Emergency Office, Balasore were also referred for better understanding of socio-economic condition of people, frequency and intensity of disasters, and mitigating measures undertaken by the government to deal with disasters. Primary data were collected from different stakeholders in the process of disaster management. For this purpose two systematic schedules were prepared, one for the victims of disasters, people's representatives & social workers and the other for government officials. The data were collected directly from the respondents by interviewing them at their door step with the help of the schedule. Some qualitative data were also collected through Participatory Rural Appraisal (PRA) and Non-participant Observation method. A group of more than 20 people of a tribal village in Chanua panchyat of Balasore Sadar block (sample block) was united and some discussion on disasters affecting them, along with the causes, their suffering and remedies to avoid such mishaps took place. Similarly, the Non-participant Observation method was adopted during the devastating flood in the aftermath of the cyclone 'Phailin' in October, 2013. Here, the researchers (performing the role of social workers) took active part in relief and rescue operation in the worst affected areas of Balasore Sadar block with the rescue team of Fire Department.

To understand the impact of disaster on various strata of society and to get information about the role of district administration in disaster management for the said Doctoral Research, the sample for the study has been designed. It is a multi-staged sample design which covers five levels namely district, block, panchyat, village and household. Firstly, the district of Balasore has been selected as the study area which is a disaster-prone district of Odisha. The district has a total number of 12 blocks and out of these 3 blocks namely Jaleswar, Balasore Sadar and Nilgiri have been selected purposively (considering their disaster proneness as per the records available with the Emergency Office, Balasore District and their location). In the next stage 3 panchyats of each block and a total of 9 panchyats have been selected purposively. Then 3 villages of each panchyat and in the process a total of 27 villages have been selected purposively for the study. From these 27 sample villages 189 households have been selected. Here proper attention has been given for adequate representation of the scheduled caste, scheduled tribe and women, as per the social group composition in the district according to Census-2011.

The Scenario in Odisha

The unique geo-physical location and climatic condition of the Indian sub-continent makes her more vulnerable to natural hazards. Natural disasters occur here with amazing frequency.

Floods, droughts, cyclones, earthquakes, landslides, avalanches etc. have been occurring in one or another part of India throughout the year. As far as natural disasters are concerned, the country's disaster problem is much diversified. While the Himalayan region is susceptible to natural hazards like earthquake, landslide and avalanches, the plain region has been affected frequently by flood every year. The desert region is affected by drought and famine and the coastal zone is prone to cyclone, windstorms and tsunami (Satendra & Sharma, 2004).

The state of Odisha which is situated in the coastal zone is prone to variety of disasters. The geographical peculiarities of the state have made her continuous victim of natural hazards. Floods, droughts and cyclones have been regular features in the history of Odisha. Climatically Odisha falls under a tropical climatic zone. The south-west monsoon and the retreating northeast monsoon predominantly determine the climatic condition. Sometimes the irregular or erratic behaviour of monsoon causes either excessive rainfall as a result massive floods leading in the state or less rainfall causes droughts in the region. The delayed monsoon which forecasts consolatory rain to the northern part of Odisha is primarily cyclonic in character. There are two cyclonic peaks in their occurrence; one during May-July, the approach time of monsoon to Odisha and the other during October-November, the period during the retreating of monsoon. In later period (October-November) maximum cyclones hit Odisha. The State Disaster Management Authority has identified 240 km coastal belt including Balasore, Bhadrak, Kendrapada, Jagatsinghpur, Puri, Khurda and Ganjam-as cyclonic hazard-prone districts. The coastal districts of Odisha have been hit by 11 severe cyclonic and 55 cyclonic storms in the last 120 years with maximum storm surges height varying between 2.3 to 5.5 meters (Khanna, 2005). Besides the western districts are droughts prone. During the summer the Mercury rises to 45°C and even higher which causes acute shortage of water in those areas (Special Relief Commissioner, 2007). Disasters are occurring more frequently in Odisha with higher intensity and causing immense loss of life, assets and livelihood. According an estimate of Inter Agency Group (IAG), Odisha since 1965 till 2003, the state has experienced flood for 17 years, droughts for 19 years and cyclone for 7 years. The same study of Inter Agency Group revealed that during the 1970s the estimated value of property loss was around Rs 105 cr. which has increased to nearly 7 times in 1980s and more than 10 times in the 1990s (IAG,

2003). According to the Annual Report-2002 of the Special Relief Commissioner, Dept. of Revenue & Disaster Management, Odisha the amount of loss due to these disasters is mounting in the recent years. Disasters have become a critical problem for the poor people of Odisha. More than 80 percent of the geographical area and nearly 90 percent of the poor people in Odisha are vulnerable to one or more disasters with more than 66 percent of the population living below poverty line. Hence the coping mechanism of the state and its people is constantly under severe strain (Special Relief Commissioner, 2002). The records available with Odisha State Disaster Management Authority (OSDMA) indicate that the state of Odisha has a long history of devastating cyclone (Table 1). During the last century around 1000 cyclonic disturbances occurred in the Bay of Bengal, out of these 500 were depressions and over 400 were either cyclonic storms or severe cyclonic storms. Out of 205 cyclonic disturbances, whose records are well documented, 55 affected the coast zone of Tamil Nadu, 59 crossed the coastal areas of Andhra Pradesh, 58 hit the coast of Odisha and 33 struck the coast of West Bengal (Selvam, 2012).

Table 1: History of cyclones in Odisha

Sl. No.	Date & Year	Category of Cyclone	Landfall	Human Casualty
1	31st October, 1831	Very severe cyclonic storm	Balasore coast	50,000
2	18th July, 1872	Cyclonic strom	Balasore	21
3	22nd September, 1885	Super cyclone	False Point, Odisha	5,000
4	8-11 October, 1967	Very severe cyclonic storm	Between Puri & Paradeep, Odisha	Not Available
5	26-30 October, 1971	Very severe cyclonic storm	Between Puri & Paradeep, Odisha	10,000
6	29th October, 1999	Super cyclone	Paradeep, Odisha	10,000 or more
7	13th October, 2013	Very severe cyclonic storm	Ganjam, Odisha	38 (21 in Phailin & 17 in flood)

(Source: osdma.org)

Natural Disasters in the District

The district of Balasore is the North-Eastern district of Odisha which is situated between 20.48°C and 21.59°C North latitude and between 86.16°C and 87.29°C East longitude. It is bounded by the Bay of Bengal in the east, Mayurbhanj district in the west, Medinipur (West Bengal) in the North and Bhadrak district in the South. It has a 82 km long stretch of coast line. The district headquarter is 208 km from the capital

of the state, Bhubaneswar. Total geographical area is 3634.0 sq km. As per the census of 2011, the population of the district is 2,317,419 and the density of population is 609 per sq km (Registrar General & Census Commissioner of India, 2011). The entire district is divided into 2 sub-divisions, 7 tahasils and 12 blocks. There are 289 panchyats and 2971 villages in this district. The entire district is covered with plain alluvial track.

Natural disasters have been regular features of the district of Balasore since time immemorial. It is one of the disaster-prone districts of Odisha. Being in the east-coast of Odisha, it is exposed to both hydrological as well as climate-related disasters like floods, tropical cyclones, tidal wave, tsunami etc. Some parts of the district are also exposed to drought. The district of Balasore is situated in the path of depressions of severe cyclonic storms which generally occur before the onset of monsoon and during the retreating of monsoon. The Super Cyclone of 1999 is an example of such mishap. Flood is also a regular feature of the district which visits the district 3 to 4 times in a year. It has also been vindicated from the records available with the Emergency Office, District Collectorate that among all the disasters which occur in the district, the river floods are often most frequent and devastating. The cause of such floods is mainly the precipitation pattern in the district. The average rainfall in the district is 1568.4 mm. But the rainfall during June to September constitutes around 75 percent of the total annual rainfall of the district (Balasore District Administration, 2008). As a result, there is very heavy discharge of flood water from the ever flowing rivers like the Subranarekha, Budhabalanga, Jalaka, Sono and Kanshabansha which flow through the district and make the district prone to hydrological disasters like floods. Creation of low pressure in the Bay of Bengal aggravates the situation further. Apart from these some other features such as, long stretch of coast line, high density of population, high population growth, environmental degradation etc. make the district more vulnerable to different types of disasters. Some of the major natural disasters are mentioned below for this purpose.

Table 2: Major Natural disasters in the district during 1998-2008.

Year	Category of disasters	Size of Population affected	No. of Human Casualty	No. of Casualty Cattle	No. of House damaged	Total damage Rs. lakh
1998	Tornado	3,000	21	30	507	371.77
1999	Super cyclone	12,55,086	62	38,778	82,443	11352.96
	Flood	4,90,562	1	No	1274	2607.72
2007	Flood	8,84,221	30	796	37,251	47353.78
2008	Flood	9,43,559	9	1	22,236	39085.26

District Disaster Data Sheet, Balasore, 1998-2008

Climate Change, Environmental Risk & Increasing Vulnerability

In the recent year it has been noticed that there is a growing share of devastation triggered by natural disasters around the world. These disasters are leaving greater impact on societies especially in developing countries. This change in climatic pattern due to global warming will further aggravate the situation and has serious consequences in future.

Climate change & sea level rise

One of the most devastating consequences of climate change due to global warming is the possible rise in the sea level; a direct impact of global warming and climate change is the key factor threatening the coastal areas of the world (Jena & Mishra, 2011). It has been projected that along the Indian coast the sea level would rise by 39 to 57 cm by 2050 and 78 to 114 cm by 2100 (Unnikrishnan et. al., 2006). The economic impact of 1 meter of sea level rise on the coastal district like Balasore could be to the tune of Rs. 360 crore (Orissa Fact sheet, Undated). Further it has been estimated in a case study from Odisha & West Bengal that in the absence of protection or proper adaptation, a one meter rise in sea level will inundate an area of 170,000 hectare, predominantly prime agriculture land and displace 0.7 million people (Sahu, 2013). The consequences of global warming on the coastal zones are major concerns among scientists as the livelihood security of the coastal communities and ecological security of the coastal zone in India is already under stress due to high population density, rapid urbanisation, industrial development, high rate of coastal environmental degradation and frequent occurrence of natural disasters. The problem is going to be further aggravated by increase in sea level rise due to climate change (Selvam, 2012). As we all know that agriculture is the lifeline of the people of the district. Besides, the people of the district depend on fishery which makes important contribution to the local development as it provides huge employment and diverse livelihood in the coastal areas of the district. The rise in the sea level will endanger the coastal people and their livelihoods definitely.

Climate Change & Increasing Disaster Situation

The Risk of Flood in the District

Flood is one of the disasters which visit the district more frequently with devastating impact. Sometimes it occurs 3 to 4 times in a year and creates havoc. The year-wise data of disasters available with the Emergency Office, Balasore and Special Relief Commissioner, Dept. of Revenue and Disaster Management, Govt. of Odisha vindicate the fact. In a report called 'Climate Change & Orissa' (Orissa Fact sheet) experts predict that Odisha should prepare herself for more severe flooding in years

to come because of deforestation, faulty flood control planning and global climate change. The analysis of data available with Indian Meteorological Department shows that parts of Andhra Pradesh, Odisha, Chhattisgarh and Madhya Pradesh have been receiving heavy to very heavy rainfall over past 50 years. The district of Balasore is not free from it. The change in precipitation pattern, the immediate impact of climate change has already been felt in the district. Around 75 percent of the annual rainfalls occur between June to September and as a result there is heavy flow of flood water in the rivers which inundate 10 out of 12 blocks of the district. Anthropogenic factors like unsustainable development, increasing settlements in vulnerable areas, destruction of vegetation along the embankments, lifting of sand from the vulnerable pockets of the river (as the people of Jaleswar & Balasore Sadar blocks alleged during the field study) have been contributing a lot for the increasing flood fury in the district. The faulty construction technique of NH-60 from Balasore to Jaleswar is an example of unsustainable development. The National Highway Authority of India (NHAI) has not given adequate attention to the drainage of flood water though people had agitated for sufficient number of bridges and drains for the passage of flood water. In the course of assessment after the series of floods from 2005 to 2008, Water & Power Consultancy, India (WAPCO), a premier consultancy organisation of Ministry of Water Resource, Government of India has blamed the faulty design and lack of drainage system in NH-60 as the major cause for the increase in intensity of flood in the district (Statesman-India, 2008). During the post-Phailin food in October 2013, the same problem has been noticed by the researcher. Due to lack of free passage, the flood water of Budhabalanga River submerged the National Highway-60 at Phuladi, Balasore Sadar block and caused huge devastation in the lower areas like Buanal, Nagram, Parikhi, Odongi, Chanua panchyats of Balasore Sadar Block etc.

Similarly, in the recent years urban flooding has become a major concern for the people residing in Balasore town. The recent incidence of urban flooding has been noticed on 21 July, 2014 as heavy rainfall occurs in the peripheral areas of Balasore town on 20 July due to deep depression in the Bay of Bengal. It caused huge devastation in the areas like Motiganj Bazar, Sahadevkhunta, Gopal Gaon and many other areas. The people of these areas said that they didn't see such type of urban flooding before. The flood water entered into the shops and houses which are even in higher places. To the people of the areas inadequate drainage, encroachment of drainage system and filling up of wet lands are major reasons.

The Risk of Cyclone in the District

The district has been facing the fury of cyclone at regular intervals. The details have been given above. Further the change in climatic pattern due to global warming is

likely to alter normal weather and climatic patterns including change in frequency and intensity of violent storms. According to Orissa Factsheet of Global Environmental Negotiation, there is a possible increase in cyclone intensity of 10 to 20 percent against a rise in sea surface temperature of 2 to 4°C. Another recent simulation study shows that there is an increase in occurrence of cyclones in the Bay of Bengal in the increased Green House Gas scenario, particularly in the post-monsoon season. The same study also indicated that wind speeds associated with cyclones will also reach maximum level due to climate change (Unnikrishnan *et. al.*, 2006). The hypothesis is that warming ocean water would feed more energy into high magnitude storms such as cyclones and hurricanes causing a significant increase in their frequency & intensity (Jena & Mishra, 2011). Hence, the coastal areas will experience inundation, storm flooding and it will accelerate the coastal erosion, intrusion of sea water into fresh ground water, encroachment of tidal (saline) water into river system and farm land. The people of Chanua and Parikhi panchyats (during the field study) expressed the possibility of the encroachment of saline water into their farm land and fresh water bodies in the absence of proper measures along the coast of the Bay of Bengal.

The Fury of Tsunami in the District

Another disaster which may affect the coast of Balasore district is Tsunami. The Odisha State Disaster Management Authority has predicted the areas which may face the possible threat of Tsunami in future (Table 3).

Table 3: Blocks of Balasore facing Tsunami threat

Sl. No.	Name of Block	No. of Panchyats	No. of Villages	Size of population to be affected
1	Bhogorai	7	16	17,272
2	Baliapal	9	9	30,553
3	Remuna	3	6	6,708
4	Balasore Sadar	17	51	49,564
5	Bahanaga	5	19	17,439

(Source: Osdma Press Release, 2009)

Population Pressure and Increasing Environmental risk

It has been observed that the coastal zones around the world are densely populated due to fertile soils, livelihood facilities such as development of fishing and shipping industries. The same is the case with Balasore district. It is densely populated. As per the Census of India-2001, the density of population was 532 per sq km. which

was almost double that of Odisha (286 per sq km). But as per the Census of 2011, the density of population has increased tremendously and it is now 609 per sq km. During the same period the growth rate of population in the district is high (14.47%) as against (13.97%) for the state (NABARD, 2011; & Registrar General & Census Commissioner of India, 2011).

The population of the district goes on increasing. The district is grappling with more number of disasters year after year. But the adaptive capacity of the people hasn't developed. Rather due to increase in population, they are building residence on/near the embankment which is vulnerable to flood. For example people are residing on the embankment of the Subarnarekha river at Gurudaspur village, Srirampur Panchyat, Jaleswar Block (Study Area). In the recent years there is increase in habitations along the coast of Balasore district. This is mainly due to illegal settlement of Bangladeshi migrants and internal migration of people (fisherman) in search of livelihood. This has posed serious threat to the coastal forests along Balasore coast. Mangrove forest, which once dominated has depleted due to over-harvesting, fresh water diversion, urban growth pressures, charcoal and timber industries and mounting pollution. Rapid depletion of mangrove forest has made Odisha coast more vulnerable to cyclones (OSDMA, 2014).

Climate change & its impact on agriculture

The Inter Governmental Panel on Climate Change (IPCC) has released its Fifth Assessment Report called 'Climate Change 2014: Impacts, Adaptation & Vulnerability' on 31st March, 2014 at Yokoham, Japan. In this report the IPCC has come out with a number of warnings about climate's vagaries which we are likely to be faced in the coming year. One such major consequence is its impact on food security especially in tropical and temperate regions. The report highlights that climate change without adaptation will have negative impact on agriculture production, mainly the production of three major crops such as wheat, rice and maize (IPCC, 2014). Many climatologists predict a significant warning in the coming decades due to rising carbon dioxide and other Green House gases in atmosphere. The changes in temperature, solar radiation and precipitation due to this will have negative impact on crop production and livestock farming. It has also an economic impact on agriculture including changes in farm profitability (Khan *et. al.*, 2009). If this is the future dismal picture, then the district of Balasore will face serious consequences. One such consequence is the negative impact on agro-productivity. Agriculture is the lifeline of the district. It generates employment for a major portion of the population. As projected the coastal zone of the district will face setback in agriculture due to

inundation and salinisation and the other parts will face the same setback due to water erosion caused by anthropogenic factor like deforestation.

Danger of Desertification in the District

Another serious consequence of climate change that is being realised in Odisha is desertification. It is a process of productivity loss of lands. When severe, it leads to permanent damages to land. It has been projected in a report of Water Initiative Odisha (WIO) that the whole state will turn to a mass of barren and desert like land in another 150 years. The same report of WIO claimed that within the period of 13 years i.e. from 1991-92 to 2004-05, severely degraded land in the state has increased by 136 percent, barren land has increased by 69 percent and land converted to non-agriculture uses has increased by 34 percent. This is about 7 percent of Orissa's total geographical area. By 2004-05, as high as 17.5 percent of Orissa has turned barren or unsuitable for agriculture. WIO has reached this conclusion using state data on lands (WIO Report, 2006). Similarly the change in precipitation pattern is a major concern for the people of Odisha. It has been observed that the annual rainfall in coastal districts like Balasore, Puri, Ganjam etc. has increased while the annual rainfall in western districts has decreased drastically. The coastal districts are moving towards desertification due to soil erosion and water logging. The anthropogenic factor like deforestation due to industrial explosion and steep increase in population has further been aggravating the situation. It has also been revealed in this report that soil erosion due to deforestation is serious in 52 percent of total geographical area of Odisha and the district of Balasore is not free from it.

An article 'Orissa among five states showing signs of Desertification' published in Maharashtra Times dt.19.12.2009 has been mentioned that Odisha comes next to Rajasthan, Jammu & Kashmir, Gujurat and Maharastra having high proportion of land undergoing degradation. The same article it has also revealed that Odisha has about 54,69,336 ha of degraded land, more than that of geographically bigger states like Andhra Pradesh, Uttar Pradesh, Madhya Pradesh and Karnataka. Odisha's degradable land mass constitutes 5.18 percent of the total geographical area of India. In Odisha erosion by water is the most pronounced processes of land degradation and desertification. Erosion by water is witnessed in 32,06,507 ha of land of the state which ranks close to the state like Rajasthan (India: Desertification, 2009). Similarly more land mass in Odisha has been getting water logged than any other state in the country. The anthropogenic factors such as deforestation caused by industrial explosion and population growth, blockage of natural drainage system, filling up of wetlands etc. make the situation more panicy in the district.

The Risk of Drought in the District

Sometimes the district faces drought or drought-like situation. The drought in 2002 can be cited here in which out of 289 panchyats, 258 were affected. The District Disaster Data Sheet, 2002 reveals that the district has a crop area of 5,34,911 acres or 2,13,964 ha. The crop area affected by the drought constituted 4,87,695 acres which was around 91.17 percent of the total farm land of the district. According to the Agriculture Department, Govt. of Odisha and the District Administration, the erratic behaviour of monsoon (late arrival or weak monsoon) was the main reason for such drought in the absence of adequate irrigation facility in the district (District Disaster Data Sheet, 2002).

Results

The above discussion vindicates the susceptibility of the district to multiple disasters. The anthropogenic factors like rapid growth of population, unsustainable developments etc. pose serious threat of environmental degradation. The rapid growth of population in the district is the major cause for fast disappearance of the forests including the coastal forests. The agriculture which is the lifeline of the district is likely to receive major setback due to erratic behaviour of monsoon consequent upon climate change. Similarly, the fishery sector which generates employment opportunities next to agriculture is likely to be affected by it. In other words climate change due to global warming is likely to aggravate the disaster situation in the district. More number of people of the district will fall victims to multiple disasters in the absence of adaptation techniques and capacity building devices. Hence capacity building in the district is the crying need of the hour since it is found that capacity to reduce risk is relatively weaker in poorer countries (Shaw & Krishnamurthy, 2009).

Issues for Capacity Building Suggestions

In a poor and disaster-prone country like India, the role of capacity building is very crucial in reducing the risk of disasters. As it is well said disaster doesn't occur itself, it occurs when a hazard hits a vulnerable group or community or society. Vulnerability reflects the incapability or weakness of the community which transforms the hazard to a disaster.

According to Wikipedia, the term 'Capacity Building' was used for the first time in the lexicon of International Development in 1940s. The Capacity Development is a conceptual approach to development that focuses on understanding the problems of inhabitants, nature of government, international organisation and non-governmental organisations for realising their developmental goals while enhancing the abilities that will allow them to achieve measureable and sustainable development. The

delegates to the symposium, 'A Strategy for Water Sector Capacity Building' which was organised by UNDP and International Institute for Hydraulic and Environmental Engineering at Delft, Netherland in the year 1991 defined 'Capacity Building' "as the creation of an enabling environment with appropriate policy and legal framework, institutional development including community participation (of woman in particular), and human resources development and strengthening of management system."

Thus, the goal of 'Capacity Building' is to enhance the ability, to evaluate and address crucial questions as the people, organisations, societies and other stakeholders strengthen, adapt and maintain their abilities over time. Capacity Building has been recognised by Capacity Development Resource Centre as a prerequisite to development and could be addressed at individual or organisational levels.

Individual Capacity: It is the ability of individuals to learn, gain knowledge and skills which can be utilized when new challenges and opportunities arise.

Capacity building at individual level

Individual capacity building in the district is outmost need of the hour while the frequency and intensity of natural disasters has been increasing day by day and the economic loss due to natural disasters is also mounting. In this situation capacity building of individual is needed to enhance their coping capacity to withstand the shock of these disasters and to recover from the same (Gonsalvese & Mohan (ed.), 2012). It is a well known that socio-economic condition of a person determines the degree of vulnerability to disaster. Similarly the level of awareness and housing pattern also determines his extent of susceptibility to disasters. According to the Census of India, 2011 in the district of Balasore the people Below Poverty Line (BPL) constitute 73.72 percent of the total population. During the field study it has also been found that the houses are mainly made up of mud wall and straw roof or asbestos sheet. Similarly it has been found that construction norms were not followed during the construction in order to make these houses disaster-resistant. The people don't have knowledge about it or in some cases their economic conditions make them unable to bear the cost of building a disaster-resistant house. The level of awareness about disaster management at grass root level is also very low in the district. During the Doctoral Research it has been observed by the researchers that 181 (95.80%) out of 189 respondents of the study area (covering 27 sample villages of 9 panchyats in the district) don't have knowledge about what to do and what not to do during disasters and in the aftermath. Only 8 (4.20%) have knowledge about it. Hence economic upliftment of the people is the urgent need of the hour. Similarly steps should be

taken on urgent basis to increase the level of awareness among the people and also to encourage them to build disaster-resistant houses.

Climate change accelerated by global warming will have devastating impact on coastal habitations. The example of such consequences of climate change is rise in sea level, increase in frequency and intensity of cyclone and flood. The details of the possible devastation have already been discussed. In many studies the effectiveness of bio-shields including the mangrove, non-mangrove coastal forests have been proved mitigating natural hazards like tsunami, tropical cyclones and storm surges (Das & Vincent, 2008). The usefulness of Jhun (Casuarina) has also recently been proved protecting cash crops in coastal areas. The Institute of Forest Genetics & Tree Buildings, Coimbatore has implemented a pilot project on plantation of 'Casuarina', a natural wind breaker along the coast to protect banana farming in coastal area and it is a ray of hope for the banana growers that the Institute has successfully saved banana plant in Coimbatore by planting the tree (Bio-shield Protects, 2013). But unfortunately the coastal people of Balasore district are unaware of this usefulness of these forests. So they are cutting down these trees for fuel wood and construction of house. As a result the bio-shields are depleting fast along the coast of Balasore and the coastal areas are becoming vulnerable to disasters like tsunami, tropical cyclones, tidal wave etc. During field study it was found that almost all (42) respondents of Parikhi and Chanua panchyats (situated along the coast) of Balasore Sadar have no knowledge about the usefulness of these coastal forests. The undivided district of Balasore (Udaypur of Balasore district to Dhamara of Bhadrak district) has 88 km of coast line. Out of this, 17 km of coastline is under the control of Ministry of Defence, Government of India and remaining 71 km of coastline is under the control of Ministry of Forest and Ministry of Tourism, Government of Odisha. Earlier this area had 88.96 ha of Jhaun (Casuarina) forests. But these forests are disappearing rapidly due to illegal settlement of Bangladeshi migrants and for accommodating new farm land and prawn farming (The Status of Coastal Forest, 2009).

Organizational Capacity: It is about people working together for a common cause and includes institutional reforms necessary for synergising efforts.

Capacity building at organisation level

Capacity building at organisation and government level is similarly important in the present scenario. In many researches the pivotal role of the community as an important institution in the process of disaster management has been acknowledged. The community is also the first respondent to any disaster and it is the community which can help itself during the disasters and immediately after the disaster. It is

quite difficult for the outsiders to reach the disaster-affected area in time because of lack of knowledge about that area and communication as well as transportation problem. During the data collection it was found that not a single village out of 27 sample villages in study area had either Village Disaster Management Plan or Village Disaster Management committee.

There is also another reason for recognising the role of community capacity in managing the disasters effectively. It is often noticed many small disasters occur frequently but these are hardly reported. How they are manage these and with what resilience and capacities affected communities face disasters as observed by Ariyabandhu & Wickramsinghe, (2005). One such disaster situation which has been managed locally is noticed in Jaleswar and Nilagiri blocks. The elderly people of these blocks reveal the usefulness of a small well called 'Dug Well' which they dig in the corner of their farmlands. It helps them a lot to avoid the drought situation to a great extent in Khariff season while the monsoon is late and irregular. According to them these wells are also very useful in maintaining the underground water level in those areas. Hence, the policymakers must think about the revival of such indigenous knowledge which the communities have since time immemorial to tackle the disasters.

Similarly capacity building at government level is also important. During the field study it was observed that the Collector is not found to be assisted by adequate trained staff as far as disaster management is concerned. The contingency planning of the district administration is rescue- and relief- centric. The expenditure in mitigation activities is almost none. Disaster risk reduction measures are not implemented in the ongoing developmental works. The construction of NH-60 is an example of such type. As a result there is huge devastation in the district by the floods which visit the district 3 to 4 times in a year. As we all know, severe cyclones visit the district at regular intervals. But there is no early warning system yet in the district for cyclone forecasting. According to the officials of India Meteorological department, Bhubaneswar, the installation of 'Dopplar Radar' for this purpose is under construction. As said earlier the BPL families constitute 73.72 percent of the total population of the district and it is their poor economic condition which makes them more vulnerable to natural hazards. It has been vindicated in many researches that the poor suffernay more in nay disasters and they also need more time for recovery (Potenza, 2010). Hence, initiative must be taken at governmental level for the economic uplift of these people. The implementation of disaster mitigation measures in developmental projects must be made compulsory and there should be paradigm shift in the approach to manage disasters at district level. The appointment of 'Disaster Manager' at district and block level will further strengthen the initiative.

The destruction of Bio-shields is also a major concern at this time. People are cutting down the jhaun trees (Casuarinas), the natural wind breakers and destroying other non-mangrove due to ignorance. Hence, creating awareness at community level is the crying need of the hour. It can be done by creating awareness among the people by giving them training on disaster mitigation and telling them about the usefulness of the mangrove and non-mangrove forests during the past disasters especially during Tsunami, cyclone and wind storms. Similarly strong law must be enacted to protect these bio-shields.

Mitigation is a strategy to pursue action that reduces green house gas emission in such a way as to lessen the severity of climate change. But mitigation alone can't fully stop the effects of climate change. Hence, adaptation needs to be included in the development strategy. Adaptation is based on the expectances of the fact that climate change is happening and pursuing strategies to minimise its impact. However, region's ability to adapt depends on its state of development (Achrya, 2012). For example the farmers of Punjab can better cope with irregular rainfall than those of Odisha in general and Balasore district in particular who become vulnerable to vagaries of monsoon. In other words it is difficult to distinguish adaptation to climate change from the process of development itself.

Conclusion

A coastal district like Balasore in the state of Odisha is prone to multiple disasters. This vulnerability is likely to increase manifold due to climate change which has the potential to affect its lifeline i.e. agriculture through desertification. The floods, storms which frequent the district cause havoc and bring untold misery for the inhabitants. The floods which took place due to faulty planning of NH-60 is a glaring example. Due to anthropogenic factors like deforestation, destruction of bio-shields and filling up of wetlands which are results of rapid urbanisation, steep increase in population and industrialisation, the likely impact of climate change on the district is predicted to be severe. The inhabitants of the Balasore district especially the marginalised section and people staying in vulnerable areas may have to bear the brunt of these possible environmental risks and hazards. In the absence of adequate adaptation and mitigation strategies, the problem may intensify. In such a scenario the adaptation of 'Capacity Building' measures are highly essential to tackle the problem. The involvement of the people of the district especially at the grass root level, the non-governmental organisations and above all the district administration is imperative. The efforts of the state government and civil society is called for to cope with the likely impact of climate change in the near and distant future. Lastly, the

long-term goal of sustainable and balanced development is to be achieved to tackle properly the problem of climate change not only at Balasore but also in the entire country.

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Disasters-Induced Displacement vis-à-vis Policy Framework: A Study of the Mishing Community of Majuli, Assam

– Mausumi Chetia[1]

Abstract

One of the main causes of impoverishment of the rural areas of Assam has been the recurrent floods and riverbank erosion. One of the life-changing consequences is Displacement. This results not only in loss of livelihoods but also has wide-reaching socio-economic and cultural effects. Thus, due to such disasters not only families but communities too are being displaced at large. This compels them to find temporary shelter and begin life from scratch. The role of the state has been highly negligible, with displacement not being perceived as an 'issue' to be addressed. A more holistic approach is thus needed to take socio-economic, cultural, political as well as ecological considerations into account.

Keywords: *Displacement, Human-induced Disasters, Marginalised communities, Policy Framework*

Introduction

An infinite passivity perpetuated through waiting ***(Anonymous)***

History unveils that some great human civilisations have grown in nature's most precious gift – river basins. It is difficult to say whether it is some inscrutable natural change or the indiscriminate use of modern technology or the destruction of natural resources by human species that has led to certain grave changes in nature. The most recent example in the country is the massive humanitarian crisis that took place including landslides, erosion and floods in Uttarakhand in June, 2013.

Beyond the more obvious and immediate outcomes of loss of life, property and infrastructure, any disaster caused due to natural hazards or aggravated due to human-induced elements has long-term and difficult outcomes. These are in terms of vulnerability to various elements: increased poverty, malnutrition, adverse affect on the psycho-social well-being, out-migration from villages, enhanced social disparities and strife.[1] *Displacement* from one's native land is one such effect, which

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has life-altering consequences. Getting displaced results not only in loss of livelihoods but also has wide-reaching social-economic, psychological and political effects. Studies suggest a pertinent point that the plight of the riverbank erosion-induced Internally Displaced People (IDPs) is much more severe than that of the victims of flood. One of the main causes of impoverishment of the rural areas of Assam has been the recurrent floods and riverbank erosion (Das, 2007).

This paper is based on a set of case studies of an academic study spread over two years (2009-2011) with the Mishing tribal community of the Majuli island of Assam (Chetia, 2011). A total of 70 households were selected using quota sampling from seven different villages of Majuli that were located in various administrative and geographical locations of Majuli including Upper, Central and Lower Majuli blocks. Four among the seven were relocated villages along the banks of the Brahmaputra in Kamalabari block and three were located at the centre and lower-end periphery of the island. Access to knowledge of political and economic rights and their exercise hold limited significance among this perennially displaced community. Given the nature of this community's vulnerable residential space (an island) and their economic capacity, recurrent bank erosion implies the kind of displacement that is of a permanent nature. This is also true to a great extent in the rest of the state. However, in the case of countless Mishing families of Majuli, a home lost once is a home lost forever.

Setting the Context

Das (Ed.) (2007) notes through case studies of displacement in his widely-read book *Blisters on their feet,* that 'displaced' persons are displaced not simply from their homes or places of habitual residence but from the world of law that establishes the principle of equality for the citizens and treats them at par with each other. The widespread and repeated floods across the north-eastern states of Assam and Arunachal Pradesh triggered the largest displacement in the world of 6.9 million people out of the total of 31.7 million worldwide in 2012. In Assam, the Central Water Commission estimated that as many as 6 million, 20 percent of the state's population, were forced to flee by rising waters.

Assam is a land of rivers by the virtue of its unique geographical location amidst the northern, eastern & southern hills, highlands and humid tropical monsoon climate. Assam happens to be a land of innumerable rivers and their tributaries. The entire state is drained by the dense networks of two river systems viz. the Brahmaputra system and the Barak system. Both these river systems are international in their extensions and go out to Bangladesh (Figure 1). According to hydrological experts, 45 percent of Assam's total landmass is prone to flooding by the Brahmaputra. The

river's wide alluvial channel in Assam having an average width of 6-8 km is dotted with more than 600 small and large sandbars, locally called *'chars'*. As regards bank erosion and channel migration, the river is found extremely unstable at some vulnerable locations, such as Mailjan, Bhairabpur, Kaziranga, Howlighat , Palasbari and Majuli (Chetia, 2011).

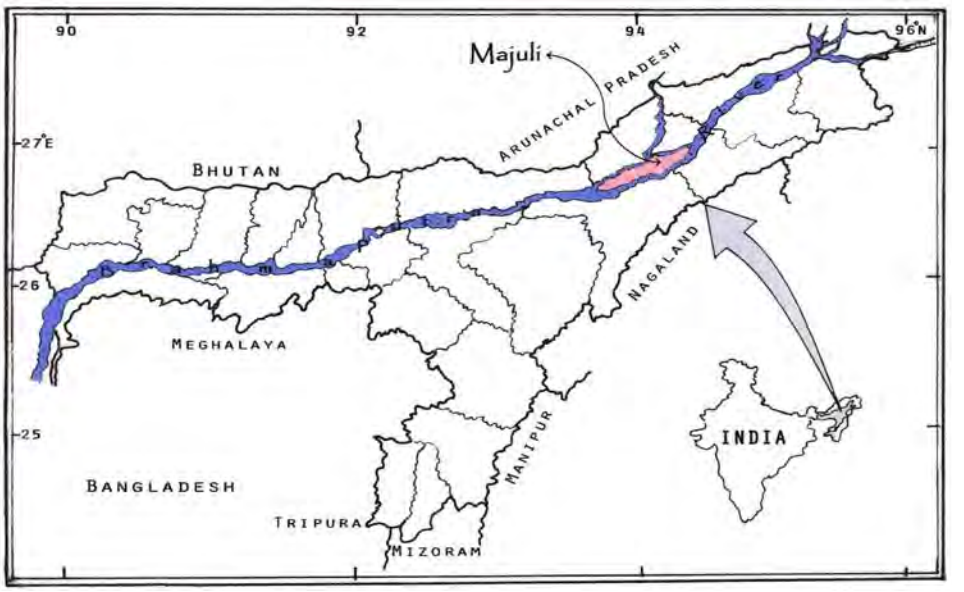

Figure 1: District map of Assam indicating location of Majuli River Island

Situated in the remote North-Eastern corner of Assam, *Majuli* is one of the largest human-inhabited river islands of the world which has a significant existence from various sides – geographical, anthropological, socio-cultural as well as political (Hazarika, 2001). It is a subdivision of the Jorhat district and is situated at the very confluence of the Brahmaputra and the Subansiri rivers. It includes 155 villages under three revenue circles (Salmora, Kamalabari and Ahatguri). The island has a population of 1.68 lakh as per 2011 census. The Majuli sub division has 45 percent ST (plains) population among which 35 percent is the Mishing tribal community. It has 20 village panchayats of which 11 are reserved for ST (Plains) communities. The tribes inhabiting the island are Mishing, Deoriand Sonowal-Kachari, of which the Mishing constitute the largest ethnic tribe in the Island (Gam, 2013).

The Mishing community is one of the scheduled tribe communities of Assam. Scholars across disciplines unanimously hold that they belong to the Tibeto-Burman

language speaking greater Mongoloid race whose ancient civilization flourished in the upper course of the Yangtse-Kiang and the Hoang-Ho-river-valleys of north-west China (Research Scholar, 2013). Hence, racially they belong to the Mongoloid stock and ethnically to the group of tribes known as Adis of Arunachal Pradesh. They have lived in Arunachal Pradesh as cognate tribes of the Adis. The community migrated to the plains more than five centuries ago and settled in the upper Brahmaputra valley (Pegu, 2012). The Mishing community inhabits the districts of Dhemaji, North Lakhimpur, Sonitpur, Tinsukia, Dibrugarh, Sibsagar, Jorhat and Golaghat of Assam state. There are about 16,000 Mishing people in three districts East Siang district, Lower Dibang Valley, and Lohit districts of Arunachal Pradesh. They were referred to as Miris in earlier times. The Constitution of India still refers them as Miris. However in the recent times, they have popularly come to be known as the Mishing community. Scheduled Tribes (STs) constitute 12.4 percent of the total population of Assam in which the Mishing tribe hails the second place after the Bodos. Demographic features of Mishing population is shown in Table 1.

Table 1: Demographic data on the Mishing community of Assam

Details	Percentage (%)	
Population	17.8*	
Urban Population	1.8**	
Literacy Rate	Female:48.3	Male: 71.4
Category of Workers***	85.6	
Child Marriage	Female: 1.3	Male: 1.5

Source: Census of India, 2001.

* Total ST population: 3,308,570 ** Total Urban population of STs: 4.7% ***Cultivators

While flood inundation has been a feature of the island since 1570, it is crucial to maintain here that the loss of land area due to erosion has been taking place since 1950 (and more rapidly in the recent past) which is comparatively much more serious, as it displaces people from their roots and occupations. The present system of embankments have also failed to check the erosion problem, therefore threatening the existence of the island and its inhabitants (Chetia, 2011). According to a study using remote sensing data and interpretation, the Brahmaputra river increased its width from 6.75 km to 8.95 km on the eastern side of Majuli island in the period between 1972-1992, eroding away a large tract of land on both the banks of the

Study of the Mishing and Deori community of Assam; Lade Jayant Deoram, Research Scholar, Dept. of History, CMJ University, Shillong, Meghalaya; *International Journal of Research in Social Sciences and Humanities* (http://www.ijrssh.com) (IJRSSH) 2013, Vol. No. 2, Issue No. III, Jul-Sep ISSN: 2249-4642

Brahmaputra (Figure 2). The present system of embankments has completely failed and rather aided to the erosion problem, therefore threatening the existence of the island and its inhabitants. Worst affected are those people who try to make out a livelihood on the edge of the river. About 47 percent of the population of the island belongs to the Mishing community. As their land and villages have disappeared over the last few decades, they have been transformed from land owning farmers to homeless and landless labourers (Chetia, 2011).

EXPLANATION

Bankline of the Brahmaputra River	1920	Eroded Land
	1975	
	1998	Sand Bars

Land area and erosion rate of Majuli Island

Year	Land area (km^2)	Annual rate of bank erosion (km^2)
1920	735.01	-
1975	613.63	2.21
1998	577.65	1.56

Figure 2: Map showing the rate of land area and erosion of Majuli Island

Methodology

The study employed a combination of quantitative and qualitative methods to meet the proposed objective. The tools used were of Structured Interview Schedule-I and Self-reporting Questionnaire - 20. Semi-structured in-depth interviews were used as qualitative tool for data collection in order to get an in depth understanding of the various factors leading to the particular effects of floods on the population and also to attain a deeper understanding of the ways in which this population copes with this disaster.

Within the framework of a collaborative study on Strategies for Extending Mental Health Care, coordinated by the World Health Organization (WHO), the Self Reporting Questionnaire (SRQ) was developed as an instrument which was designed to screen for psychiatric disturbance in primary health care settings, especially in developing

countries (Chetia, 2011). In recent years the SRQ has been used in some 30 studies from which its psychometric properties can be assessed and in languages as varied as Portuguese, Spanish, Hindi, Bengali, Kashmiri etc.

The sampling procedure employed was quota sampling. Data was collected in two phases through the months of May and October, 2010. The sample population among the Mishing community was selected from seven different villages of Majuli that were selected from various administrative and geographical locations of Majuli including Upper, Central and Lower Majuli blocks. The data was based on structured interview schedules conducted with 70 participants and another 10 participants with whom in-depth semi-structured interviews were conducted.

Analysis, Results and Discussion

Impacts of Displacement

This study brought out that 81 percent of the participant-households had experienced multiple displacements, over multiple times. Out of these, 49 percent were displaced within the range of 1-5 times in their life time. For instance, the entire village of Naambotiamari of Central Majuli was displaced for over more than four times till 2010. Three percent of the households among these were displaced for 11 times and above.It is but natural for such high frequency of displacement from one's habitual residence to have multiple implications on those displaced. Borgohain & Lahiri (2011) note the plight of the people of Rohmoria, a mouza (Taluqa) in the Dibrugarh district. The place has been suffering severe bank-erosion post the earthquake of 1950 in the south bank of the Dibru-Saikhowa segment of the Brahmaputra causing rapid bank line migration in both the north and the south banks. By 1979, a significant portion of the Dibrugarh, Rongagorah, Tinsukia metalled road, the main link that used to connect Rohmoria with the two important townships of Dibrugarh and Tinsukia, was cut heavily due to this erosion. All of a sudden, the lifeline for business and general transportation was snapped and the earlier well-connected Rohmoria was reduced, almost in one go, to a hinterland, a very interior place to which most of the town-based doctors would refuse go even in an emergency. Therefore, erosion can make a peasant landless overnight. Massive rate of river-borne erosion tends to open up a Pandora's box of related issues. These can be in the form of encroachment of forests by the uprooted people from the erosion-affected places, subsequent eviction of these displaced people by the state, pauperisation of these affected people and then rapid rate of internal migration and overpopulation of the urban centers with "unauthorised" people who lose the right to claim even the basic amenities of a civil society.

Therefore, few striking elements of such multiple-displacements are:

- Increase in poverty rate,
- Lack or absence of livelihood opportunities,
- Increased dependence on market,
- Disorientation of family identity and role-reversals,
- Adverse effect of lack of education or its poor quality on health,
- Changes in community life,
- Food habits and social networks.

Following case vignettes highlight the qualitative nature of the aforementioned issues.

In the words of a 52 year old male participant from a low middle-class socio-economic background,

"In times when the flood was not a problem, we were much closer and happier. We would all sit together and have our meals and chat over food. However, over the last few years, we had to dislocate to various secure places away from the river. The number of members in the family also decreased during this time. This resulted in the decrease in the amount of interaction with each other."

Introspecting on his family's dwindilingeconomic condition, he said,

"Although we had our own land, it was all washed away by the erosion.("maati asile jodiu khohoniyai sob loi gol"). Our economic condition deteriorated only after the bank erosions started to take place."

According to a partially visually challenged, 80-year old male senior citizen from a low socio-economic status, he is habituated now in making a public street his home. In his words,

"When my family was together, we used to cultivate our own land and grow crops on our own. But in that flood, when this area was completely flooded, all our land was washed away and we started living on the roads."

A 42 year old male primary school teacher from a low middle-class socio-economic background said:

"I had to discontinue studying because my mother had got Tuberculosis. And we did not have cycle or anything in our family at that time to call any local person for help. However, somehow we managed to take her to Tiyok Civil Hospital in Jorhat for treatment."

In the words of 27-year old financially independent female participant, the quality of life of her family has decreased due to displacement.

"The floods have displaced us from our permanent place of residence and we had to shift our house to new places. Since carrying cement pillars from one place to another was a herculean task, we had to leave those back at the original place and build a "kachha" chang-ghar the first time we shifted our house. Since then, every time we have left a place of stay, the family has been living in a kachha house."

A 56-year old home-maker feel erosion and floods have decreased the nutrition-content of her family's diet. In her words:

"…during those times the island used to be covered by large forest areas. Different kinds of vegetables used to be available there. Moreover, we had our own piece of land where we used to grow vegetables for the family. Hence, the diet used to be very nutritious and rich. However, the situation has changed now. The forests have either been turned to places of human inhabitants or are under the mighty Brahmaputra."

Impact on livelihood

Forty percent of the participants were engaged in agriculture, as cultivators in their own land or as landless labourers; 21 percent were in the organised sector, 6 percent in the unorganised sector while 17 percent were self-employed and 16 percent werehomemakers. With regard to income in cash, 19 percent earned between Rs. 20000 p.a. to Rs. 50000 p.a. while 3 percent earned below Rs. 10000 p.a.; 20 percent earned in kind i.e. rice grains between 100 to 500 kg per annum. Majority of them worked in other's land as labourers or had taken land on lease. Many others wereself-employed either in private jobs, shops, government offices as well as to do petty businesses which could not fetch all the needs of the family at all times. Therefore, the families did not have a stable source of income nor did they own any immovable property like a piece of land which was the most disturbing or troubling aspect of this entire process of change for them. The insecurity of survival and instability in

the source of income are the basic causes of worry and undesirable events in their families.

Says the 80-year-old partially visually challenged male participant, "The children are earning a meagre amount just enough for survival through as daily-wage labourers. We are meeting our basic needs in that way" (Original statement in Assamese: "jene-tene lora suali-bure enei hajira kori, taake khaisu aru").

Coping mechanisms of the Mishing community

Centuries of experiences of Majuli's Mishing community have taught them how to live with floods and erosion. Studies highlight that the Mishing community of the Dhemaji district uses various coping strategies to deal with the yearly flood problem such as building Stilt houses *('chang-ghar'),* residing in embankments which are preferred for immediate shelter during floods and some people who have lost their homes stay back for a long time, and even permanently, on the embankment (Global Estimates, 2012). Different forms of alternative livelihoods of these people include selling fish including dried fish, selling liquor, carpentry, daily wage labour, and labour migration. Food-storage techniques are both novel and creative to protect it from floodwaters. Although it has decreased to a great extent now, one of the most common and old practices is to leave their old homes and settle in new areas when their old villages were engulfed by the river or became too vulnerable to erosion.

Coping Mechanisms adapted by the Mishing Community of Majuli:

a) *Jovial and buoyant nature of the community:* One of the striking characteristics of members of this community observed throughout the period of data collection is their ever-energetic and jovial mood. This community optimism appears to have also helped them to fight with floods and erosions all these years. Thus, despite of living like nomads with insecurity of life and livelihood at most times, they can carry a bright smile on their lips and say, *"What will we do getting angry or upset with the Brahmaputra? Floods are a law of nature. They will come."*

b) *Adapting to alternate livelihood options:* Every participant of the study was a farmer or a cultivator by origin. However, most of them had changed their occupations during the period of the study. Most people are engaged in unskilled work like daily wage labourer or construction worker, semi-skilled work like carpentry (for the better-off), making and selling local liquor (Aapong), barbers, landless labourer, driving, conductors in ferry services etc.

Few women pursued their traditional knowledge of weaving into a profession. Others had taken to poultry, and other kinds of animal husbandry.

c) *Strong identity as a community:* Mishing festivals of Ali-Aai-Ligang, Porag festival, Dobur Puja and so on are about celebrating the spirit of the community, its culture and unique identity. These festivals bring the young and old of the community together to feast, dance and celebrate their sense of belongingness as one community. These kinds of celebrations give individual members a sense of belongingness to a community which in turn also gives a sense of security when the need arises. Thus, this spirit of togetherness is visible not only in good times but also in times of crisis when the whole community runs for rescue of one another and offers help as per one's capacity.

d) *Stilted houses called Chang-ghar: Chang-ghar* is the Mishing word for a traditional Mishing house. It is stilted and has a thatched top and is patterned simply like the letter 'I'. It is built usually with wooden posts, beams, truss and supporting forks, but bamboo is used extensively for flooring and roofing. The more the number of nuclear families living in the same house, the longer the 'I' would be. This design of house serves two basic purposes. In the earlier times, to live on fertile banks of a river primarily for occupational purposes and still be safe, they started building their houses with a considerable gap from the ground so that when floodwater comes, it cannot enter into their houses. This same rationale is behind the Mishing community of Majuli living in Chag-ghars. Moreover, they are also generally found living in joint families where the number is quite huge. Hence, this particular design enables them to accommodate a large number of family members.

e) *Keeping boats for transportation and food storage:* Those families who had a comparatively strong socio-economic background generally keep a boat in the premises of their chang-ghar. The boat was used at times of emergency when floodwater would enter their houses and they are required to escape from that place. Moreover, at times when escaping would not be an option and their chang (floor of the chang-ghar) would get drowned, they built another temporary chang on top of the original one, put their boat (s) on it and use it for preparing their meals.

Displacement: a critical eye on policy framework

As the largest democracy of the world, India has no dearth of systemic regulations in any sector. These are in the form of various policies, schemes, programmes, acts and laws, government agencies and so on. Likewise is the case in the field of disaster

management, where a whole set of regulations, statutory bodies and functionaries exist to handle the situation in need. However, framing policies, keeping the macro picture in perspective is one art and managing the micro picture on the ground with equal efficiency is another. This section endeavours a critical review of the various schemes and policies of both the Government of India and the Assam government regarding Disaster Management in Assam vis-à-vis displacement.

Measures at the state level

To prepare comprehensive plans of flood management for Brahmaputra and Barak Valleys, the Brahmaputra Board, an autonomous statutory body was set up by Act of Parliament (The Brahmaputra Board Act, Act 46 of 1980), under Ministry of Water Resources. However, floods continue to play havoc to the people of Assam and their lives despite measures taken by the Centre as well as the State Government. A study by Das (2007) showed that one of the worst floods of the state was in 1998 in which the level of submergence crossed all previous records. Of Assam's then existing 23 districts, as many as 21 districts were affected in the most devastating flood. As per the funds for relief, restoration and rehabilitation, the requirement was put at Rs. 1000 crore in a memorandum submitted by the Government of Assam (GoA) to the Government of India (GoI). The same study highlighted that the annual damages have increased since 1998. In his memorandum submitted to the Prime Minister on 21st. November, 2004, the then Assam Chief Minister reported that the damage due to flood during 2004 was tremendous. It affected a population of 1,30,00,000. A total of 491 people were killed. The loss of cattle was estimated at 65,000. More than 6,000 houses were damaged. The damage to crops, buildings and public infrastructures, such as bridges, roads and embankments amounted to Rs. 2,400 crore in terms of money. GoI's assistance in that year was the highest – Rs. 557 crore. Compensation in the form of land was provided by the state government in earlier times to the people displaced by erosion. However, in the recent decades, the state finds it difficult to continue with this due to ever increasing pressure of population on land and conflict on territoriality. Only meagre compensation (in cash) is provided by the state, for fully damaged houses it is Rs 4,000 per family and Rs 1,500 per family in case of partially damaged houses.

Schemes of the Centre

The PM National Relief Fund was set up by the then Prime Minister of India in 1948 primarily with public contributions to assist displaced persons from Pakistan. In a period of last five years from 2008-2013, the fund has raised an amount of Rs. 1107 crore of which Rs. 827 crore has been spent on various kinds of disasters

including riots, flood, drought, earthquakes, cyclones, tsunami etc. Rs. 280 crore is the balance which is in the fund. The National Calamity Contingency Fund (NCCF) is another Central Government scheme. It was set up in the financial year of 2000-2001. Under the revised Scheme for Constitution and Administration of the NCCF, the kind of Calamities to be covered under the Scheme is mentioned. In the words of the Constitution, *Natural calamities of cyclone, drought, earthquake, fire, flood and hailstorm, considered to be of severe nature requiring expenditure by the State Government in excess of the balances available in its own Calamity Relief Fund by the National Centre for Calamity Management (NCCM) will qualify for relief assistance under the Scheme*. Tsunami of 2006, Kosi Flood of 2008, Orissa Super cyclone, Gujarat Earthquake of 2002 are few of the calamities that have been provided financial assistance through this scheme.

The nature of assistance provided through both these schemes by the Central Government is that of grant, implying the non-return of the aid provided. In the case of any such calamities in Assam, only a partial assistance has been provided as Grant. Das (2007) reported that the demand for Assam's flood to be declared as a national problem is also crucial because it would then imply that all central assistance for structural flood control measures are grant. Currently a major portion of it is received by the GoA as loan from the GoI. For example, from 1974-1975 to 1999-2000, Assam received a total of Rs. 401.03 crore as central assistance for structural measures out of which Rs. 390.94 crore was in the shape of loans and only the remainder Rs. 10.09 crore as grants. However, the GoI has yet not agreed. It is worth mentioning here that the anti-erosion measures require a huge fund and without the Central Government's assistance it is not at all possible to execute any major anti-erosion work for an economically weak state like Assam.

National policies: Government of India adopted the National Water Policy in 1987, which was subsequently revised. It embodies the Nation's resolve that planning, development and management of water resources would be governed by national perspective. The National Water Policy however has to be backed by the State Water Policy with an operational action plan. One of the most intriguing facts is that flood management is a State subject. Flood control schemes are planned, funded and implemented by the state governments out of their own resources and as per their own priorities, whereas the role of the Central government is only to assist the states in terms of technical, catalytic and supportive aspects. Hence, the primary function of the Central government is to provide the financial and logistical support which is implemented through PM Relief Fund and the NCCF. Thus, the management of a flood disaster can be well-managed in an economically sound state like Tamil Nadu

whereas the managing of an equal or bigger similar event can weaken the economy of states like Bihar and Assam. The apex technical organisation in the country for the development of for development of water resources is the Central Water Commission (CWC), an attached office of the Ministry of Water Resources. Implementation of the National Water Policy is an important concern of the Commission. CWC's one of the most important functions regarding flood management is flood forecasting and warning systems and maintaining uninterrupted communication.

The year 1996 witnessed floods in the state of Assam that affected a population of 30.76 lakh, the number of deaths caused was 42 and there was a loss of 3000 livestock. About 27539 houses were damaged which were spread over 4797 villages. Hence from such studies, it is only natural to be doubtful about the effective implementation of such national policies and programmes.

The Disaster Management Act, 2005: The DM Act came into force in 2005 under the National Disaster Management Authority (NDMA) of which the Prime Minister of the country is the Chairperson. The bringing of this Act to the table indicated a major paradigm shift to the management of disasters in the country, in line with the global orders. Until recently, the focus was of management after a disaster on relief and rehabilitation. However, the present focus puts greater emphasis on mitigation and vulnerability reduction. The Government of India has adopted mitigation and prevention as essential components of its development strategy. Several programmes and projects are in existence to deal with different types of disasters, e.g., earthquake risk mitigation, a project for cyclone mitigation (estimated cost Rs 1,050 crore), disaster risk management programme (for 17 multi-hazard prone states with the assistance from UNDP, USAID and European Union).

Many countries across the world have disaster-related legislations including Japan, South Africa, New Zealand and Canada. Several Indian states have relief codes, like the state of Gujarat has a specific legislation known as the Gujarat State Disaster Management Act, 2003 which came into existence after parts of the state were ravaged by an earthquake in 2001. In the light of such legislations and also the UN Guiding Principles on Internal Displacement, few gaps seems to still exist in the Act after almost a decade of its enactment.

First and foremost, the definition of a 'disaster' as an event of substantial loss of life and property is a vague one in nature. There is no yardstick mentioned anywhere in the Act or by the NDMA about the criteria to define an event as a disaster. Under Section 13 it refers to 'disasters of severe magnitude' which is again left for the reader's faculty of deciphering. Secondly the Act refrains from zoning and mapping of 'disaster-prone'

areas which comes as a natural mandate of an Act of this nature. Zoning of disaster-prone areas especially flood, erosion and earthquakes will only aid in mitigating the disaster more effectively and also contribute to the preparedness of the localities situated in such zones. This classification is well-detailed in the Guajarat State DM Act. Like most other national acts and policies formulated including the recent ones of Food Security Bill and the National Action on Climate Change, there is no scope of engagement of those communities on which the Act shall be implemented, those who would have a better understanding of the local context. As Sarkar and Sarma (2006) note, one of the striking features under the Emergency Programme Act of British Columbia, Canada, is the importance of decision-making placed in the hands of the local authority. The local authority is empowered to declare local emergency, if it is satisfied that an emergency exists or appears imminent. The Gujarat Act makes the community, private sector enterprises and even the individuals duty-bound to assist the collector or the commissioner in countering disasters. More importantly as is noted further, another significant gap in the Act is the limited acknowledgement and use of traditional knowledge-system of the local communities. For instance, stilted houses made of locally available materials are used in many flood-prone areas of India. However, the emphasis appears more now on a western model of 'building codification' which stands redundant in a rural area here. In a similar context, Felding (2013) notes that the main approach of the Central Government and the Government Assam to address these risks are through the implementation of technologies to control the river (Brahmaputra).

Additionally, as per the Hyogo Framework for Action 2005-2015 of the United Nation's International Strategy for Disaster Reduction (ISDR), the third priority for action is use knowledge, innovation and education to build a culture of safety and resilience at all levels. Compilation and dissemination of relevant knowledge and information on hazards, vulnerabilities and capacities are an essential part of this action.

What is most alarming in the current context is the absence of mention of the issue of *displacement* (of any kind) arising due to disasters in the entire gamut of the aforementioned policies & programmes. Additionally, there is an urgent need to recognise and acknowledge the issue of displacement as one that is so integrally associated with most natural disasters, especially in a country like India. Riverbank erosion besides floods is a grave problem in Assam leading to displacement of people due to the disappearance of villages year after year. The total area that has eroded from 1954 till date is approximately 386476 ha which means that about 7 percent of the land in the state's 17 riverine districts has been lost due to river erosion in the last 50 years. Vulnerability to natural disasters combined with socio-economic vulnerability of the people living in the state pose a great challenge to the government machinery

and underscores the need for a comprehensive plan for disaster preparedness and mitigation. Assam, is in fact one of the most socio-economically vulnerable states of India with approximately 36 percent of the population living below poverty line (ASDMA, 2014). This only adds to the problem. [Cross-border displacement due to ethnic conflict in Assam: An influx of migrants from Assam's neighboring countries of Bangladesh, Nepal and Burma (Myanmar) has caused a massive population increase and subsequent competition for resources and jobs. This has also spurred ethnic conflicts over land and fighting for political autonomy or secession. Ethnic clashes over territorial issues, insurgency against the Indian government for separate homelands and communal violence among the Assamese against 'foreigners', mostly immigrants from Bangladesh, have led to widespread displacement. In November 2003, communal violence displaced at least 18,000 people who fled to about 40 camps in and outside Assam. Besides the Bangladeshis, the Nepali population in the Bodo Autonomous Council (BAC) areas constitutes 2.5 percent of the total population there. However, the presence of the Nepalis along with the 63 percent non-Bodos (Bodos make up 34 percent) constituted a major threat according to the Bodos. During the ethnic cleansing of these areas a considerable number of Nepalis was displaced].

Disasters-induced displacement

An overview of International Regulations

According to the UN Guiding Principles on Internal Displacement, an internally displaced person(s) or groups of persons are those who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result, in addition to others, due to natural or human-made disasters, and who have not crossed an internationally recognised State border. It categorically states that it is the primary responsibility of the state to prevent and avoid arbitrary displacement of its people. Ironically, the Act appears to have concentrated more on disaster management through government system rather than focusing on the fact that the affected communities also have a right to relief and rehabilitation as well as the right not to be displaced involuntarily. Therefore the case of displacement due to natural or man-made disasters can be contexualised well even in the Indian scenario as has been adapted by many other countries as well.

The Operational Guidelines on Human Rights and Natural Disasters has been adopted by the Inter-Agency Standing Committee in 2006 and revised in 2010; they apply to all disaster-affected persons, including displaced persons. The Hyogo Framework for Action 2005-2015, ISDR, UN framework promotes a strategic and systematic approach to reducing vulnerabilities and risks to hazards. It underscored the need for, and identified ways of, building the resilience of nations and communities to disasters. It

points out five major priorities for action that include (a) Governance: organisational, legal and policy frameworks; (b) Risk identification, assessment, monitoring and early warning; (c) Knowledge management and education; (d) Reducing underlying risk factors; (e) Preparedness for effective response and recovery.

The currently existing most important international document on climate change adaptation is the Cancun Adaptation Framework (Framework), part of the Cancun Agreement the main formal result of the 2010 UNFCCC COP16 in Mexico. The Framework argues that the final approach to climate change adaptation has to be "guided by the best available science and, as appropriate, traditional and indigenous knowledge" (Cancun Agreement 2010, paragraph 12). This is in a context of climate change according to the Cancun Agreement (2010, p. 2) being "felt most acutely by those segments of the population that are already vulnerable" emphasising among other geographical location, status as indigenous and gender as factors that determine vulnerability. The Framework calls for the first time in the history of climate change negotiations under UNFCCC for action taking into account measures "in regard to climate change induced displacement, migration and planned relocation, where appropriate, at the national, regional and international levels;" (Cancun Agreement, paragraph 14f) (Felding, 2013)

As noted by Klein (2011) existing human rights norms and the Guiding Principles on Internal Displacement provide sufficient protection for those forcibly displaced inside their own country. For Example, IDMC notes that many countries have yet to develop comprehensive legal frameworks or policies to guarantee IDPs' rights. Progress was made, however, in the Philippines, where congress enacted the Rights of Internally Displaced Persons Act in February 2013. In Afghanistan, the Ministry of Refugees and Repatriation initiated the development of a national policy on IDPs. The challenge is proper the implementation, not the lack of appropriate norms. The main challenge is to clarify or even develop the normative framework applicable to persons crossing internationally recognised state borders in the wake of sudden-onset disasters as a consequence of slow-onset disasters in the aftermath of the "sinking" of Small Island States. However, a close critical review of such literature reveals its nature which is essentially international and not contextual in the Indian scenario. In a country like India and more so in a state like Assam which is still an agro-based economy, for displaced people fleeting borders due to climate change-induced disasters is hardly heard of or recorded. Extremely limited financial and governmental resources, lack of well-functioning state agencies, high-level of corruption in this border state make migration plausible and possible only within the state or at the most within the boundary of the country.

The state of landlessness, lack of suitable livelihood opportunities and resulting nomadic-like state make the internally displaced people of Assam, least potential vote bank for those wishing to rise through power. With nearing elections, a few sheets of tarpaulin and blankets does it all to earn back their trust. Those are the invisible faces whose existence does not help in the cause of an economically globalising state and country. As was also reiterated through this researcher's study, *Rajib Lusan Pegu* (a Mishing person), the current Minister of State for Water Resources is serving his second term in office hailing from Majuli. As noted by one of the participants living in a PWD constructed road, "The wheels of his (R.L.Pegu's) speeding car make my whole house dusty almost twice a day at times. However, he has never found the time to step down from that same car and come looking for our needs except of course when he comes with folded hands and a bright smile on his face just before the elections".

Thus, for the erosion & flood displaced Mishing survivors of Assam, equality, justice and home, with the element of permanence is still a secluded dream.

Conclusion: The Exigent yet Achievable

Ameliorating the cross-cutting issue of marginalisation based on community/ language, economic and social backwardness and limited accessibility to constitutional and political rights forms a major part in the road to justice. Hence, effective implementation of any inclusive developmental activity still remains a distant dream for such refugees in their own land. Therefore, in a state where huge landmass gets eroded by bank erosion and flood water every year and there always exists a fight over territoriality of land, an urgent need arises to study the subject of Disaster Management while treating the northeast of India as a unique case study. Additionally, as Borgohain & Lahiri (2011) note, "the energy and speed with which the state (Assam) is implementing the massive hydroelectricity projects in the mountains surrounding the upper reach of the Brahmaputra valley is only seen in war-like situations. In comparison to that, even a bare minimum interest is not shown in understanding and addressing the problem of erosion and the consequences that come along with it."

Few pragmatic efforts that can be initiated are included below:

> Rigorous efforts need to be made by the state as well as non-state actors to explore, develop and implement programmes that make such displaced communities financially independent. Ideas about such adaptive livelihood measures and aptitude of the communities in question must also be taken into consideration.

At the policy-level, the Assam State Disaster Management Authority (ASDMA) in particular and NDMA through the Act need to make it conveniently compulsory to recognise and take action on displacement as a crucial element of disaster management. To begin with, both these authorities require to develop a broader perspective through the serious consideration of the UN Guiding Principles and implementation of actions on the suggested lines. Additionally, the Hyogo Framework is binding to all DRR activities executed in the country.

It is around time that the ASDMA shifts its focus beyond emergency relief and urban development and protection to the appropriate implementation of DRR and rehabilitation activities in rural Assam, which is the start and end points of the displaced people. A well-delegated coordination between the DM and relevant Department personnel shall add quality to all aspects of the service-provision, as is already a key focus of professionals working in the field.

Under the first priority for action, social and economic development practices like promoting food security in ensuring the resilience of communities to hazards; Endeavouring to ensure, as appropriate, that programmes for displaced persons do not increase risk and vulnerability to hazards; Promoting diversified income options for populations in high-risk areas to reduce their vulnerability to hazards, and ensure that their income and assets are not undermined by development policy and processes that increase their vulnerability to disasters need to be initiated.

All of the aforementioned efforts deem to be addressed with the realisation that for any such efforts, it is the survivors and the would-be-victims/survivors of such disasters that are at the receiving end. Therefore, taking their consent and traditional knowledge into consideration while engaging in such actions is but natural.

Through a closer look at India's The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, a greater need is sought for concerned actors, both at the governmental as well as non-governmental levels, to cohesively advocate the inclusion of such populations as aforementioned within the Act's ambit. Although the term Never mind the word 'displacement' skips the nascent Act in entirety, it is to be reiterated that these are the citizens of the country who lose their land due to the combined acts of various natural hazards, aggravated to attain the level of disasters through human-induced endeavours of industrialisation, development of essential infrastructural facilities and urbanisation as is mentioned in the said Act. Such be the case, it shall not be too late for the displaced people due

to natural disasters of Assam to be included under the Act. Assam and the entire Northeast India is a growing hub of numerous upcoming ambitious multi-purpose river valley projects besides other development-related activities, wherein the equilibrium of demand and supply are beyond any quantifiable measures of balance. The wait shall not last too long.

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The Trend of Chemical Disasters in India: Past Three Decades 1980-2010

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Abstract

The Study was an attempt to reveal the trend of chemical disasters in India for the past three decades (1980-2010). Retrospective and Preliminary Hazard Analysis (PHA), method was used to chart out the trend. The reported chemical disasters (RCD) from open access sources and websites were collated that enabled the study to know the trend in number of chemical disasters (CD) state, union territory and year-wise in India. RCD was chronologically identified ranked and termed as identified reported chemical disasters (IRCD). The types of CD was identified based on its origin, the hazardous chemicals (HAZCHEMS), natural and manmade origin was identified. It was clear that the trend of chemical disasters was varying for the time period; in year 1994 and 2003 the maximum number of CD was identified, Maharashtra state stood highest in CD and the RCD was 37. Crude oil, ammonia, chlorine, sulphur compounds are mostly reported HAZCHEMS. Oil spills, toxic gas leakage, explosion are the type of IRCD. Orissa super cyclone was only the natural calamity that triggered CD 99 percent of IRCD was manmade. Thus, this study reveals the status of CD that has occurred in India. The study will be beneficial to planners to plan better preparedness and mitigation strategies to mobilise resources, strengthen capacities for to cope up those chemical disasters not to occur again, lessons for to implement "Safety as Culture" in India's developmental policies and planning. Help government to draw more guidelines, policies and regulations for chemical safety during manufacture, storage, transport of HAZCHEMS, to bring new technologies to early warn these situations.

Keywords: *Trend, Retrospective Method, Chemical disaster, Reported Chemical Disasters (RCD), Hazardous Chemicals (HAZCHEMS), Safety.*

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Introduction

India at present is achieving new milestones to become developed nation. The economic breakthroughs are moving ahead for sustained industrial growth from agrarian base (Draft NCP, 2012). It has become crucial to attain progress in the chemical sector. The progress of chemical and industrial sector stands vital to mankind, by providing the basic needs that improve the quality of life (textile, paper, paint, soap, pharmaceutical, detergent and varnish, etc.). Chemical industries contribute 7 percent of GDP to India (Draft NCP, 2012).The growth of chemical sector has increased the use of chemicals that are hazardous or HAZCHEM (NDMG, 2009) used in manufacture, to store, to supply and to transport. Growth of MAH has enhanced the risk and posed threat to cause chemical accidents or chemical disasters (CDs). MAH facilities and industries constitute major threat to property, population and environment (Maruthappa, 2009). Instance of the accidents and the probability due to chemical disasters have now become a cause of concern (NDMGCD, 2007). To prevent accidents in future (*Wagenaar and* van der Schrier, 1997), it is essential to learn from previous accidents and incidents (Lindberg *et al*., 2010; Kletz, 2001).

Initiators of chemical disasters

There are innumerable causes that lead to major or minor chemical disasters (Maruthappa, 2009). Chemical accidents may originate in manufacturing and formulation installations including during commissioning and process operations; maintenance and (GSDMA-Gujarat State Disaster Management Authority) disposal, material handling and storage in manufacturing facilities, and isolated storages; warehouses and godowns including tank farms in ports & docks, fuel depots and transportation (road, rail, air, waterways and pipelines) (Tamil Nadu Fisheries University). Human errors trigger chemical accidents that lead to chemical disasters. Main human errors occur due to neglect of safety instructions, lack of information and lack of emergency warning procedures. Technical errors: the defects in design systems, fatigue, metal failure and corrosion etc. Organisational errors are caused by weak crisis planning, co-ordination and non-delivery of mock drills at regular time intervals. Terrorist attacks/sabotage, chemical disasters, and warfare activities further vandalise HAZCHEM facilities like transportation vehicles (NDMGCD, 2007).

Types of chemical accident/disaster

No two accidents are exactly the same; similarly each disaster is unique. Important types of chemical accidents or disaster are: explosion in a plant or in a storage facility, fire, toxic releases and chemical poisoning.

Impacts

The impacts of chemical disaster depend upon HAZCHEMS involved, quantity stored, used, released. Impacts depend upon the nature of chemical (Figure 1) and its dispersion to the abiotic and biotic factors.

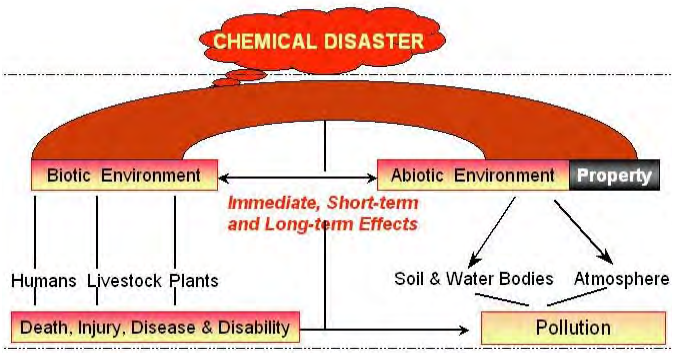

Figure 1: Impact of Chemicals. Adapted from: Gupta & Nair, 2012; Training Module Chemical (Industrial) Disaster Management, NIDM, GOI, Ministry of Home Affairs

Methodology

To analyse chemical disasters *Retrospective* method was used, that allows better understanding of historical records and enables to foresee hazardous situations (Silano, 2006). The study of past accidents, their course effects, and circumstances in which they occurred stands a basic key for identifying hazard situations. Retrospective method facilitates the definition that implies to implement preventive measures and emergency response measures for chemical disasters (Silano, 2006) not to happen again. Trend analysis is *sine qua non* for the development of vulnerability assessment methodologies for formulating policy scenarios and rationalising decision-making for proactive disaster preparedness. It is the practice of collecting information and attempting to spot a pattern, or trend. Although trend analysis is often used to predict future events, it could be used to estimate uncertain events in the past (Yoganath et al., 2009). The retrospective method was used to collect the information of past accidents and incidents pertaining to CD and trend analysis used to know the situation of CD during the period. Preliminary Hazard Analysis (PHA) method was used to structure the chemical and industrial accidents data in chronological order.

Analysis

A detailed review literature on CD was collected from open access sources and search engines (websites - government & nongovernmental portals) that reported

CD Incidents/Accidents) having occurred in India for the time period. Based on the available electronic documents (portable document files, document files and html, etc.), data was obtained mainly from studies conducted by Surianarayanan & Swaminathan; Maruthappa, 2009; Blue Waters 2010, 2009; National Disaster Management guideline for Chemical Disasters, 2007 documented by and ranking the chemical disasters in chronological order state wise and year wise.

The data on Reported Chemical Disaster (RCD) were classed and arranged in MS-Excel 2007. Thus, the RCD was identified and documented according to name of the state, date, month, year, location of accident, natural or manmade cause, type of accident (explosion, release, leakage), name of chemical material involved, physical state of material, material storage, quantity, reported deaths, injury, exposed, number of persons evacuated. Thus, the trend was analysed by using MS-Excel to obtain the result.

Results and Discussion

Learning from accidents helps integrate knowledge and experience and also identify the need of future research (Lindberg *et al.,* 2010). There are different methods to analyse accident (Wagenaar and van der Schrier 1997). The present study is based on bibliographical investigation of chemical disasters that occurred in India during 1980 to 2010, based on available literature.

The Reported chemical disasters were identified from various web sources and documented in MS-Excel data sheets as 'Identified Reported Chemical Disasters (IRCD)'. A total of 140 IRCD (major and minor) in 18 States, 1 Union Territory and 1 National Capital Territory (Delhi) during the period were identified (Table 1). The 18 states reported 118 incidents, 2 union territories reported 22 incidents.

Table 1: Chemical Disasters in India for Past Three Decades 1980-2010

Total Numbers Reported		**Total Identified Reported Chemical Disasters (IRCDs)**
States	18	118
National Capital Territory (Delhi) & Union Territory	1+1=2	22
Total		140

Similar historical studies were conducted by Purohit and Suthar (2012) for all types of disasters during past two decades (1990-2009). Maruthappa (2009) studied major chemical disasters in India. Surianarayanan and Swaminathan also studied 100 case histories of accidents in Indian chemical Industry (1988-2000) and developed

BLAZE database to document chemical industry accidents. Courtesy to Joseph, et. al. (2004); Janak, et. al. (2007); Jayachandran (2011); Bhawana and Fulekar (2011); Jyoti and Suthar (2012) are solicited. The articles delivered the status and perspective of chemical disasters management and their data served as the source of information for CD study.

Similarly, study by Dev and Bhattacharya (2012) documented case histories of chemical industrial accidents and disasters. Amongst the total 140 IRCDs documented in Ms-Excel database, only few important are listed below (Table 2); these are based on life lost.

Table 2: Important IRCDs based on life lost

1.	Mandir Asod plant explosion on 3rd May 1980: a fire explosion was reported, plant was storing explosives, around 50 people died in the Fire explosion.
2.	In Assam Dhulabar in 1983 in a plant fire broke out from cylinder of crude oil stored; 76 died, 60 injured.
3.	Toxic gas release (Methylisocynate) Bhopal 1984, on 2nd and 3rd December, Union Carbide plant in Bhopal; about 25-27 tons of the deadly methyl isocyanate gas spread. About 2500 persons died, half a million people were exposed to the gas.
4	Oleum gas tragedy Delhi on 4th to 6th December 1985 was reported at the Shriam Foods Ltd.; more than 150 deaths and 130 injuries, incident lasted for two days.
5.	SEDCO West Coast 1989: Indian Coast- 3 lost in a fire blow out.
6.	Gas Leakage: Transport accident at Patna on 16th April 1990; gas leaked from a transport vessel leaked 100 death and 100 injuries were reported.
7.	Release of metal fumes in Delhi 1994 metal fumes was released and 14 Death was reported 12 persons were exposed to the fumes and caused respiratory arrest.
8.	Fire At Delhi 1998 in Fire was caught to plastic and toxic cloud of fumes was released into the atmosphere. 6 reported death to the incident and the injured are inaccessible
9.	Digboi Assam in 7th March 2003, refinery had broke out with fire from a tank stored motor sprit (liquid), 11 death, 112 injured and exposed.
10.	Mumbai Maharashtra on 14th July 2010 at Mumbai port trust (650 kg cylinder) chlorine leaked 120 people injured and evacuated

Akhil Adapted from Dev & Bhattacharya, 2012 (Academic Thesis)

Trend of IRCD, state & union territory wise

The states that reported chemical disasters were Andhra Pradesh, Assam, Bihar, Goa, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. Maharashtra state stood first

to report maximum number of major and minor IRCD (37 incidents reported) during past 30 years (Figure 2). The reason for maximum number of IRCD in Maharashtra was due to its high industrial growth. The state contains 38150 registered factories, 31100 working factories, 3200 chemical factories, 336 MAH units (Figure 3) as the statistics shown by Disaster Management Institute in Bhopal. The presence of major industrialised cities, Mumbai, Pune and Thanae bears chemical factories and MAH. The cities of Maharashtra are densely populated with people. So, the impacts and vulnerabilities to chemical disasters are high to the region. Delhi, the National capital city of India which stood second in IRCD (20 number of incidents reported in 30 years). The region contains 15 MAH units (Saxena, 1998) it might be the cause for increased number of incidents. Though Gujarat has 260 MAH units (Saxena, 1998) it stands third in IRCD (14 number of incidents), probably safe measures for handling HAZCHEMS was practiced in chemical facilities of Gujarat. Tamil Nadu stood fourth (11 number of incidents), Andhra Pradesh fifth (10 number of incidents) in IRCD. Rest of the states has shown considerably low in IRCD (1-7 in number of incidents) to 30 years time period. The states that did not report the chemical disasters are Arunachal Pradesh, Chhattisgarh, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Uttar Pradesh, Sikkim and Tripura. Among 7 the union territories in India, Delhi and Andaman Nicobar (2 number of incidents) has IRCD.

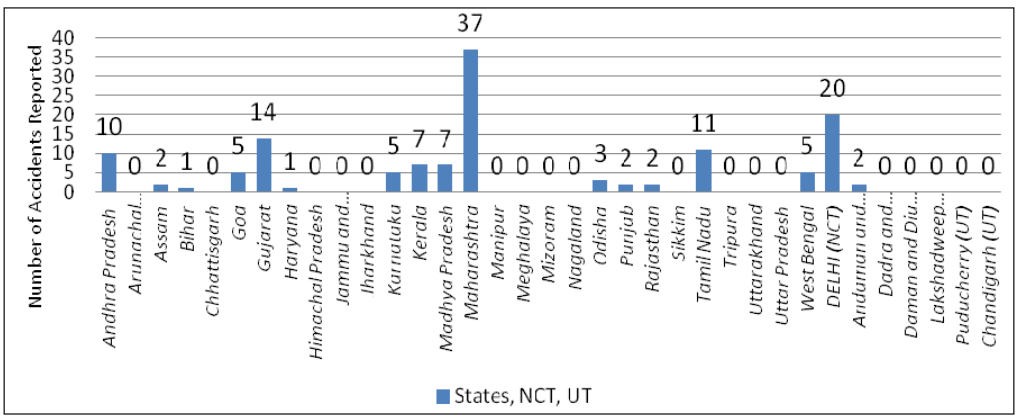

Figure 2: Identified Reported Chemical Disasters in India 1980-2010

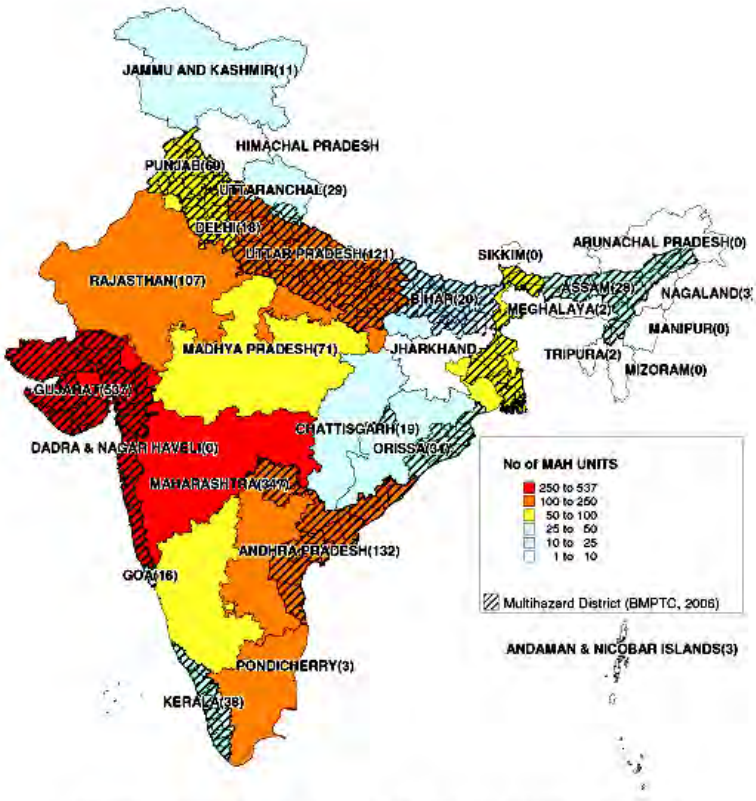

Figure 3: Major Accident Hazard Units in India (Gupta & Nair, 2012)

Trend of IRCD year wise (1980-2010)

The trend of chemical disasters for past 30 years (1980-2010) in India revealed considerable variations with passage of years (Figure 4). In the year 1980 the IRCD were considerably less, only 1 incident was reported in Mandir Asod plant, on 3rd May an explosion was the first incident reported from the study. The highest number of IRCD (10 incidents) was reported in the years 1994 and 2003 (Figure 4). Second highest IRCD (9 incidents) was in 1993 while the third highest IRCD (8 incidents) in 1989 and 1993. The fourth highest was in the year 1992, 1997 and 2004 with a total of 7 IRCD. In fifth, during 1985, 1991, 1995, 1996 and 2006 years 5 number of incidents were reported. The year no IRCD were 1981 and 2008 (the reason was unknown). The IRCD of remaining years were in the range, 1 to 4 incidents.

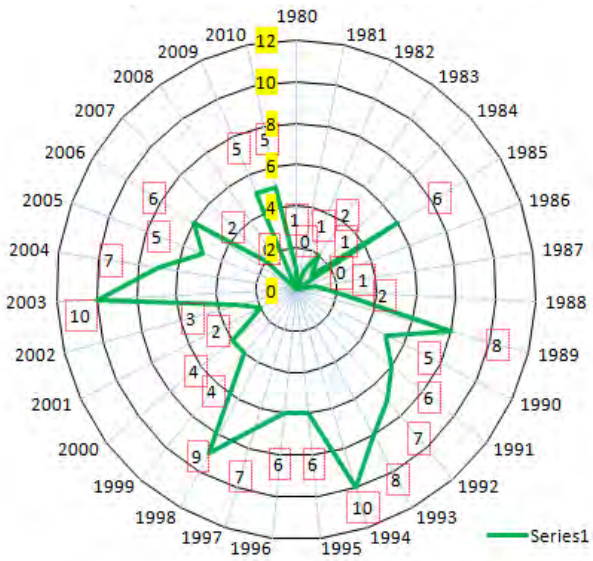

Figure 4: Year wise Trend of Identified Reported Chemical Disaster (IRCD) in India, 1980-2010

Decade wise trend of IRCD

The linear forecast trend line from past three decade revealed (Figure 5) an increasing trend for CDs and polynomial trend line revealed decreasing trend. The linear forecasting trend was not satisfactory because chemical disasters are unpredictable, there might not be any increasing trend unless the Hazard probabilities of HAZCHEM facilities are known.

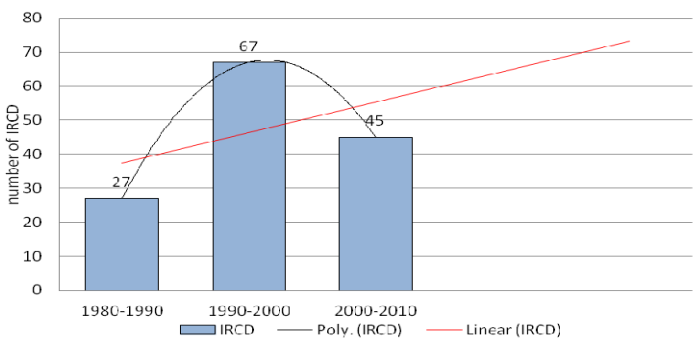

Figure 5: Decade wise Trend of IRCD in India, 1980-2010

The polynomial trend based upon the available IRCD was found to be true and India's status in CDs for the first decade was less (22 IRCD) when compared with second and third. In the second decade (1990-2000) it has tremendously increased to 67 IRCD and in third (2000 to 2010) decade CD was decreased to 45 IRCD when compared to the second decade (Figure 5). The period 1980 to 1990 India was on verge of industrialisation and development. Industrialisation was continued to metropolitan cities and few states only. There was less production and handling of HAZCHEMS and facilities or installations. During 1990s India's economic growth was mainly due to the industrial sector, more number of chemical factories and industries emerged. The reason to increase CDs tremendously during 1990-2000, the second decade was due to the lack of awareness among the manpower to use the sophisticated technologies in the facilities leading to human errors. The scenario of chemical disasters has changed from the Bhopal gas tragedy during 1984. For the effective safety measures, laws and regulations formulation, implementation with regard to chemical safety and management of chemical and industrial accidents Indian government put forth an umbrella act 'Environmental Protection Act in 1986 (EPA,1986)'. It provided a wholesome cover for all environmental issues rules, regulations and guidelines laid from for hazardous chemicals, hazardous waste, and emergency preparedness and planning (Gupta & Nair, 2012). The holistic act that covers all types of disasters was enacted by India government as Disaster Management Act, 2005' that might be the cause of decrease in number of incidents in the third decade. It can be presumed that a chemical safety culture came into being by embracing appropriate production, storage and transportation facilities with utmost care for safety as reflected in the decreasing number of IRCD (Figure 5).

Types of IRCD

Figure 6 shows the types of identified chemical disasters reported during 1980-2010. There are 10 types of chemical disasters that were identified. They are fire, explosion, fire and explosion, leakage, release, oil spills, transport accidents, toxic release by leakage, food poisoning and unknown types. Oil spills were mostly reported (68 number) during the period, which might have been due to unsafe transportation mechanisms and improper handling of the crude oil in the facilities or in the container vessels during shipping, loading/unloading the vessels. Oil spill causes great disruption and damage to the aquatic and marine life and ultimately causes economic loss. The spills of crude oil, diesel, petrol, etc. were reported. Toxic chemical release stands second, 17 number of toxic release or leakage were reported. Fire, another type of chemical disaster that stands third, a total of 15 incidents was reported due to fire. The number of explosions occurred were 11. Four number of incidents were found to be of unknown origin.

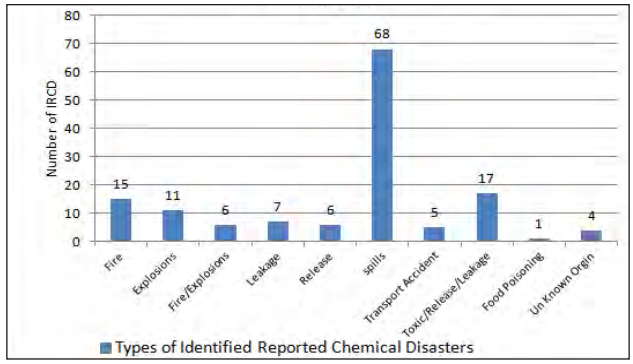

Figure 6: Types of IRCD in India 1980-2010

The reported increase in oil spills can be probably attributed to the open access. This was brought to limelight by the Indian Coast Guard through their newsletter. Other types of CDs could have been increased to the time period due to the study limit on availability of CD from open access, though the reliability to types of chemical disasters can vary.

Trend of HAZ-CHEMS and their physical state

A total of 140 IRCD with 38 types of hazardous chemicals (HAZ-CHEMs) were identified. The HAZ-CHEMs identified (Figure 7) and are Ammonia, Benzene, Chlorine, Crude Oil, Diesel oil, Ethane, Explosives (Fire work), Fuel oil, Furnace fuel oil (FFO), Gas, Gasoline, Hexacyclo-pentadiene, Hexane, LPG, Metal Fumes, Methylisocyanate, Motor Spirit, Naphtha, Nitrocellose, Oleum gas, Petroleum, Petrol, Propane, Plastic (Polythene), PVC Coating, Sodium Hydride, spillage of HAZ CHEM, Sulphios, sulphur, Sulphur Dioxide, Sulphuric Acid, Superior Kerosene oil, Tanker Wash, Toluene, Toxic Gas and Tri-chloro Ethylene.

Among HAZ-CHEMs identified, crude oil was mostly reported, the reason for abundance of crude oil was due to the increased number of oil spills reported (Figure 6) by Indian Coast Guard; 40 number of incidents were reported due to crude oil spills. Fuel oil accounts for about 18 number of HAZCHEMs incidents CD. Chlorine and Ammonia stand the third HAZCHEM that reported 8 number of CDs for past 30 years.

Depending upon the chemical property and quantities, the vulnerability and consequences posed by HAZCHEMS vary. Ammonia and chlorine are environmental hazards as also respiratory irritants to humans and animals, with potential to pollute atmosphere and environment. The disasters posed by these types of HAZCHEMS the impacts are harsh.

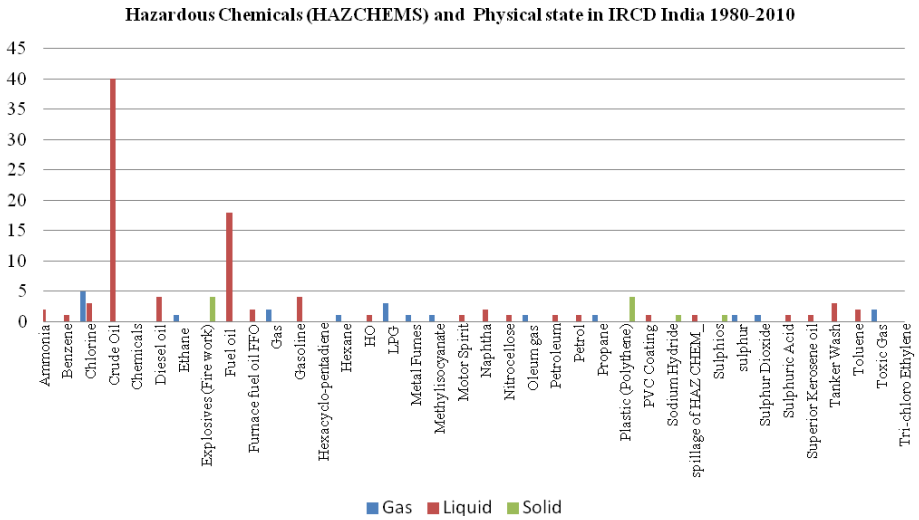

Figure 7: Hazardous Chemicals and Physical State (IRCD) in India 1980-2010

Trend of Natural and Manmade IRCD

The Orissa super cyclone was the only natural disaster that has lead to cause chemical disaster (Figure 8). In the year 1999 at Paradeep where Ammonia gas leaked from a cylinder in M/s Oswal Chemical and Fertilizers Limited, it was the only IRCD. No death on injury was reported.

The analysis revealed that majority of CD was caused by manmade source. From the past 30 years 99 percent of the IRCD were manmade. The human errors posed much of the CDs, the reasons for CD was not unveiled to the lack of information. Shear negligence and lack of awareness by the man power might be the reason. Gordon et al., 2005 have attributed the human factors responsible for accident in off shore oil and gas Industry in UK. Many studies carried out to find the cause of accidents have endorsed human errors as main factor.

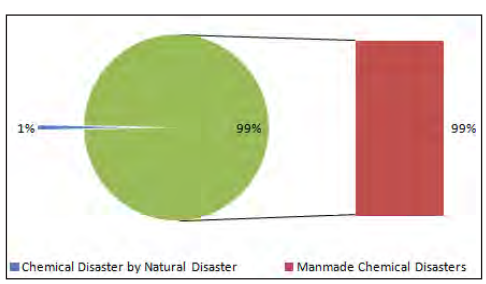

Figure 8: Natural and Manmade IRCD in India 1980-2010

Conclusion

The trend of chemical disaster in India for past three decades (30 year, 1980 to 2010) was pioneer study in India that shows the trends of IRCD like, state & union territory wise, year wise, decade wise, hazardous chemical and their physical state wise, cause of chemical disasters by natural or manmade wise. The different types of IRCD were analysed. The outcome of the study will be beneficial for the government and non-government bodies, corporate companies, chemical industries, hazmat industries, educational institutions etc. to know the current status of chemical and industrial disasters that have occurred in India. The prospective beneficiaries can plan better preparedness methods for mobilising resources, to strengthen capacities to cope chemical disasters not to occur again and to impart "Safety as Culture" in India.

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Indices for Drought Hazard mapping, Monitoring and Risk Assessment: Analysis of Existing Tools, Techniques and Approaches

– Sreeja S. Nair[1], M.S. Nathawat[2] and Anil K. Gupta[3]

Abstract

Drought has always been cited as a scourge to mankind since biblical time and is still remaining as an unconquered ill. Drought means differently to different sections of the society and there is no common definition for drought. Drought Indices are used for mapping, monitory and risk assessment globally and their potential is well established. Different indices are used for drought assessments depending on the typology i.e. meteorological, hydrological and agricultural drought. Review of various methods shows that researchers and practitioners use combination of different indices to understand the impact of meteorological phenomena (i.e. low rainfall) on hydrological and agricultural systems. Socio economic impact of drought has also been mapped using indices developed based on mortality, number of persons affected, economic losses and other development indicators. Review of the existing tools, techniques and methods depicts that none of the indices are inherently superior or inferior to others. Selection of the indices shall be based on the purpose of the study, data availability and feasibility. Combination of indices gives better results in the case of drought due to the complexity of the phenomena.

Keywords: *Drought Indices, meteorological drought, hydrological drought, agricultural drought.*

Introduction

Since dawn of civilisation, drought has ever been viewed as a scourge to mankind and still remains a daunting challenge. Drought is an insidious hazard of nature and it ranks first among natural disasters throughout the world in terms of the number of persons directly affected (Hagman, 1984; Hewitt, 1997). Drought has different meaning to different sections of the society and there is no universal definition of drought. In lay

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terms, drought means shortage of moisture in the root zone for crops for a farmer, below average water levels in streams, reservoirs, ground water etc. for a hydrologists and water shortage which adversely affects the economy for an economist (Palmer, 1965). Drought has been defined by the international meteorological community as a "prolonged absence or marked deficiency of precipitation," a "deficiency of precipitation that results in water shortage for some activity or for some group" or a "period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance" (World Meteorological Organization 1992; American Meteorological Society 1997). Drought differs from other natural hazards in several ways. It is a slow-onset natural hazard (Gillette, 1950). Droughts fall into four types i.e. meteorological, hydrological, agricultural and socio-economic (Palmer, 1965). An occurrence of drought is often triggered by deficiency in precipitation called as 'meteorological drought' (Wilhite and Glantz, 1985, 2005). It is considered as 'hydrological drought' when precipitation shortage affects the surface and ground water resources either due to precipitation shortage for a longer period (one to two years) or due to loss of storage or overexploitation (Meigh et al., 1999).

It is important that a drought by itself is not a disaster; the hazard or meteorological phenomena becomes a disaster by causing impacts on environmental and socio-economic systems. Therefore, the key vulnerabilities are embedded in the environmental and social dimensions. Socio-economic drought is rather the consequence of differential impact of drought on different groups within the population, depending on their access or entitlement to particular resources, such as land, and/or their access or entitlement to relief (Wilhite, 2005). Drought indices provide accurate results for identifying drought intensity, frequency, severity and spatial extent for monitoring and management studies. This helps in early drought detection and preparedness. This paper presents an analysis of various drought indices used globally with advantages and limitations. Besides this the paper gives an overview of vulnerability assessment methods specific to drought.

Indices for Hazard Mapping, Monitoring and Risk Assessment

Drought indices integrate data on rainfall, stream flow, water supply, vegetation indicators to present a brief picture of drought scenario. A drought index value has been found more useful than raw data for decision making, as it allows comparisons on temporal and spatial scales helping planners to prioritise and communicate information to diverse users (Wilhite, 2000). There are several studies on use of drought indices for monitoring drought situation and understanding the impacts of different type of droughts i.e., meteorological, hydrological and agricultural drought.

Although none of the 'major' drought indices for assessing meteorological drought is inherently superior or inferior to the other, these indices broadly help in depicting departure in precipitation during a given period of time from historically established norms. Some most commonly used drought indices are 'Percent of Normal', 'Standardised Precipitation Index', 'Palmer Drought Severity', 'Crop Moisture Index,' 'Surface Water Supply Index', 'Reclamation Drought Index' and Deciles. The first comprehensive drought index developed in the United States by Palmer, in 1965 called Palmer Drought Severity Index. The key limitation of this index is that Palmer values may lag emerging droughts by several months and less suited for mountainous land or areas of frequent climatic extremes. The index is complex and has an unspecified, built-in time scale that can be misleading (Hayes, 2000).

Standard Precipitation Index (SPI), developed by McKee et al. in 1993 for deriving index bases on precipitation is based on the probability of precipitation for any time scale. The SPI calculation for any location is based on the long-term precipitation record for a desired period. This long-term record is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SPI for the location and desired period is zero (Edwards and McKee, 1997). Positive SPI values indicate greater than median precipitation, while negative values indicate less than median precipitation. Because SPI is normalised, wetter and drier climates can be represented in the same way, and wet periods can also be monitored using the SPI developed by McKee, et al. which can be computed for different time scales, and can provide early warning of drought and help assess drought severity, and is less complex than the Palmer values (Heim, 2002; Hayes, 2000). SPI can be computed for multiple time scales shorter for example 1-, 2- or 3-month, for early warning of drought and help assessing drought severity. Its spatial consistency makes the index suitable for comparisons between different locations in different climates and its probabilistic nature gives it historical context, which is well suited for decision-making. Although versatile, SPI is practically and numerically difficult to use if there are many grid points of many stations. It is based only on precipitation and thus, ratio of evapotranspiration potential is not taken into consideration.

Willeke et al. (1994) developed 'Percent by Normal' method for meteorological drought analysis. It is calculated by dividing actual precipitation by normal precipitation (typically considered to be a 30 year mean) and multiplying by 100 percent. This can be calculated for a variety of time scales. This method is quiet effective for comparing a single region or season. Major limitation of Percent by Normal precipitation is that the mean or average precipitation is often not the same as the median precipitation, which is the value exceeded by 50 percent of the precipitation occurrences in a long-term climate record. Precipitation on monthly or seasonal scales does not have a normal

distribution. Use of the percent of normal comparison implies a normal distribution where the mean and median are considered to be the same. Precipitation records over time and location, varies considerably and there is no way to determine the frequency of the departures from normal or compare for different locations. It is difficult to establish link between the departure from normal and the impact due to the departure at a particular location using this index, and hence mitigating the risks of drought based on the departure from normal and form a plan of response (Willeke et al., 1994).

Gibbs & Maher (1967) used deciles of precipitation for assessing meteorological drought which provides an accurate statistical measurement of precipitation. Major limitation for using DI is that accurate calculations require a long rainfall data record. Drought monitoring has been using seven meteorological indices viz. Deciles Index (DI), Percent of Normal (PN), Standard Precipitation Index (SPI), China-Z Index (CZI), modified CZI (MCZI), Z-Score and Effective Drought Index (EDI) by Morid et al. (2006).

SWSI developed by Shafer and Dezman (1982), represents water supply conditions unique to each basin. Changing a data collection station requires that new algorithms be calculated, and the index is unique to each basin, which limits inter-basin comparisons. Groundwater Resource Index (GRI) can be used as a reliable tool useful in a multi-analysis approach for monitoring and forecasting drought conditions in Mediterranean climate (Mendicino et al., 2008). The Global Water System Project (GWSP) examines global water assessment indicators with links to poverty and food security, such as the Water Wealth Index (WWI) (Sullivan et al., 2006). The Water Wealth Index has five major components, viz., (i) agricultural productivity (ii) institutional capacity (iii) food security (iv) environment and (v) human health, which provides for scientifically-based, defendable process of aid prioritization as decision support for allocation of water-related aid.

Standardised Water-Level Index (SWI) developed based on mean seasonal water levels of 20 years (1984-2003) has been used to assess ground-water recharge deficit in Aravalli Region by Bhuiyan et al. (2006). SWI values of the wells were interpolated using spline interpolation technique in a GIS environment to generate SWI maps of the region. Vegetation drought indices like Vegetation Condition Index (VCI), Temperature Condition Index (TCI) and Vegetation Health Index (VHI) have been computed using NDVI values obtained from Global Vegetation Index (GVI) and thermal channel data of NOAA AVHRR satellite. The study revealed that negative SPI anomalies do not always correspond to drought and vice versa. SWI and VHI, however, represent the negative impact of adverse meteorological and hydrological conditions on water and vegetation respectively and hence presents better picture of drought than SPI for decision making. Similar results were found in a study on drought hazard and vulnerability mapping using SPI, VCI and SWI for Bundelkhand region, where drought events are more consistent with SWI and VCI values and not corresponding to lower value of SPI (Singh

et al., 2013; Nair et al., 2013).

Mpelasoka et al. (2007) carried out a study based on comparison of two indices viz. rainfall deciles and Soil Water Moisture Index, to assess future drought events over Australia under global warming attributed to low and high greenhouse gas emission scenarios for 30-year period centred on 2030 and 2070). The results of the study based on both the indices are consistent with the drought events observed in Australia during 1970-2004. However comparison of the indices with projected drought scenarios shows that Soil-Moisture Deciles-based Drought Index is more relevant for resource management planning since it accounts for 'memory' of water status and meteorological drought indices alone are inadequate for reliable assessment of drought.

Remote sensing data and GIS technology has been used for mapping, monitoring, forecasting agricultural drought by space agencies, and other technical and scientific organisations worldwide. Tucker (1979), suggested Normalised Difference Vegetation Index (NDVI) as an index for monitoring vegetation vigor. Vegetation Condition Index (VCI) was used to understand the relative NDVI change, with respect to minimum historical NDVI value by Kogan (1995).

Hydrometeorological and Vegetation Indices for developing integrated systems for drought monitoring and assessment of water resources for Tuscany region of Italy have been carried out by Caparrini & Manzella (2009). Cross-evaluation of the SPI, Vegetation Indices from remote sensing (from MODIS and SEVIRIMSG), and outputs from the distributed hydrological model MOBIDIC, was used in real-time for water balance evaluation and hydrological forecast in the major basins of Tuscany.

Drought Risk and Vulnerability Analysis for Bundelkhand region of India using six indices has been carried out by Singh et al. (2013) and Nair et al. (2013). A range of indices for drought monitoring has been applied to analyse the nature of the drought and calculate the frequency and intensity of hydrological, meteorological, agricultural drought and composite drought risk. Percent by Normal, deciles of precipitation and SPI for meteorological drought, Standard Water Level Index (SWI) for Hydrological Drought, NDVI and VCI for agricultural drought were derived at district level. The response of the environmental system (i.e., in terms of hydrological and agricultural system) to meteorological drought has also been analysed using SWI, and VCI. The study helped in revealing the interrelationship between different drought types i.e., meteorological, hydrological and agricultural drought at district level for all the 13 districts of the region. Drought declaration incidences (by states) were consistent with periods of hydrological drought and agricultural drought and not actually with the hazard severity (i.e., metrological drought). This is evident from the example of Lalitpur district (in Madhya Pradesh) where extreme meteorological drought was reported during 2009 but there was no drought declaration.

Sadeghipour & Dracup (2007) analysed the regional frequency of multi-year hydrologic drought based on three parameters, viz. magnitude, severity and duration. A multivariate simulation model is used to estimate exceedance probabilities associated with regional drought maxima, taking advantage of random variations of droughts in both time and space. Regional extreme drought method developed is capable of generating a series of drought events which have not occurred historically, and are more severe than historic events.

Conceptual Framework, Tools, Techniques and Approaches for Vulnerability Assessment

Vulnerability is defined by various researchers as set of conditions, a measure of the resistance, and resilience against the impact of hazards or stresses (Baikie, 1994; Cutter, 1996; Wisner et .al, 2003; Adger, 2006). Cutter et al. (2003) developed a Social Vulnerability Index (SVI) based on 30 socio-economic variables, which contribute to reduction in a community's ability to prepare for, respond to, and recover from disasters for entire United States at county level. South Pacific Applied Geosciences Commission (SOPAC), the United Nations Environment Programme (UNEP) and partner institutions developed Environmental Vulnerability Index (EVI) to analyse the environmental vulnerabilities of Small Island Groups (Pratt et al., 2004). The EVI was one of the earliest efforts and examines vulnerability to environmental change and the index has been developed using 50 biophysical or natural environment (50 indicators) grouped into three sub-indices (hazards, 'resistance', damage), which excludes the human systems (Kaly et al., 2004). The EVI concept of vulnerability has been elaborated with environmental inputs as 'Environmental Entitlements' by Leach et al. (1999) similar to the Sen's entitlement framework (1982) and up-scaled from household sustenance to livelihood system level. 'Agricultural Water Crowding' was developed for analysis and mapping of vulnerability factor for water stress in terms of number of people sharing water (Sullivan et al., 2006).

Global mapping of drought patterns and impacts taking into account the meteorological and hydrological drought and social vulnerability was carried out by International Water Management Institute (Eriyagama et al., 2009). Drought Risk Index (DRI) developed by Zongxue et al. (1998) is an integrated drought risk index that combines precipitation, river discharge, reliability, resilience and vulnerability.

A methodology for assessing and mapping the composite vulnerability of agriculture to climate variability in the Indo Gangetic plains was demonstrated by Sehgal et al. (2013). Vulnerability of agriculture has been determined using three core components viz. hazard, sensitivity to climate change and adaptive capacity considering climatic and socio-economic factors and Agriculture Climate Vulnerability Index has been

derived at district level for Indo-Gangetic plain covering five states of India.

Table 1: List of Indices used for drought hazard and vulnerability assessments

S. No.	Index	Advantages	Disadvantages	Developed by
1.	Palmer Drought Severity Index (PSDI)	The first comprehensive drought index developed in the United States	Palmer values may lag emerging droughts by several months; less well-suited for mountainous land or areas of frequent climatic extremes; complex, has an unspecified, built-in time scale that can be misleading	Palmer, 1965
2.	Percent by Normal	Quite effective for comparing a single region or season	Easily misunderstood, Can't be used for different regions	Willeke et al., 1994
3.	Decile of Precipitation	Provides an accurate statistical measurement of precipitation	Accurate calculations require a long climatic data record	Gibbs & Maher, 1967
4.	Crop Moisture Index (CMI)	Designed to monitor short-term moisture conditions	The CMI's rapid response to changing short-term conditions may provide misleading information about long-term conditions	Palmer, 1968

S. No.	Index	Advantages	Disadvantages	Developed by
5.	Standard Precipitation Index (SPI)	SPI can be computed for different time scales, can provide early warning of drought and help assess drought severity, and is less complex than PSDI	Values based on preliminary data may change	McKee, et al., Colorado State University, 1993
6.	The Surface Water Supply Index (SWSI)	Represents water supply conditions unique to each basin	Changing a data collection station or water management requires that new algorithms be calculated, and the index is unique to each basin, which limits inter basin comparisons	Shafer and Dezman, 1982
7.	Reclamation Drought Index (RDI)	RDI is calculated at a river basin level; it incorporates the supply components of precipitation, snowpack, streamflow, and reservoir levels	Index is unique to each basin, which limits inter basin comparisons	The Bureau of Reclamation
8.	Water Wealth Index (WWI)	Considers multiple indicators; useful in prioritising policy and management responses to the crisis facing freshwater resources	Complex and based on 18 indicators under 5 categories.	Sullivan et al., 2006

S. No.	Index	Advantages	Disadvantages	Developed by
9.	Standard Water Level Index (SWI)	Simple and easy to calculate since it is based on single type of data set and is useful in assessing areas of ground water deficit		Bhuiyan et al., 2006
10.	Normalised Difference Vegetation Index (NDVI)	Simplicity of the algorithm and its capacity to broadly distinguish vegetated areas from other surface types, the NDVI also has the advantage of compressing the size of the data to be manipulated by a factor 2 (or more), since it replaces the two spectral bands by a single new field; most successful in quickly identifying vegetated areas and their condition	NDVI is sensitive to a number of perturbing atmospheric factors. Over use of NDVI without ground checks for monitoring agricultural drought	Tucker, 1989
11.	Vegetation condition Index (VCI)	Useful for comparing the NDVI value of the year with long term mean	Derived from NDVI and hence beset with similar limitations	Kogan, 1995

S. No.	Index	Advantages	Disadvantages	Developed by
12.	Storage Capacity Index (SCI)	Capture adequacy of storage water capacity; storage capacity assessed in proportion to total renewable fresh water resources (surface and ground water)	Challenges in quantifying total renewable fresh water resources (surface and ground water)	Wilhite, 2005
13.	Storage Drought Duration Length Index (SLI)	Assessing the storage capacity in proportion to monthly water needs at country level	Based on monthly surface water withdrawals, ground water not taken into consideration	Used by Eriyagama et al. (2009)
14.	Socioeconomic Drought Vulnerability Index (SDVI)	Considering both physical and socio-economic factors	Complexity due to the integration of 3 other incidences: Employment Diversity Index, Income Diversity Index and Crop Range Index	Used by Eriyagama et al. (2009)
15.	Environmental Vulnerability Atlas (EVI)	EVI developed based on 50 biophysical indicators; rapid and standardised method for characterising vulnerability in an comprehensive way	Excludes the human systems; developed for Small Island Groups	South Pacific Applied Geoscience Commission (SOPAC), the United Nations Environment Programme (UNEP), 2005
16.	Drought Risk Index (DRI) is an integrated drought risk index	Combines precipitation, river discharge, reliability, resilience and vulnerability	Vulnerability based on the maximum drought intensity not socioecomic vulnerability	Zongxue et al., 1998

S. No.	Index	Advantages	Disadvantages	Developed by
17.	Agriculture Climate Vulnerability Index (Composite and Normalised Vulnerability Index)	Considered climatic, environmental, physical and socio economic factors; based on past data (and not climate projections)	Agriculture-focused although covering other socio economic and physical factors	Sehgal et al.(2013)
18.	Disaster Risk Index (4 natural disasters viz. earthquake, tropical cyclones, floods and drought	One of the first efforts towards DRI; based on past disaster data and simple index derived based on mortality and number of persons exposed	Only based on Mortality; other risks are not covered; huge gaps in historic data on disaster particularly the people died or indirectly affected by drought	Bureau of Crisis Prevention and Recovery, BCPR, UNDP (2004)
19.	DRI (Mortality and Economic Losses)	Mortality Risk Index, Risk of Economic Losses in proportion of GDP developed for 6 natural hazards	Gaps in historic data on disasters particularly the people died or indirectly affected by drought and economic losses. Not addressing livelihoods and environmental losses since they are not available in historic databases	Dilley et al. (2005)

Source: modified by the authors after Heim, 2002 & Eriyagama et al., 2009.

Jones & Preston (2011) reviewed various approaches to vulnerability mapping, their benefits and risks. A review of 45 studies on vulnerability assessment was carried out and categorized the assessments in 4 conceptual models viz. Risk Hazard Models (31%), Social Vulnerability Models (7%), PAR Models (51%) and Expanded Vulnerability (9%). Although tremendous advancements were made in the field of geospatial data availability and tools which enhanced the potential of vulnerability mapping, there are challenges associated with mapping vulnerability particularly social vulnerability. Review of studies revealed that results of the vulnerability

assessments vary significantly within the same conceptual frame work for analysis. 'The over arching challenges associated with vulnerability mapping are absence of best practices, scales of assessment and data availability and management of uncertainties'. Four major indicators (availability, accessibility, utilisation & entitlement) and 14 variables were used for deriving composite Food Security Index (FSI) in the Food Security Atlas of Rural Uttar Pradesh and Rural Madhya Pradesh (IHD & WFP, 2008).

Cost and benefits of different mitigation strategies viz. insurance (non-structural interventions) and development of ground water irrigation (structural interventions) and its implications on rural livelihood was carried out by Mechler et al. (2008). Farming households mostly deriving income from subsistence farming were takes as unit of study. The studied revealed that a combination of insurance and irrigation i.e., the integrated approach offer more benefits at lower costs than single set of intervention.

Climate Change Vulnerability Index (CCVI) developed by Maplecroft (2011) identifies hotspots of climate risks based on 42 social, economic and environmental factors to assess national vulnerabilities across three core areas. The core areas include exposure to climate-related natural disasters and sea-level rise; human sensitivity, in terms of population patterns, development, natural resources, agricultural dependency and conflicts; and future vulnerability by considering the adaptive capacity of a country's government and infrastructure to combat climate change.

Conclusion

Different indices based on meteorological data, hydrological data, vegetation data and socio economic data etc. are used globally for hazard mapping, monitoring and risk assessment. Review of different indices for mapping and monitoring of drought revealed the potential of the indices and inherent limitations. Combination of more than one index gives better results due to the complexity of the phenomena of drought. It is important to understand the merits and limitations of the different tools, techniques and methods while using the indices. Selection of various indices for analysis shall be based on the purpose, availability of data and drought typology.

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Landslide Susceptibility Zonation of Tawang District of Arunachal Pradesh using Geospatial Technology

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Abstract

Tawang district of Arunachal Pradesh is geologically fragile and vulnerable in terms of seismicity and topography. The district is plagued by large scale landslides in many parts due to human-induced activities on these fragilities. The present study was undertaken to map the probable landslide susceptible areas of Tawang district using Geographic Information System (GIS). The aspects of geology, seismicity, slope, soil, drainage, elevation, existing landslide locations and the anthropogenic activities were taken into consideration for the study. Weighted overlay multicriteria analysis of GIS was applied to find out the spatial distribution of susceptible areas in terms of landslide. By integrating all the thematic layers with proper weightages and influences, an area of about 144 sq. km of the district is designated as highly susceptible to landslide. Moderate susceptible area is about 27.80 percent while about 65 percent area of the district falls under moderately low and low susceptibility to landslide. The findings of this study regarding the spatial distribution of areas under risk due to landslide could be useful for the management authority for mitigation of landslide hazard.

Key words: *Tawang, GIS, weighted overlay, landslide hazard, susceptibility*

Introduction

The Indian Himalayan and adjoining regions are vulnerable due to natural catastrophic events, namely earthquakes, landslides, flash floods and cloudburst (Sati & Gahalaut, 2013). Landslide is one of the important natural hazards and an active process that contributes to large scale erosion (Pimentel et al., 1995/ Shiferaw & Holden, 1999; Bewket and Sterk, 2002). Different natural phenomena and human disturbances trigger landslides. Natural triggers include meteorological changes, such as intense or prolonged rainfall or snowmelt, and rapid tectonic forcing, such as earthquakes or volcanic eruptions (Guzzetti et al., 2005). Human disturbances include land use changes, deforestation, excavation, changes in the slope profile and agricultural practices in the fragile hilly slopes (Sarma & Barik, 2010). Many landslides occur

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simultaneously when slopes are shaken by an earthquake or over a period of hours or days when failures are triggered by intense rainfall or snow melting (Cruden & Varnes, 1996). These two phenomena are prominent in the eastern Himalayan region (Sarma et al., 2013). Soil erosion triggered by landslide has a range of environmental impacts (Newcombe & MacDonald, 1991) and effective control of soil erosion is a critical component of natural resource management (Pimentel et al., 1995).

For management and control of soil erosion, cause identification and proper delineation of vulnerable sites is pivotal. Geospatial technology could be utilised for identifying the potential areas of soil erosion caused by landslides considering various physical and anthropological aspects of an area. A Geographic Information System (GIS) is well suited for the systematic estimations leading to slope stability evaluation and hazard zonation mapping by handling and analyzing various associated spatial data sets (Boroughs & McDonald, 1998; Baban & Sant, 2004).

Landslide hazard vulnerability study has become a global issue as a consequence of its applied implications (Valentín et al., 2005). The study related to mass movements triggered by landslides has been conducted globally depending on its contribution towards the conservation of ecologically fragile areas (Smith, 2008; Godfrey et al., 2008; Reid et al., 2010). The selection of any appropriate hazard modelling technique is dependent upon the management scale, site-specific conditions and data availability (Carrara et al., 1999). The present context could be related with numerous scientific literatures carried out globally using GIS (Van Westen 1993; Van Westen et al., 2003; Armesto & Martinez, 1978). The spatial data analysis using GIS tools (Issaks & Srivastava 1989/ Rossi et al., 1992; Jackson & Caldwell, 1993) and its consequent advances allow more extensive examinations of spatial analysis (Pastor et al., 1999; Sarma & Barik 2010/ Sarma et al., 2012; Sarma et al., 2013). Global attempts have been made to establish the various methods to predict landslide hazards (Keaton et al., 1988; Lips & Wieczorek, 1990; Coe et al., 2000; Crovelli, 2000; Guzzetti et al., 2002).

Tawang district of Arunachal Pradesh, which is strategically located in the state of Arunachal Pradesh (Figure1), is prone to various natural and man-induced hazards. The fragile geology, seismicity, steep slopes, torrential rainfall and construction of roads and other anthropogenic activities make the district vulnerable to large scale landslides. This is a regular event in the district during the monsoon and post-monsoon seasons, which has plagued the movement of goods and people. The district is cut off with the rest of the world for months due to this human-induced natural phenomenon. In this study, an attempt has been made to identify and map the spatial distribution of different categories of landslide susceptible zones so that proper steps canbe taken by the authorities to check it from more damage.

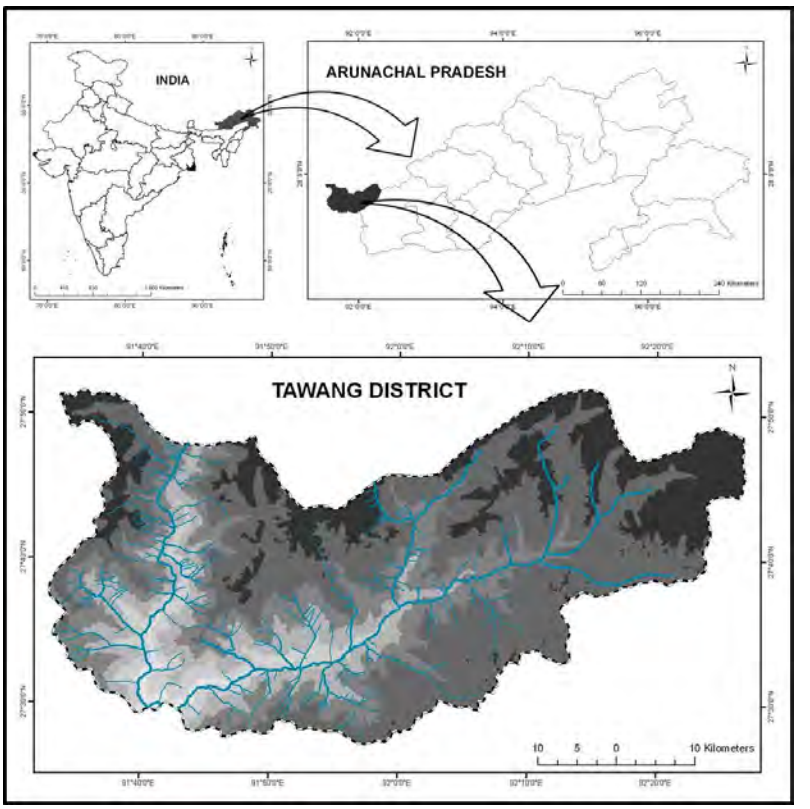

Figure 1: Location of Tawang district of Arunachal Pradesh

Method and Materials

Various thematic features of Tawang district have been delineated on1:50,000 scale using UTM projection system; spheroid and datum used were WGS 84 with UTM zone 46N (Sarma et al., 2012). The soil, geology, river, road and landslide inventory maps were taken from the published maps of State Remote Sensing Application Centre, Department of Science and Technology, Government of Arunachal Pradesh. The image features on the satellite data (Landsat 8, 2014) were interpreted through visual image interpretation to prepare land use/ cover map using the various image elements like tone, texture, pattern, shape, size, shadow, location and association (Garg et al. ,1988/ Lillesand and Kiefer 1987). The relevant Survey of India topographical maps (78M/9, 78M/10, 78M/13, 78M/14, 78M/15, 83A/1, 83A/2, 83A/3, 83A/5, 83A/6, 83A/7 and 83A/8) were utilised for validation of the features prepared. The elevation and slope maps were prepared from the aster DEM data. Intensive field survey was carried out

for validation of the results. The GIS and image processing softwares used are ArcGIS 10.1 and Erdas IMAGINE 2014.

Weighted Overlay Analysis

For the preparation of accessibility index the line features like lineaments, river and road and point feature of landslide location were converted into polygon with desired distance from source by delineating multiple buffers. All the thematic polygon features were then converted into raster (Grid) with pixel size of 50m x 50m (Figures 2-12).

Integration of thematic layers was performed using weighted overlay analysis model. Based on the contribution and understanding of the behaviour of different thematic layers, a weightage, which is a qualitative relative measure, has been assigned on a scale of 1 to 9 depending on their overall susceptibility potential level. The influence percentage of each thematic layer has been assigned according to the contribution (Table 1). All the thematic raster features with related item weight and integrated with one another through GIS (ArcInfo spatial analyst environment). As per this analysis, the total weightage of the final integrated grids were derived as sum of the weightage assigned to the different layers based on suitability. In the present study, landslide hazard vulnerability mapping of Tawang district of Arunachal Pradesh has been generated by integration of all above grid layers. The delineation has made by grouping the grids of final integrated layer into five vulnerable zones viz., high, moderately high, moderate, moderately low and low.

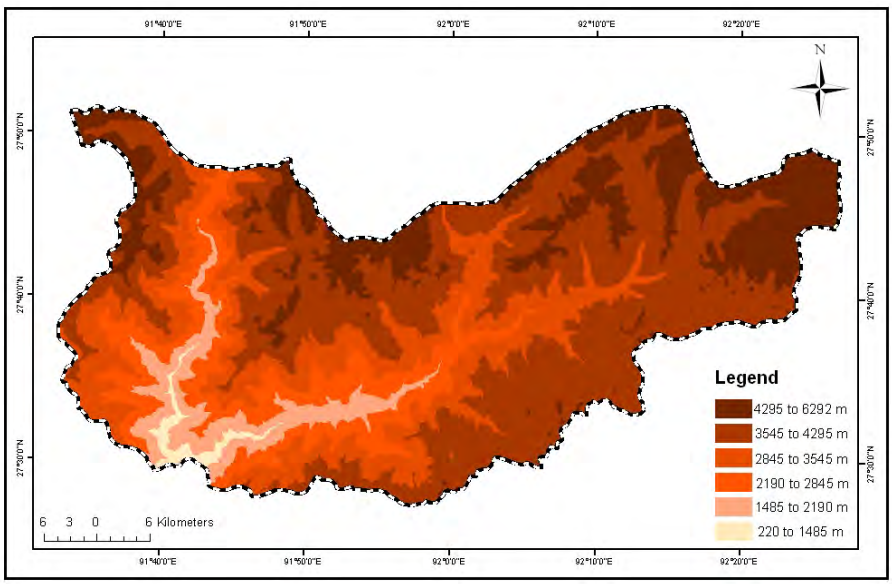

Figure 2: Elevation of Tawang district

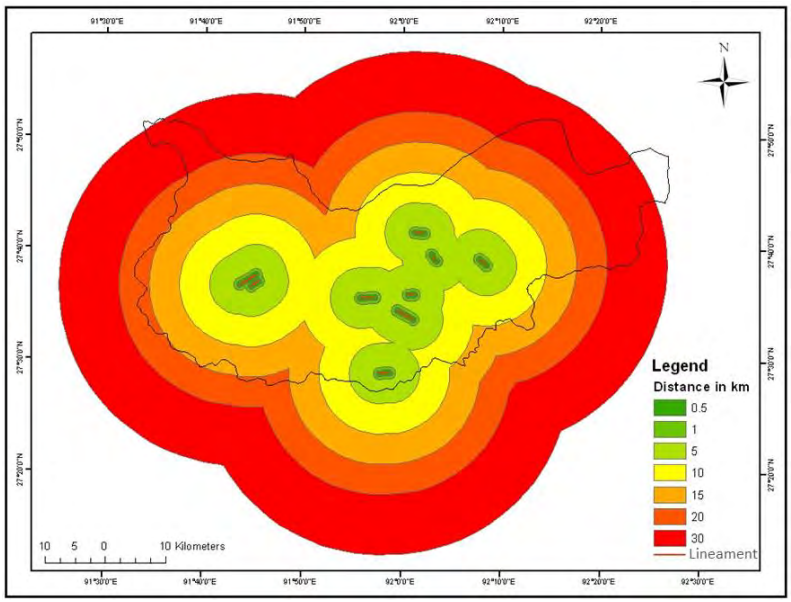

Figure 3: Accessibility of lineaments in Tawang district (Source: State Remote Sensing Application Centre, 2005)

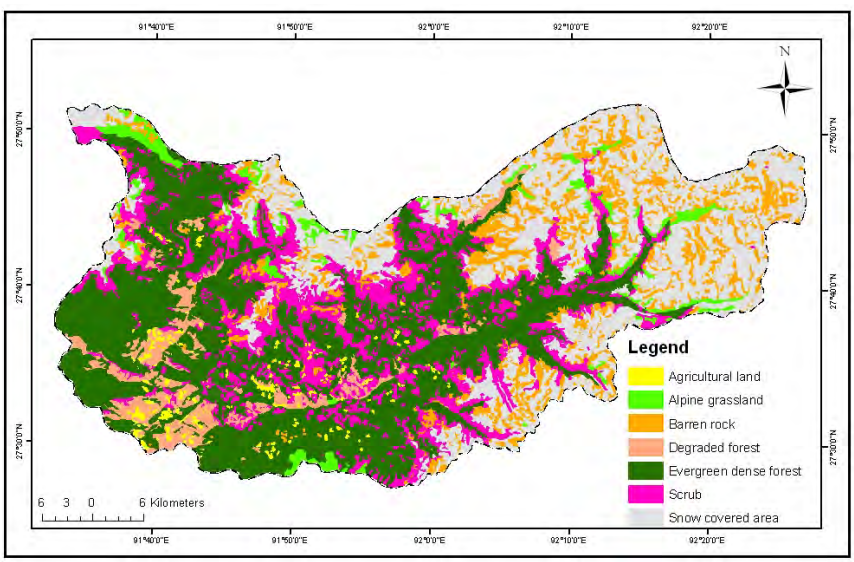

Figure 4: Land use/ cover of Tawang district

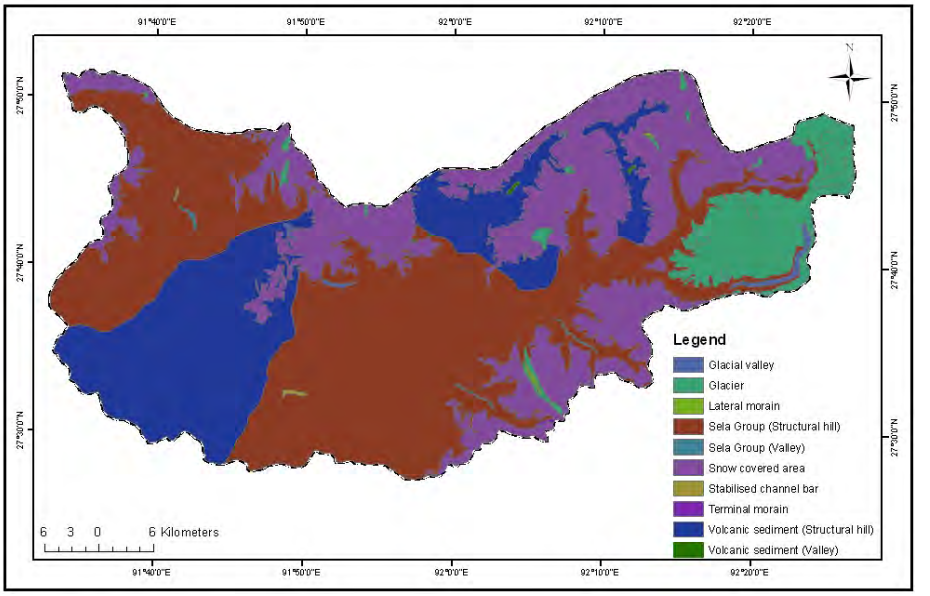

Figure 5: Geology of Tawang district(Source: State Remote Sensing Application Centre, 2005)

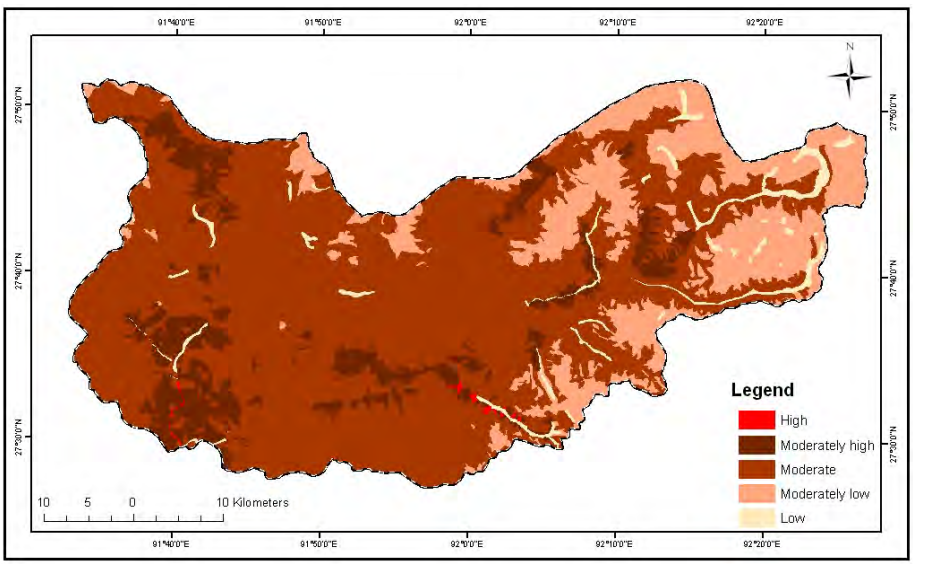

Figure 6: Landslide hazard zonation map of Tawang district(Source: State Remote Sensing Application Centre, 2005)

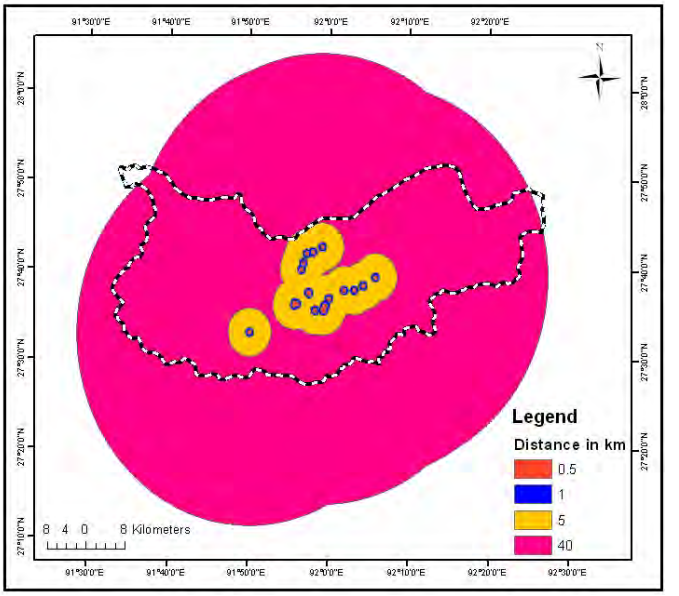

Figure 7: Landslide impact zones of Tawang district (Based on the field data)

Figure 8: Accessibility of main rivers in Tawang district

Figure 9: Accessibility of tributaries in Tawang district

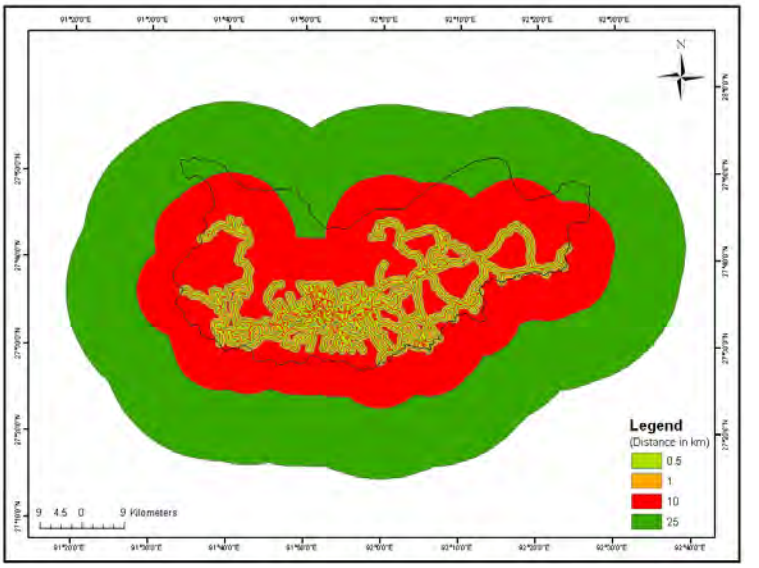

Figure 10: Accessibility of roads in Tawang district

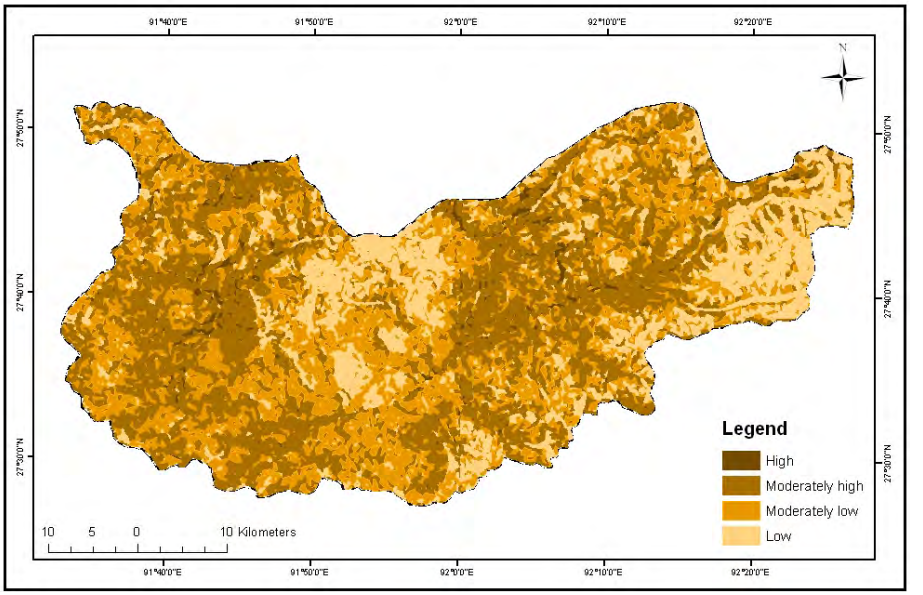

Figure 11: Slope of Tawang district (Refer Table 1)

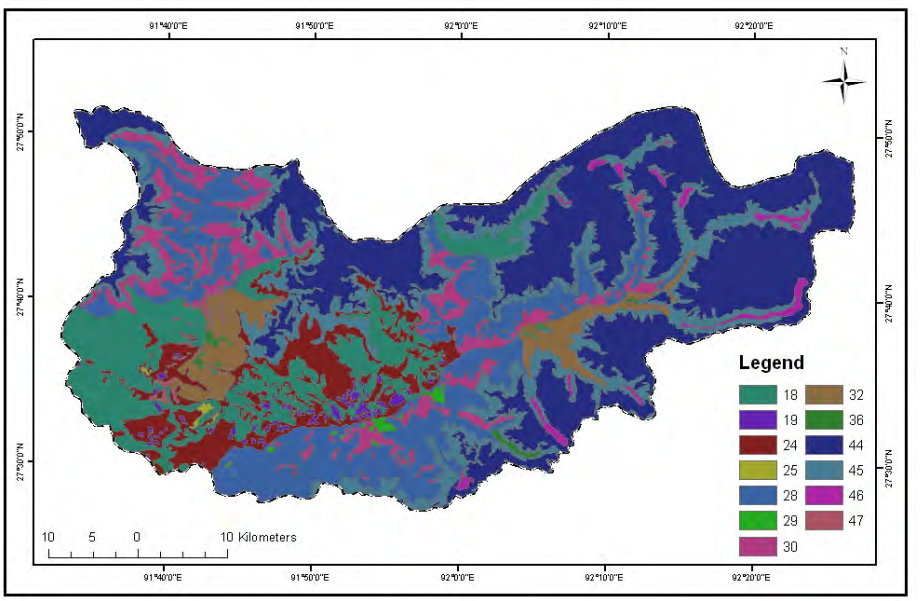

Figure 12: Soils of Tawang district (Refer Table 1) (Source: State Remote Sensing Application Centre, 2005)

(18. Rocky mountain/permanent snow cover; 19. Rocky mountain/seasonal snow cover; 24. Steep slope/tree cover/moderate to severe erosion; 25.Steep slope/scrub/forest blank/severe erosion; 28. Dense forest/steep slope/slight to moderate erosion; 29. Very steep slope/forest blank/severe erosion; 30. Landslide zone; 32. Forest blank/very steep slope/severe erosion; 36. Dense forest/steep slope/moderate erosion; 44. No vegetation/jhum land/steep slope/severe erosion; 45. Scrub/jhum land/steep slope/moderate to severe erosion; 46. Scrub/steep slope/severe erosion; and 47. Glacial valley/gravel-pebble-soils brought down by slide of snow).

Table 1: Weighted Overlay Analysis for delineating overall landslide susceptibility of Tawang district, Arunachal Pradesh

Features	Influence (%)	Type	Weightage (1-9)
Elevation	**7**	**Height in m**	
		221-1487	1
		1487-2188	2
		2188-2844	3
		2844-3544	5
		3544-4293	7
		4293-6292	7
Fault	**10**	**Distance in km**	
		0.5	9
		1	9
		5	8
		10	8
		15	4
		20	3
		30	2
Landuse / cover	**9**	**Type**	
		Barren rocky	3
		Snow covered area	2
		Scrub	4
		Dense evergreen forest	2
		Alpine grassland	3
		Degraded forest	8
		Agriculture	8

Geology	**8**	**Type**	
		Snow covered area	7
		Glacier	7
		Sela Group (structural hills)	6
		Glacial valley	4
		Lateral morain	9
		Sela Group (valley)	3
		Volcanic sediment (valley)	1
		Stabilised channel bar	5
		Volcanic sediment (SH)	2
		Terminal morain	6
Landslide hazard zone	**9**	**Type**	
		Moderately low	4
		Moderate	6
		Low	2
		Moderately high	7
		High	8
Landslide location	**12**	**Distance in km**	
		0.5	9
		1	7
		5	4
		40	2
Main river	**8**	**Distance in km**	
		0.5	7
		1	6
		5	4
		18	2
Tributary	**7**	**Distance in km**	
		0.5	6
		1	5
		5	3
		25	2

Road	**7**	**Distance in km**	
		0.5	8
		1	6
		10	3
		25	1
Slope	**12**	**Slope in degree**	
		31 to 44 (Moderately high)	8
		Below 18 (low)	3
		18 to 31 (Moderately low)	5
		44 to 89 (High)	9
Soil	**11**	**Soil characteristics**	
		Rocky mountain / permanent snow cover (18)	1
		Rocky mountain/seasonal snow cover (19)	1
		Steep slope/tree cover/ moderate to severe erosion (24)	4
		Steep slope / scrub / forest blank / severe erosion (25)	6
		Dense forest / steep slope / slight to moderate erosion (28)	3
		Very steep slope / forest blank / severe erosion	7
		Landslide zone (29)	8
		Forest blank / very steep slope / severe erosion (32)	7
		Dense forest / steep slope / moderate erosion (36)	3
		No vegetation / jhum land / steep slope / severe erosion (44)	9
		Scrub / jhum land / steep slope / moderate to severe erosion (45)	8
		Scrub / steep slope / severe erosion (46)	8
		Glacial valley / gravel-pebble-soils brought down by slide of snow (47)	5

Results and Discussion

By utilising the weighted overlay analysis models a map showing different areas of landslide susceptible zones of high, moderately high, moderate, moderately low and low has been prepared (Figure 13 and Table 2). The findings of the study reveals that a considerable portion of the district (6.66 percent) is found to be susceptible for landslide, probably due to maximum anthropogenic influences in terms of slope cutting for road construction, removal of vegetation cover with steeper slopes comprising of loose soil conditions and other geological conditions. All these criteria attribute for delineating the areas susceptible to landslide in already fragile Tawang district.

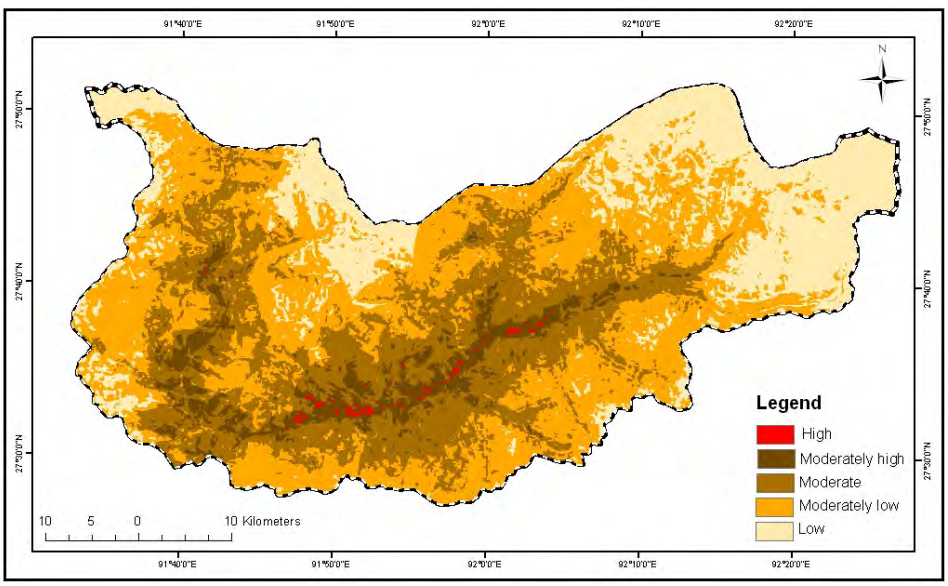

Figure 13: Spatial distributions of landslide vulnerable areas in Tawang district of Arunachal Pradesh

Table 2: Vulnerable areas of Tawang district of Arunachal Pradesh

Vulnerability	Area in sq. km	Percentage
Low	548	25.23
Moderately low	876	40.31
Moderate	604	27.80
Moderately high	138	6.38
High	6	0.28
Total	**2,172**	**100.00**

The large scale soil erosion triggered by landslide is the result of interrelationships among vegetation, topography, drainage, bedrock and soil (Lucía et al., 2010). The present study shows that various geological, topographical and man-induced activities are responsible for making the district vulnerable for landslides (Pimentel et al. 1995/ Shiferaw & Holden 1999/ Bewket & Sterk 2002/ Sarma et al. 2012). Sarma et al. (2012) concluded that the main factors for large scale erosions in northeast India are anthropogenic activities along the fragile hill slopes which are accelerated by torrential rainfall.

Baban & Sant (2005) while studying the susceptibility mapping for the Caribbean island of Tobago using GIS, multi-criteria evaluation techniques with a varied weighted approach found that about 6.4 percent of the total area is under severe risk due to landslide. This finding is in absolute support of the present research. Anbalagan et al. (2008) analysed the relationships of slope morphometry with different aspects like lithology, structure, land use/ cover, and relief. They assigned the maximum impacts where higher slope is free from vegetation cover and with the influence of other anthropogenic activities. Their approach is in agreement with the present study. The findings of this research show that soil erosion rates are influenced by slope, drainage, geology, soil and human induced activities. Besides other factors vulnerability is maximum in the areas where human interferences are more. This study is a point to the findings of Neil & Fogarty (1991); Prove et al. (1995) and Edwards & Zierholz (2001). Similar observations are found by Erskine et al. (2003) and Mahmoudzadeh et al. (2002). The probable vulnerable areas of soil erosion as depicted after the present research is in agreement to these observations.

Conclusions

Being the part of folded Himalayan mountain chain, Tawang district of Arunachal Pradesh is fragile in terms of geology, seismicity and topography. Due to its strategic location, potential for hydroelectric power and tourism, various developmental activities are coming up in recent times and as a result of that large scale landslides are triggered in many parts of the district. Moreover, the region is highly vulnerable to seismic activity which can accelerate the landslides in many parts. This phenomenon has created havoc to the people living downslopes and completely stops the movement of goods and people. The findings of the present study could be utilised to predict the potential areas of landslide hazards and this method could be used in any part of the globe which are prone to this type of natural hazards. The findings of the present research would be useful for the concerned authority to take proper steps for mitigation of landslide hazards.

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Lessons from 1st May 2013 Doda (India) Earthquake Reiterate Urgent Need to Mitigate Seismic Risk

– C.V.R. Murty[1], Ajay Chourasia[2], Hari Kumar [3], Anup Karanth[4] and Pradeep Kumar R.[5]

ABSTRACT

The Doda Earthquake of 1st May 2013 at 12:27 Hrs. (IST) hit border region of two states of India (Jammu & Kashmir and Himachal Pradesh) (Mw= 5.8). This paper describes the findings of the 5-day post-earthquake reconnaissance survey undertaken in the affected areas with particular emphasis onbuilding typology, construction materials and construction practices. Post-earthquake damage assessment of the built environment suggests that recently built structures do not have adequateearthquake resistant featuresto resist severe earthquake shaking (of about IX on MSK scale) expected in the region. On the other hand, traditional constructions with good earthquake resistant features performed much better.The maximum intensity of shaking during the said event was only about VI on MSK scale, and the damage was less. But, the type of damage suggests that huge losses can be incurred in the region during a future earthquake of higher intensity, if the built environment is not retrofitted.

Keywords: *Doda earthquake, reconnaissance survey, construction materials, construction practices, building typology, seismic risk mitigation*

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Introduction

An M5.8 earthquake occurred on 1st May 2013 at 12:27 hours IST. As per the report of India Meteorological Department (IMD), the epicentre was located at latitude 33.1°N and longitude 75.8°E which is about 17 km NE of Bhadarwah town in J&K state near the border of the states of Jammu & Kashmir (J&K) and Himachal Pradesh. The earthquake was a shallow-focus event (focal depth 15 km) with ground shaking lasting for about 40 seconds in the epicentral region and it was felt across north India. One death was reported in J&K state after this event due to rolling boulders. And, it was claimed that about 25,000 houses declared to be partially, severely or fully damaged. The Himalayan region in the Indian subcontinent is seismically active due to continental collision of the Indian and Eurasian plates, with the Indian Plate subducting under the Eurasian Plate[Valdiya, 1964]. In the past, the J&K region of the Himalayas has faced many earthquakes of M>7 of which 1770 Srinagar Earthquake (M7.7) and 2005 Muzaffarabad Earthquake(M7.6) are the largest documented events. M_w5.8 event of 1 May 2013 was relatively a smaller event in comparison. As per IMD report, this earthquake was followed by four aftershock events of magnitudes 3.7, 4.6, 3.7 and 3.5 till 5th May 2013, and eleven aftershock events of magnitude 3+ till June 2013.

The presentpaper provides insights into the effects of the earthquake on the built environmentwith particular reference to the traditional construction practices (Dhajji-dewari houses), unreinforced masonry with burnt clay bricks/stones in mud/cement mortar, RC buildings, and important facilities like schools, hospitals and lifelines and highlights the initial important observations. Lessons learnt from the damage assessment of different building infrastructures due to this event provide answers to some of the important questions leading to reduce theearthquake risk in future earthquake scenarioand also propose a road-map to reduce ever increasing seismic vulnerability of the region.

The Earthquake

The earthquake was centered about 17 km NE of Bhadarwah (Doda District of J&K, India) caused a maximum intensity of shaking VI+ on the MSK scale, lasting about 40 seconds. The expected intensity of earthquake shaking as per the Indian Seismic Code (BIS 1893-2002) is about VIII in earthquake affected areas of Doda and Kishtwar districts (seismic zone IV). The event was recorded by strong motion accelerographs

at 11 stations (http://pesmos.in/2013/) (Figure 1). The acceleration time histories of the station closest to epicenter, *i.e.*, Chamba, recorded the maximum peak ground acceleration (PGA) of 0.015g (Figure 2). The pseudo-acceleration, velocity and displacement response spectra of the recorded ground motion time history at Chamba station are also shown in Figure 2. The acceleration response spectra at Chamba station suggest that the input energy is the largest for short period structures (namely stiff structures, such as low-rise unreinforced masonry (URM) load-bearing and RC frames with URM infill walls). Thus, even though the recorded PGA is much smaller than the design acceleration; hence, reasonably significant damage to built environment in the current event reflects the vulnerability of the region.

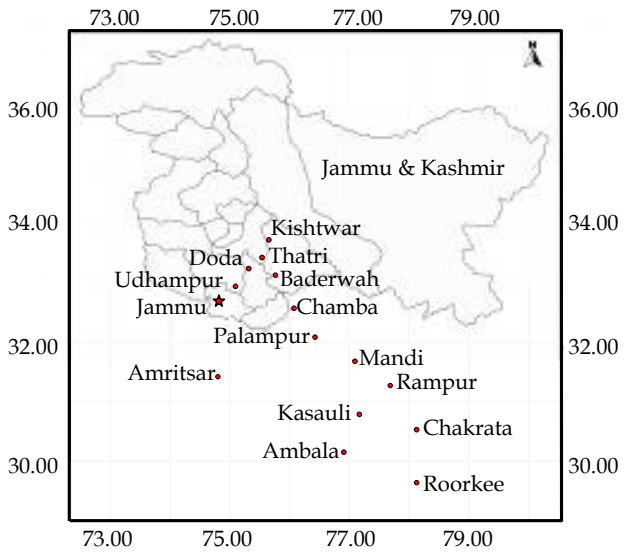


Figure 1: Location of 11 strong motion accelerograph stations operated by Department of Earthquake Engineering, IIT Roorkee, India around the area affected by the 01 May 2013 event

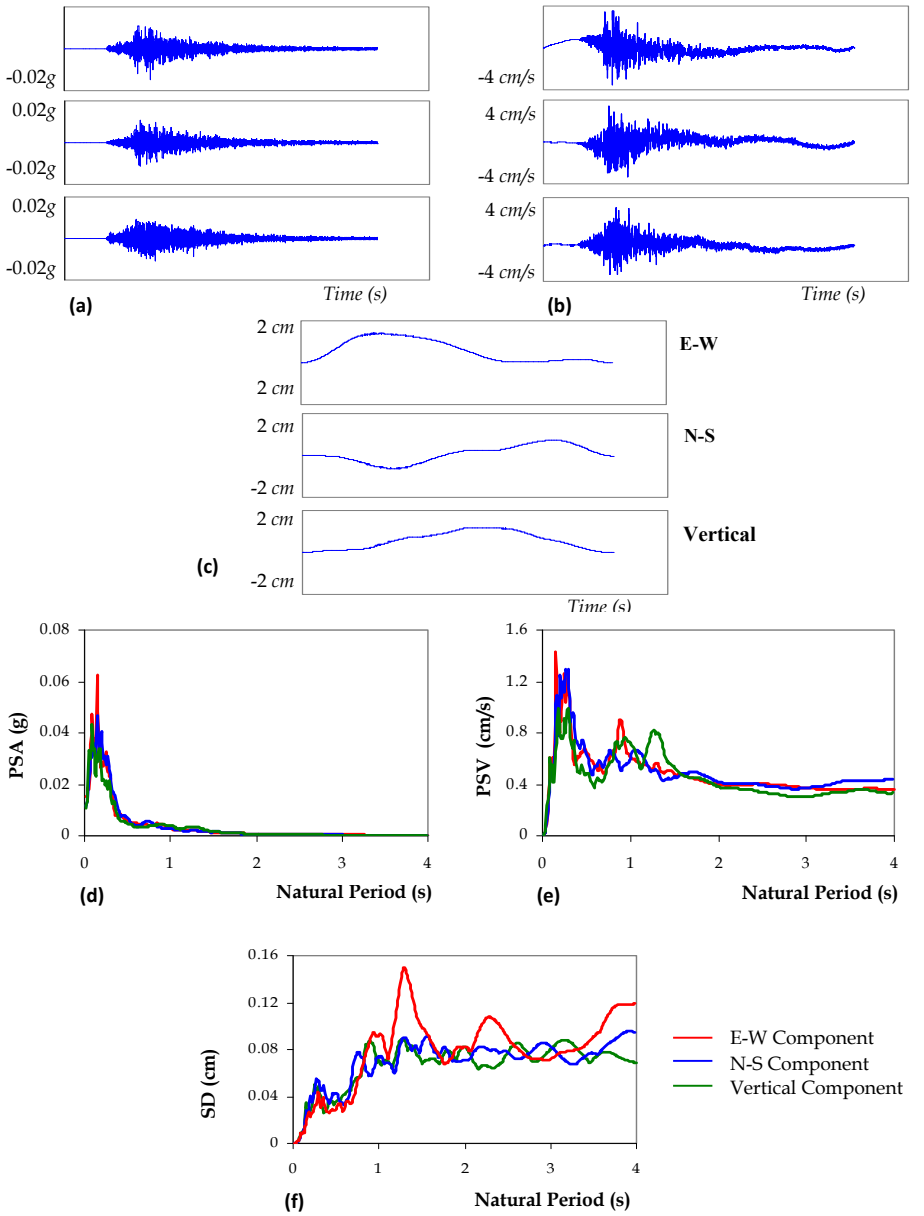


Figure 2: Ground Motion Time Histories at Chamba Station, closest to epicentral region (a) acceleration, (b) velocity, (c) displacement; and corresponding (d) pseudo-acceleration, (e) velocity and (f) displacement response spectra

Performance of Built Environment

The landscape of Doda town shows settlements on both hill slopes and river terraces (Figure 3) andthis is typical of most of the other towns nearby(like Gandoh and Premnagar). These hill slopes and river terraces are composed of heterogeneous materials – highly weathered sandstone rock, some granite outcrops, rounded to angular but smooth river boulders, cobbles, gravel, sand, silt, clay and other suspended matters that have been collected over centuries in the river terraces and hill slopes. For this reason, the ground shaking is not necessarily uniform all through the affected area. Another prominent feature of development in the area is the same constructiontypes is followed in the valley as well as on the steep hill slopes. In general, houses built along the rim of river terraces have showed signs of settlement, while houses on the flat land seemingly had no such foundation damage; and houses founded on soft soils in towns of valley areas (like Kishtwar town), vertical cracks were visible in foundation arising from the soil.

(a) **(b)** **(c)**

Figure 3: Ariel views showing dense development on hill slopes/river terraces (a) Doda (b) Gandoh (c) Premnagar town

Housing

In general, damage to buildings in the affected area was limited to poorly built houses. The pointers inidentifying poorly built houses include: (a) weak construction material, (b) informal construction practices with incremental changes made over time with different materials and styles of construction, (c) absence of earthquake-resistant features, and (d) significant vertical irregularities largely attributed to slopingground and floors meeting the ground at different levels, causing earthquake shaking input to the building at multiple floor levels; this causes excessive damage especially when the structure has features (a)-(c) mentioned above. Typical housing in Doda and Kishtwar districts of J&K state are 1 or 2-storeyed in the hills and up to 4-5 storeyedin town areas. Structural systems practiced in the region include: (i) Dhajji-Dewari houses; (ii) Unreinforced masonry (URM) with burnt clay bricks and mud/cement mortar; (iii) URM with stone and mud/cement mortar; and a few

(iv) Reinforced Concrete (RC) Moment Resisting Framedbuildings with URM infill walls. Some constructions are of hybrid type, *i.e.,* combination of two or more above systems.

Dhajji-Dewari Houses

This traditional Dhajji-Dewari style of building construction utilizes wood frame with burnt clay brick or stone masonry wall panels in-filled in the bays created by the wood members (Figure 4) and hasmaximum upto 4 storeys. Typically, the foundation and in some cases even plinth is made up of random rubble stone masonry. Walls in all storeys are made up of wood frame (consisting of horizontal, vertical and diagonal wooden members). The roof was originally made up of wood planks topped with mud. A typical floor is made of wooden joist (100x150 mm) placed at 400 mm centers. Over these joists, 25 mm thick wooden planks are laid, which in turn is topped with 50 mm thick stone chips. The final course is either a mud or cement concrete flooring of 125mm thickness. And, the typical roof has the same configuration as mentioned above for floors, with mud topping of 200-300 mm thickness. But, in recent times, roofs are made up of corrugated GI sheets over timber trusses resting on the wood wall plates atop the stone/brick walls.

(a) **(b)**

Figure 4: Variant of Dhajji-Dewari Houses: (a) without diagonal wood members, and (b) with no Dhajji (wood frame) in the ground storey

This is a housing typology with excellent earthquake-resistant features in which the traditional wisdom has been embedded gradually over centuries asearthquake disasters have been perennial concern for people living in the Himalayan region. The well builtDhajji-Dewari construction performed exceptionally well during the earthquake. But, over time, the traditional knowledge may not be completely efficient, when the modern construction has become an aspiration of the larger populace. Seismic deficiencies, identified in the recent editions of this typology, include large openings; large size rooms; tall storey; poor connections between foundation andwalls, wall towall and walls-to roof; absence of continuous plinth, sill and lintel bands; loosely packed infill masonry; low strength mud mortar, and heavy roof.

URM Houses with Burnt Clay Bricks and Mud/Cement Mortar

Use of URM with burnt clay brick upto 3-4 storeys are on the rise in Doda and Kishtwar districts (Figure 5).

(a) **(b)**

Figure 5: Brick masonry houses: (a) houses with RC floors did better even though they had no earthquake-resistant features like horizontal bands, and (b) houses with heavy wood floors did poorly; the walls dilated outwards in both plan directions and reduced the bearing of wood floors on the walls

Such houses are regular in plan constructed using poor strength of brick units with excessive mica content. Majority of construction are in mud mortar and with limited cement mortar of mix variationbetween 1:6 and 1:8 (by volume). In general, prominent deficiencies observed include (a) absence of horizontal bands and vertical reinforcing elements at wall corners; (b) absence of gable bands; (c) dilation of masonry walls at top floor due to lack of eaves band on which the roof is rested; (d) use of plain mud mortar in walls; (e) lack of complete roof truss; (f) excessively large opening in walls; (g) lack of reinforcement around door and window openings; (h) use of very heavy floors/roofs; (i) direct bearing of roof truss on the masonry walls, not adequately anchored into walls; (j) weakmasonry courses – all headers in one course, all stretchers in the other, resulting in joints not being staggered; and (k) outward bulging of walls at floor levels due to heavy wooden floors.

Unreinforced Masonry (URM)Houses with Stone and Mud/Cement Mortar

This is the most common housing construction type which are regular in plan, and mostly rectangular, and do not have any irregularities in elevation;constructed using random rubble type with slate stones (Figure 6). River boulders, angularly broken stone or semi-dressed stone (on the outside face); in rare exceptions, dressed stone load bearing masonry was also noticed.

(a) (b)

Figure 6: (a) Two-storey stone masonry house with basic earthquake-resistant features of seismic bands MISSING, and (b) Two-storey stone hybrid masonry house (with Dhajji-Dewari system adopted in upper elevations) but no earthquake-resistant features in lower storeys

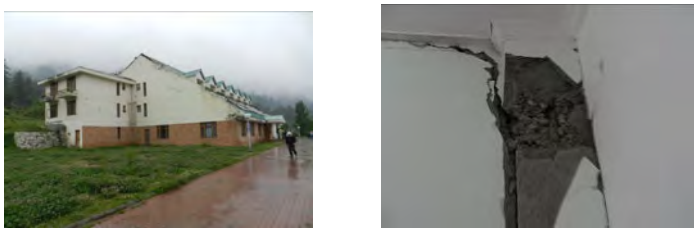
This housing typology has good architectural design from earthquake safety point of view, but poor structural characteristics. The limited negative architectural features include adjacency and pounding; re-entrant corner; and mismatch of floor and roof levels. The main structural deficiencies include:(a) no use of through-stones leading to independent two leafs of stone masonry walls; (b) Inadequate or no connectivity of two perpendicular walls at intersections; (c) stone masonry is not dressed, but outside surface is ensured to be plumb; half dressed stones with pyramidal shape are prone to rotating outwards; (d) no bands are at any level; cut lintels in wood are used over openings

in walls; (e) weak mortar mix; (f) large mass, especially concentration of large mass at roof level of the building when heavy slate roofs are employed; and (g) poor connections between foundation-and-wall, wall-and-wall and wall-and-roof.

RC Buildings

RC buildings are becoming increasingly popular in the area. Most of these buildings are non-engineered, built on steep slopes, very close to each other. The buildings are up to 6-storeyed in the Doda town with a storey height of 3m, wherein 3-4 storeys are below ground level or otherwise buildings are constructed over slopingland connected at multiple (~2.7 m verticals) levels. Mostly the building seems to be constructed for gravity loads and no provision is made to resist lateral loads. The RC column with dimension 200×300mm with nominal reinforcement, lapped at beam-column junction, absence of seismic detailing and cast in poor grade of concrete is prevalent in the region. The RC frame is provided with brick laid in cement sand mortar as infill units. The column grid is generally closely spaced (around 3.0-4.5 m) with high degree of plan and vertical irregularitiesdue to excessive cantilever projection,

indiscriminate use of unsupported partition walls leading to inadequate load path. Only a few buildings such as government, academic institution buildings may be categorised as engineered ones, *i.e.,* designed and constructed using prevalent codes and practices. The typical damage sustained by these RC buildings includes frame-infill separation, spalling of concrete at the top of the column (where concreting is poorly done and reinforcement detailing is such that there is extreme congestion of steel reinforcement) and cracking/falling of bathroom tiles, as observed in the yet-to-be commissioned Tourism Department Building (Figure 7). Similarly, damages are noticed in the newly constructed Sub-District Hospital buildings in Badarwah.



(a) (b)

Figure 7: (a) TRC building in Badarwah, (b) damage to column tops showing poor concrete and reinforcement detailing

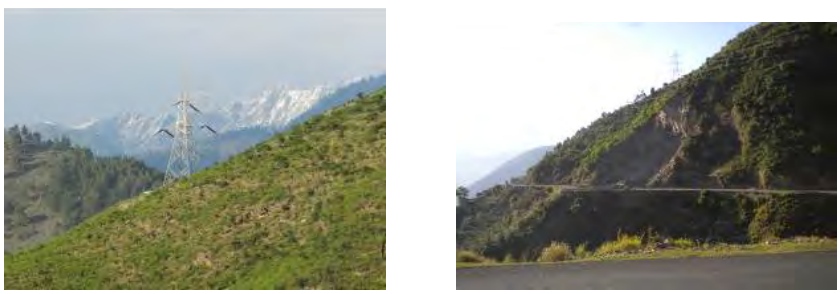
School Buildings

Around 660 school buildings are reported to be damaged in Doda and Kishtwar districts due to earthquake to such an extent that they are abandoned and classes were held in tents. Most of the school buildings are 1-2 storiedconstructed using stone masonry in mud mortar and plastered using cement mortar, and most of which lags in earthquake resistant features, as discussed in preceding sections.

(a) (b) (c)

Figure 8: (a) Informal trusses rested directly on stone walls without any wall plates (at Gandoh), and (b) large stone gables not provided with gable bands and gable end trusses are not complete with bottom chord and vertical posts (at Bhalessa), and (c) falling of false ceiling due to poor anchorage

Figure 9: Wood frame single-storey school construction with brick masonry up to sill level and light roof



(a) **(b)**

Figure 10: Transmission towers running across Doda and Kishtwar districts pass through difficult terrains: (a) soft soils, and (b) adjoining vertical cuts made for roads

Figure 11: Earthquake-induced landslide at Shalimar (Kishtwar) on National Highway

The injuries in these schools were also reported due to collapse of stone masonry gable wall, separation of walls at junctions, separation of wythes of walls, and falling of false ceiling due to poor anchorage (Figure 8).

But, there are also good examples of school buildings constructed using traditional constructions, in conformance with seismic resistant features;which can act as role-model for replication in future constructions (Figure 9).

Hospital Buildings

Hospitals are most critical facilities and are expected to be completely functional before, during and in the aftermath of earthquakes. However, most of the health facilities in Doda and Kishtwar districts, are of 2 storiedconstructionusing stone masonry in mud/cement mortar and recently constructed with RC frame structure and were damaged disproportionately even in small shaking thataffectedthe region. The causes of failure are similar as discussed in the preceding sections for URM in stone and RC structures.

Lifelines

The 132-KW high voltage transmission line of National Hydroelectric Power Corporation (NHPC) serves the districts of Doda and Kishtwar of J&K state. As such there was no loss in power transmission during or the aftermath of the earthquake, because there was no surface rupture due to the earthquake, which is normally expected in earthquakes with higher intensity of shaking. However, these transmission lines are founded on soft soil adjacent vertical cuts (Figure 10), which are vulnerable and may cause secondary hazard.

Roads are the only modes of transportation system constructed by freshly cut on the hill slopes, causing four earthquake induced massive landslides (Figure 11) in the region. These landslides are attributed to the geology and intense rainfall in the area. Further, the human intervention such as cutting for roads and embankments, excavation for buildings etc., adds instability toslopes extensively.

Lessons Learnt

The current trend of constructions is alarming, to say the least; there is no concept of earthquake resistance in the planning, design and construction strategies. The following are some major lessons learnt:

(1) Evaluation of landslide and rockfall potential and subsidence is essential in Doda and Kishtwar Districts, especially along critical roads and in areas withlarge population and built environment. Development of redundant road networks is critical in these vulnerable areas;

(2) Creation of a professional and regulated environment by Government of J&K for design and construction of new RC buildings is crucial in J&K state, if it has to be earthquake-resistant;

(3) Existing structures need to be assessed for earthquake safety in a prioritised and phased manner, especially because ~18,80,000 of the ~20,00,000 houses in the state are made of masonry, largely unreinforced. Thus, seismic retrofitting may benecessary.

(4) Partnership between Government of J&K, Archaeological Survey of India, and State Department of Archaeology, to plan and protect all cultural structures in state;

(5) Development of a Manual of Good Construction Practices on traditional Dhajji-Dewari construction;

(6) Dissemination of technical knowledge to professional architects and engineers in the state on the methodology for assessment and retrofittingof structures damaged during earthquakes;

(7) Development of a cadre of professionals, as part of Post-Earthquake Damage Assessment Teams, trained to have capabilities to provide sound judgement on usability of structures damaged during earthquake shaking;

(8) Prohibitany new unreinforced masonry constructions in J&K, and Retrofitexisting ones, especially critical, lifeline and governance structures with a sense of urgency, and rest in a phased manner;

(9) Documentation of all losses incurred due to damage occurredby non-structural elements, and dissemination of technical know-how to architects and engineers on methods of protecting non-structural elements in buildings and structures;

(10) Commission an investigation team to study thedetail reasons behind this loss of communication systems, and put in place systems to ensure no-blackout of communication systems in any area of the state during future earthquake events; and

(11) Encourage training of engineers each year in earthquake-resistant design and constructions; trained engineers advice all stakeholders in state on matters related to built environment.

Strategies for Risk Mitigation

Virtually, all lessons learnt from this *low-intensity earthquake* have been noticed after each of the past 10 damaging earthquakes in India, namely *1988 Bihar-Nepal* Earthquake, *1991 Uttarkashi* Earthquake, *1993 Killari* Earthquake, *1997 Jabalpur*

Earthquake, *1999 Chamoli* Earthquake, *2001 Bhuj* Earthquake, *2002 Diglipur* Earthquake, *2005 Kashmir* Earthquake, *2006 Sikkim* Earthquake and *2011 Sikkim* earthquake. The built environment does not have earthquake-resistant features and *no more earthquakes are required* to start the *tenuous* and *arduous* work in India of undertaking structural changes in governance of the country for (1)Creating the ethos for earthquake-resistant *education*, *training* and *research*, (2)Developing and enforcing *regulatory framework* to ensure compliance of earthquake-safety standards; and (3)Undertaking phased *seismic retrofitting* of at least the critical and lifeline buildings and structures.

Post-Earthquake Damage Assessment

A national program should be launched on *Post-Earthquake Damage Assessment*, to

(1) Develop *technical criteria* for post-earthquake damage assessment of different structures;

(2) Train *selected engineers and architects* in each state of the country in assessment of different typologies of that state with the help of specialists (within India and from abroad) with background to assess quickly the extent of damage and determine safety of buildings and structures for their continued use;

(3) Constitute *Post-Earthquake Damage Assessment Teams* (PEDATs) comprising of both engineers and architects;

(4) Accord legal status to *assessment criteria* and the *trained manpower to undertake the task*.

Competent technical teams should be deployed to study scientific aspects of the earthquake and their effects. Aspects to be studied include:

(1) Study of precise variation in intensity across the affected area;

(2) Study of geology of the hill slopes of affected areas that led to occurrence of landslides and affected the performance of roads along hill slopes, and give guidance on potential future slides and land use;

(3) Damages to critical and lifelines systems, e.g., bridges, water mains & reservoirs, electric supply, communication systems, schools and hospitals; and

(4) Damages to residential houses and buildings and other structures, in particular of the traditional Dhajji-Dewari constructions.

Intermediate Shelters

Urgent action is required for -

(1) Identifying acceptable engineering materials, technologies and architectural designs for construction of intermediate shelters. Also, inspiration should

be drawn from and confidence laid on traditional construction practices viz. Dhajji-Dewari Systems.

(2) Evidence based design guidelines for earthquake resistant features of these intermediate structures during the expected strong shaking.

Seismic Retrofitting

Based on the current construction practices, most of the existing structures are deficient in earthquake resistance, and demand seismic retrofitting, for which followings are suggested:

(1) Mandatory seismic retrofit should be undertaken for existing deficiencies incritical and lifeline structures.

(2) Arrangement for mobile retrofit camps or clinics with technical teams offering sound engineering advice to owners of private buildings and structures, which can be done at their own costs and consequences;

(3) Necessary legislation may have to be enforced to mandate retrofitting in at least government owned and rented structures; and

(4) Demonstration projects on seismic retrofit of existing structures of different typologies should be launched as a confidence building measure for the people, and the engineers.

Study of Housing Typologies and Guidelines for Good Construction Practices

Two prominent observations for improving the construction practices include:

(1) A large repository of good construction practices is already available related to the dominant construction typologies of the region, namely stone masonry houses, brick masonry houses, and RC constructions. The same should be translated into local language and disseminated.

(2) A strong techno-legal regime to be enforced urgently, to regulate both new constructions to be made earthquake-resistant and retrofit of existing vulnerable structures.

Development Control Regulations & Municipal Bye-laws

The urban population of J&K State (2011 Census) is indicative of the growing urbanization. The percentage share of total urban population by residence has increased from 24.81% in 2001 to 27.21% in 2011 census. Among hill states of India, J&K is the most urbanized state and cities are the focal points of urbanization. This increase in urban population puts increased pressure on urban services, social infrastructure

and housing sector. Municipal bodies are challenged by this unprecedented growth and this is compounded further with acute shortage of capacity, especially disaster risk management. While cities have become engines of economic growth, urban development has assumed utmost importance. Thus, development control regulations and municipal bye-laws should focus on the following:

(1) All the schemes shall adopt and actively implement the Bureau of Indian Standards Code of Practice for construction and earthquake safety making additional provisions in development control regulations and structural safety in building regulations / bye-laws.

(2) Provisions can be made for defining mitigation measures for risks from natural hazards as part of Building Byelaws (land use zones, structural safety on basis of hazard zones).

(3) In all the existing Acts, Rules and Bye-Laws in the State of J&K, provisions should be made for hazard risk mitigation.

(4) The development and construction activities in high seismic prone regions have to be regulated and controlled by the respective urban local body. Separate provisions may be developed for rural, town and city developments in areas affected by the earthquake.

Mobile Clinics for Earthquake Resistant Technologies

Establishment of *Mobile Technical Clinics* is one way to promote earthquake-resistant design and good construction practices. Mobile clinics manned by a small group of trained personnel, will include a trained civil engineer and a trained construction artisan, who will give advice to house-owners, engineers, developers, contractors, masons, and material supplier on earthquake safety. The clinics shall house a portable desk with resource materials (IEC materials), building prototype models which demonstrate earthquake-resistant features, and a small working model (portable shake table) to demonstrate the impact of ground shaking on buildings with seismic and non-seismic resistant features. Also, the clinics can move to construction sites of owner-built building construction or community infrastructure, such as school buildings, and offer free advice. For existing small and non-engineered buildings, which require seismic upgradation, free consultations shouldbe provided to the owners.

5.7 Earthquake Resistant Design & Construction Education

Two pronged strategy is essential for enabling engineers to undertake good construction practices, viz. *short-term awareness* and *long-term training*. Towards this end:

(1) Training to trainers - Faculty members of Polytechnics should be trained in the subjects of earthquake resistant design and construction;

(2) All the engineers and architects in the region should be imparted training of basic concepts of earthquake resistant design and construction practices of the systems commonly adopted.

(3) Formulation of comprehensive *Human Resource Development*plan for *quantum improvements* in the existing situation. Such a plan should include:

   (a) Long-term *Training of Engineers* through degree programs,

   (b) *Licensing of Engineers*responsible for new constructions and retrofit of existing constructions in the state of J&K to ensure competence ; and

   (c) *Certification of Artisans* of different trades, *e.g.,* masonry and carpentry.

Earthquakes Awareness and Preparedness Campaign

The gap areas need to be plugged urgently, to make communities prepared to face future earthquakes with less uncertainty. These are:

(1) Earthquake awareness campaigns to make people aware of the prevalent high seismic hazard, the associated perils and the needed preparedness steps to be undertaken individually and collectively;

(2) Mock drills shall be arranged in schools, hospitals, communities and offices as a regular feature to help people internalize the needed actions in the aftermath of earthquakes; and

(3) Help people appreciate the possible earthquake damages to their houses and buildings, and being able to take informed decisions on retrofitting their own houses and buildings. In particular, house owners need to appreciate the distinction between *earthquake-resistantconstructions* and *earthquake-proof constructions*.

Conclusions

Most of the Indian subcontinent is in high seismic zones. But, there is considerable increase in earthquake risk due to vulnerableconstructions that do not have required earthquake-resistant features. This reiterates the urgent need to mitigate seismic risk by outlining and strictly implementing proactive measures. Since the current stock of built environment in J&K, in general, does not have earthquake-resistant features, systematic overhaul is required at the J&K state level to formallyenforce a techno-legal regime to ensure earthquake-resistant constructions. There is a need for implementation of applicable codes and regulation enforcement by alleviating involvement of intimate professionals. A major capacity building program is essentially

required to undertake education in technical (engineering and architecture) colleges, polytechnics and ITIs of J&K state. Nonetheless, capacity building programs are required to upgrade practicing engineers and architects.

Acknowledgement

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Plan of Action for Strengthening the Forest Fire Management System in India

– Satendra[1] and A.D. Kaushik[2]

Abstract

Forest fire is a major cause of injury and loss to forests. In most of the cases forest fires are caused by human beings. In the present day context forest fire is said to have developed a dangerous relationship with the global warming by adding Green House Gases. In the present paper an attempt has been made to identify the key gaps in forest fire management through analysis of secondary as well as primary information collected from various stakeholders. A comprehensive action plan, incorporating various issues to fill the gaps has been suggested to capacitate forest departments at national, regional and local levels for making forest fire management system more effective and reducing the vulnerability of the Indian forest to fires. The plan discusses in brief various strategic areas, which need to be strengthened to make the forest department at various levels more capable of dealing with the menace of forest fire in the country. The plan gives an idea about the gaps, the goal and the strategy to be adopted to fill the gap. The plan has been developed through an interactive consultation process with a variety of key stakeholders on forest fire management within and outside of forest department.

Keywords: *Forest fire, Forest department, Forest fire management, Green House Gases*

Introduction

Forest fire is a major cause of injury and loss to forests. With the population increase, the frequency and subsequent damage of the forest fire is increasing day by day. The impact of the fire is diverse on the forest ecosystem. Besides directly damaging the forest trees, the fire also affects forest regeneration, microclimate, soil erosion, and wild life etc. adversely. In most of the cases, the forest fire causes retrogression of forest vegetation. Forest fire is one of the major degenerating factors, which extensively damages the growing stock and its generations and making area vulnerable to erosion. It has wide-ranging adverse ecological, economic and social implications. In most of the cases forest fires are caused by human beings, especially to promote new flush of grasses, collection of minor forest produce or to prepare land for shifting

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cultivation. While statistical data on fire loss in India are very weak, it is estimated that the proportion of the forest areas prone to forest fire annually ranges from 33 percent to over 90 percent in different states.

The 'disaster' brought by fire is though usually very small in geographical scales, yet its effects can spell devastation. In general there is a lack of concern about the detrimental impact of forest fire on society, mainly because the direct loss in term of human lives loss, property damage (house building, infrastructures etc.) is not much in comparison to other natural disasters like flood, cyclones, tsunami etc. However, if viewed in term of intangible impact of forest fire, it is much more than that of other common disasters. The intangible loss due to forest fire include impact on biodiversity, damage to watershed services, loss of soil fertility, increase in soil erosion and landslides etc. In the present day context forest fire is said to have developed a dangerous relationship with the global warming by adding Green house Gases. Albeit, the direct loss due to forest fire may not be much evident in economic term, its long term impacts, mainly on environment are more devastating and need sincere efforts to manage forest fires in more effective manner.

Forest fire management in India has to deliberately set to gain specific ecosystem services as a tool to reduce degradation as perceived by the beneficiary of these services, while on the other hand, the same fires may be considered by foresters, ecologists, and forest managers, to cause forest degradation. The approach of Integrated Forest Fire Management (IFFM) referred also as Community-based Forest Fire Management (CBFFM), is based on the assumption that communities can successfully incorporate fire usage into sustainable land use and vegetation management systems. According to the Indian Forest Act of 1927, setting fires is a punishable offence and it is mandatory for all forest dwellers to assist in the prevention of fire. The National Forest Policy of 1988 has the same spirit although it lays greater emphasis on the use of modern fire prevention tools while continuing to stress the involvement of local communities including Panchayati Raj Institutions, youth and women of remote particularly adivasi areas residing close to forests, who can be helpful in the prevention of fires. The present study is an attempt to fill the gaps and strengthen the existing forest fire management system by implementing a comprehensive plan of action based on identified key gaps at various levels in the country.

Managing Forest Fire: the Key Gaps

The key gaps in Forest Fire Management (FFM) have been identified through analysis of secondary as well as primary information collected from various stakeholders i.e. forest officials, policy makers and implementers, district and local level

administrative officials and staff, NGOs and CBOs representatives, and community through interaction, meetings, workshops etc. are enlisted as –

- Lack of appropriate policy and planning to tackle forest fire- Existing forest policy and other documents, including plans etc. lack clear cut guidelines for effective forest fire management.
- Lack of proper Institutional mechanism: In general forest fire management-related work in the country is carried out by the forest department along with other activities. There is no separate wing in the department, even in very fire prone regions to look after the forest fire.
- Emphasis on response only: In general response to forest fire is the main concern of forest department. Very less or casual importance is given to other issues i.e. mitigation, preparedness, human resource development, providing scientific input, awareness generation.
- Lack of proper Hazard Risk Vulnerability Assessment (HRVA) study: There is rarely any systematic hazard, risk, vulnerability analysis done in respect of forest fires in the country.
- Lack of funding: In general there is no provision for separate budget for forest fire management at state level. Forest fire management activities in general are carried out using forest protection fund. The State Forest Departments are being financially supported under Centrally Supported Schemes rationalised by the Ministry of Environment & Forests time to time and recently during 2012-13, however this allocation is not sufficient to meet the challenges
- Not many initiatives to involve local community: The local community may play significant role in forest fire management, however, except in few states, there is not much sincere effort in this regard.
- Poor response to Human Resource Development (HRD) and other capacity building initiatives: The officials and other staff of the forest departments in most of the cases are not trained and have little knowledge about forest fire and its behaviour. The forest department training institutes are also not well equipped to provide training in the field of forest fire management. Though forest fire has been included in the list of disasters (HPC, 2002), it is however, not being given due consideration in the training programmes being conducted by various disaster management training institutes at national and regional levels.
- Lack of proper contingency plan and rehearsal/ drills for fire suppression: There is need to develop a proper contingency plan at beat level and update it every year before the fire season.

- Poor early warning system: In the recent past there have been many developments in the field of early detection of forest fire using various indicators and disseminating the information received to the field staff to take quick possible action. However, the techniques and methodology used by most of the forest departments are not showing many changes and still using the traditional methods to detect fires and disseminate information at field levels. There is urgent need to revitalise the system using modern techniques and train the field staff to use them more effectively.
- Lack of preventive and preparedness measures to ensure better response: Preparedness activities like clearing fire lines, removing the fuel (dead wood, leaves etc.), recruiting forest fire watchers, making the equipment ready to use, rehearsal and drill practices, reuniting fire protection committees etc. are essential to prevent and get prepared for an any forest fire incident. But in general these issues are not taken seriously leading to frequent fire accidents.
- Lack of coordination: The coordination of forest department with other agencies, whose support may be very important in forest fire management, is very poor. The sharing of information is minimal, causing huge gaps in knowledge sharing and using knowledge available for better forest fire management planning. There is no proper coordination among research institutes in forestry sector and the service provider. Similar situation exists for the data generating institutes and the user groups. The meteorological, forest and disaster management departments may play significant role in forest fire management; however, the forest department coordination with these departments and their regional and local level offices is very poor; which prevents eliciting valuable support in detecting/ identifying forest fire and its suppression.

Plan of Action

Forest fire management in India is the mandate of the forest department, therefore it is imperative that forest department be capacitated at national, regional and local levels for making forest fire management system more effective and reducing the vulnerability of the Indian forest to fires. This needs a comprehensive action plan, incorporating various issues mentioned in the preceding text. With this background a Plan of Action for Forest Departments has been developed. The plan briefed in the succeeding text in discusses various strategic areas, which need to be strengthened to make the forest department at various levels more capable in dealing the menace of forest fire in the country. The plan gives an idea about the gaps, the goal and the

strategy to be adopted to fill the gap and make the department more effective in dealing with forest fire.

The plan has been developed through an interactive consultation process with a variety of key stakeholders on forest fire management within and outside of forest department.

Objective and purpose: The objective of the plan is to strengthen forest fire prevention, preparedness and response mechanism within the forest departments at various levels to deal forest fire more effectively.

The plan of action will be used to–

- Provide Forest Department with a framework to strengthen skills and increase capacities for FFM, enabling it to play effectively the role of a service provider in times of need;
- Upgrade Forest personnel's services to manage forest fire and reduce the risk;
- Contribute to better coordination between key stakeholders at different levels, and in particular at local levels; and
- Provide a framework within which to report performance and success.

Principles and philosophy: The plan is designed on the vision of the Government of India policy statement on Forest Fire Resolution No.13/52-F, dated the 12th May 1952, as well as New Forest policy, 1988 Resolution No. No. 3-1/86-FP, dated the 7th December 1988. Within this context the Plan of Action:

- Considers Forest Fire management as an integral component of forest management planning,
- Proposes to build on what already exists and strengthen it in respect of Forest Fire Management i.e. to upgrade the existing capacity of forest department in context of forest fire management,
- Counts on partnerships with other stakeholders, including National and State Government line departments, GOs, NGOs and CBOs, based on complementarities and mutual comparative advantages,
- Promotes the development of high professionalism in Forest department on forest fire management and
- Defines forest dwellers and other community and also country as a whole the ultimate beneficiaries.

Thrust areas proposed for forest department interventions

To strengthen Forest Department in respect of Forest Fire Management, the identified main result areas (MRA) are as follows:

1. Institutional Setup for Forest Fire Management within the Forest Department at various levels
2. Policy frameworks for Forest fire management
3. Capacity building and awareness creation
4. Technical options for forest fire management
5. Collaboration and coordination
6. Strengthen Early Warning System

Institutional Setup for Forest Fire Management within the Forest Department at various levels

Gaps to be Addressed: At present there is no specific entity mandated within Forest Department to be responsible for fire risk reduction. The new role of Forest Department in FFM requires a well defined institutional set up, partnerships and networks.

Goal: Ensure efficient institutional mechanism within Forest Department at various levels covering all aspects of FFM and coordinating with other stakeholders and role players.

Proposed Strategies: What needs to be done?

- Institutionalise capacities for FFM in forest department
- Develop a well defined institutional framework within forest department at national and state levels
- Identify duties and responsibilities of various role players in the newly developed framework

Proposed Institutional Framework

Keeping in view the severity of forest fire, the existing organisational structure, both at central and state level seems to be unsatisfactory. At present, the Forest Protection Division, headed by Inspector General (IG) level officer looks after the forest fire management work at national level. It is required that for an effective dealing, a

separate division is to be established for forest fire management, which exclusively can address this issue. Air Operation Wing, which has been wrapped up long back, may again be operated to tackle any unforeseen severe forest fire as of 1995 in Uttar Pradesh and Himachal Pradesh. Establishing such wing, though a costly affair, may also be used for regular forest surveys and other associated activities. The wing is to be established at par with international standard to face any type of mishappening. The air craft or helicopters of the wing may also be utilised during other types of disasters like flood, earthquake etc. and may be very useful in supplying relief and rescue team without wasting time.

The Ministry of Environment & Forest has regional offices, which act as coordinating offices with the state forest departments. These offices may be used to regulate forest fire management activities and for this a separate wing may be established exclusively to look after forest fire.

At State level, the forest fire management operations are looked after by regular forest staff, which is already over burdened. It will be appropriate, if a separate wing is established at state forest headquarter, headed by Chief Conservator of Forest level officer. This wing may work in collaboration with central level unit and provide all types of guidance, supervision etc. to all forest divisions of the state regarding forest fire management. In the lean period, the wing may work on data compilation, preparedness and mitigation measures. Training programmes for forest officials in fire fighting may also be organised at training schools. Sufficient fund provision is to be made for research and development and suitable projects may be sanctioned to state level research institutions to establish a strong data-base. The wing in collaboration with publicity division of the forest department may carry out effective awareness generation programmes among community through various Information, Education and Communication (IEC) materials. In sensitive areas, Forest Fire Protection Committees may be established ensuring community participation. During forest fire situation, this wing may work as Emergency Operation Centre (EOC) equipped with all communication and other facilities and may supervise and guide suppression work. In the case of severe fire conditions, necessary assistance may be sought from central level too, if required.

Depending upon the severity of the situation, similar arrangements may be made at Divisional level too. In fire-prone divisions, a range office or Assistant Conservator of Forest (ACF) level officer may be deputed to look after all forest fire related activities of the division under the overall supervision of Divisional Forest Officer.

Policy framework

Gaps to be addressed

The present policy/planning documents do not give due consideration to Forest Fire Management. Revised key policy documents need to incorporate clear guidance about Forest Department and other stakeholders' role and contribution to FFM.

Goal

Revised policy and planning framework includes FFM in more comprehensive and systematic manner.

Proposed strategies

- Incorporate FFM issues in existing policy and planning documents in more systematic way: Though National Forest Policy 1988 is in place, yet there is need to incorporate clear cut guidelines and responsibilities of different role players to capacitate forest department and other stakeholders to manage forest fire in more systematic manner.
- Develop/update forest fire manuals for field staff for guiding them in simple way, to detects report about and suppress forest fire and handle related issues.
- Incorporate FFM issues into other national/regional/local level Disaster Risk Management programmes.
- The approach to fire management at the policy level runs counter to the approach to fire management at the level of local, forest-dependent communities. The approach to fire management at the policy level also runs counter to the possibility that some ecosystems may have evolved with fire as a natural disturbance, and that fire is an essential component in dynamics of ecosystem. The mismatch between the policy level and local level approaches to fire management is likely to exist so long as there are people who directly depend on forests for their livelihoods.

Though legal and policy framework exist in favour of fire protection, there is need to strengthen and make it more practical and implementable. Existing acts though quite effective in forest and wild life conservation, do not give specific attention to forest fire management. Since in more than 90 percent cases forest fire is a human-induced phenomenon, there is urgent need that some special Act be formulated and enacted to provide appropriate legal frame-work at national and state level both. Such Forest

Fire Prevention Act will also strengthen the forest department in controlling and checking the illegal activities within or near the forest, leading to severe forest fires.

Subject to the enactment of suitable legislation, it is also necessary to evolve detailed regulations to help in enforcement of the law. The existing codes/regulation/laws related to forest / wildlife protection and preservation are to be reviewed and suitable mechanism be evolved for their effective enforcement.

Knowledge management, capacity building and awareness generation

Gaps to be Addressed

The knowledge of Forest staff about FFM and the operational skills needed to implement fire prevention, preparedness and suppression activities needs to be updated and upgraded. Therefore, awareness creation and capacity building on FFM are keys. There is also a lack of knowledge and awareness about FFM at the community level. Forest department can play a crucial role in creating awareness and translating FFM policies into concrete action.

Goal: Use knowledge and training to build a culture of innovation, safety and resilience, and institutionalise training on FFM for Forest Department, other role players and also at community levels.

Proposed strategies

Enhance and maintain Forest fire specific data base and enlist good practices: Forest fire specific data is very limited and if available, not very reliable. For most of the states, forest fire database is either not available and if available is very sketchy. This prevents in designing an appropriate forest fire management planning and to make necessary resources available to deal the problem effectively. There is need to use modern scientific technique to collect, compile and document forest fire-related data. To prepare an effective strategy for forest fire management, it will be of immense significance that a robust and sound information data base is prepared. The Forest Survey India may be strengthened to collect and compile strategic information regarding forest fire at national level. Efforts are required to be made at state level also to verify and enrich data network.

The data network may consist of:-

- Information about climate, weather, etc.
- Historical documentation of forest fires, including location, type of vegetation, history, causes and other details.
- Number of forest fires, the area burnt and other adverse impact.

- Type of vegetation burnt, the flora and fauna of the area.
- Resources, including human resource available with the state govt. to detect and and combat forest fire.
- Other area-specific relevant information.

  Various modern techniques including remote sensing may be used to collect and compile information related to forest fire. Remote sensing, GIS etc. can provide data base which can be used in forecasting and locating forest fire, its extent and appropriate technique to suppress the same.
- Documentation of good practices: At national and international levels there are many good practices in forest fire management. There is need to document such practices in proper way so that good lessons are adopted for utilise them in making forest fire management system more effective and practical. These good practices need to be shared with other stakeholders and role players to be implemented with an objective to reduce fire risks.
- Systematically utilise outputs and knowledge created by different projects for FFM: Several forest fire management-related projects has been implemented in different states in the past with national and international support. The learning and outputs of these projects will be of immense use in making forest fire machinery at national and state level more effective.
- Develop/update operational field manuals and guidelines for field staff with sufficient inputs on FFM: Several state forest departments have developed field manuals for forest staff; however, such manuals in general lack proper guidelines and techniques to detect, communicate and suppress forest fires. There is need to upgrade such manuals and develop new ones in the states where such manuals are not available.
- Enhance capacities of Forest Department training institutes and trainers: Almost all the state Governments have their State Forest Training Institutes and Colleges. Forest fire management needs to be an integral part of course curricula of these institutes. The course being taught in such institutes about the forest fire management should be updated and enriched with latest information about forest fire detection, suppression and rehabilitation.
- DM institutes: For wider dissemination of forest fire management knowledge and capacitating more resources and skilled force, it is required that forest fire management be included in the course curricula of the Disaster Management Institutes at national and regional levels. It will also help in better coordination among forest department and disaster management functionaries.

- Increase community awareness: Community participation has proved very useful in forest fire management. More people participation may only be ensured by making community aware about the significance of FFM and its benefit to community. Different methodology and IEC means may be used for it. As in more than 90 percent cases forest fire is ignited by human being, community awareness can play significant role in preventing forest fire.
- Local people particularly of adivasi areas should be involved through participatory and/or community-based approaches including environment-friendly sustainable livelihood programmes implemented at village level. Because they are often main actors in landscape fire management activities, they suffer directly from the fires which threaten their livelihoods and might also be involved in some of the fire causes.
- Local publicity through mass media and cultural activities like dramas/melas should be organised in forest fire-prone forest areas. The publicity can be carried out by using IEC materials such as pictorial booklets and brochures being designed for generating awareness and publicity amongst local people and the field staff of forest departments time to time by MoEF and National Institute of Disaster Management (www.nidm.gov.in.

Assess and monitor forest fire risks and enhance sustainable application of warning systems

Gaps to be Addressed

For the efficient and timely generation and transfer of information related to fire warning it is necessary to enhance the capacity of forest management functionaries at various levels to generate timely warning and translate it into useful information for field staff and others. In addition there is need to prepare forest fire vulnerability maps based on past experiences and other variables like forest vegetation, weather conditions etc.

Goal

Increased capacity in generating relevant warning, increased understanding of warning systems by forest management functionaries and sustained support and coordination between the partner organisations.

Proposed Strategies

- Capacity building for the better use of early warning (technical efficiency and HRD): The forest officials need to be trained in using various indicators to get

prior information about forest fire and identify them in time to take timely action. The forest department may be provided with necessary equipment for detecting forest fire at the earliest possible. Forest officials are to be trained in using valuable information, available at national and international levels and translate it into local languages.

- Strengthen collaboration with partner organizations involved in generating warning: Necessary collaboration is required with organisations involved in generating early warning about forest fire. Meteorological Departments and other national and international sources providing weather-related information may be collaborated to get prior information about the temperature and rainfall situation, which are two main deciding factors for forest fires.
- Disseminate refined early warning product outputs at field levels in user-friendly way: The information available from different sources need to be dovetailed for making use at local level and necessary arrangement be made to disseminate this information at field level for appropriate preventive, preparedness and response actions in time.
- Assess risks and prepare vulnerability & risk maps: To get prepared and necessary preventive measures in time it is necessary that the vulnerability/ risk maps of forest area be prepared, depending mainly on past history, climatic conditions and other human-induced factors like population density, socio-economic conditions etc.

Technical Options to Reduce Underlying Risks

Gaps to be Addressed

A significant amount of technical options to assist Forest Department in increasing their resilience, preparedness and response capacities against forest fire are known and available at regional, national and international levels. However, the spectrum of available options is often not known or easily accessible. To make FFM more effective, it is of utmost significance that available options are systematically assessed, documented, shared and adapted to location-specific needs in a participatory way.

Goal

Increased capacity to manage forest fire, involving community and using a variety of tested technical interventions.

Proposed Strategies

- Assess indigenous knowledge and techniques to detect and suppress forest

fire, and upgrade it with scientific inputs and research: At local and regional levels many indigenous techniques and knowledge are available, there is need to compile and collect such information and upgrade with scientific input and field test to find its suitability in making forest fire system more effective, useful and less expensive.

- Promote FFM-related research and technology innovations: The research institutes involved in forestry and related research may be pursued to do research in developing appropriate techniques in getting prior information about forest fire, detecting it, and suitable mechanism to suppress it.
- Technology transfers at various levels and use it with required location-specific modification, involving scientific inputs: Tested and useful technologies in forest fire management may be shared at regional, national and international levels. The technologies such borrowed need to be further modified as per the location-specific requirement.

Collaboration and Coordination

Gaps to Be Addresed

To address the issues of forest fire management effectively, forest departments need to strengthen collaboration with other organisations and agencies, such as Disaster Management Authorities (National, Regional levels), Meteorological Departments, Research institutions and other stakeholders and role players.

Goal

A strategy and operational mechanisms in place in forest departments for efficient coordination and collaboration.

Proposed strategies

- Enhancing collaboration with Disaster Management Authorities: Forest Department is challenged to develop a strong operational mechanism for close interaction with the Disaster Management Authorities at national and regional levels aiming to mainstream forest fire disaster in the disaster management agenda of these institutions. Forest Department needs to share forest fire-related data and other relevant information with the Disaster Management Institutes at national and regional levels for optimum utilisation. While redesigning its training policy, Forest Departments will seek optimum support from disaster management departments.

- Strengthening linkages with other stakeholders at national level: Forest Department will intensify its collaboration with other GOs, CBOs and NGOs, through the introduction of an annual technical working session, organises hosted by the DRM Core Group; these sessions will focus on annually selected technical areas of joint interest; they will have the main purpose of experience/ information sharing and enriching and sharing of training material and modules.
- Sharing knowledge about forest fire management-related technologies: Through the dissemination of its quantitative and qualitative forest fire-related information through the Disaster Management Information Centre (DMIC) forest departments will increase accessibility of its data to the wider audiences, including NGOs and CBOs.

Conclusion

In present scenario forest fire management system of the country needs a comprehensive action plan to strengthen the forest departments at various levels to be more capable of dealing with the menace of forest fire in the country. This plan of action has been developed through an interactive consultation process with a variety of key stakeholders on forest fire management within and outside of forest departments. Thus it is comprehensive and provides an idea about the gaps, the goal and the strategy to be adopted to fill the gaps and make the forest departments more effective in managing forest fire by the involving the local communities including Panchayati Raj Institutions, youth and women particularly from remote or adivasi belts prone to forest fires through the implementation of environment-friendly sustainable livelihood programmes at local level.

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Disaster Preparedness and Risk Reduction - Significance of Empowering Panchayati Raj Institutions

– Dr. K. Gireesan[1]

Abstract

Passing the 73rd and 74th Constitutional Amendment Act was a defining moment in the history of decentralisation of political power in India. These amendments have resulted in changing the dynamics and equations of power significantly in the country at the cutting edge levels. The uniqueness of Local Governments is that it not only provides direct participation of people in administration but also plays an important role in bringing good governance at the grassroots through various dimensions like accountability, transparency, responsiveness, equity, inclusiveness, effectiveness, efficiency and consensus. This paper highlights the significance of empowering the Panchayati Raj Institutions (PRIs) in the process of disaster preparedness and risk reduction. PRIs can analyse the hazard, risk, vulnerability and capacity effectively, which is imperative in disaster preparedness and risk reduction. Being close to the people and by virtue of its sheer mandate for local leadership, they have a greater responsibility to take all possible efforts to forecast, prepare and meet any such eventualities. Local knowledge about the resources, facilities and support systems, and the alternative options are crucial in disaster management. In addition, PRIs are in a better position to understand the social vulnerability of the disasters, and to address its differential impacts on children, women, differently abled, the sick and the elderly. To perform effectively and efficiently during disasters, PRIs must have an organisational set up, a disaster management plan for the village and capacity building of its stakeholders. Local Government is the most important political institution to realise 'community-based disaster preparedness' by ensuring active involvement of elected members of PRIs, officials at the local level and community members. While conceiving and operationalising the capacity building programmes, emphasis can be given to youth who may bring in new ideas, approaches, strategies and practices in disaster preparedness and risk reduction.

Keywords: *Disaster Preparedness, Empowerment, Panchayati Raj Institutions, Social Vulnerability, Capacity Building, Role of Youth*

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Introduction

Disaster is a sudden calamitous event bringing great damage, loss, destruction and devastation to life and property. It results in a serious disruption of the functioning of the society, causing widespread human, material or environmental losses which often exceed the ability of the affected society to cope with it, using its own resources. The damage caused by disasters varies with the geographical location, type of earth surface, climate, degree of vulnerability, etc. Disaster influences the mental, socio-economic, political and cultural state of the affected area. The damage caused by the disaster is not easily measurable and may have ever-lasting impacts on the psyche of those affected and survivors.

National Disaster Management Act (2005) views disaster as 'a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man made 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'.

India has a large land mass with diverse geo-agro-climatic zones. The country has varying topographical features ranging from the great mountain zones (Himalayan region), plain lands (Indus-Ganges-Brahmaputra regions), deserts (Kutch and Thar regions) and the peninsular region (South of Vindhya mountains). The country also faces diverse climatic conditions like snow-clad regions almost throughout the year in Himalayan regions, varying climate at different times in plain lands, extreme climates in deserts and moderate climate in the peninsular region. India has been traditionally vulnerable to natural disasters like floods, droughts, earthquakes, landslides and cyclones, on account of its geo-agro-climatic zones. Because of very large geographical size of the country, India often faces natural hazards like floods, cyclones, drought, etc. occurring frequently in different parts of the country. Significantly, some of the areas that are normally subjected to drought situations may be flooded in subsequent years and vice versa.

India is vulnerable, in varying degrees, to a large number of natural as well as man-made disasters. National Policy on Disaster Management (2009) reported that 58.6 percent of the landmass is prone to earthquakes of moderate to very high intensity; over 40 million hectares (12% of land) is prone to floods and river erosion; of the 7,516 km long coastline, close to 5,700 km is prone to cyclones and tsunamis; 68 percent of the cultivable area is vulnerable to drought, and hilly areas are at risk from landslides and avalanches. The country has several unique features which add to its

vulnerability like very large population, large number of housing units, significant size of BPL population, significant number of illiterate population, lack of sanitation coverage, non-availability of potable water to all, poor health, low nutrition intake, poor infrastructure, absence of multi-purpose institutional facilities, etc.

Disasters differ in terms of their nature and extent of impact. Disasters like earthquakes and landslides occur suddenly but are restricted in their impact in terms of time and space. Cyclones and floods occur with some element of warning, but their occurrence is confined in duration. Drought spans over a much longer time frame and its adverse impact on the economic activities and the life of an area is more lasting. As the nature and extent of impact of disasters differ, the measures for disaster preparedness also vary significantly.

One of the UNDP documents defines 'Disaster preparedness' as that 'minimises the adverse effects of a hazard through effective precautionary actions, rehabilitation and recovery to ensure the timely, appropriate and effective organisation and delivery of relief and assistance following a disaster' (Kent, 1994). The same document highlights the differences between 'active' and 'passive' forms of disaster preparedness measures. 'Passive' aspects of disaster preparedness incorporate the preparation of disaster manuals, stockpiling of relief goods and the development of computerised lists of resources and personnel, whereas 'Active' aspects include developing comprehensive response plans, monitoring hazard threats, training emergency personnel, and training members of the communities at risk. In this context, as a prelude to the discussions on disaster preparedness, certain disastrous events affected in the South-Asian region will be highlighted.

In October 1999, the super cyclone hit the coastal districts of Odisha, causing immense loss of human lives, livestock, agriculture and ecology, in addition to destruction of property. Balasore, Bhadrak, Cuttack, Dhenkanal, Gajapati, Ganjam, Khurda, Keonjhar, Mayurbhanj, etc. were some of the most affected districts of Odisha. On 26 January 2001, a devastating earthquake measuring 6.9 on the Richter scale shook different parts of Gujarat, the areas of Kutch and Bhuj were affected badly with death and destruction all around. In December 2004, an earthquake of magnitude 9.0 on the Richter scale in the Indian Ocean triggered a Tsunami that seriously affected the coastal areas of Thailand, Srilanka, Maldives, and many other countries. The Tsunami caused extensive damages especially in the southern coast of India and the most affected areas were Andaman & Nicobar islands, parts of Tamil Nadu, Puducherry and Kerala. The official death toll in India was reported around 11,000 which excluded many thousands missing from the islands of Andaman & Nicobar. During June – July 2013, flash floods and cloud bursts affected several parts of Uttarakhand resulting

in loss of several human lives and animals, severe damage to infrastructure, and irreparable loss to the environment. After each disaster, lack of preparedness used to be reported by the media. Reports published in major dailies like The Hindu, Indian Express, The Times of India and Deccan Herald in English and, Malayala Manorama and Mathrubhumi in Malayalam during June-July 2013 portrayed the magnitude of damage caused in Uttarkhand. No doubt, better preparedness measures, the casualty and damages owing to disaster could have been brought down significantly. Interactions with the personnel involved in the relief and rehabilitation of the 2013 floods in Uttarakhand indicated that the disaster in the State affected the livelihood of people in the area significantly the author held discussions with functionaries of Pragya, Janamaitri Kalpgathi Youth Organisation, NGOs actively involved in the relief and rehabilitation works in Uttarakhand.

Disasters indicated above point towards the need for a holistic and integrated approach in disaster management, with thrust on measures for preparedness and risk reduction. Setting up of the High Powered Committee on Disaster Management was the first major initiative by the Government of India in this direction. The Committee was set up in August 1999 by the Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India along with the National Disaster Response Plan. The scope and mandate of the Committee was enlarged in April 2000 to cover man-made disasters also, in addition to chemical, industrial and nuclear disasters. The report of the High Powered Committee on Disaster Management (2002) advocated for ushering in a new culture of disaster management which will stand on the four pillars - culture of preparedness, quick response, strategic thinking and culture of prevention. The report, while explaining the culture of preparedness, explains that destruction from natural hazards can be minimised by the presence of well-functioning warning systems, combined with preparedness on the part of the vulnerable community. Warning systems and preparedness measures reduce and modify the scale of disasters. A community that is prepared to face disasters, receives and understands warnings of impending hazards and resorts to precautionary and mitigatory measures, is able to cope better and resume normal life sooner.

National Disaster Management Act (2005) laid down institutional, legal, financial and co-ordination mechanisms at different levels. The Act clearly indicated that these institutions are not parallel structures and will work in close harmony. The Central Act advocated for a paradigm shift in Disaster Management from relief-centric approach to a pro-active approach that lays greater emphasis on preparedness, prevention and mitigation for conserving developmental gains and to minimise loss of life, livelihood and property. It also paved way for new institutional mechanisms

like National Disaster Management Authority (NDMA), State Disaster Management Authority (SDMA), District Disaster Management Authority (DDMA), National Institute of Disaster Management (NIDM), National Disaster Response Force (NDRF), etc. As a natural follow-up to the promulgation of Act, NDMA brought out several disaster-specific guidelines, which enabled the practitioners and other stakeholders in managing disasters more effectively and efficiently.

National Policy on Disaster Management (2009) visualises a holistic and integrated approach towards disaster management with emphasis on building strategic partnerships at various levels. Community-based disaster management, capacity development in all spheres, etc. were some of the themes underpinning the policy. The objectives of the National Policy on Disaster Management are:

- Promoting a culture of prevention, preparedness and resilience at all levels through knowledge, innovation and education.
- Encouraging mitigation measures based on technology, traditional wisdom and environmental sustainability.
- Mainstreaming disaster management into the developmental planning process.
- Establishing institutional and techno-legal frameworks to create an enabling regulatory environment and a compliance regime.
- Ensuring efficient mechanism for identification, assessment and monitoring of disaster risks.
- Developing contemporary forecasting and early warning systems backed by responsive and fail-safe communication with information technology support.
- Ensuring efficient response and relief with a caring approach towards the needs of the vulnerable sections of the society.
- Undertaking reconstruction as an opportunity to build disaster resilient structures and habitat for ensuring safer living.
- Promoting a productive and pro-active partnership with the media for disaster management.

Among the objectives listed above, certain key words like traditional wisdom, developmental planning, efficient mechanism for identification, and caring approach towards the needs of the vulnerable sections of the society could be well

integrated with the attributes of Local Governments. However, a review of disasters mentioned above and post-disaster interventions in these affected areas indicate that the Local Governments had no specific role. It is reported that 'they had practically no stake in the disaster management – no administrative decisions or operational activities pertaining to prevention, mitigation, preparedness, response, recovery or rehabilitation' (Placid, 2006).

A document by the Trust for Village Self Governance (2007) highlighted that 'We must equip our Panchayat for effective disaster management. It is the body vested with first response to disaster and front line response to disaster. The Panchayat needs a plan and the process should be participatory'. It is noted that the process of developing the village-specific plan is equally or more important than the end-product, looking from the view of empowering PRIs and members of youth organisations.

This paper attempts to document the role of PRIs in disaster management through its different phases. It analyses the efforts for capacity building of elected members of PRIs, officials of local level institutions (including those from Gram Panchayat, School, Anganawadi, Balavadi, Health Centre, Village Administrative Office etc.), and community members by examining the measures for disaster preparedness and risk reduction. It highlights the significance of empowering Local Governments by suggesting several areas to be incorporated in the capacity building sessions, for elected members of PRIs, officials, members of youth organisations, and other stakeholders.

Methodology

Interactions and deliberations with the key informants formed the major inputs for this paper. Elected members of PRI from different parts of the country provided useful inputs for the deliberations (the author interacted with the elected members of PRIs from Assam, Bihar, Jammu and Kashmir, Jharkhand, Kerala, Meghalaya, Nagaland, Sikkim, Tamil Nadu, Tripura and West Bengal, as part of capacity building programmes organised for them). As they are local leaders and opinion makers, they are able to bring in positive approaches and attitudes among the community. In addition, office bearers of political organisations, functionaries of non-political organisations and other members of community also provided the inputs. Among the elected members of PRIs, necessary efforts were made to interact with more young men and women respondents using semi-structured interview schedule. These categories of respondents were preferred as they are more active, challenge-taking, dynamic, and may bring in new ideas, approaches, strategies and practices. In addition, it is hoped that they shall ensure active participation of the community

in disaster-related activities. Focus Group Discussions (FGDs) were held with the office bearers of youth wings of major political parties across the country (Assam, Bihar, Jharkhand, Kerala, Sikkim, Tamil Nadu, Tripura and West Bengal) towards understanding their involvement and participation in disaster preparedness. Interactions with the functionaries of non-political organisations like Youth Clubs, mahila mandals and Self Help Groups (SHG) in Andhra Pradesh, Jharkhand, Karnataka, Kerala, Lakshdweep, Odisha and Tamil Nadu were also undertaken using semi-structured interview schedule. These deliberations provided several useful inputs to highlight the role of different stakeholders during demanding situations. In addition, the researcher interacted with the officials of various local institutions like Schools, Health Centres, Anganawadis, Public Distribution System (PDS) shops, Agriculture Office, Veterinary Hospital, etc., who also provided with several useful inputs.

Regarding the process of data collection, interactions with the elected members were made either in Panchayat office, in public place or in their homes. Interviews with most of the elected women members were organised in their home itself, as they felt more comfortable there, when compared to the Panchayat or other public places. FGDs were held with the office bearers of youth wings of major political parties in public places like Schools, Libraries, etc. Deliberations with the functionaries of non-political organisations were organised mostly in public places. In most of the cases, the interviews and FGDs with the respondents were held after fixing the date, time and venue as they were busy in various engagements.

Role of Panchayati Raj Institutions in Disaster Management

Constitutional status to Local Government was an important moment in the history of decentralisation of political power in India. It has brought in a paradigm shift in the operational domain of local governance in the country. The 73rd and 74th Constitutional Amendments enabled the Local Governments with the power, authority and resources to function as 'units of self government', though with varying levels of initiative, drive, interest, intensity and diversity of operations in practice. Drawing power and inspiration from the Constitution of India, the Local Governments have started assuming the centre stage by ushering in effective, efficient, people-centric and responsive system in decentralised governance, at least in the selected areas of the country.

Impact of the historic constitutional amendments has resulted in changing the dynamics and equations of power significantly at the local level. The uniqueness of Local Government is that it not only provides direct participation of people

in administration but also play an important role in bringing good governance at the grassroots through various dimensions like accountability, transparency, responsiveness, equity, inclusiveness, effectiveness, efficiency and consensus. It is also noted that the significance, operations and the impact of PRIs across the country are improving over the period, despite wide disparity in their approach and extent in different parts of the country.

The Report of High Powered Committee on Disaster Management (2002) indicated that disaster management should be seen as a part of good governance. It is viewed that Local Governments can be effective instruments in tackling disaster through early warning system. They can be relied on at the time of relief distribution, providing shelter to the victims, medical assistance, etc. since they are closer to the communities. They are in a better position to undertake such tasks than the State and Central government. The report viewed that creation of motivation, community level coordinated action, disaster mitigation education, etc. are all tasks that can be provided by the Panchayats and Urban Local Bodies. For the above, it is required that they be involved in the formulation and implementation of disaster management plan and subsequently look into the short term, medium term and long term development plans.

National Policy on Disaster Management (2009), highlighted that 'local authorities like Panchayati Raj Institutions (PRIs) and Municipalities will ensure capacity building of their officers and employees for managing disasters, carry out relief, rehabilitation and reconstruction activities in the affected areas and will prepare Disaster Management Plans'. While citing the role of State, District and Local Authorities, it is reported that 'the local authorities like PRIs and Municipalities will play a significant role in the entire process, particularly in response and rescue operations, relief and rehabilitation, awareness generation and disaster preparedness, restoration of livelihood options and co-ordination with NGOs and civil society'.

It can be seen that Local Governments in rural as well as urban areas have an important role to play in disaster management, with special reference to disaster preparedness and risk reduction. Some of the major roles of Local Governments in different phases of disaster management (Gireesan, 2011) are discussed in the subsequent section.

Role of Local Governments in the Pre-Disaster Phase

Local Governments are expected to carry out the following, in line with the measures for disaster preparedness.

(i) Initiate the 'Mapping of Resources and Facilities' in and around its functional area with emphasis on their suitability for disaster management. For example, identifying temporary locations for keeping evacuated persons, storage of food, drinking water, medicines, etc., availability of necessary equipment and its status like tractors, trolleys, JCB, etc., list of human resources with their skill-sets like doctors, engineers, nurses, plumbers, electricians, etc., and, list of emergency items to be procured.

(ii) Carry out 'Vulnerability Mapping' of the area and update the vulnerability profile at regular intervals.

(iii) Prepare an 'Evacuation Plan' with priority for children, women, differently abled, the sick, and the aged.

(iv) Devise an 'Early Warning and Reporting System' with the list of Nodal persons from the functional area and update their status at regular intervals.

(v) Prepare a directory of blood donors, youth volunteers, etc. with contact address and update their status.

(vi) Constitute a 'Disaster Management Cell' at the local level which will act as a 'Core team' for all the activities. Each member of the core team will be assigned with specific responsibilities (Main and Stand-by) to avoid overlapping and duplication of efforts.

(vii) Capacity building of different stakeholders will be organised at regular intervals: every family to prepare the 'emergency kit' in case of an emergency; every official on documenting vital information for disaster management; every citizen on 'Disaster-specific drills'; every youth volunteer on application of first aid, carrying out safe evacuation procedures, operation of stand-by power and communication equipment, etc.

(viii) In case of an early warning about the onset of disasters, core team member will brief the nodal persons about the disaster plan and their expected assignments.

(ix) Formulation of a Plan for Disaster Management in the area, with inputs from elected members of PRIs, officials, village elders and community members.

(x) Setting up of community volunteer teams for search and rescue, communication, first aid, preparation of shelter, provision of food and water, maintenance, etc. The teams may consist of primarily consisting of elected members of PRIs, representatives of youth organisations, community leaders and other stakeholders. Capacity building programmes for the members of these volunteer teams need to be taken up in this phase.

It is noted that the role of Local Governments in the 'pre-disaster phase' is significant, as they are expected to take appropriate measures for disaster preparedness and risk reduction. Local Government is in a better position to analyse the hazard, risk, vulnerability and capacity effectively, which is imperative in disaster preparedness and risk reduction. Local knowledge about the resources, facilities and support systems, and the alternative options are crucial in disaster preparedness. Being close to the people and by virtue of its sheer mandate for local leadership in its functional area, the Local Government has a greater responsibility to take all possible efforts to forecast, prepare and meet any such eventualities. And, they are in a position to understand the social vulnerability of the disasters, and to address differential impacts of disasters on different sections of the society, with special reference to children, women, differently abled, the sick and the elderly from their functional area. Based on the above, they are expected to formulate a 'Disaster Management Plan' for the village, which is an essential component for disaster preparedness and risk reduction. For effective application, this plan needs to be revised at specified intervals depending upon the changes in environment, availability of resources and facilities, etc. In this phase, Local Government is expected to function as a '*Leader*', through mapping of resources and facilities, formulation of a plan and constitution of a team with defined functions and responsibilities. It is also expected to take up appropriate measures to develop the capacity of different stakeholders towards systematically and comprehensively address the situation.

When compared to other levels of government, role of PRIs in the pre-disaster phase is quite unique and significant. It is unique for a simple reason that it is the nearest government to the people; and it is significant, as it is expected to take appropriate measures for disaster preparedness, depending upon the local context. However, interactions with elected members of PRIs, officials, functionaries of Youth Clubs, Mahila Mandals, SHGs and office bearers of youth wings of major political parties revealed that the measures adopted towards the disaster preparedness and risk reduction are far below expectation. Interactions with the different stakeholders revealed that the preparatory measures were limited to formation of a core team in certain areas. It was noted that there was no proper allocation of responsibilities to the members of the core team, which ultimately reflects the presence of the team in theory rather than in practice.

Role of Local Governments in the Disaster Phase

During the onset of any disaster, the following activities are expected to be taken up by the Local Governments.

(i) Opening of a 24 x 7 emergency control room with necessary data bank about the resources and facilities, communication equipment, back-up power and staff.

(ii) Core team members are to be available in the control room, round the clock, for continuous monitoring of all the activities.

(iii) Convene an emergency meeting of all political parties, non-political bodies and Community-Based Organisations, towards seeking support and enabling co-ordination.

(iv) Ensure that all communications, both out-going and incoming, are to be channelised through a single point.

(v) Collect the field data from the nodal persons, verify the information, collate them and communicate the same to the Block and District administration.

During disasters, people look up to the Local Government at the first instance, for addressing their basic needs, concerns and issues. Being the nearest government, it is likely that the affected persons will approach the Local Government for their basic services and other requirements. And to perform up to their expectation, the Local Government must be adequately equipped to tackle such situations with efficiency and speed. PRI is expected to gear up its activities to take all possible steps to monitor the situation and ensure that forward and backward communication is established at the earliest. They are expected to gather and verify that the information furnished is 'correct and complete' to enable them to seek and receive necessary support from the District Administration and other agencies. In this phase, the PRI is expected to perform as a '*Co-ordinator and Communicator*'.

Interactions with the different stakeholders indicated that the PRIs played only a limited role in this phase. During disasters, it is reported that many Local Governments did not even open a control room and even where it was started, it did not have the minimum required facilities like communication facilities and stand-by power. There was no record of communication received from different parts of the area and communication forwarded to the Block/ District Administration. Significantly, no emergency meeting of various stakeholders was convened by the Local Government. All these show that there was no sign of any significant role played by the PRIs during the disaster phase.

Role of Local Governments in the Post-Disaster Phase

Local Governments are expected to perform the following in the post-disaster phase.

(i) Ensuring provision of basic needs like drinking water, food, clothes, etc. to the needy.

(ii) Regulating the supply of ration, utencils for kitchen and dress and ensure their supply to every needy family.

(iii) Construction of temporary shelters and sanitary facilities, with thrust on women, differently abled and aged.

(iv) Ensuring supply of water purifying tablets and emergency medicines; organise medical camps at different parts.

(v) Ensure continuity to the food and nutrition programme for children, adolescent girls and pregnant mothers through Anganawadis.

(vi) Co-ordinat the activities of government departments, non-governmental agencies and community-based organisations for providing livelihood support for the affected families and ensure their optimum benefit.

(vii) Restoration of education and other basic services to the citizens at the earliest opportunity.

(viii) Restoration of livelihood assets like roads and infrastructure in the locality.

(ix) Providing psycho-social care to the needy persons, to enable them to get over the traumatic period.

Local Government has an important role to perform in the rescue, relief, rehabilitation and reconstruction activities during the post-disaster phase. In this phase, it is expected to function as '*Provider, Co-ordinator and Facilitator*'. It has a primary function as a 'Provider' of various basic services and facilities, followed by special services depending upon the local context. In addition, its role is visualised as a 'Co-ordinator' as co-ordination of various activities in the field cannot be successfully carried out without the active involvement of PRIs. Being the government institution at the grass root level, PRI is expected to take the role of a 'Facilitator' also, as they are notified as the nodal point for distribution of food and other basic services. In addition, they are in a better position to examine the differential impacts of the disaster among the members of community.

Interactions with the elected members of PRIs, officials and citizens revealed that the Local Governments played an important role during the disaster phase, with their active involvement in rescue and relief. They took special efforts to provide drinking water, food, clothes, medicines and other basic services, with the support of district administration, non-government organisations (NGOs), CBOs and

others. Construction of temporary shelters, starting community kitchen, organising medical camps, arranging mobile medical facilities, etc. were some of the significant activities carried out by the PRIs in this phase. However, the efforts made by the PRIs in providing livelihood activities, rehabilitation and restoration activities in their functional area were not satisfactory. It may be owing to the reason that they did not have the adequate administrative, functional and financial autonomy to conceive such initiatives and interventions or they have not received the required support from the State Government, District Administration and other agencies. It is noted that they were able to provide the services with the limited resources and facilities at their disposal, but could not take up any long-term projects without the required support from Government Departments and other agencies. This may be so because they have not documented the extent of disaster occurred and could not scientifically project their requirements to the Government and other funding agencies or they could not receive the requisite support and guidance in this direction.

Towards functioning effectively and efficiently during disasters, Local Governments must have the following: an organisational set up, a specific disaster management plan and capacity building of its stakeholders. The organisational set up for meeting any eventualities must include representatives from all major stakeholders. It must have a disaster management plan with the details of resources, facilities and equipment for any rapid action. The plan also must specify the roles, responsibilities and functions of elected members, officials of local level institutions, NGOs, CBOs, etc. Capacity building indicates towards the provision of training and awareness programmes for elected members of PRIs, officials, functionaries of youth organisations, mahila mandals, SHGs, etc. which is very important in empowering them in disaster preparedness and risk reduction.

Capacity Building in Disaster Preparedness and Risk Reduction

Capacity building in disaster preparedness and risk reduction is the ability of the Department/ Institution/ Agency/ Community to prepare, equip and reduce the impact of the disaster and bring it back to normalcy after the happening, considering the potentials of human beings and other support systems. Building capacity of different stakeholders highlights the provision of training to elected members of PRIs, officials, and members of community to enhance their awareness, as well as creating an organisational set up to take up appropriate interventions in times of need. Creation of a disaster management plan for the area in a participatory manner with specific roles and responsibilities to the members of the core team and other stakeholders must form part of capacity building exercises.

The report of the High Powered Committee on Disaster Management (2002) recommended that 'for effective implementation of disaster mitigation strategies, training and awareness needs to be provided to the members of local bodies as well as the gram panchayats, thereby setting up a trained task force that would be immediately activated should a disaster strike. They should be provided with training to handle modern communication equipment such as fax, wireless sets, etc. Of critical importance in a disaster situation is coordination between the various government agencies and at all levels - both vertically as well as horizontally'.

Involvement of community in the development process, which includes disaster preparedness and risk reduction, is essential because of the following practical considerations (Abarquez & Murshed, 2004).

(a) Nobody can understand local opportunities and constraints better than the local communities themselves, who therefore need to be involved in the identification and resolution of disaster vulnerability issues.

(b) Nobody is more interested in understanding local affairs than the community whose survival and well-being is at stake. Therefore the information should be generated in a manner and language that is understood by the community.

By virtue of its position closer to the community and their natural responsibility for local leadership, the Local Government is expected to perform specific roles and functions in different phases like pre-disaster, during disaster and post-disaster. However, in comparison with other two phases, the Local Government can play a pro-active and significant role during the pre-disaster phase, which needs to be manifested through adoption of appropriate measures for disaster preparedness and risk reduction. During disaster and post-disaster phases, it is in a position to execute immediate rescue and relief measures.

And, elected members of PRIs, being the local leaders, are able to mobilise community opinion, bring in positive approaches and attitude among the community members, and ensure the wholehearted participation of the community. Elected members of PRIs in general and young elected members of the PRIs in particular are visualised as one of the important target groups for capacity building. Similarly, among the functionaries and members of youth clubs, mahila mandals, SHGs, etc. who constitute an important segment of community, young persons are identified as an important target group for capacity building. Elected members of PRIs and citizens in this age group corresponds to young and dynamic individuals who are looking for active participation and can also play a pro-active role in bringing positive social changes (As per the National Youth Policy (2003), the term 'youth' refers to the persons

in the age group of 13-35 years. However, the draft document of the National Youth Policy (2012) suggested to keep the target age group at 16 – 30 years. Operationally, the term 'Young Elected Members' of PRIs denote those elected members who fall in the age group of 21-35 years and the term 'Young Citizens' refer to those men and women from the area in the age group of 18-35 years). It is hoped that when properly trained, they will be able to play a key leadership role in community-based disaster preparedness and risk reduction, more effectively and efficiently. That is the prime reason for targeting them in the capacity building programmes.

Capacity building for the elected members of PRIs will include mapping of the resources and facilities, mapping of vulnerable areas and points, preparation of evacuation plan, early warning and reporting system, starting of a disaster management cell at the local level, preparation of the disaster management plan for the area, etc. Formulation of Village Disaster Management Plan (VDMP) is the most important element in implementing Community-Based Disaster Management in any area, as it is expected to empower the community to deal with disasters on their own with necessary preparedness. It includes 'situational and hazard, risk, vulnerability and capacity analysis, response plan, mitigation and preparedness plan, family disaster preparedness plan, etc.' (Walia & Guleria, 2012). It also includes the list of activities the village is expected to follow to prevent loss of life, livelihoods and property in the event of a disaster. The VDMP identifies several steps in advance, which special reference to the action to be taken by the community members so that each individual knows what to do on receipt of a warning message or in the event of disaster.

Voluntarism is one of the important features of youth. Disaster preparedness and risk reduction invariably demands lot of voluntary efforts from the community, especially from the young citizens. In line with its constitutional status, popular will and leadership at the local level, the Local Government is expected to mobilise support from the youth clubs, mahila mandals, SHGs and other CBOs working in the functional area. All these organisations are expected to be registered with the Local Government to enable their services to be appropriately used for the benefit of community (In States like Kerala, there is a practice of registering the Youth Organisations and SHGs with the PRI, which enable their services to be properly utilised by the PRI for the community. Generally, communications will be sent to these organisations inviting for Grama Sabha and other programmes/activities organised by the Local Government). Representatives of these organisations can be invited to the programmes organised by the PRI and their active involvement in the preparation of Disaster Management Plan for the village would be very crucial.

Sending out invitations to them for the discussions and meetings by itself will infuse a sense of recognition to these organisations which in turn will motivate them to participate actively in the preparation of plan and make necessary contributions and support to the Local Government. And it needs no emphasis that PRI is the 'right institution' to enable proper convergence of potentials, resources, services and efforts of such grass root organisations in disaster preparedness. In this context, capacity building of key functionaries of community organisations like youth clubs, mahila mandals and SHGs is very much imperative. By undergoing suitable training sessions, the skills and competencies of community members also will be enhanced, which is expected to develop their capacity to adopt suitable measures for disaster preparedness and risk reduction.

Capacity building for the community members will include mapping of the resources and facilities; mapping of vulnerable areas and points; preparation of evacuation plan, early warning and reporting system; preparation of emergency kit, disaster-specific drills, application of first aid, carrying out Cardio Pulmonary Resuscitation (CPR) and safe evacuation procedures; and, operation of stand-by power and communication equipment. Capacity building programmes for the community members will enhance their knowledge, attitude and skills to perform as 'Trained Volunteers' in the demanding situations. While going through the experience at Dahod district, Gujarat. It is noted that the community-based programme has a two-layered intervention - one focussing on infrastructure capacity building like formation of grain bank, watershed programme and horticulture; and, the other focussing on knowledge-based capacity building which includes formation of SHGs, youth groups, and village development committee, task force, village mitigation committee and preparing village contingency plan (Disha, n.d.). It needs no emphasis that the capacity building sessions for the elected members of PRIs, officials and community members need to be organised in a participatory manner and interactive mode.

Interactions with the elected members of PRIs, officials and community members revealed that most of them have not received any specific training pertaining to disaster preparedness and risk reduction. But in certain places, the practice of keeping the details of the resources and facilities was noted, though it was not maintained keeping in view the disaster preparedness. Traditional wisdom and knowledge contribute significantly to take appropriate measures for disaster preparedness, but no serious effort was made to document them. Discussions with the young elected members of PRIs, functionaries of youth organisations and young citizens indicated that dynamism, energy and voluntary spirit of the youth could not be incorporated appropriately for adopting measures for disaster preparedness and risk reduction.

Preparation of a work plan is necessary to guide decision makers in executing the most important tasks in the right sequence during disasters. Here, the emphasis is on what, who, when, where, resources and reporting in the event of a disaster. It points to the need for a Responsibility mapping with details about the responsibility for each stakeholder in various steps in the process. It is suggested that capacity building programmes of appropriate duration is to be taken up for the elected members of PRIs, officials and community members with thrust on preparation of a 'Disaster Management Plan for the Village' and formulation of a 'Responsibility map' for all the stakeholders.

Conclusion

The paper discusses the significance of empowering Local Governments in the process of disaster management, with thrust on disaster preparedness and risk reduction. Analysing the efforts made for capacity building of the elected members of PRIs, officials and community members, with special focus on youth, it is noted that lot more to be done to empower Local Governments to take suitable measures for disaster preparedness and risk reduction. The paper highlights the importance of mapping of resources and facilities in view of disaster, and the need to ensure co-ordination and convergence of efforts by the government departments, NGOs, CBOs, and other stakeholders towards seeking their participation, ensuring active presence and visualising sustainability.

It is accepted that Local Government can analyse the hazard, risk, vulnerability and capacity effectively and there is a need to formulate a 'Disaster Management Plan' for the village, which will be updated periodically. It is also noted that the Local Government is in a better position to understand the social vulnerability of the disasters with differential impacts on children, women, differently abled, the sick and the elderly, which is imperative in disaster preparedness and risk reduction. In this context, presence of able leaders, and committed and efficient officials at the local level is quite significant. In addition, pro-active role of community members at the grassroots is also very much essential. At the same time, the elected members of PRIs, officials and community members must be aware about their specific responsibilities in disaster preparedness and risk reduction. And there is a need to update the skills and competencies of elected members of PRIs, officials and community members, in line with the changing threat perceptions, rising demands and environment.

Youth have an important role to play in disaster preparedness and risk reduction, irrespective of their position and status. Their creativity, dynamism, energy level, innovative ideas, leadership qualities, pace of work, voluntary spirit, etc. need to

be properly channelised. And Local Government is the most important political institution to realise 'community-based disaster preparedness' by ensuring active involvement of elected members of PRIs, officials at the local levels, members of youth organisations, and other stakeholders. It is hoped that the emphasis on youth while conceiving and operationalising the capacity building programmes, will lead to incorporation of new ideas, approaches, strategies and practices in disaster preparedness and risk reduction.

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Social Support in Disaster Coping and Mitigation in the Case of Recurrent Disaster: A Qualitative Investigation

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Abstract

Disaster studies have generally held a definition of disaster (floods) which is narrow to the extent that it fails to contain in its ambit the specific nature of recurrent floods. Recurrent floods are more devastating and destructive than the sudden disasters according to the data. Social support system is been seen as the major relief mechanism in the post-disaster situation. This paper attempts to show that in the situation of recurrent floods, this idea of social support faces severe challenges because of traditional entanglements. The study was carried out in the one of the important flood-prone district of Uttar Pradesh, Ballia. The study involved the retrospective qualitative analysis of information collected through a qualitative interview schedule. It was found out that the flood-stricken community does not run into a frenzy of coping up. Instead the social divisions continue to govern the relief mechanisms as well due to the lack of uncertainty. This paper provides empirical evidences to establish the need for a 'different sensitive' approach.

Keywords: *Disaster, Flood, Natural Disaster, Social support*

Introduction

Floods are the most frequent natural calamities faced by India (Jain et al., 2007; Gupta et al., 2003) in different magnitudes, year after year (Table 1). The main causes of floods in India are inadequate capacity of river sections to high flows, silting of river beds, and drainage congestion. 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). Every year millions are rendered homeless due to floods and lakhs of hectares of crops are damaged (Arya, 2007). Twenty-three out of 36 states/union territories in the country are subject to floods and 40.0 million hectares of land, roughly one-eighth of the country's geographical area, is prone to floods (Arya, 2007; Gupta et al., 2003). According to the *Rashtriya Barh Ayog* (National Commission on Flood), the area prone to floods in India is 40.0 million hectares (Ministry of Water

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Resources, 1999). The average area annually affected by floods is 7.52 million hectares out of which the agricultural area is 3.52 million hectares. Roughly 30.0 million people in the country are affected by floods and more than 1500 lives lost each year. Assam, U.P. and Bihar are among the most flood-prone states in the country (Jain et al., 2007). Floods are mainly of two types: Recurrent (seasonal) and Flash floods. Flood occurs when a river or stream breaks out from their natural or artificial bank due to heavy rainfall, melting of snow, dam failure etc. Usually, inundation is temporary and the adjacent land is inundated by overflow from a river, stream, lake, or ocean (Jain et al., 2007). Recurrent floods, unlike the flash floods, are predictable and foreseeable with the seasonal changes happening around the year. India faces floods primarily in the monsoon period which last from June to August. Flash floods are more sudden and episodic and the reasons for such disasters are the unpredicted climatic changes caused by human-induced interventions. Table1 shows that in any form of impendence (killed, affected and economic loss), flood has the major share of all disasters.

Table 1: Top of Natural Disasters in India (June 2005 - June 2013) and the resultant damage

As per number of people killed			As per total number of people affected			As per cost of economic damage in INR		
Disaster	**Date**	**Number**	**Disaster**	**Date**	**Number**	**Disaster**	**Date**	**INR (in millions)**
Flood	12/Jun/2013	6054	**Flood**	24/Jul/2005	20000055	**Flood**	28/July/2006	203.671
Earthquake (seismic activity)	8/Oct/2005	1309	**Flood**	3/Jul/2007	18700000	**Flood**	24/July/2005	200.066
Flood	24/Jul/2005	1200	**Flood**	12/Jul/2007	11100000	**Flood**	28/June/2005	138.184
Flood	3/Jul/2007	1103	**Flood**	11/Jun/2008	7900000	**Flood**	25/Sep/2009	129.172
Flood	11/Jun/2008	1063	**Flood**	22/Sep/2007	7200000	**Flood**	18/Sep/2010	100.934
Flood	July/2009	992	**Flood**	15/Aug/2011	5549080	**Flood**	12/Jun/2013	66.088
Extreme temperature	April/2013	557	**Storm**	25/May/2009	5100000	**Earthquake (seismic activity)**	8/Oct/2005	60.08
Flood	25/Sep/2009	350	**Flood**	28/Jul/2006	4000065	**Flood**	23/Sep/2011	55.874
Flood	28/Jul/2006	329	**Flood**	23/Sep/2011	3443989	**Flood**	5/Jul/2010	26.856
Extreme temperature	28/Jun/2005	311	**Flood**	18/Sep/2010	3267183	**Flood**	5/Sep/2011	25.955

Source: EM-DAT: the OFDA/ CRED International Disaster Database (www.embat.be) accessed on 29 June 2014.

The above data clearly indicates that in accordance with the number of people killed, flood stands outrageously higher than all other major disasters in last ten years. From 2005 to 2013, flood leads in the ten top most natural disasters in affecting people adversely, storm being the second one. Flood is the leading disaster in terms of the economic damage occurred too. The frequency and the impact of flood therefore, we see exceeds all other natural disasters. Thus, it is not very difficult to fathom that floods are the most destructive disaster ruining lives of the people at a massive scale. It is important to note that the recurrent floods are more devastating than flash floods because of the frequency of occurrence and consistent lack of mechanisms to mitigate, control and manage floods. With the beginning of the monsoon, the situation of inadequate water availability changes into a situation of huge water. It comes from the Himalaya- Ganga region in every monsoon, when the flow reaches the plains of Southern Nepal, Northern Uttar Pradesh, Bihar and West Bengal; rivers overflow their banks and inundate the land leading to the large scale disruption of social and economic life (Dixit, 2003). Every year these areas meet with the annihilating tendencies of the floods without gearing up for the destruction to be caused. The uncertainty of rate and intensity further makes the conditions even more deplorable for the people.

When we look at flood (recurrent or Flash) under the arena of term disaster, we find that disaster has been seen as "non-routine events in societies... that involve conjunctions of historical conditions and social definitions of physical harm and social disruption" (Kreps & Drabek, 1996). It is also defined as a basic disruption **of** the social context within which individuals and groups function (Fritz, (1961) cited in Kaniasty & Norris (2004). Another pragmatic definition follows as, "a disaster is the result of vast ecological breakdown in the relation between human and their environment, a serious and sudden event on such a scale that the stricken community needs extraordinary efforts to cope with it often with outside help or international aid" (Nozi, 1997). Susman, Okeefe and Wisner define disaster as "the interface between an extreme physical event and a vulnerable human population" (Perry, 2006). Even a cursory glance will make it clear that the focus of disaster has primarily been on studying it as a 'non-routine', 'disruption' and 'sudden' event. The issue of regular, frequent and recurrent events such as floods in monsoon period is ignored by these analyses. The dominant models of coping with the disaster that have come up in the recent period have been designed on an understanding of disaster which is dominated by sporadic, abrupt and flash events that are unpredictable and uncertain. The seasonal and recurrent floods in agricultural areas for example are merged and therefore undermined within the larger ambit of disaster as episodic events.

Risks Involved in Recurrent Floods

Disasters are not phenomena that occur as isolated, autonomous entities. They exist as the impacts on the consequence for individuals, families and groups of people within a specific social time, geography and particular culture (Buckle, 2005). While economic damages and loss of life are pronounced in urban and coastal areas due to the concentration of infrastructure and people, floods in rural areas are both closely linked to agricultural production and livelihoods of rural populations (Manuamom, 2009). Disasters are events that are life changing for a whole economy, people and area. It is equally true of floods but in case of recurrent floods, it takes a leap ahead. It is not just life changing an event but primarily life designing a concern, for their frequency and regular nature makes it a part and parcel of the lives of the people facing it. Recurrent floods in India are phenomena occurring mainly in agricultural belt. According to Food and Agriculture Organisation (FAO), Agricultural Assessment Report, the monsoon floods caused damage of unprecedented scale to agricultural crops, livestock, fisheries and forestry and destroyed primary infrastructure such as tube wells, water channel, household storage, house, animal sheds, personal seed stock, fertilisers and agricultural machinery (World Food Programme, 2010). Uttar Pradesh (UP) for example is one of the flood-prone regions in India. Located in the Indo-Gangetic plain, Ganga, Yamuna, and other perennial rivers along with their tributaries drain the land year round accounting for high fertility of the soil in this region. Fertile soil accounts for high agricultural fecundity making it one of the leading states in food grain production and other crops. However, 85 percent of the average annual rainfall of 990 mm is received during June to September. This is the time when the river overflows from their beds and causes destruction at a large scale. Using the example of Uttar Pradesh, we can see the enormous loss caused by the frequent floods occurring mainly in this region.

Table 2: Losses due to flood in Uttar Pradesh (1973-2008)

Year	No of affected district	Affected Population (in lakh)	Villages affected	Affected total area (lakh ha)	Affected agricul-ture land	Affected house-hold	Life losses		Approxi-mate loss INR crore
							Human	Animal	
1973	40	141.50	30004	35.00	22.23	2.98	163	375	286.84
1974	39	73.90	14948	19.86	12.24	2.03	72	160	173.16
1975	35	92.84	18629	23.65	14.21	2.0	181	892	92.44
1976	36	131.95	32962	33.49	18.49	2.05	240	1434	92.44
1977	31	37.00	7536	12.87	6.42	0.51	157	887	77.04
1978	55	225.87	48889	72.50	38.82	11.92	739	7430	688.24
1979	16	21.05	3913	7.03	5.18	0.23	77	220	67.57
1980	46	303.47	44629	58.57	30.94	19.23	1309	5242	790.67

1981	33	146.27	20706	29.91	16.35	4.91	427	1356	286.38
1982	44	232.91	32459	55.38	33.09	10.18	562	2517	585.65
1983	56	155.34	24713	38.36	24.99	5.16	519	2101	754.03
1984	39	65.75	11500	16.68	0.31	0.83	209	432	26215
1985	55	195.59	27113	40.28	24.19	6.20	804	3806	1216.26
1986	45	59.19	8925	10.34	6.45	0.51	233	725	278.64
1987	9	38.24	5807	5.81	3.16	1.80	163	990	186.14
1988	46	182.04	24721	31.76	17.14	3.71	765	2102	134.68
1989	25	48.62	8281	10.03	6.52	0.78	165	516	-
1990	51	85.34	15524	22.03	10.64	1.32	471	2889	-
1991	29	24.19	3372	8.10	2.10	0.78	214	369	-
1992	20	29.24	4254	5.91	3.34	0.34	140	979	-
1993	34	75.05	11765	15.11	7.91	1.37	314	2088	-
1994	45	39.07	9627	9.86	5.98	0.66	317	4855	-
1995	51	36.91	8874	12.79	7.98	0.88	321	1287	-
1996	44	72.20	8827	11.24	6.78	0.09	313	1232	-
1997	29	10.21	2284	3.49	1.55	0.03	102	144	-
1998	55	121.19	156118	25.23	14.15	3.84	1355	3384	-
1999	11	1.83	2.99	5.39	4.069	0.0049	17	9	-
2000	40	63.86	5882	7.84	4.724	0.0839	453	977	-
2001	21	27.15	3819	4.63	2.89	0.09	201	251	-
2002	14	3.86	770	1.10	0.62	0.0061	33	36	-
2003	54	134.80	17011	23.60	15.03	0.35	964	3201	-
2004	2	14.36	865	2.439	-	-	88	217	-
2005	35	24.511	3652	3.597	3.853	0.7732	203	259	-
2006	12	4.53	678				353	588	-
2007	23	26.53	758	8.49	5.66	0.34	272	170	519.86
2008	32	41.75	6287	4.988	-	6.30	889	1898	-

Source: (Bhad Prativedan Uttar Pradesh , 2008)

Table 2 makes clear the massive frequency of floods in UP for more than two decades with an increasing loss of lives and livelihood with each consecutive year. It must be noted that these floods have been very regular and not at all sudden or shocking in nature yet continue unobstructed. Heavy monsoon takes its toll on the carrying capacity of most of the rivers resulting in floods in several districts specifically in the eastern and central districts. Secondly, outpouring of water from the rivers in Nepal towards India also contributes to flooding in rivers of the eastern UP. The recurrent

and annual floods in the major tributaries result in high seasonal water logging conditions. Due to flooding and subsequent water logging, a large area of productive lands turns into wasteland restricting crop growth in the kharif as well as rabi season (Climate Profile of India, 2010). The flood is also accompanied by reduced availability of food and other commodities which leads to increase in the price of essential commodities and a reduction in the amount that could be purchased by households. Food security was compromised by reduced expenditure on food resulting from additional constraint on household budget and rising food prices. In case of recurrent floods, the risk once caused is ameliorated converting the already worse conditions into a hazard for the next upcoming flood.

In 2005, Indian government passed the Disaster Management Act 2005, which provides for the effective management of disasters in the country. The Act provides for setting up of a three tier hierarchical the National Disaster Management Authority (NDMA) under the Chairmanship of the Prime Minister, the State Disaster Management Authorities (SDMA) under the Chairmanship of the Chief Ministers, and the District Disaster Management Authorities (DDMAs) under the Chairmanship of Collectors/ District Magistrates/Deputy Commissioners. The regions prone to recurrent floods therefore demand a continuous flow of relief and mitigating support structure both in the pre-and post-disaster stage. In such cases, social support becomes an important structure in resilience.

Disaster outcomes are based on pre-existing social structures and the consequences of these structures for both organisational and individual responses (Dynes, 1993; Oliver-Smith, 1996). In the post-disaster scenario, the immediate relief that is procured by the victims is from the social support system which includes family, neighbours and other community members. In the whole event local community has different roles to play in different stages of the disaster cycle: from rescue to relief to rehabilitation to preparedness (Shaw, 2003).

Conceptualisation

In the realm of disaster studies, 'Social Support' is considered as an important substructure for the disaster recovery process. Disaster sufferers tend to rely primarily on their indigenous support networks called social networks for coping and resilience post disaster. Social networks are key social units that respond to disasters (Kreps, 1984). This network is a buffer against hazards and protects an individual from the uncertainty of a disaster. There is also a lot of formalised aid offered by government and relief agencies especially in the affluent regions of the world. The pattern of help receipt post-natural disasters could be better represented as a pyramid with its broad foundation being helped from family, followed by support from other primary

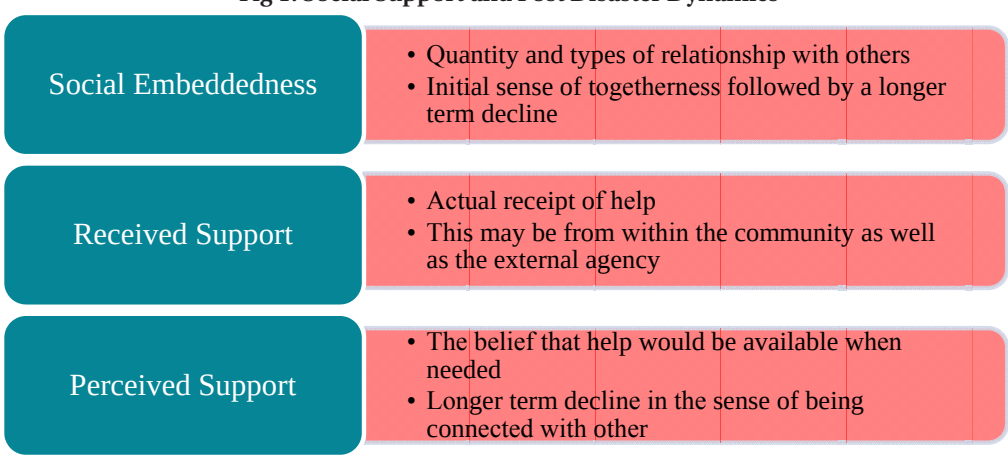
support groups such as friends, neighbours, and local religious congregations, and its narrow top being the aid provided by formal agencies and professional services (Kaniasty & Norris, 2004). Oliver Smith (2000 Catastrophe and Culture) further explains disaster as an opportunity to 'unmask the nature of the social structure, resilience of relationship and other alliances. It also provides a unique view of a society's capabilities for resistance or resilience in the face of disruption'.

Social support influences the rumination and the coping behaviour of the individuals. Gonzalez de la Rocha (1991), Lomnitz (1977), Reyes Morales (1994), and Velez-Ibanez (1983) have all described how the poor in Mexico use family and other close relationships to mobilise resources in their struggles to overcome some of the vicissitudes inherent in poverty and political disenfranchisement (Norris et al., 2005). Social support is directly proportional to the strength of the social networks. It depends on individual interaction and kinship network. Further, supportive social networks are often cited as a buffer against stress (Realmuto et al, 1991; Pittman & Lloyd, 1997; Brewin et al, 2000; Karanci & Acarturk 2005). In their study with the survivors of the Yugoslavia war, Rosner et al. (2003) found that being a member of a group was a predictor of growth. The opportunity of membership may provide for sharing trauma history, worldview, and collective coping strategies with each other. Thus, Social support seems to be an important facilitator of growth (Tedeschi, Park, & Calhoun, 1998). To summarise, higher the level of community participation, more is the social support and greater is the likelihood of developing successful coping skills (Perry, 1983).

Social support imbibes within itself three major facets of social support: social embeddedness (quantity and types of relationships with others), received support (actual receipt of help), and perceived support (the belief that help would be available if needed) (Kaniasty & Norris, 2004). In short, perceived support refers to helping behaviour that might happen, received support refers to helping behaviour that does happen, and social embeddedness represents the most basic structural component from which these functional components emerge. It is well established by several studies that in the aftermath of a sudden disaster, the community plunges into action regardless of the routine bias and prejudices of societal relationships. There is an upsurge of local help flowing in from the members of the society for sufferers. This stage has been referred to by scholars by several labels such as 'heroic and honeymoon phases', 'democracy of distress', 'altruistic community', 'post-disaster utopia', 'stage of euphoria' (Wolfenstein, 1957; Barton, 1969; Frederick, 1980). However, as rightly argued by Kaniasty and Norris, this stage begins to fade as soon as the communities begin to recover & there is a departure back to the pre-event situations. It is difficult for these elevated levels of solidarity and mutual support to last the full length of

the recovery period (Kaniasty & Norris, 2004). They cite several reasons for the deterioration of this initial mobilisation of support: firstly, disruption of social networks by natural disaster through 'death, injury, and relocation, secondly, 'the need for support among all affected frequently surpasses the availability' which also leads to a decline in perceived support and thirdly, decreased participation in social activities with relatives, friends, neighbours and community organisations. Further, Kaniasty & Norris point out that this immediate heroic support is not as egalitarian and homogeneous as generally assumed to be as factors such as race, age, and economic status affect the distribution of resources in recovery. It is important to remember that post-crisis exchanges of support take place in a context of pre-existing socio-political andcultural structures, and thus they are reflections of complex transactions among characteristics of the individuals, the community, and the stressor (Kaniasty & Norris, 2004). All these combine to cause a reduction in the perceived support as well which, as earlier mentioned, is the expectation of the availability of help among the people fighting the disaster (Fig. 1).

Fig 1: Social Support and Post Disaster Dynamics



Source: Kaniasty & Norris, 2004

On the basis of these assumptions, several scholars have argued that the focus must be shifted from initial immediate support through the social relationships to the 'received support' which is what is actually received by the afflicted people from sources outside and inside the community. The stregthening of the received support will also positively impact the 'perceived' support and therefore improve the mental and psychic conditions of the sufferers. They argue for a community-centric intervention by assuring communtiy participation in evaluating the needs and determining which actions are most suitable'.

In areas prone to recurrent disasters, however, such suggestions are found to be highly limited. It is important to note that as we mentioned earlier the concern of disaster studies has been narrowed down to the situations of flash disasters, similar confinement is faced by the assumptions and arguments stated above. The places afflicted with recurrent floods for example never witness the so-called heroic or honeymoon period because of the lack of unpredictability about the occurrence of a disaster. Recurrent floods hardly 'shock, traumatise or plunge into depression' the victims who have become accustomed to welcoming a disaster owing to their frequent experience with them. The communities in these areas never show signs of coming together and working in a harmonious and homogeneous environment. The traditional prejudices and irrational hostility that governs the social relationships in such areas continue to decide the priority order of the distribution of help. It is scarce to find a change in the pattern of relief procurement where women, children (mostly female) and lower class and caste people continue to be deprived of even the primary help.

In such a scenario, the arguments about working hand in hand with a communtiy to design and execute a policy are restricted. The very understanding of a community that is envisaged on paper is very different from what occurs in the field reality. A community in the post-disaster situation (read sudden disasters) is generally imagined as a grief stricken, traumatised and in the 'state of nature' where a new utopian community of people can be constructed that would work for the mutual benefit of all.

Methodology

Field area

The study was conducted in one of the important flood prone districts of Uttar Pradesh (UP) Ballia. The selection of the district was purposive. Bairiya tehsil (Ballia) is the most affected flood region in UP and the district is frequently fraught with heavy flood conditions in rainy season. Based on the objectives of the study, one of the villages named *Shival* (Bairiya tehsil) was chosen as the area of study.

Flood is a recurrent phenomenon in the village *Shival,* crippling the livelihood options and destroying the resource base. The annual nature of flood leaves little time for coping and resilience as no sooner the former wounds begin to heal, a new scar arises. There is a complete lack of external aid post disaster due to administrative apathy and people have to rely on their informal networks for assistance and recovery.

Research design and instrument

The study involved the retrospective qualitative analysis of information collected through a qualitative interview schedule. The data were collected during the month of October 2011 and January 2012 as a part of fieldwork for my M Phil dissertation. The sampling was purposive and convenient. Interview schedule and observation were the major tools of data collection. A brief purpose of the study was described to all the respondents and an informal consent was obtained from them for the purpose. Social workers mediated this distrust and facilitated rapport building. Part of the data was also collected using anthropological tenet of 'key informants'. The sample size was that of 20 households apart of the key informants for the purpose of this study. Key informants for this study were the Gram Pradhan, Lekhpal (Revenue Officer at the Village level), Auxiliary Nurse Midwife (ANM), personnel and counsellors and other stakeholders who provided major insights on the phenomenon of flood in the village. The subjects had the privilege to withdraw from the interview process at any moment in case of discomfort. Confidentiality and anonymity were also ensured. Interviews were conducted to obtain information regarding basic demography, flood exposure, coping mechanism and aid/assistance available. Interviews typically lasted for 40-50 minutes.

The qualitative data collected from the field were transcribed, i.e. they were typed (from interviews, and observational notes) into word processing documents. The researcher then carefully read the transcribed data, line by line, and divided the data into meaningful analytical units (that is segmenting the data). When meaningful segments were located, they were coded. The coding was done by marking the segments of data with symbols, descriptive words, or category names. During coding, the researcher kept a master list (list of all the codes that were developed and used in the study). After coding, the data were thematically analysed according to the objectives of the study.

Caste and economic network and social support

In *Shival,* the nature of social support is more caste-based and the caste affiliation is an important predictor of social support and assistance post disaster. The caste acts as a major interest group and mobilises support and assistance post disaster. The members of the same caste are pre-eminently closer and exercise stronger network ties. The social cohesion is stronger within a caste group which often acts as a buffer during crisis for the people belonging to the caste community.

The village *Shival* is a multicaste village inhabited by numerous caste groups such as Yadavs, Thakur, Gond, Dvishad, Nai and Kurmi. The Yadavs are the 'dominant group'

due to their numerical strength and have been holding the reigns of leadership since decades. They are economically established and have been dominating the local population leading to the conflict between the Yadavs and the Thakurs who are the potential aspirants for political supremacy but have been unsuccessful due to the numerical majority of the formers. The Yadavs and Thakurs control the major resource base of the village possessing major land holdings in the village. Being economically affluent they employ other lower castes as the manual labourers on their fields for the cultivation thus providing livelihood to the landless and marginal farmers in the village. This perpetuates the traditional jajmani system where the landowning castes provided food grains to the service and labour classes. Notably the Yadav and the Thakur preferably lend their land to the Gond and the Dvishad respectively. This network is very useful during normal as well as crisis, as the destitute bank upon them for their livelihood and survival.

Elucidating the nexus between the social support and caste system, one of the informants, Harihar Nath Yadav described: *"The notion of social support has almost sublimed in the village. These days people have gotten quite self-interested and nobody wants to help others. Further, monetary help is available only to the near and dear ones. People are divided in the name of caste and creed. And nobody wants to help members from the other community. The members of the caste group are particularly averse to helping the other castes and thus little help available is, particularly mobilized by caste ties".*

In *Shival*, village structure is marked by informal networks and based on the interdependence of labour reflecting the jati (caste) system. The rural economy is invariably based on the division of labour. The economy is another potent construct ruling the social village. Rich people utilize this situation to give a high interest loan to poor. Another informant Shiv Gond replied: *"Society has drastically changed over these years. The only help available is from the community members but, it's more of an informal kind such as providing food, childcare help and manual. Monetary help is a distant phenomenon. Now the sense of social responsibility has almost vanished. The social support is also biased by caste and creed. The rich and affluent lend only to those who have sufficient resource to mortgage in case of non-payment of loans.The poor and the marginalised have no recourse but to die in poverty and misery".*

He emphasised that rich people have become too selfish to help the poor and the needy. They look down upon flood as an opportunity and try to harness maximum revenues on the loans. Profit maximisation is their utmost priority. Further, villagers are divided on communal lines and communal solidarity is very divisive. People

preferentially extend aid and support to their community members. Since most of his community members (Gond) are poor and marginalised they have little to offer in case of crisis. Thus, social support is more dependent on the personal networks within and outside the community.

In the words of Ram Pujan: *"The floods have an unequal impact on the poor victims. The poor and impoverished are particularly vulnerable due to their poor fiscal strength and coping capabilities. The poor are the worst sufferers due to floods. No sooner, the Ghagghra raises we the poor, the hapless are left to the vagaries of nature. The floods divest us with our resources as well as the employment opportunities".*

He further added that almost all the householders have registered a decline in their fiscal state due to recurrent floods. Often a buffer period is too short for the proper recovery of the losses incurred before the next flood. In such case, social support or the help from the community members becomes out of the question. Little help is available from the kin and acquaintances often in the form of food grains or mutual help and assistance post flood. Sometimes people have been found to take minor loans from the relatives or neighbours but that is not sufficient.

Political Network and social support

Yadavs and the Thakurs have hold over major village resources and have a major say in the local politics. Both groups try to grab the local leadership which is a major bone of contention between them. However due to numerical majority, the Yadavs usually secure political reign in the village. This has led to the creation of two factions in the village. Both castes try to outdo each other in local elections. The Gonds and the Dvishad act as a vote bank for the Yadavs and the Thakurs respectively. This reciprocity is also viable during crisis when each subordinate population banks on their superiors for help and support. Hence, it could be easily deduced that local leadership, economy and caste affiliation are an important interface to social support.

In the words of Ramdev Thakur, a barber by profession: *"The concept of 'social support' is nonexistent in the village. The Yadavs and the Thakurs are the dominant and affluent groups and control major resources. They maintain their monopoly over these resources and extend help only within their networks. The poor and the needy are only remembered during the elections when each tries to establish their predominance and supremacy to secure votes. The rivalry between the duos never leaves any scope for the growth and development. They are more concerned with securing power and position with the support of the poor and the needy".*

Gender and Social Support

Women are the community's first line of defence since traditional social norms compel them to be homebound, in the care of children (Tan, 2008). With the disruption of established male-dominated social control mechanisms, women and their children are the first to be neglected and/or abused. Women encounter strong institutional barriers to organisational efforts. Women are less likely to organise, either out of seclusion, lack of education, or outright threat. Bolin and Stanford (1999) suggested that women are particularly vulnerable to the effects of disaster because of their care giving roles and relative lack of power and status (Norris et al., 2005). Hoffman (1999) argued that women tend to lose conflict over scarce resources. These factors may have also contributed to women's lower levels of perceived social support (Morrow, 1999).

Kalavati described: *"A babua humni ke, ke dehi…..ab hamar admi rahat ta kauno baat rahit… U rahen to sab udhari det rahen par hum mehraru ke koi na dela"*. (meaning: who is going to help us. When my husband was alive, things were different. When he was there, people would easily lend money but now nobody lends to a single woman.)

According to Chandrapati Devi: *Afsran ke saamne human jana ka bolit. Mardan ki bheed mein mahraarun ke ke boleai deyi.* (meaning: what do we speak in front of officers? How do we speak in a group of men?)

The specific demands of women remain unheard in the evaluation process where the community leaders are the male heads of the family. The particular nature of the requirements of women in post-disaster situation is subsumed under the larger societal needs which are mainly patriarchal understanding of the issue. It is a failure of the community and the agencies dealing into disaster situations that fall short of giving recognition to vulnerable sections of the community.

Results and Analysis

From the above evidence, we can see it clearly that there is an unequally distributed social support system which is hindered by the differences existing in such areas in the form of caste, class and gender. Earlier we had established that the disaster studies are replete with arguments of a strong base of social support that runs into action in the event of post-disaster. The immediate social mobilisation that occurs in such areas acts as the primary source of distributing relief and resources. However, the evidences from the fields depict it on the contrary in the recurrent flood situation. In these areas, the socio-political nexus of caste, class and gender continue to decide

the help distribution in the aftermath of a disaster. Since in areas prone to recurrent floods, the residents are not incognizant of the state of affairs that might arise after the flood, they are never led into frenzy and work in a predictable manner.

In such stances, arguments about strengthening the 'received support' also lies bare because of consistent presence of the social bias in formulation and execution of a relief programme. In the lack of a former 'social embeddedness', the 'receive support' fails to go beyond the existing dominant structure and ends up replicating the latter. As we could see from the statements from female interviewees, there exists a complete disappearance of women from the policy making process to an astonishing degree. One of the interviewees mentioned about the issues of sanitation and child care that specifically bother them every time a disaster hits. Such problems hardly are voiced to the authorities who visit the disaster hit areas to evaluate the situations. The caste nexus that is dominated by the upper castes prohibits the lower caste and class people to raise their concerns related to the issue of inaccessibility and affordability of resource bank. This major failure deprives a large chunk of the population from participation.

Thus this paper suggests a 'difference-sensitive approach' to dealing with disaster especially in case of recurrent disaster. While the role of received support is undeniably important, we must keep in mind the specific nature of the afflicted area. To strengthen social justice in disaster hit societies the affordability, accessibility and availability of the relief and resources without any obstacle must be ensured among all members. In heterogeneous society in case of recurrent floods, the attempt must be made to recognise the polarities sustaining in the society. A difference blind approach along with a fancy imagination of homogeneous society comes rolling down when implemented in the field. The shift from the focus on strengthening social embeddedness in a disaster hit area to consolidating the 'received support' fails to recognise in the process that the pre-event hostilities continue in the received support also. In case of recurrent floods such polarities are more intense because they do not witness the initial frenzy of support also that occurs in the aftermath of the flood. These are the specific characteristics of a site that is prone to recurrent disaster and stratified into segments of people on the basis of caste, class and gender.

Conclusion

The social support in the community is not homozygous. The whole process is marred by the eschewed patterns of representation of different social groups in the local decision making bodies. In this situation marginal and the vulnerable sections like the lower castes, children, women, elderly, and invalids are almost often

excluded from access to these. Caste, class and gender played an important role in increasing the susceptibility and coping and resilience post disaster in the study. The field experience provided explicit insights into the village structure and posed clear picture about the interplay of social elements and natural hazard.

The curious interplay of caste, gender, and economic nexus shapes all social relations including the distribution of the resources in the community. Though all disaster plans envisages the principles of equality giving little attention to the idea (practice) of equity. The programmes foresee all the victims as essentially equal and having similar access to relief. In this scenario, when the disaster management officials strategise preparedness and mitigation, their policies are bound to be shaped largely by the interests of the upper castes (or dominant castes). Clearly, participation by all sections of the society, which is the key to effective disaster management, suffers heavily in this situation. Further, the exclusive and limited nature of disaster studies to only flash or sudden events has also contributed to the throttling and suppression of successful policy execution. There is an ardent need of devising models and methods in disaster areas that are cognizant of the particularities of areas prone to recurrent disasters. Thus we need an approach that is considerate of the differences and nexus of the society for a successful mitigation, prevention and relief programme.

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Disaster Risk Reduction through Integrated River Basin Management - A Policy Approach

– Afroz Ahmad[1]

Abstract

The present paper deals with the disasters associated with mismanagement of water and provide policy approach for integrated surface water resources management considering river basin as a Hydrological Unit. Increasing demand for water globally has resulted in water crisis and established conditions for conflict over access at a range of levels from the river basin or aquifer level, through the sub-national level between regions of the country, down to local level between communities. Transboundary water resources disputes have become particularly significant in recent years. In India, out of 24 river basins, six basins namely; Sabarmati, East flowing rivers between Pennar and Kanyakumari, and West flowing river of Kutch and Saurashtra including Luni, Cauvery and East flowing rivers between Mahanadi and Pennar fall under the water scarcity category (1000 m^3/capita/annum) and many more are expected to come under this category by the year 2025 and 2050. The eutrophication of most of Indian major rivers and lakes has caused serious problems of drinking water, ecosystem needs, irrigation, water supply, etc. The destruction of wetlands is taking heavy toll on water quality because it serves as a sink in storing nutrients. The existing state of water (quality and quantity) environment has already led to 'conflicts on water' in various countries of the world. In India, conflicts on water had already started and there is a likelihood that it would be of serious concern in future, if the protection and wise management of most valuable of the world's renewable resources are not given top priority. The mismanagement of water in India had already created serious problems of floods affecting millions of people in Uttarakhand, Uttar Pradesh, Bihar, Assam, Orissa draughts covering 20 percent area of the total land area of the country affecting States like Jharkhand, high rainfall State Kerala, Himalayan States namely Manipur, Assam; advancement of desertification covering 20 percent of India's total land area in the States like Rajasthan, Gujarat, Maharashtra, Jammu & Kashmir, Orissa and Andhra Pradesh affecting critically the livelihoods and flood security of million in the country. The River Basin approach for management of water resources could not follow quick succession globally after the Tennessee Valley Authority (TVA) in the United

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States in 1934 and Indian Damodar Valley Authority (DVA) in 1948. Water being our common heritage, and the fact that we all share the responsibility of protecting it for future generations, a breakthrough for really sustainable water resources development and management is required. The ecosystem based-policy approach for the integrated management of water resources (River Basin approach) involving scientific, technical and engineering factors on the one hand and social, economical, environmental and legal factors on the other hand in various missions mode is need of the hour for disaster risk reduction and ensuring food, energy, water, land security in the country.

Keywords : *Disaster Risk Reduction, River Basin Management, River Basin approach.*

Introduction

Water is a key to sustainable development, crucial to social, economic and environmental dimensions. Water is life and essential for human health. Many people regard access to drinking water and sanitation to be a human right. There is no substitute for water, without it, humans and other living organisms die, farmers cannot grow food and business cannot operate.

Human consumption of freshwater threatens to push to the limits of capacity of nature to supply benefits to mankind. Increasing demands for water jeopardise flows in rivers and wetland ecosystems. In many areas, a failure to manage resources effectively has led to over obstruction of surface waters; some rivers are reduced to a mere trickle by the time they reach the sea; and lakes have dried out or significantly reduced in size, for example the Aral Sea in Central Asia. This in turn disrupts aquatic and other terrestrial ecosystems, the quantity and quality of water supplies, and the wider natural environment. Problems include vegetation loss and siltation, which lead to reduced capacity of rivers and increased risk of flooding. Poor land use practices (farming, deforestation and land drainage) have a major detrimental effect on the environment, and hence on its capacity to support and maintain hydrological process (Department of International Development, 2001).

Even so, this available fresh water would seem at first sight to be enough to supply all fundamental human survival needs, if divided by the total population of the Earth. Indeed – although the exact water volume necessary to fulfil human needs is still a matter of debate – it is estimated that theoretically there is sufficient fresh water on the planet to support about 20 billion people. Unfortunately it is not distributed evenly, as the large arid and semi-arid regions testify. And, thanks to seasonal weather pattern, this is sometimes not available when most needed, or arrives in excessive amounts, causing widescale flooding and loss of human life. To add to this problem, water is polluted when it is used in industry, agriculture and for domestic

purposes and thus the amount of water of acceptable quality available for human use is reduced still further. As a result of shortages, water of inferior quality is often used to meet demand. Conversely, the need for clean water makes heavy demands on total resources (Department of International Development, 2001).

Methodology

The assessment of the State of water environment globally and in Indian scenarios have been made. The factors responsible for mismanagement or poor management of water and its impacts on accelerating natural disasters like floods, droughts, advancement of desertification/degradation of land, climatic variability, etc. have been assessed. The legal regime governing management and development of water resources in Indian context have been examined and accordingly policy and programmes based on ecosystem approach have been proposed/advocated for ensuring integrated river basin management to minimise disaster risks.

Results

Global Scenario

Of all the earth's water reserves, 97 percent is saltwater and thus of no use to human beings as drinking water; two percent is locked up in glaciers and the polar caps as freshwater, and only one percent freshwater is accessible. It would be wrong, however, to say without qualification that the world is suffering from a water shortage. The total volume of this one percent that is available in the hydrological cycle is estimated to be 500 000 cubic kilometers - theoretically more than enough for the whole of humanity. The major problems that do exist stem from a huge imbalance in the regional distribution of these water reserves and the fact that an expanding world population is demanding ever more of this vital yet finite resource (Federal Ministry for the Environment, 2002).

Freshwater is a finite and precious resource that is essential for sustaining life, as are the natural systems that provide and maintain its supply. As demand increase, this resources is becoming increasingly scarce. Global freshwater consumption rose six fold between 1900 and 2000, more than twice the rate of population growth and the rate of consumption is still accelerating. Demand for water resources is increasing both because of population growth (particularly in developing countries) and because of rising demand per person due to such causes as irrigation development, industrialisation and increasing use by individuals as incomes rise. A potential crisis is looming where available resources can no longer meet needs (Department of International Development, 2001). The Stockholm Environment Institute has estimated

that, allowing for predicted population growth and assuming moderate projections of development and climate change the proportion of the world's population living in countries of significant water stress will increase from approximately 34 percent in 1995 to 63 percent in 2025. Those living in poor countries in Asia and Africa, with low and unreliable rainfall and high level of utilisation of the total water resources, will be most at risk of water stress impacting severely on their lives and livelihoods (Department of International Development, 2001). The world now has less than half the amount of water available per capita than it had 50 years ago. In 1950, world reserves (after accounting for agriculture, industrial and domestic uses) amounted to 16,800 cubic meters per person. Today, global reserves have dropped to 7,300 cubic metres and are expected to fall to 4,800 cubic metres in just 25 years (Sadeq, 1999). The water resources in developing countries of Himalayan region viz. Afganistan, Bangladesh, Bhutan, Burma, China, India, Nepal and Pakistan; of the Andean region of the south America: of the Altas countain of Moracco and the mountain regions of Ethiopia, Tanzania, Ruanda, and Burundi as well as of the mountain areas of the Pacific Island region are under threat of safe drinking water supply and sanitation. The exhausted river, falling water table, and shrinking lakes, all testify to worldwide human abuse of water resources (Ahmad, 1990 & 1999).

In the Middle East, it is now water, not oil, which is the real threat to regional peace. With Environmental and Political factors dramatically affecting the flow of the Nile, Jordan, Tigris, and Euphrates, the need for water could lead to unexpected and potentially explosive new alliances – between Iraq & Syria, for instance both threatened by Turkey's control of the Tigris-Euphrates. Israel's determination to hold on the West Bank, Golan Height and South Lebanon, for instance, is partly to preserve access to water resources (Ahmad, 1989).

Throughout human history, water resources have been a source of conflict. As demand for water rises, the potential for conflicts may increase. Many international Commentators argue the water will be an increasing cause of dispute (some suggest even war) in the years ahead. Increasing demands for water may establish conditions for conflict over access at a range of levels from the river basin or aquifer level; through the sub-national level between regions of the country, down to local level of lists between communities. Transboundary water resources disputes have become particularly significant in recent year. The exploitation of fresh water reserves for human use increased six-fold between 1950 and 1995, growing twice as fast as the population. Roughly two-thirds of the world's population will suffer from a shortage of water by 2025. This also entails a growing risk of armed conflict across the water (Department of International Development, 2001).

Presently, more than 1.3 billion people live without electricity, 768 million people lack potable water, 2.8 billion live in areas of high water stress and 2.5 billion people without sanitation. Water security is an important issue in 21st century.

In nut shell, the mismanagement or poor management of water is main factor for disasters like floods, droughts, climatic variability, advancement of desertification, landslides, etc. Many of the impact of natural disasters on socio-economic development occur through water. Water-related hazards accounts for 90 percent of all natural hazards and their frequency and intensity is generally rising. Some 373 natural disasters killed over 2,96,800 people in 2010, affecting nearly 208 million others and costing nearly US$ 110 billions (UN Secretary General Report, 2010).

Indian Scenario

The river systems of India can be classified physiographically into four groups viz. Himalayan rivers, Deccan rivers, Coastal rivers, and Rivers of the inland drainage basin. The main Himalayan River Systems are those of Indus and Granga-Brahmaputra-Meghna systems which receive very heavy rainfall in monsoon. The flows in the summer months are due to melting of snow and glaciers and, therefore, these rivers have continuous flow throughout the year. The important river systems in the Deccan are the west flowing rivers of Narmada and Tapi and the east flowing rivers of Brahmani, Baitarni, Mahanadi, Godavari, Krishna, Pennar and Cauvery. The Deccan rivers are rainfed and some of them are non-perennial. While only a handful of such rivers drain into the sea near the deltas of east coast, there are as many as 600 such rivers on the west coast. The west coast rivers are short in length and have limited catchment areas. A few rivers in Rajasthan do not drain into the sea. They drain into salt lakes or get lost in sands with no outlet to sea (Ministry of Water Resources, 1999).

India has sufficient water resources on the average in comparison to many other countries in the world. It has been assessed that out of the total precipitation of around 400 million ha. metre (M.ha.m) in the country, the surface water availability is around 185 M.ha.m. Out of this only about 69 M.ha.m. can be put to beneficial use because of topographical and other constraints. The country has been divided into 24 river basins comprising 3287260 km^2 catchment area. At present 13 water surplus basins are available where less than 105 ha of net sown area per million cubic metres of water potential exists. The availability of surface water in various regions in the country is uneven. The Ganga-Brahmaputra-Meghna system covers a land areas of 33 percent and accounts for 60 percent of India's water resources, while the catchment of river flowing west is 3 percent and they account 11 percent of India's water resources. Therefore, 71 percent of India's water resources are available to 36 percent of the area while the remaining 64 percent has only 29 percent water resources.

The countries having 1000 m^3 water availability per capita and per annum are considered under very low category scarcity conditions. Based upon this criterion, already six basins viz. Sabarmati, east flowing rivers between Pennar and Kanyakumari, Pennar, west flowing rivers of Kutch and Saurashtra including Luni, Cauvery and east flowing rivers between Mahanadi and Pennar fall into this category. More and more basins will become water scarce by 2025 and 2050 with the population increase (Indian Water Resources Society, 1997). The per capita water availability in India was 5150 m^3/capita/annum during 1947 which reduced to 2200 m^3/capita/annum in 1998 and it is predicted that by the year 2017, it will go down to 1600m^3/capita/annum resulting in serious water crisis leading to disasters.

Since the industrial revolution, water pollution problems have become first regional, then continental, and now global. The major factors associated with the accelerated pace of fresh water pollution leading to greater challenge of water resources development and management are:

– Urbanisation (17.29% in 1951, 23.33% in 1981, 25.72% in 1991 and 35% in 2014) and the consequent increase in population.

– Intensification of agriculture and growth in industries.

– Deforestation (507 km^2 during 1993 and 1995 i.e. 25350 ha/annum and 367 km^2 in two years i.e. between 2009 and 2011) leading to siltation of water bodies and diminishing of perennial water springs.

– Alteration in land use as well as discharge of domestic, industrial and municipal wastes – 57 million tonnes/annum industrial and hazardous wastes – 6.23 million tonnes/annum plastic wastes – 10,000 tonnes/day, e-wates – 11017 tonnes/annum in Mumbai, 9730 tonnes/annum in Delhi, 4648 tonnes/annum in Bengaluru and 4132 tonnes/annum in Chennai.

– Conversion of water bodies into hydroelectric dam without environmental management programme.

– Accidental water pollution (burst pipes and tanks, major leaks, fires and oil spills).

– Destruction of wetlands resulting loss of capability of storing and degrading many pollutants such as phosphorus and heavy metals.

– Loss of pesticides, fertilisers, and manure from agricultural fields during run-off.

– Encroachment in lake catchment area.

– Mining and industrial development.

– Invasion by exotic weeds.

– Primary energy consumption leading to increased atmospheric emissions of sulphur and nitrogen oxides, the main cause of acid rain.

These human-induced activities have caused challenges to the technologists, scientists and water managers worldwide to now adopt integrated approach for river basin management for reduction of disaster risks (Ahmad, 1999). Some of the disasters occurred due to mismanagement of water in India are as follows.

Floods

Floods affect vast areas of the country, transcending state boundaries. Out of 45 million ha of flood-prone area in the country, on an average, floods affect an area of around 7.5 million ha per year (Ministry of Water Resources, 2002). The Ganga basin is worst affected due to flood i.e. about 50 percent of the total flood-prone area in the country. The recurring floods cause huge loss to life and property every year viz. the States of Uttar Pradesh and Bihar had lost Rs. 110 crore and Rs. 24 crore respectively due to crops, houses and public utilities damages. In 2008, the floods coupled with burst of Kosi embankment resulted in inundation of 1000 villages in 5 districts of Bihar involving 3 million people. According to the UNDP Assessment, the valuation of houses damaged stands around Rs. 880 crore. Enormous amounts of goods were lost, including food grains and domestic items estimated to be worth Rs. 400 crore and 155 crore respectively (United Nations Development Programmes, 2009).

The heavy floods in 2014 have led to huge loss of lives and properties in the States of Assam, Orissa, Uttar Pradesh, Uttarakhand and Bhihar. The floods of Mahanadi in Orissa have affected about 10 lakh people in 1553 villages in 23 districts and death toll to 34 people. In Assam, the floods due to Brahmaputra and its tributaries have affected about 3 lakh people in 1066 villages in 15 districts covering 90,867 hectares of cropland. In Uttarakhand, heavy floods caused death of about 27 people and huge loss of properties. In Uttar Pradesh, floods due to Ganga and its tributaries namely Rapti, Ghaghra, Saryu, Gandak, etc. have affected 1500 villages in 9 districts, loss of lives of 89 people and huge loss of crops and properties. In Bihar, floods have affected about 11 lakh people in 13 districts.

The Central Water Commission had assessed floods damages in India which indicates maximum damage to crops, house and public utilities to the tune of Rs. 8864.54 crore in 2000 (Central Water Commission, 2010).

The epidemics in the aftermath of floods events are also responsible for considerable loss of human lives. For instance, the floods of July-August 2007 led to an outbreak

of cholera in four districts of Orissa, killing more than 100 people (SAARC Disaster Management Centre, 2008).

Droughts

The South-west monsoon contributes more than 75 percent rainfall in India. The failure of such monsoon and mismanagement of water after monsoon resulted in droughts and advancement of deserts including climatic variability. Presently, 68 percent area is vulnerable to droughts due to India's unique physiographical features.

According to the World Bank report of 2008, about 20 percent of India's flat land area is drought-prone. As per the Ministry of Agriculture, 14 states declared drought like situation in 338 districts with Himachal Pradesh, Assam, Jharkhand, Manipur and Meghalaya declaring all the districts as drought-prone in the year 2009. The Government of Kerala also declared drought in 14 districts in 2010 due to acute water shortage and drying up of water resources.

Desertification

Twenty-five percent of India's total land is undergoing desertification while 32 percent is facing degradation that has affected its productivity critically affecting the livelihoods and food security of millions across the country. The states suffering from land degradation/desertification are Rajasthan, Gujarat, Maharashtra, Orissa, Andhra Pradesh, Jammu & Kashmir.

The mismanagement of water resources is main reason for above disasters which is increasing alarmingly every year. The economic, social and environmental impacts of such disasters are escalating due to poor water management resulting in serious impediments to the economy of the country.

Discussions

The modern history of river basin management can be traced back to two events. The first was the creation of the Tennessee Valley Authority (TVA) in the United States in 1934. The second event was the creation of Damodar Valley Corporation (DVC) in July, 1948 for development and management of the basin as a whole. Further river basin management schemes in India followed in quick succession but elsewhere in the developing world the adoption of the river basin planning approach has not been adopted, with most countries concentrating on single large scale, high prestige projects.

Global Scenario

The present State of the water environment which led to disasters in both developed and developing countries have attracted attention of all classes of people globally. The UNEP has been involved in a number of international water projects, stressing its programme of Environmentally Sound Management of Inland Waters (EMINWA). To date UNEP has cooperated with riparian countries in EMINWA efforts in a variety of regions, including the Zambezi River Basin and Lake Chad Basin of Africa, the Mekong River Basin of Southeast Asia, the Aral Sea Basin of South Central Asia, the San Juan River Basin of Central America, the lake Titicaca Basin of South America, and in the Xinjiang Autonomous Region of north-west China. EMINWA projects are ongoing or planned for the Caspian Sea Basin of Eastern Europe, the Nile River Basin of Africa, and within the Human Autonomous Region of south-west China.

The UN, has also taken a number of initiatives and declared the years 1981 to 1990 as the International Drinking Water Supply and Sanitation Decade. The 1992 International Conference on Water and the Environment in Dublin was the first to lay down principles for action at local, regional and international level. In 1997, a special session of the UN General Assembly launched an International freshwater initiatives and in the spring of 1998, a strategy on freshwater was adopted at the Commission on Sustainable Development (CSD) Conference. In its millemium session in the year 2000, the UN announced its aim to cut by half the proportion of people without access to clean drinking water by 2015 and to put an end to non-sustainable use of water resource. In December, 2001, an innovative meeting took place in Bonn, focusing on water as key to sustainable development. The water issue was further discussed in 2003 at Kyoto, Japan and thereafter series of meetings in various parts of the world.

Agenda 21 was adopted in 1992 at the UN conference on Environment and Development in Rio-de-Janerio. In 40 chapters, it describes all major policy areas for environmentally sound and sustainable development. Chapter 17 and 18 are particularly relevant for water resource management.

Chapter 17 deals with protection of the oceans and all kinds of seas including coastal regions and the protection and efficient utilisation and development of their living resources.

Chapter 18 lays down objectives for the protection of fresh water resources in terms of quantity and quality. The chapter describes seven different programme areas:

– Integrated planning and management of water resources,

– Assessing water supply,

– Protecting water resources, water quality and aquatic ecosystems,

– Drinking water supply and sanitation,

– Water and sustainable urban development,

– Water for sustainable food production and rural development,

– Impacts of climate change on water resources.

The Nile basin provides a current example of an International initiatives of a regional partnership under which the countries of the Nile basin are engaging in co-operation on the Sustainable Development and management of the waters of the Nile. The Nile Basin Initiatives was launched in Dar-es-Salaam in February, 1999. The member countries are Burundi, Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Ruwanda, Sudan, Tanzania and Uganda. The Nile Basin Initiatives has established a strategic Action Programme to promote the shared vision to achieve sustainable socio-economic development through the equitable utilisation of, and benefit from the common Nile Basin water resources.

Indian Scenario

The Constitution of India lays down the legislative and functional jurisdiction of the Union, State and local Governments regarding 'water' under the scheme of the constitution. 'Water' is basically a State subject and the Union comes in only in cases of inter-state river waters.

India is a Union of States and the constitutional provisions in respect of allocation of responsibilities between the States and the Centre fall into three categories namely; the Union List (List-I), the State list (List-II), and the Concurrent list (List-III). Article 246 of the Constitution deals with subject matter of laws to be made by the Parliament and the Legislature of the State. As most of the rivers in the country are interstate, the regulation and development of water is a matter included in Entry 17 of List-II i.e. State list. This entry is subject to the provisions of entry 56 of list-I i.e. Union list.

Article 262 provides:

- Parliament may be law provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-state river or river valley.
- Notwithstanding any things in this constitution, parliament may, by law provide that neither the Supreme Court nor any other court shall exercise jurisdiction in respect of any such dispute or complaint as is referred to in clause (1).

River Boards Act, 1956

Under entry 56 of the List-I of the Constitution, the River Board Act, 1956 was enacted for the establishment of River Boards for the regulation and development of Inter-state River and River Valleys. Central Government has however not been able to constitute any River Board under this act so far for the integrated planning, development and management of water resources of the river basin as a whole. The Government, however constituted the Betwa River Board, Banasagar Control Board, Tungabhadra Board, Brahmaputra Board, Narmada Control Authority (NCA) and Upper Yamuna River Board outside the River Boards Act, 1956 for specific purposes for the planning, management, regulation of water resources in specific river basins.

Interstate Water Disputes (ISWD) Act, 1956

Under Article 262 of the Constitution, Parliament has enacted Interstate Water Disputes Act, 1956 for adjudication of disputes relating to waters of inter-state rivers and river valleys. Section 11 of the ISWD Act, 1956 also precludes all the Courts including Supreme Court from having jurisdiction in respect of any water dispute which may be referred to Tribunal under this Act.

The Union of India has made various institutional arrangements for development and management of water viz. National Water Resources Council (NWRC), National Water Board, Negotiated Settlements, Standing Committee on Inter-State issues. The Government of India has also initiated the Basin approach for the management of the water resources through Commissions, Boards and Authorities as follows:

Krishna-Godavari Commission: The Krishna-Godavari Commission was constituted in 1961 for ensuring coordinated planning and integrated operation of all projects in the basin.

Sone River Commission: The Sone River Commission was constituted in 1980 for preparing a comprehensive Sone river basin plan for optimum utilisation of its water for various uses. The commission has since been wound up in 1988.

Ganga Flood Control Board (GFCB) **and** ***Ganga Flood Control Commission (GFCC):*** The Ganga Flood Control Board was set up in 1972 by a Government of India Resolution. The GFCC has completed the master plans of 23 river systems of Ganga sub-basin. The problems of erosion and drainage caused due to Ganga flood are dealt by GFCC in the States of Bihar, Haryana, Himachal Pradesh, Madhya Pradesh, Rajasthan, Uttar Pradesh, West Bengal and NCT Delhi.

Brahmaputra Board : The Brahmaputra Board was set up in 1980 to prepare a master plan for control of floods in the Brahmaputra Valley giving due regard to the

overall development and utilisation of the water resources of the valley for irrigation, hydropower, navigation and other beneficial purposes.

Upper Yamuna Basin: The Yamuna water dispute was resolved by signing a memorandum of understanding (MOU) on 12.5.1994 by the Chief Ministers of the co-basin states of Haryana, Uttar Pradesh, Rajasthan, Himachal Pradesh, and NCT of Delhi. The agreement takes care of the irrigation and consumptive drinking water needs of all co-basin states and has opened up of development of water resources in the upper yamuna river basin.

Bhakara-Beas Management Board (BBMB): Bhakara-Beas Management Board was constituted through an executive order in accordance with the section 79 of the Punjab Reorganisation Act 1966 to regulate the supply of the waters of rivers Sutlej, Ravi and Beas to the States of Punjab, Haryana, Rajasthan and NCT of Delhi and to distribute power from the Bhakra-Nangal and Beas projects to the States of Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir, Union Territory of Chandigarh and Delhi.

Narmada Control Authority: The Narmada Control Authority has been set up as per the final orders and decisions of the Narmada Water Disputes Tribunal (NWDT) as machinery for implementation of its directions and decisions. The Authority started functioning from 20th December, 1980. The role of the Authority comprises overall coordination and direction of the implementation of all the projects including the engineering works, the environmental protection measures and the rehabilitation programmes and to ensure faithful compliance of the terms and conditions stipulated by the Central Government at the time of clearance of the aforesaid projects. With Union Water Resources Secretary as ex-officio Chairman of the NCA, the decisions of the Authority are final and binding on all the party States. However, a Review Committee consisting of Union Minister of Water Resources as Chairman, Union Minister of Environment and Forests and Chief Ministers of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan as Members may *suo-moto* or on the application of any party State can review any decision taken by the Authority. The Secretary, Ministry of Water Resources, Government of India, shall act as convenor to the Committee.

Besides above, several other organisations like Betwa River Board for Rajghat dam across Betwa, the Bansagar Board for Bansagar dam across Sone, the Mahi Control Board for Mahi Bajajsagar project across Mahi and the Narmada Control Authority for Sardar Sarovar Project (SSP) across Narmada are examples of the river basin organisations set up mainly for achieving efficient, economic and early execution of important inter-state water resources development projects.

Why River Basin Development in India?

The mismanagement or poor management of Water Resources has led to serious problems of floods affecting millions of people in Uttarakhand, Uttar Pradesh, Bihar, Assam, Orissa. Draughts covering 20 percent area of the total land area of the country are affecting States like Jharkhand, high rainfall State Kerala, Himalayan States namely; Manipur, Assam. Besides we witness advancement of desertification covering 20 percent of India's total land area in the States like Rajasthan, Gujarat, Maharashtra, Jammu & Kashmir, Orissa and Andhra Pradesh affecting critically the livelihoods and flood security of millions in the country.

India's population is now above 1.2 billion and is expected to reach around 1.4 billion by 2025 and 1.6 billion in 2050. The per capita land is 0.13 ha and hence large percentage of income in poor families goes in meeting food requirement. The food security challenge and livelihoods are of utmost importance. The nutrition security is also a dream for 300 millions of people. The Planning Commission, Government of India estimated that despite significant progress in the 1970s and the 1980s, nearly 30 percent of the people remained below poverty line in 2004-07. Presently 27 crore people are below poverty line. The share of landless and wage-dependent households in this group is growing. There are presently more than 300 million unemployed and severely underemployed persons in the country.

Agriculture in India is mainly dependent on irrigation. The net sown area in the country has almost stabilised at about 145 million ha while the gross cropped area is about 175 million ha. Taking into account areas sown more than once, it is unlikely that net sown area will increase in the future. The only way to increase the gross cropped area is to expand irrigation facilities and to facilitate intensive agriculture in a sustainable manner, avoiding e.g. over irrigation, salinisation and flooding. The gross irrigation is estimated to have increased from 22.6 million ha in the year 1951 to about 108 million ha which means, about 77 percent of the ultimate irrigation potential has since been created. Further development is must to meet food security challenge of growing population. The food grain production which was about 210 million tonnes in the year 1999-2000 may have to be raised to about 350 million tonnes by 2025. The demand of water for irrigated agriculture will also go up from 630 km^3 in the year 2000 to 770 km^3 in the year 2025. The demand of drinking water supply would increase to 52 km^3 in 2025 from 33 km^3 in year 2000 and the demand of industrial water is expected to go up from 30 km^3 in year 2000 to 120 km^3 in 2025. The per capita water availability was 5177m^3 in 1951 has come down to 1820 m^3 in 2001 and is now projected to 1314 m^3 in 2025 and 1140 m^3 in 2050.

At the energy front India has made rapid progress in terms of the installed generating capacity, from a mere 1362 MW at the time of independence to about 237742 MW by

February, 2014. Though this growth appear to be impressive but in December, 2013, there was a deficit of 5547 MW of peaking power in the country. The percentage of installed thermal, hydel and nuclear power stations capacities are around 73, 24 and 3 respectively. The hydro-electricity has still vast untapped potential.

The River Basin approach for management of water resources could not follow quick succession globally after the Tennessee Valley Authority (TVA) in the United States in 1934 and Indian Damodar Valley Authority (DVA) in 1948. Water being our common heritage, and the reality that we all share the responsibility of protecting it for future generations, a breakthrough for really sustainable water resources development and management is imperative. The ecosystem-based policy approach for the integrated management of water resources (River Basin approach) involving scientific, technical and engineering factors on the one hand and social, economical, environmental and legal factors on the other hand in various mission modes is need of the hour for tackling disasters like floods, droughts, erosion, landslides, climatic variability, advancement of desertification, land degradation and to meet the food, energy, drinking water, irrigation, ecosystems security challenges of today and tomorrow, Integrated Management of Water Resources (IMWR) deserves due attention for ensuring environmentally sustainable development in the country.

Recommendations

Following recommendations based on ecosystem approach deserve due consideration globally for the integrated river basin management to prevent disasters like floods, droughts, desertification's, climatic variability, etc.:

1. The water should be made a Union/Concurrent subject in the Constitution. It should be considered as a National asset and accordingly comprehensive National Policies and Strategies for integrated Water Resources Management that link water to National Development goals should be framed.

2. The multi-disciplinary River Basin Authority exclusively funded by Central Government should be established under River Boards Act, 1956 under entry 56 of List-I to promote integrated development of water resources especially inter-state rivers, and river valleys. The water management must be organized to maintain or restore the ecological balance (terrestrial and aquatic ecosystems) and guarantee water supplies on a sustained basis in terms of quality and quantity. The Centre, State and Local bodies (Panchayats, Corporations, Municipalities, Traditional Industries, etc.) should play an important role.

3. Multidisciplinary River Basin Authorities in each States for Integrated Intra Water Resources Management (IIWRM) and Sustainable Development. The

policy and programmes for Resettlement and Rehabilitation (R&R) of displaced persons and Environmental Management should be an integral part in the Authority.

4. The River Basin authorities of the States should formulate programmes under various Missions through people participation to ensure livelihoods to the basin population and at the same time for ensuring Natural Resources Management and sustainable development in the basin. These missions could be as follows:

   a. *Water Mission* (construction of multi-purpose water resources projects, water harvesting, rehabilitation of degraded rivers, rivulets lakes, ponds, water quality surveillance).

   b. *Aquaculture Mission* (based on technical feasibility and economic viability, capacity building, marketing, etc.).

   c. *Livestock Mission* (value chain development in dairying, goatery, piggery, poultry, duckery, capacity/institutions building, entrepreneurship development, etc.).

   d. *Forestry Mission* (protection and management of forests, plantation in both urban and rural areas, rehabilitation of degraded forests, incentive to forest growers and owners of sacred groove in North-East).

   e. *Agriculture and Horticulture Mission* (cropping pattern for irrigated agriculture, nursery for horticulture, improved seeds for agriculture, extension services, marketing and storage infrastructure for agriculture and horticulture produces at Panchayat level).

   f. *Tourism Mission* (potential tourists sites/places already existing and identification of new sites, infrastructure development, institution and capacity building and linking of tourism with water sports, forestry, horticulture, agriculture, game farming, game fishing, etc.).

   g. *Energy Mission* (with focus on geo-thermal, solar, wind, biomass, hydel, tidal resources in Ganges delta and Sundarbans, Gulf of Kutch and Khambhat).

   h. *Apiculture Mission* (oriented towards value chain development, capacity and institution building, entrepreneurship development, etc.).

   i. *Sericulture, Weaving and Artisan Mission* (capacity and institution building, extension services, marketing, etc.).

j. *Health Mission* (focus on Sanitation and Hygiene).

k. *Vocational Training Mission* (opening of ITIs in rural areas).

5. Interstate rivers disputes should be resolved timely so that translation of disputes into conflict over shared water resources could be avoided. The Tribunal constituted under the Inter-State Water Disputes Act, 1956 should be multi-disciplinary, headed by a judge. The time line should be fixed for final order, clarifications and supplementary orders. Appeals to the Apex Court should also be prescribed under the Statute.

6. The following dimensions of the water protection area should be given due emphasis :

Catchment zone-I. Any pollution of the bank area and the water in the catchment zone is to be avoided. The catchment zone belongs the waterbody of standing waters and its bank areas, the storage body and take-out construction of reservoirs. Considering terrain exposition and morphological, geological and local conditions, the catchment zone, as a rule, to be determined at 100 to 200 m around the waterbody measured in the projection from the highest storage line.

Narrow protective zone-II. The narrow protection zone encircles the catchment zone and has to be so dimensioned that the catchment zone is protected against all threats that may result from utilisations or pollution within the broader protective zone. In an inclined terrain it is to be extended to all areas that drain directly into the catchment zone, in a shallow terrain, it can be upto 500 m. wide. All impairing utilisations in this zone that may have negative effect upon the catchment area should be prohibited.

Broader protective zone-III

- The measurement of development e.g. mining, drilling, soils development etc. are to be coordinated with the interest of water management.
- Special places for the storage of residues are to be determined that shall have no possibility of pollution of the water.
- The handling of oil and petroleum products should be carried out scientifically.
- Enterprises, which utilise, store or produce poisons according to the law on poisons have to take special precautions with respect to water treatment and safeguarding populations against catastrophe.
- The waste products of agricultural production and processing plants are to be utilised in agriculture itself.

- Nitrogen, manure and minerals washout should be controlled.
- If colonies get waste water canalisation, the waste water is to be let out of the drinking water catchment area or to be brought to sufficient waste water treatment.
- Soil cultivation is principally to be carried out at right angles to the slope.
- A slope with an unfavourable relief, necessary erosion mindering measures are to be implemented.
- Slopes with an inclination between 12 to 18 percent are preferably to be utilised as permanent grass land or forest.
- Slopes with an inclination over 18 percent are to be utilised by forestry. The plantation has to be carried out to develop special forests with protective function.

7. International community to strengthen its commitments and efforts to enable developing countries to manage water sustainably and to ensure equitable sharing of benefits from internationally shared water resources. The UN system should have to play an important role in coordination and strengthening of activities on water issues.

Conclusions

The problems associated with integrated surface water resources management considering river basin as a Hydrological Unit are a great global challenge. The existing state of water environment had already given way to 'conflicts on water' on one hand and disasters like floods, droughts, landslides on the other hand in various countries of the world mainly in North Africa, Middle east, Western Americas, South-east Asia. In India, the mismanagement of water is main reason for conflicts between various states and disasters like floods, landslides, droughts, climatic variability, advancement of desertification, etc. jeopardising livelihoods and posing food security challenge of millions on one hand and major economic, social and environmental impacts on the other hand. In India, conflicts on water will be of serious concern in future, if the protection and wise management of most valuable of the world's renewable resources are not given top priority. The integrated management of water resources (River Basin approach) involving scientific, technical and engineering factors on the one hand and social, economical, environmental and legal factors on the other hand is need of the hour. Water being our common heritage, and the fact that we all share the responsibility of protecting it for future generations, a breakthrough for really sustainable water resources development and management is required.

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