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Contextual Findings and Lessons



5

CONTEXTUAL FINDINGS AND LESSONS

5.1 Introduction

The Uttarakhand disaster of June 2013 was one of the worst natural disasters in the history of India. Because of its severity and the geographical spread, the disaster posed enormous challenges for rescue, relief and rehabilitation activities. The enormity of the disaster and its impact has raised numerous questions related to the underlying causes of the disaster and the preparedness levels when the calamity struck.

This chapter endeavours to find answers to impending quests in order to offer contextual findings, to identify gaps and to draw lessons to improve mitigation and preparedness from perspectives of future risk reduction, be it for either natural or human-induced disasters. There is a need to precisely understand what went wrong and address those issues in our future strategies for safe and sustainable development through effective, prudent and site specific approaches of Disaster Risk Reduction (DRR). After reviewing and analyzing these contextual findings, several specific lessons have been drawn that would be helpful not only for the Government, but also for others including Community Based Organisations(CBOs), Non Government Organisations (NGOs), academicians, disaster management professionals and researchers, and the community at large.

The National Institute for Disaster Management (NIDM), in accordance with its mandate initiated documentation of this mega disaster to understand its causes and impact, and to draw lessons for the future. The study used Primary as well as

Secondary data sources. Various secondary sources i.e. books, memoirs, articles, research papers, Government reports, magazines and news papers, along with video clippings, etc. were considered for the purpose of the contextual findings. National Remote Sensing Centre (NRSC) website was referred for the spatial analysis. Apart from these, maps and statistical data were collected from concerned departments of the Government, such as India Meteorological Department, Uttarakhand State Forest Department, Uttarakhand Space Application Centre, etc. Data pertaining to the demography of the state was collected from the publications of the Registrar General and Census Commissioner, India.

For assessing of the situation, NIDM carried out two field visits to the affected sites to:-

- get first hand information of the disaster (from 22 to 24 June, 2013)
- conduct random sample survey in four disaster affected valleys, - Yamunotri, Gangotri, Kedarnath and Badrinath (from 10 to 31 July, 2013)

To compile and collate primary information, the survey was conducted in the affected areas of Uttarakhand, to draw lessons from the disastrous events of flash floods and landslides. Information was gathered through personal interviews, focused group discussions (FGDs), structured questionnaires and field observations. Seven categories of stakeholders - directly or indirectly related to disaster mitigation and management in the present context - were engaged for the survey. Seven types of questionnaire, separate for each category, were used in the survey. These categories included the following:

- Local people affected by disaster
- Community representatives
- District level officers
- State level officers
- Police/Army/ITBP/NDRF personnel involved in the rescue operation

- Academic institutes
- Pilgrims/tourists

A comprehensive and detailed survey was conducted by involving research students from Hemwati Nandan Bahuguna Garhwal University, Srinagar. Students were engaged to compile primary information from various categories of respondents mentioned earlier in the formats developed by NIDM. The information was collated, compiled and analyzed at NIDM.

Findings from the surveys were analysed to understand various stakeholders' perception regarding preparedness and preventive measures, existing management efforts in place and the actual requirements to manage such mega disasters. Based on these inputs, recommendations are made to manage future disasters in a more effective manner.

NIDM teams made extensive visits to affected areas and interacted with stakeholders, including administrators, representatives of CBOs, NGOs, academicians, local activists, responders and policy makers. Separate interactions and discussions were held with academic and research institutes, which were involved in scientific research related to environmental, geological, socio-cultural and other developmental issues of the Uttarakhand region, and had come out with significant inputs in understanding the causes of this large scale devastation.

In addition to field surveys and investigations, two National Workshops briefly discussed below were also organised at the NIDM :

- "Uttarakhand Disaster- 2013 : Lessons Learnt" workshop was organized at NIDM on 19 August 2013. More than 130 delegates participated in the workshop. Relevant Government agencies, Non Government Organizations, UN agencies, and educational & research organizations involved in the response, rescue, relief and rehabilitation participated in the workshop and shared their experiences and key findings. Broad structure and strategies for documentation of Uttarakhand disaster was presented and discussed in the



Figure 5.1: Workshop in progress

workshop, and feedback from various delegates were used to improve the process of information collection, drawing interpretations and conclusions.

(i) A concluding strategic workshop was organized on "Uttarakhand Disaster 2013: Lessons Learnt and Way Ahead" during 13-14 March 2014 at the NIDM. The final draft of the documentation of Uttarakhand Disaster 2013 was circulated to all the concerned authorities, agencies and stakeholders for getting their feedback and suggestions. Along with dedicated technical sessions on sustainable and safe reconstruction and future risk reduction strategies in Uttarakhand, the final outcome, contextual findings and lessons learnt were presented and discussed in the workshop.

The complete Process of documentation of the 'Uttarakhand Disaster- 2013' is reflected in Figure 5.2.

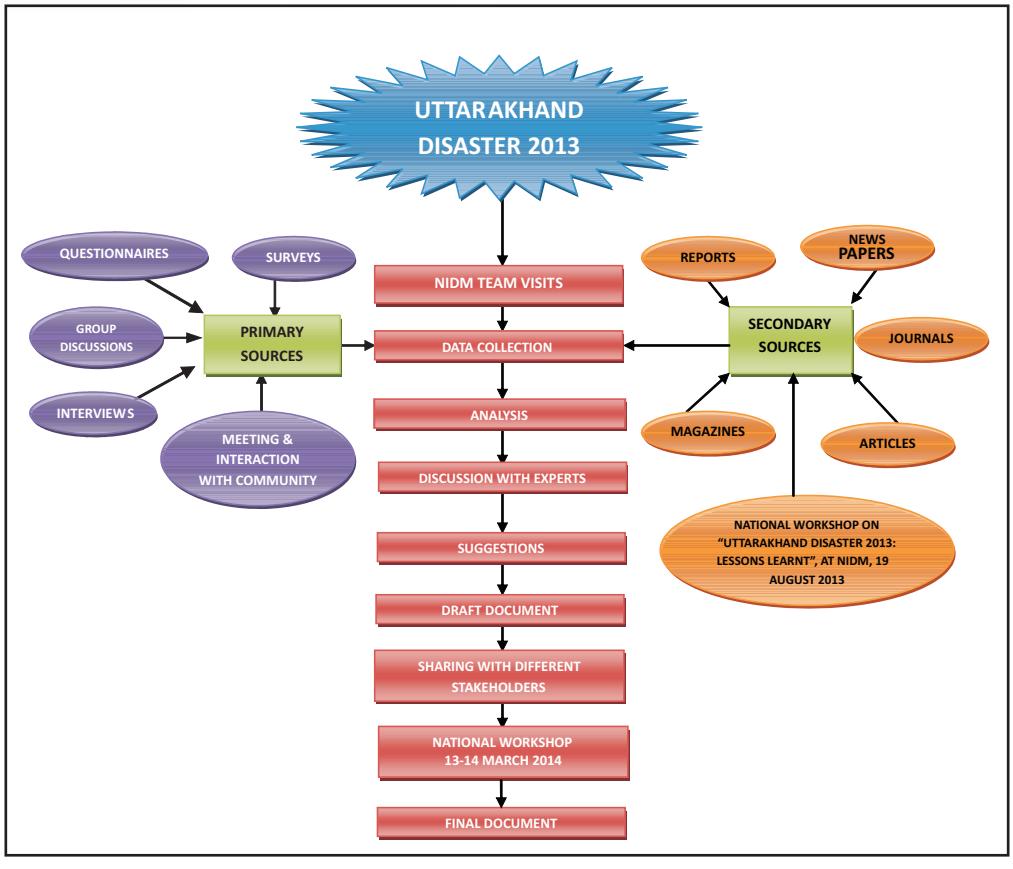


Figure 5.2: Documentation Process

Based upon the outcome of the field visits, interaction with the stakeholders, workshops and meetings with concerned authorities and officials, contextual findings and lessons learnt in regard to the Uttarakhand disaster are developed in three parts:

(i) Pre-disaster perspective

(ii) Preparedness

(iii) Response & Relief

5.2 Pre-disaster Perspective

Geology of Uttarakhand is ridden with numerous fault lines and thrusts. According to recent scientific findings, climate change is likely to aggravate frequency of flash floods due to high intensity rainfall, the Glacial Lake Outburst Floods (GLOFs) and

landslides, increasing the ecological and socio-economical vulnerability. Meanwhile, the ongoing development activities in the State continue to impact upon the ecology of the area. The influx of large number of tourists & pilgrims, particularly during the summer and rainy seasons, further puts anthropogenic pressure on environment while putting large number of pilgrims at risk in the event of adverse weather.

Effective response to disaster is not possible without - timely early warning to the people at risk and well tested disaster management plans of the local administration, a State or local disaster response force, training of police and community volunteers in rescue & relief and, effective communication and equipment mobilization. In the context of the Uttarakhand disaster, all these factors have been analysed in detail and appropriate suggestions are being made, which will help to reduce the impact of such disasters in the future.

5.2.1 Disaster Mitigation and Development

After the formation of State of Uttarakhand, there has been a rapid pace of development activities, including economic and infrastructure development without adequate care for environmental safety and sustainability**.** Most of these developmental activities were carried out without giving much attention to geological, geo-morphological, and ecological conditions.

5.2.1.1 Land use Planning

Despite the Uttarakhand Flood Plain Zoning Act, 2012, to protect flood zones[1] hundreds of new buildings came up in the flood zone of rivers and in many instances on the riverbed itself. During its visit, the NIDM team observed that in Srinagar town, a number of buildings, including training centre of the Sashastra Seema Bal (SSB) were constructed in the flood plain of river Alaknanda. Such buildings were terribly damaged by the flash floods. The powerful water current also washed away the thick cement blocks from the boundary of the SSB camp. Flood also affected houses near the SSB training centre and thick mud was

deposited in these buildings.

Similarly, Geological Survey of India found that the *Gurudwara* at Gobind Ghat (district Chamoli) and adjoining buildings were constructed on old terrace and immediate hill slopes, which were geologically unsuitable locations for such constructions. Adjoining buildings along with their foundation which were washed away, were perhaps not anchored with rock at the base, and became unstable due to scouring as well as due to force of the river current. The concrete protection / retaining wall too was founded within riverbed and hence fell prey to scouring. On the right bank of Alaknanda river, about 350 m downstream of main *Gurudwara* premises, multi-storeyed parking structure, commercial buildings and part of main approach road to Gurudwara from NH-58, were constructed on old debris cone partly on river terrace and, therefore were completely washed away by the flash flood.

Lessons Learnt

- Government of Uttarakhand needs to implement the provisions of "Flood Plain Zoning Act" regulating construction within the flood plain of a river.
- Legal framework needs to be developed to avoid construction on unstable or steep slopes and ensure land use planning based on Hazard, Risk and Vulnerability studies.
- Encroachment in riverbeds must be strictly prohibited and all past encroachments must be removed.

5.2.1.2 Implications of Hydro-Power Projects

Uttarakhand has 45 Hydro Electric Projects of varying capacities installed by the State and Central Government agencies and the private sectors. Hydropower projects are also known to generate huge amount of muck during tunneling, blasting and other processes. The projects are required to have a muck disposal plan to include designated areas above the high flood levels to be used as muck disposal sites. The plan should also include land stabilization and provision of

safety walls for such sites. Direct dumping of muck into the river causes changes in the river course, which further changes river morphology. These in turn, aggravate erosion and flooding in the area due to meandering and cutting force of the muck material particles. Such debris laden rivers can also create massive landslides along the banks[2].

In the current floods, the muck dumped by the 330 MW Srinagar HEP might have intensified the factors responsible for causing damages downstream. When the flooded rivers carry muck, boulders and other debris, they have much greater erosion capacity and they also leave behind massive heaps of muck in the flooded area. In Srinagar town, a number of houses were buried under 10-15 feet of muck.



Figure 5.3: The muck dumped in Alaknanda riverbed at Srinagar was probably one of the major causes for damage and huge siltation downstream

In addition, hydro power projects are also blamed to disturb ecological balance in the sensitive fragile zone of Himalayas, leading to more landslides and other associated risks.



Figure 5.4: The muck dumped in Alaknanda riverbed at Lambagad village in Chamoli district



Figure 5.5: At Vishnupryag HEP in Chamoli district, a temple constructed in the middle of the River Alaknanda

The impact of hydropower projects on environment, ecology, biodiversity, and economic and social life of the region has always been a matter of concern. In this context, the observation made by the Supreme Court of India is very significant.

Observation of the Supreme Court in Civil Appeal No. 6736 of 2013 Uttarakhand disaster[3]

The Executive Summary of Chaturvedi Report on the question of 'Environmental Impact of Projects', reads as follows:

- Development of new hydropower projects has impact on environment, ecology, biodiversity, both terrestrial & aquatic and economic and social life. 69 hydropower projects with a capacity of 9,020.30 MW are proposed in Bhagirathi and Alaknanda basins. This includes 17 projects which are operational with a capacity of 2,295.2 MW. In addition, 26 projects with a capacity of 3,261.3 MW (including 600 MW Lohari Nagpala hydropower project, work on which has been suspended by Government decision) which were under construction, 11 projects with a capacity of 2,350 MW CEA/TEC clearances and 16 projects with a capacity of 1,673.8 MW under development.
- The implementation of the above 69 hydropower projects has extensive implications for other needs of this society and the river itself. It is noticed that the implementation of all the above projects will lead to 81% of River

Bhagirathi and 65% of River Alaknanda getting affected. Also there are a large number of projects which have very small distances between them leaving little space for river to regenerate and revive.

- The above mentioned Reports would indicate the adverse impact of the various hydroelectric power projects on the ecology and environment of Alaknanda and Bhagirathi river basins. The cumulative impact of the various projects in place and which are under construction on the river basins have not been properly examined or assessed, which requires a detailed technical and scientific study.

- We are also deeply concerned with the recent tragedy, which has affected the Char Dham area of Uttarakhand. Wadia Institute of Himalayan Geology (WIHG) recorded 350 mm of rain on June 15-16, 2013. Snowfall ahead of the cloudburst also has contributed to the floods resulting in the burst on the banks of Chorabari Lake near Kedarnath, leading to large scale calamity leading to loss of human lives and property. The adverse effect of the existing projects, projects under construction and proposed, on the environment and ecology calls for a detailed scientific study. Proper Disaster Management Plan, it is seen, is also not in place, resulting in loss of lives and property. In view of the above mentioned circumstances, we are inclined to give following directions:

1) We direct the MoEF as well as State of Uttarakhand not to grant any further environmental clearance or forest clearance for any hydroelectric power project in the State of Uttarakhand, until further orders.

2) MoEF is directed to constitute an Expert Body consisting of representatives of the State Government, WII, Central Electricity Authority, Central Water Commission and other expert bodies to make a detailed study as to whether Hydroelectric Power Projects existing and under construction have contributed to the environmental degradation, if so, to what extent

and also whether it has contributed to the present tragedy occurred at Uttarakhand in the month of June 2013.

3) MoEF is directed to examine, as noticed by WII in its report, as to whether the proposed 24 projects are causing significant impact on the biodiversity of Alaknanda and Bhagirath River basins.

4) The Disaster Management Authority, Uttarakhand would submit a Report to this Court as to whether they had any Disaster Management Plan in place in the State of Uttarakhand and how effective that plan was for combating the present unprecedented tragedy at Uttarakhand.

- Reports would be submitted within a period of three months. Communicate the order to the Central and State Disaster Management Authority, Uttarakhand.

In view of above, civil appeals and transferred cases are disposed of.

.....J.

(K.S. Radhakrishnan)

.....J.

(Dipak Misra)

New Delhi,

August 13, 2013

In contradiction to above, it is also argued that dams play a mitigating role by arresting sediment load of the flood which may otherwise cause huge damage.In the present context also, there is a view that the storage of the flood waters in the Tehri dam prevented inundation of downstream habitations at Rishikesh and Haridwar, adding another dimension to the desirability of storage type hydro electricity projects.

Another important facet of hydro power projects argued is that hydro power is a 'green' source of energy and it plays the essential role of providing peaking power in grid management. If equivalent energy were to be generated by coal fired thermal plants (there being inadequate supply of domestic gas and imported gas being costly), it would add significantly to generation of Green House Gases (GHGs), which would have its own impact on the environment, including faster melting of the glaciers that feed the Himalayan rivers that environmentalists strive to protect.



Figure 5.6: Destruction in Vishnuprayag HEP in Chamoli district (400 MW)



Figure 5.7: Pandukeshwar village under threat of landslide just downstream Lambagad village in Chamoli district

Lessons Learnt

- Along with the Environmental Impact Assessment (EIA), hydropower projects in ecological sensitive regions like Uttarakhand must have comprehensive Disaster Impact Assessment (DIA) mandatory for project clearance.
- Hydroelectric projects must have a muck disposal plan, with proper site for muck disposal, and plans for transportation of muck to the designated sites well above the high flood levels.
- Alternative energy options like solar / wind / bio energy need to be further explored in the Himalayan region.

5.2.1.3 Management of Landslides

Most of the landslides occurred at geologically weak zones, i.e., faults / thrust areas. The Mandakini valley which was worst affected during the disaster was formed by

the erosion and depositional processes of glacio-fluvial origin. The Kedarnath town is situated on the outwash plain of Chorabari and the Companion glacier. Houses downstream near Rambara and Gaurikund, have been built on the old colluvial or fluvial deposits, which are loose in nature and prone to landslides and river erosion.

The large-scale debris flow in the Mandakini River from the upstream of Kedarnath was probably the result of massive landslides. In the preliminary assessment, a total of 2,395 landslides were identified along the river valleys of Mandakini, Basuki Ganga, Mandani, Kali, Madhyamaheshwar, Bhillangana, parts of Alaknanda (including upper Saraswati valley) and its tributaries like Kalpa Ganga, Kalapani Gad, Khirao Ganga and Rishi Ganga from Srinagar to Chamoli (also around Jakhpur, Kalpeshwar, Khiraogarh and Mana) and parts of Bhagirathi around Gangotri. The area encompasses major towns like Kedarnath, Sonprayag, Gaurikund, Okhimath, Guptkashi, Mansuna, Phata, Agastmuni, Rudraprayag, Srinagar, Gauchar, Karnaprayag, Nandprayag, Chamoli, Jakhpur, Kalpeshwar, Khiraogarh, Mana, and Gangotri[4].

Almost all major roads were blocked or terribly damaged due to large number of landslides and rock falls, disrupting the communication and linkage to disaster hit areas. The landslides in the region need effective management to mitigate future risks.

Lessons Learnt

- There is an urgent need for landslide risk zonation mapping of the region using ground truth observations and detailed information of landscape, geology, ecology, vegetation and soil characteristics, human settlements, landslide and flood history of the site.
- It is important that such landslide risk zonation is enforced with appropriate guidelines, regulations and codes for landslides risk assessment and mitigation through an integrated approach, involving State agencies/departments and local administration.
- Sincere efforts need to be made for slope stabilization at landslide prone locations. There are various scientific techniques available at national / international levels, which can be used for effective stabilization of slopes

in shear and weak zones. (A few of such techniques are discussed in Chapter 6 of the book). While constructing new roads or widening\repairing the old ones, such techniques must be applied along shear/weak zones.

- As far as possible, blasting for developmental activities must be avoided because frequent blasting may destabilize the weak rocks of the region, which may result in landslides and rock falls.

5.2.1.4 Riverbed Mining

Un-attenuated side effects of developmental activities on landscape and ecology, coupled with accelerated forest degradation and deforestation have led to increase in erosion, and thus, adding more sediments to the riverbeds, ultimately leading to reduction in water carrying capacity of the river channels. Removal of excess sediment from riverbeds through riverbed mining may help in increasing the water carrying capacity of the rivers, and therefore, may reduce the risk of floods to some extent. However, removal of gravels and sediments in huge quantities, higher than the capacity of the river to replenish them, may lead to changes in river channel. River Bed Mining (RBM), including unauthorized mining, is common in many rivers of Uttarakhand for extracting sand. Mining-induced changes can lead to loss of fertile streamside land, which can destabilize riverbed and banks and result in dramatic readjustments of river course. Sand also acts as sponge and helps in recharging of water table. Its progressive depletion in the riverbed due to mining leads to sinking of water table in the nearby areas.

Lessons Learnt

- River Bed Mining related issues are to be tackled systematically, based on the scientific investigations, taking care of ecological aspects. The issue needs an area specific approach before giving lease for River Bed Mining.
- Unsustainable mining of the riverbeds must not be allowed and illegal mining must be stopped.

5.2.1.5 Road Construction

The construction of roads in Uttarakhand accelerated after the 1962 Chinese war. Many new roads to interior places like Saung, Munsiyari, Chirbatia, Rikshal, Bungidhar, Salakhet, Thaliasen, Gotgarh, Netwar, Patkot, Mandoli, Jurasi, Arokot, Betalghat, Kunyakhanak, Mandal and Nagachun were constructed for defence purposes.

Major roads in hill region of the State are maintained by the Border Roads Organisation (BRO). The State Public Works Department (PWD) makes roads that branch off from the trunk roads maintained by BRO. The process of road construction by the State PWD has quickened since formation of Uttarakhand as a new State.

It is true that the roads are lifeline and play a significant role in development. However, road construction projects are seldom undertaken with due consideration to eco-geological aspects of the region. Indian Institute of Technology (IIT) Roorkee, carried out a detailed study about the road conditions in Uttarakhand and reported that most of the roads have been constructed ignoring local geological and ecological conditions. The report released at the International Conference on Energy Resources and Technologies for Sustainable Development in February 2013 at Howrah, Kolkata, states that more of such landslides are waiting to happen, if unplanned road construction continues in Uttarakhand. The IIT professionals also mentioned that crucial parameters like ground safety factor, slopes, and characteristics of rocks should be considered before making a road in the Himalayan terrain[5].

Management of debris generated because of road construction process is also a major challenge. This debris is mostly left unattended and usually dumped in the riverbeds, reducing river's water carrying capacity and, thus, increasing the chances of flash floods and floods.

Lessons Learnt

- This is the right time to review the alignments of existing roads in consultation with Geological Survey of India (GSI) and other scientific agencies.

- In view of the importance of roads connecting pilgrimage centres and sensitive border areas, a Special Central Programme for construction of new roads, and widening and renovation of existing roads should be undertaken, so that roads are built in a scientific manner.
- It is equally important that separate evacuation routes/roads are constructed by BRO from major pilgrim centres, even if they are for short stretches.
- Stabilization of landslides/shear zones should be given top priority while constructing roads in the hilly terrain.

5.3 Preparedness.

Notwithstanding the enormity of the disaster, it was more than evident that the level of preparedness was much short of expectations. Very important lessons have emerged in the context of preparedness.

5.3.1 Disaster Management Plans and Policies

Guidance to each segment of Government and other role players at all levels is essential to ensure adequate preparedness and response for major disasters across the State. Hazard-risk and vulnerability analysis and a detailed management plan comprising environment, engineering, social and economical measures, including response and other associated issues are necessary at local/district level as a fundamental to disaster management plan.

It was assessed that key decision makers were not familiar with 'why things went wrong' and what was actually lacking in disaster management plans and preparedness. While interacting with district, block and local level administration, it was found that at many places a Disaster Management Plan existed but most officials were not very well aware of its content and were ignorant about their duties and responsibilities, especially in a pre-disaster situation. Such plans were not updated since long. This lack of understanding of the "Disaster Management Plans" resulted in sub-optimal coordination at the State, district, and local levels affecting the disaster response. Additionally, a Disaster Management Plan itself provides

only the 'base plan' outlining the overall elements of preparedness and response. State and District departments and agencies were required to develop supporting operational plans and Standard Operating Procedures (SOPs) to integrate their activities into the State level disaster preparedness. In most cases, when Uttarakhand was hit by the flash floods, integrating SOPs were either non-existent or still under development. Consequently, specific procedures and processes of the Disaster Management Plan were not in place.

Lessons Learnt

- The State Government should take initiative to revise and update existing Disaster Management Plans, ensuring a functional operational structure and establishing a clear and accountable process for all State level disaster preparedness efforts. In doing so, the State Government must ensure that Emergency Support Functionaries at the State level, viz., SDRF / Police / Civil Defence and Home-Guards are organized, trained, and equipped to perform their roles and responsibilities.
- An effective disaster management planning is not possible without proper Hazard, Risk, Vulnerability and Capacity (HRVC) analysis. HRVC analysis for various parts of the State is non-existent and, therefore, it is difficult to plan appropriate mitigation and preparedness measures. The State Government needs to carry out region wise detailed HRVC analysis exercise to assess the risks of various disasters and accordingly develop disaster management plans. The HRVC analysis, mitigation and preparedness planning must also take into consideration the effects of climate change, ecological and natural resources, livelihood and local development issues.
- There is need to develop Standard Operating Procedures (SOPs) for different disasters to specifically assign duties and responsibilities to key role players and stakeholders. Capacity building of all the stakeholders in disaster management, especially of main role players, is essential for effective response. NIDM has developed 11 training sub modules in Incident Response System (IRS) in close coordination with US Forest Service. The State Government can adapt to the IRS for effective disaster response and get its officials trained in IRS to improve its response mechanism.

5.3.2 Reliable Telecommunication System

During the disaster, fixed and mobile telecommunication was terribly affected because the lines and towers were damaged and could not be repaired, as the road connectivity was lost due to landslides. Some towers, though undamaged, became dysfunctional as their diesel generators went dry and could not be replenished. The limited numbers of satellite phones with district administrations were inoperative due to certain regulatory reasons. As a result, during disaster, District Officials could not contact their field functionaries, including *Patwaris*. All these factors led to delay in sharing information about the disaster and adversely affecting rescue and relief operations.

Lessons Learnt

- There is need to review the existing emergency communication system. Government of Uttarakhand must plan for an alternative back up communication system for use in case of failure of normal communications during disasters.
- Augmentation of wireless, satellite and ham radio communication system is required for carrying out effective response and rescue operation in case of a disaster. There should be provision of battery operated chargers in disaster prone areas.
- For emergency alerts, some effective network like Short Message Services (SMS) Gateway system must be used to alert and warn people in case of disaster.

5.3.3 Early Warning System

Although the India Meteorological Department (IMD) provided warning of 'heavy to very heavy rain', there was little inkling that the rain could induce such a massive disaster. As previous experience showed, excess rainfall caused greater damage when it occurred in late July, August or September, as it happened in the year 2010 when the expectation was that the forecasted precipitation would be soaked up by the dry mountainside. The lack of a warning system for flash floods and the inability to predict area specific precipitation were evident. An effective early warning

system necessitates that various hydro-met data inputs are seamlessly available for accurate modelling of flash floods or rain induced landslides. The underlying data and information needed for an early warning system typically comes from a wide range of sources, which are often not shared or integrated in a way that facilitates timely and accurate decision-making. This situation aggravates by the lack of common standards for data collection and dissemination, resulting in difficulties for the end-users, typically the authorities responsible for disaster warning and response.

Lessons Learnt

- A review of the existing weather forecasting and information systems is necessary. Accuracy of the disaster warnings, communication with local authorities, hydro-met data collection, and sharing capabilities should also be targeted for improvement.
- Establishing advanced automated early warning system (EWS) for inaccessible parts of the catchment areas on a permanent basis is highly desirable.
- Community involvement in the design and implementation of early warning system is essential.
- Investments in monitoring weather, glacial lakes, and river flow is fundamental for improving the accuracy of risk mapping. This will allow lead-time to provide warnings.
- There is an urgent need to put clearly defined monitoring system in place, which is capable of prompt reporting of actual rainfall events, so that the downstream population and administration can be alerted well in time.
- Coordinated action of all EWS related public agencies under one umbrella organization can improve monitoring, warning, preparedness and response.

5.3.4 Tourism

During the disaster, majority of the people reported killed or presumed dead were tourists and pilgrims visiting the State for religious or recreational purpose.

According to Uttarakhand Tourism Department, the number of tourists visiting Uttarakhand since 2000 has increased by 155%. Safety of the pilgrims should have been given top priority during *Char Dham Yatra*, but there was no system to record the details of movement of tourists entering the pilgrimage sites or other tourist spots of the State. In addition, the tourists were also not prepared for the rigours of mountainous terrain in case of adverse weather situations.

The increase in the tourist influx has led to the development of tourist lodges, hotels, restaurants etc., even at ecological sensitive locations. For instance, during its visit, the NIDM team observed that few hotels *and* tourist resorts have been constructed along the river channels and on steep slopes. At Nandprayag, a tourist colony was located near the confluence of Mandakini and Alaknanda. Such constructions, which are on riverbeds or steep slopes, are not only prone to floods and landslides, but also create obstruction in the natural flow of water, thereby endangering the lives of people using these facilities.

Lessons Learnt

- While using the riverbanks in the region for any type of habitation, construction, or developmental activity, it is essential that river history and other information related to past disasters be taken into account, so that these spots do not become death traps for tourists and pilgrims. Besides, ecological, slope and drainage characteristics of upper reaches should also be taken into account.
- While planning for tourism related developmental activities, besides environmental and socio-cultural issues, the carrying capacity of tourism sites should also be kept in mind.
- In disaster prone areas of Uttarakhand, where pilgrims constitute a major proportion of floating population, there should be an effective pilgrim (or tourists) management system. This will enable control of movement and assist in rescue and relief operation in any adverse situation.

- There must be limited points of entry and exit and provision for registration of pilgrims and tourists entering the ecologically sensitive areas to effectively regulate the tourist influx.
- Before entry to disaster prone/high altitude areas, tourists and pilgrims should be clearly warned about weather conditions. They should be sensitised about the importance of physical fitness to sustain themselves during adverse climatic conditions and road blocks. They must also be provided basic ''do's and dont's'' and latest information about weather.
- To create awareness and orientate tourists and even local population, a museum may be established in Kedarnath, displaying memories of the Uttarakhand Disaster-2013. People visiting Uttarakhand from different parts of the country may be made aware about various aspects of disaster management including do's and don'ts for disasters, through posters, documentaries, models etc. in the museum. Similar museums are established in China (Beichuan Earthquake Museum - memorial museum of the 2008 Wenchuan earthquake located in Beichuan County, Sichuan, China)[6], Japan (Tokyo Memorial Hall - Museum providing historical information on the 1923 Tokyo Earthquake)[7] and in other parts of the world.

5.3.5 Training and Capacity Building

Inadequate level of local preparedness contributed significantly to the increased risk to life. Flash Flood disaster of year 2013 has brought attention to the need of professionally trained officials in disaster management for carrying out various activities pertaining to search and rescue operations, relief distribution, medical emergency, and trauma management. It also highlighted the inadequate level of trainings of officials and other stakeholders in disaster management to various complications during response, rescue and relief operations.

In Uttarakhand, main agencies responsible for training and capacity building - primarily targeting Government officials and NGOs - on issues related to disaster management are the Uttarakhand Academy of Administration, Nainital and Uttarakhand Disaster Mitigation and Management Centre, Dehradun.

Lessons Learnt

- Exhaustive training on various aspects of disaster management for all the stake holders and role players is inevitable. The training should include various aspects such as approaches and means of disaster risk reduction, development of DM Plans including HRVCA, mitigation and preparedness plans, incident response system, structural & non structural safety in hospitals and schools, rapid visual screening of buildings, search & rescue operations, psycho-social care, techno-legal issues, ensuring housing safety, shelter, food security etc.
- All the stakeholders such as police, home guards, doctors, engineers, architects, contractors, teachers, volunteers, government functionaries, masons, construction supervisors, planners, and NGOs/CBOs should be targeted for capacity building in disaster management. Local level training of youth and women groups needs to be given priority.
- To make response system more effective, the State officials, mainly the responders must be trained in Incident Response System.
- Keeping the vulnerability of the region to different types of disasters in view, it is essential that the State government reviews its training strategy and strengthens its training capacity. There is need to develop area specific training strategies and training modules based upon a detailed "training need assessment" study. The training modules developed by NIDM may also be used for this purpose after due customization.
- NIDM maintains data base (State-wise and course-wise) of officials trained in disaster management. This data base available at the NIDM website (www.nidm.gov.in) includes contact details of officials and the courses attended by them. The services of such trained officials and individuals need to be used during disasters. Uttarakhand Government should also develop a State specific data base of people trained in disaster management by State level institutions and make it available to all district magistrates.

5.3.6 Availability of Essential Supplies

Scarcity of essential commodities during the disaster was a common observation as marked by almost all the agencies involved in search, rescue, and relief operations. Non- availability of sufficient food, fuel, warm clothes, polythene sheets, tents for shelter, drinking water, life saving medicines led to enormous hardships to all the affected people. Apart from this, scarcity of essential items led to the black marketing of commodities in the affected areas. Shortage of cooking gas cylinders during the crisis was also a major problem for population and the administration.

District administration in affected areas informed that some food grains were stored before the onset of monsoon, but it was not a regular practice. Most of the administrative officials informed that there was "no clear cut guidelines for storing essential items" at local level. Some officials also informed that procuring such items through tendering was not easy and thus there should be some flexibility in the existing procurement procedures.

Lessons Learnt

- Lack of connectivity and transportation becomes a major challenge during disasters in hilly terrain and, therefore, there must be provision for stocking essential items like food grains, blankets, medicines at block and panchayat levels for emergency purpose.
- A storage network along with built in shelters for providing food to the stranded people needs to be established in disaster prone districts of the State.
- Government must develop the capacity to conduct large-scale logistical operations that supplement and, if necessary, replace the State and District logistical systems by leveraging resources within both public sector and private sector.
- There must be some flexibility in procedures for procurement of essential items during emergency situations. Government must consider delegating special powers to the local level officials for procuring essential commodities to provide immediate relief to the victims.

- Administration must also plan for and take effective steps to check black marketing of essential commodities during disaster situations.
- The desirability of maintaining mules and ponies for supply of essential commodities to areas inaccessible by road should be considered, as this disaster has manifested importance of animals for transportation in the hilly terrain.

5.3.7 Updation and Utilization of India Disaster Resource Network (IDRN).

While responding to disasters, timely availability of resources helps in reducing damages. The IDRN is very useful tool for enhancing preparedness for disasters, which provides all essential information about resources, equipment, and critical supplies available at district level with line departments and agencies. The responsibility of updating relevant data on the network rests with respective State governments. It is important that all State governments set up a mechanism to ensure that the 'resource data' on the IDRN is always up to date, so that it can be used during the critical emergency response phase of any disaster.

India Disaster Resource Network (IDRN)

IDRN was initiated by Ministry of Home Affairs (MHA) under the GOI - UNDP Disaster Risk Management (DRM) Programme in the year 2003 to build up a systematic inventory of equipment, skilled human resources and critical supplies so that disaster managers can find the location and details of the resources easily, without losing precious time for immediate response. The inventory has been collected from various line departments



and response agencies at district level. At present IDRN is having more than 1.5 lakh records from all the States/UTs of the country. The primary focus is to enable the decision makers to get details of readily available and updated information about equipment and human resources required to combat any emergency situation. The database in IDRN also enables Disaster Managers to assess the level of preparedness for specific disasters. Considering the national importance of the portal, Ministry of Home Affairs entrusted National Institute of Disaster Management (NIDM) with the responsibility of monitoring and maintaining the IDRN since 2008.

Key Objective of the IDRN is to facilitate readily available and up-to-date information on various resources required for efficient and timely response during emergencies and disaster preparedness. The State and District authorities can use IDRN during emergency situations to get updated information of all the available resources in time which will be extremely helpful in minimizing loss of life and damage to property and other infrastructure. Besides this database can be useful for Resource mapping for preparation of contingency plans and Disaster Management Plans at District and State level and also for assessing level of preparedness in the pre-disaster phase.

IDRN portal is currently monitored and maintained by NIDM centrally. However NIDM's role is limited to user administration and technical enhancement of the portal. State Department of Relief/ Revenue/ Disaster Management and SDMA coordinate with District Magistrate/District Collectors regarding updating of data in IDRN portal. District Collector/ Magistrate is the authorized officer for facilitating data collection and updation at the district level. Data collection formats are distributed from District Collectorate to the line departments/ agencies. Data entry is to be done at the district level, availing the technical services of District Informatics Officers of NIC. For further details about IDRN Portal visit www.idrn.gov.in

Lessons Learnt

- Data of material, human resources and critical supplies available in India Disaster Resource Network is very useful for emergency response. If such resources were available the response time could have been reduced.

- Updating of data in India Disaster Resource Network be included as one of the regular activity of the Disaster Management Department at State Level through the district administration. An official may be identified and assigned this task.
- All District and State Disaster Management Plans and departmental plans should include an annexure of available resources which need to be synchronised with data in IDRN Portal.
- A copy of the up-to date resource inventory may be maintained in the form of hardcopy and also a softcopy in the local systems since disasters can lead to power failures and internet problems.

5.4 Response & Relief

It is unrealistic to presume that a strong disaster management framework can perfectly anticipate and overcome all challenges in a crisis situation. NIDM team interacted with a number of Government officials, people's representatives, tourists, and local people and assessed their experience and suggestions for improving disaster response system. The people in general suggested that there was an urgent need to strengthen the local level Disaster Management System to facilitate immediate help to victims during disasters. While interacting with the community and other stakeholders, a number of issues were highlighted such as lack of coordination among various agencies, scarcity of essential items, flaws in relief distribution, delays in response and providing relief to the victims.

5.4.1 Unified Management of State Disaster Response

Effective incident management of a catastrophic scenario requires coordination among wide range of organizations and activities, both public and private. Under the current response framework, the State Government coordinates resources to meet the needs of district and local administration based upon their requests for assistance. State and District agencies build their command and coordination system in conformity with Incident Response System (IRS) at relevant levels and the Disaster Management Plans. However, during catastrophic events, large-scale competing needs, insufficient resources, and coordination issues at lower levels pose critical challenges.

Lessons Learnt

- During the Uttarakhand disaster, necessity of proper functioning and coordination of SDMA / DDMA and other agencies involved in disaster response and relief clearly emerged as an important aspect. SDMA / DDMA should formulate contingency plans and conduct regular mock exercises as this will ensure effective response in the eventuality of a disaster.
- Government must take all necessary steps to incorporate IRS into its response mechanism.

5.4.2 Search, Rescue & Evacuation

The State / District level response to Kedarnath devastation demonstrated that Indian Army / Air Force / ITBP / NDRF etc., have the capability to play an important role in the response to catastrophic events. During the period of disaster response, Indian Army / Air Force / ITBP and NDRF – demonstrated that along with the Uttarakhand Police they possessed real operational capabilities to operate in dangerous and risky mountain terrain. In addition to deploying operational personnel in good numbers who are trained and equipped for search and rescue operations, these forces have robust communication infrastructure, logistics, and planning capabilities.

Despite sincere efforts by rescue teams, several shortcomings also emerged from the rescue operations, which need to be taken into account for any future strategy with regards to handling such mega disasters. The overall search and rescue efforts demonstrated the need for greater coordination among different rescue teams, i.e., Indian Army, Air force, NDRF, and ITBP etc. Basically their training and working environments have different procedures and methodologies to handle disaster situations. During the rescue operations, many of the courageous lifesavers were put at unnecessary risk by a structure that failed to support them effectively. The rescuers, in a situation where existing roads had been washed away by rains and there was landslide debris throughout the route, did not know alternative routes. Lack of helipads at strategic locations also hampered rescue operations. Scarcity of sufficient fuel and equipment also caused great difficulty in carrying out rescue and relief operations.

Lessons Learnt

- The Civil Administration, SDMA, DMMC - Uttarakhand etc. should lead an inter-agency review of current policies and procedures to ensure effective integration of all State / District level search and rescue capacities during disaster response.
- Indian Army / Air force / ITBP / NDRF and State level police and other rescue teams should jointly develop a comprehensive plan for providing necessary support to the administration in rescue and relief operations.
- Importance of helipads became quite evident during *Operation Sahayata* and *Rahat* in Uttarakhand. State Government must identify suitable locations and develop helipads for helicopter operations, which may assist evacuation during disasters. Advice of Army, IAF and also of geologists should be taken by State Government to identify such locations and develop all weather helipads.
- All disaster prone areas which have high concentration of population, like Kedarnath and Badrinath, should have alternate routes available for evacuation, wherever feasible. These routes must be identified and maintained by the State Government.
- Disaster Response plans of the State Government must cater for logistics set up required in the Disaster affected areas. These plans must cater for reserve stock of rations, supplies and fuel pre-located at critical locations.
- Utilizing the services of retired personnel of armed forces (who are in good number in the State) in disaster management activities may be considered by the State Government. The retired personnel of armed forces may be provided necessary basic training in search and rescue and their services may be used for disaster management related activities like search and rescue and awareness and capacity building of local communities etc. In this regard it is suggested to form a Disaster Task Force, on the pattern of Eco Task Force, which did marvelous job for environment conservation in Uttarakhand.
- The NDRF faced problems in carrying their heavy equipment in difficult terrain. There is need to provide equipment suitable and easily transportable

for search and rescue operations in hilly terrain.

- The data on IDRN should be kept updated and regularly be used for providing necessary resources during disasters.

5.4.3 Deployment of Armed Forces

The Armed Forces of India continue to play a major role in dealing with such calamities. The need for coordination and synergy of effort with civil administration, at every level, cannot be overstated in the backdrop of the requirement for optimizing resources and "time criticality" in rescue and relief operations.

Lessons Learnt

- There is need for a Unified Command and Control of all agencies including NDRF, CAPF, State Armed Police, Home Guards, Maritime and Civil Aviation Resources to facilitate effective coordination and speedy execution of task. This will enable the civil Administration in optimizing the overall relief and rescue effort.
- The National Disaster Response Reserve Stores proposed to be procured from the National Disaster Response Fund under the aegis of NDMA should be placed in disaster prone areas with the NDRF Battalions / Companies. These should be provided to the Armed Forces for use during disaster response.
- At the National and State level, there is a need to have representation of Armed Forces personnel in NCMC, NDMA, SDMA, SEC, etc. Regular skeleton exercises should be held between local army units / formations and civil administration. In addition, following aspects need to be pondered:
    - A network of airstrips / ALGs and helipads is required in remote areas for evacuating stranded people and for supply of relief materials.
    - Wireless communication needs to be strengthened to enable the rescue and relief work.

5.4.4 Non-Governmental Aid

During the course of Uttarakhand disaster response, a significant capability for response resided in organizations outside the Government. Non-Governmental and faith-based organizations, as well as private sector organizations made substantial contributions to rescue and relief operations.

The number of volunteers, non-profit, faith-based, and private sector entities that aided in the Uttarakhand Disaster relief effort was truly extraordinary. Nearly every national, regional, and local charitable organization of India and many from abroad, contributed aid to the victims. Trained volunteers from Indian Red Cross, Reliance Foundation, Tata Industries, Care-India, Medecins Sans Frontiers, Oxfam, Save the Children, Plan India and *Gayatri Parivar* etc., as well as several volunteers from various other agencies engaged across the affected areas in Uttarakhand to support and assist Government efforts in rescue and relief operations

Following issues were mentioned by NGOs, CBOs and other stakeholders during interactions:-

- The distribution of relief material by the NGOs at some places was not very systematic. In many of the cases, relief distribution was restricted to the villages located near roads and the relief from these agencies could not reach the remote villages.
- The relief material distributed by most of the agencies was not as per the actual need of the affected population.
- Some of the NGOs and volunteers were also involved in search and rescue operations. But most of them were not trained or were lacking professional knowledge about search and rescue.

Lessons Learnt

- The State level response should more effectively integrate the contributions of volunteers and non-governmental organizations into the broader State level effort. If planned prior to an emergency situation this integration would be best achieved at the district and local levels. In particular, State and district administration must engage NGOs in the planning process, credential their personnel, and provide them the necessary training and resource support for their effective involvement in a joint response.
- For effective coordination with NGOs and other voluntary agencies, the State Government should appoint an officer as Nodal Officer in each district. Nodal Officer should also maintain database of active NGOs in each district with their contact details and areas of intervention.

5.4.5 Psycho-Social Care & Traumatic Stress Management

During the Uttarakhand disaster, there were victims who had escaped death but witnessed many including their own loved ones die in front of their eyes. People recounted sleeping near dead bodies and family members seeing their loved ones being washed away. Trauma remains for very long with those who survive such disasters and psycho-social care is needed to withstand such traumatic stress. In case of a family member being lost, a person sometimes may also suffer from survivor's guilt. Traumatic impact of the disaster was huge and professional intervention was important. A good number of doctors (both Private and Government) and nurses rushed to the scene to treat physical injuries, but limited psycho-social staff was available at disaster scene.

Lessons Learnt

- There is an urgent need of trained volunteers for psycho-social support in the aftermath of disasters. Trained volunteers can be mobilized to provide psycho-social support to affected population in such eventualities.

- Psycho-social support should be integrated into the overall medical treatment of disaster victims.

5.4.6 Critical Health Care

The Uttarakhand Disaster of 2013 created enormous public health and medical challenges, especially in Rudraprayag District (Kedarnath, Rambara, Gaurikund, Sonprayag and Kalimath). Most local and State public health and medical assets were overwhelmed by these conditions, placing even greater responsibility on externally deployed health personnel. Some of the critical areas were:-

- Identification and treatment of acutely sick, traumatized and injured pilgrims;
- Management of chronic medical conditions in large numbers of evacuees with special health care needs;
- Assessment, communication and mitigation of public health risk; and
- Provision of assistance to State and local health officials to quickly re-establish health care delivery systems and public health infrastructure.

In spite of the fear that floating dead bodies (of both humans and animals), mass cremation of dead bodies and disposal of animal carcasses could generate contamination and cause some epidemic/ outbreak of infectious disease, no outbreak of epidemic or infectious disease occurred in the State because of the preventive measures.

Lessons Learnt

- In coordination with the Department of Disaster Management and other emergency support functions, the Department of Health should strengthen State Government's capability to provide public health and medical support during a crisis situation. This will require improvement of command and control of public health resources, development of deliberate plans, and additional investment in deployable operational resources.
- Medical relief plans should also be dovetailed into disaster response plans and resources earmarked accordingly.

- Though the deployment of hundreds of ambulances during the disaster proved very effective and useful in saving lives, yet their mobility and effectiveness was hampered due to frequent road blocks. As a result many patients were taken on shoulders across the road blocks under very risky conditions. There is need to equip Response Teams with adequate number of air ambulances for immediate medical care in difficult terrain.
- State Government should depute one official from Health Department as Nodal Officer in each district for maintaining the list of health / ASHA workers and volunteers trained in primary health services etc., who may be deployed during an emergency situation. The training of these grass-root level workers in disaster management and primary health needs to be given due consideration.

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6 Summary Recommendations



6

Summary Recommendations

The Uttarakhand disaster 2013 exposed the infirmities in the disaster management system at ground level that prevailed when the tragedy struck and are needed to be addressed for safer and sustainable development in the region. It is noteworthy that the weaknesses exposed do not relate only to preparedness but to all the constituents of the classical disaster management system including risk mitigation, reconstruction and recovery. Though the disaster occurred in the Himalayan region of Uttarakhand, lessons learnt and brought out in the previous chapters may be of universal significance to a range of stakeholders for improving disaster risk management in different regional contexts as well. Recommendations outlined herein are essentially important for adopting a strategic approach towards efficient disaster management.

Response and Preparedness

Emergency rescue and relief operations during the Uttarakhand disaster were executed by multiple stake holders under most challenging climatic conditions in extremely inhospitable mountains terrain in a praiseworthy manner. However, weaknesses in disaster management observed during the incident- particularly in response and preparedness components, need immediate attention. Important recommendations are following:

- Proper functioning and coordination of SDMA/DDMA and other agencies involved in disaster mitigation and response need to be made more effective. Disaster management plans need to be regularly reviewed and updated to ensure a functional structure and accountability for all actions initiated by the State Government to enhance preparedness. Framework for the existing system of immediate response and relief must be reviewed regularly for improving the response time and coordination among various agencies.

- Investments in infrastructure development for monitoring and forecasting related to weather, glacial lakes, river flow, etc. are fundamental for improving the accuracy of risk forewarning and risk area mapping, and thereby allowing more lead-time in the warnings provided by IMD, CWC, GSI and NRSC etc.

- Advanced Doppler Radar System for improving early warning systems (EWS) related to flash floods may be deployed in the inaccessible parts of the catchments areas on a permanent basis. Apart from this, Automated Rain Gauge Stations (ARS) must be deployed in inaccessible areas throughout the region.

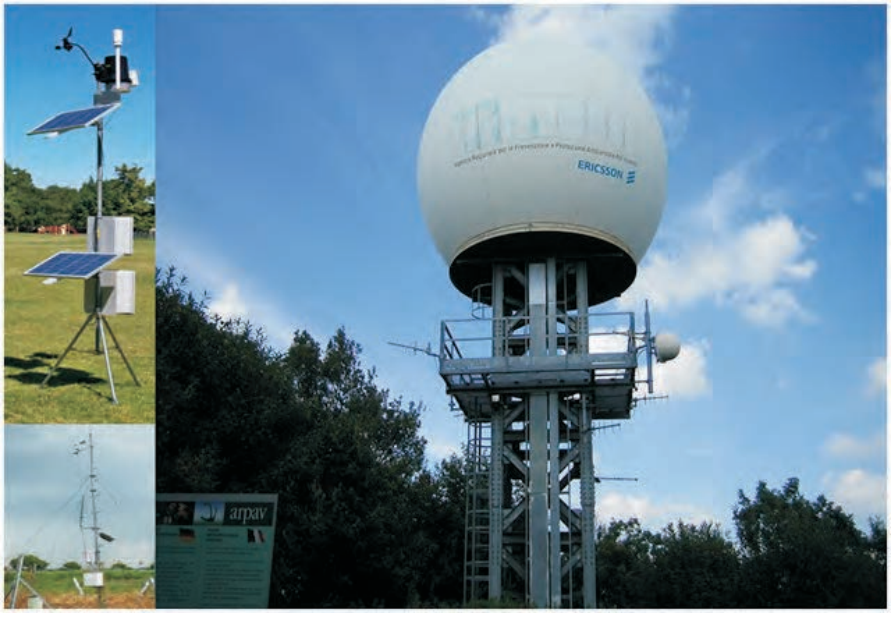


Figure 6.1: Weather related infrastructure needs to be established in disaster prone areas

- Existing emergency communication system is needed to be reviewed regularly to ensure last mile connectivity during disasters. Emergency alerts must be disseminated at all levels by leveraging the technology. Establishment of the proposed National Disaster Communication Network (NDCN) may be expedited to improve the prevailing system. A clearly defined monitoring system if put in place for reporting of actual rainfall events can enable timely and more accurate warning and dissemination of information to downstream population and administration.



Figure 6.2: Emergency communication system needs to be established immediately after the disaster

- Emergency Support Organizations at state level, viz. SDRF/Police/Civil defense & home-guards be organized, trained and equipped to perform their roles in response operations. Incident Response System (IRS) in the disaster management mechanism may be adopted and practiced with required customization. State and district agencies need to build their command and coordination structures to support the local command and to function within the coordinated structures during an emergency. A Unified Command and Control system is required to synergize the rescue and relief operations and optimize the resources of all agencies such as Indian Armed Forces, NDRF, CRPF, State Armed Police, Home Guards, Maritime and Civil Aviation etc.



Figure 6.3: Rescue operations - by multiple Governmental agencies

- Supply of essential commodities by animal based transport in remote disaster prone areas should be examined on regular basis and included in the disaster management plans. Stockpiling of essential items like food grains, blankets, medicines etc. must be ensured at block/panchayat levels in designated areas for an emergency.



Figure 6.4: Essential commodities to be procured and distributed timely



Figure 6.5: Timely distribution of need based essential commodities

- A network of airstrips / Advanced Landing Grounds and helipads need to be created in remote areas for better management of emergency response and the crisis situation. In addition, alternate routes/tunnels may be explored for safe evacuation during crisis situation in the hilly areas.



Figure 6.6: Helipads to be created in remote areas for emergency response

- The aspect of psycho-social support is necessary to be integrated into the medical plans for the disaster affected people.



Figure 6.7: Psycho-social support needs to be integrated in plains

Risk Mitigation

The disaster risk-mitigation is related to set efforts to reduce loss of life, property and environment by lessening occurrence and intensity of hazards or their effects by enhancing risk-knowledge and forewarning, by reducing the vulnerability. Mitigation includes structural and non-structural interventions mainly to reduce the vulnerability of land and people, by adjusting physical, social and environmental context of development. Effective mitigation requires understanding of local risk in the backdrop of environmental and social settings, critical choices in the light of long-term community wellbeing, ecological sustainability and demand of infrastructure and economic development. The risk mitigation step involves development of mitigation plans designed to manage, eliminate, or reduce risk to an acceptable level. Some of the recommendations in this context are following:

- Hazard, Vulnerability, Capacity and Risk Assessment (HVCRA) must be exercised to assess risks for the entire state which is fundamental for development of sound disaster management plans for various parts of the State.
- For clearance of all hydro-power projects in ecologically sensitive regions like Uttarakhand, the Disaster Impact Assessment (DIA) and requirement of an effective muck disposal plan may be made compulsory within the Environmental Impact Assessment (EIA) process of project appraisal. Necessary improvements in the framework and legislations regarding EIA, environmental audit, and project clearance process need to be effected in this context.



Figure 6.8: Power Houses washed away by the Uttarakhand floods need to be relocated



Figure 6.9: Need for consideration of local environmental aspects while constructing Hydro Power projects

- Any plan of Infrastructure development in disaster prone areas should include provision for helipads, alternate routes/tunnels to be utilized during disasters besides the location and design aspects of safe structures and buildings looking at the type and level of disaster risks. Alignments of existing roads may be reviewed in consultation with Geological Survey of India (GSI). Alternate evacuation routes should be constructed for all the major pilgrim centres for all seasons.



Figure 6.10: Infrastructure to be created in disaster prone areas includes helipads, alternate roads and tunnels for emergency operations.

- Landslide risk zonation mapping should be completed on priority and at micro level incorporating factors of anthropogenic pressures, geological features and ecological settings including soil, vegetation, microclimate, etc. Development and enforcement of guidelines, and codes for landslide risk reduction is critical for such areas. Effective stabilization of slopes in shear and weak zones need to be undertaken using scientific techniques available at national/international levels.



Figure 6.11: Landslide need to be identified and mitigated to avoid future disasters.



Figure 6.12: Protective measures related to landslides need to be adopted to avoid future damages

- Blasting for developmental activities may be avoided as it may destabilize weak rocks in mountainous regions. An integrated programme for construction of new roads and renovation/improvement of existing roads in a scientific manner needs to be undertaken with proper environmental Impact assessment (EIA) and environmental management plan (EMP) to address ecological and other side effects of road constructions in hilly terrain.

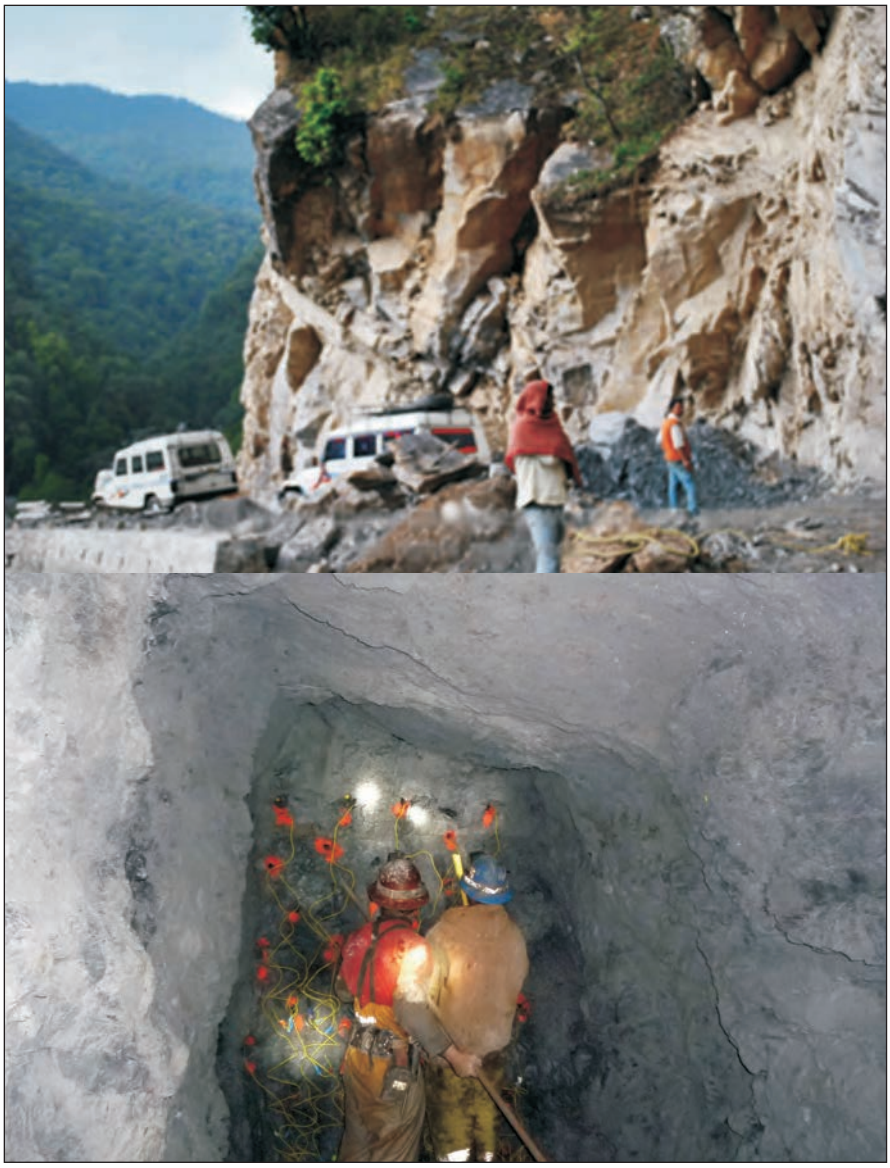


Figure 6.13: Stone blasting weakens the overall strength of the rock mass and also degrades the environment and ecology of the area - needs scientific approach

- Flood plain zoning act regulating construction activities within the flood plain of a river should be implemented in a transparent manner. Unsustainable mining of the river beds needs to be stopped.



Figure 6.14: Unsustainable riverbed mining activities need to be checked

- Regularly conducting mock exercises for rehearsal of emergency response plans by SDMA/DDMA and at local levels is must. Standard Operating Procedures (SOPs) for various functions related to disaster response and relief and related roles and responsibilities of different agencies/stakeholders may be specified accordingly.

- Tourism related development should not be allowed along the river banks. An effective pilgrim control and regulatory body may be constituted for management and control of pilgrims/tourists. The Central Government must enhance the capacity to conduct large-scale logistical operations to supplement the state and district logistical systems.



Figure 6.15: Development of tourism along the river needs to be checked



Figure 6.16: Construction of hotels along the river banks may endanger lives

- Need to integrate the contributions of volunteers and non-governmental organizations in disaster response at the State level. This integration would be best achieved at the District and local levels. NGOs should be engaged in the planning process for their involvement in a joint response.

- A museum may be created to preserve the historical perspective of the disaster as also follow up actions and outcome of the recovery, reconstruction and rehabilitation initiatives at various administrative levels. Such a museum will be an asset for enhancing the awareness levels of people and preparedness for such disasters. A museum could be created at Kedarnath by creating a structure to encompass some of the damaged/destroyed buildings, to be preserved for posterity to comprehend the impact of such disasters. Besides all historical data relating to the disaster such as rescue and relief operations, destruction of infrastructure, contribution of various government and non-government agencies and the scientific community, could also be preserved. The highlights of recovery and rehabilitations could also be preserved. Similar museums such as the Kobe Earthquake (1995) Memorial Museum, Japan and the Sichuan Earthquake (2008) Museum, China and many others have been created in several parts of the world.



Figure 6.17: A suitable museum may be created at disaster site for commemoration and enhancing awareness

Reconstruction and Recovery: Strategy

Reconstruction after a disaster is needed not only to regain the pace of development but also to ensure better future safety and sustainability. Planning and implementation of these developmental activities including reconstruction of damaged structures and buildings after the disaster has brought an opportunity to ensure that development does not increase but further reduces vulnerability of the land and its people. Reconstruction and technological interventions must be seen as an integral part of overall sustainable recovery framework along with indigenous and traditional knowledge, ecological and social considerations and livelihood issues. Process of reconstruction needs to enable effective recovery support to disaster affected areas of Uttarakhand in a unified and concerted manner. It needs to concentrate on how best to restore, redevelop and revitalize the health, social, economic, natural and environmental fabric of the community and build a more resilient State. Following are important issues for consideration in post-disaster reconstruction and long-term recovery framework in Uttarakhand disaster context:

- Post-disaster impact (damage and loss) assessment need to be comprehensive enough to encompass the aspects of ecological sustainability, livelihood, natural resources, sustainable tourism and carrying capacity based developmental planning process. EIA of disasters as a new tool being popularly used to integrate sustainability concerns may be adopted in this case as well.

- Land-use and developmental planning at regional/local levels with special emphasis on infrastructure, settlements and pilgrim/tourist destinations need to be reviewed and improved. Geological and ecological concerns as also carrying capacity in terms of population and built-environment pressures Should be taken care of.

- Technical assessments are necessary to identify vulnerable structures in the entire region including areas which were not severely affected in June 2013 flash flood disaster. Assessment needs to include damage surveys and looking into the erstwhile design practices, construction methods, and building materials that either failed under the forces generated by the flash flood or could withstand such forces.

- Reconstruction planning should begin with risk sensitive land use and landscape management based on hazard risk assessment concerned with

the ecological, social, and economic sustainability at local levels. Any constructions like buildings, dams, roads, etc. especially along river valleys and in temple towns in Uttarakhand, need to ensure that their design and materials meet safety standards to minimize damage due to disasters, including earthquakes.

- Detailed plan of reconstruction and long-term recovery must be people centric but environmentally compatible, and be built through a consultative process involving local people and other stakeholders including ecologists, developmental experts, engineers and technologists, etc. Such plans may be subjected to a review for their impact on people's livelihood, natural resources, environment and social aspirations of development, besides opening window of economic development.



Figure 6.18: Reconstruction of dilapidated infrastructure as per BIS Standards needs to be followed.



Figure 6.19: Reconstruction of damaged infrastructure for all weather conditions should be the main priority

- Transition to recovery is essentially a developmental activity, which grasps the opportunities offered by crisis to make the transition from unsustainable to sustainable development. Risk mitigation strategies must be integrated into the whole recovery process with 'Build Back Better' strategy and resilience to risk of disasters.

Mainstreaming Disaster Risk Reduction into Development

Mainstreaming of Disaster Risk Reduction (DRR) into developmental planning and local actions is fundamental to ensuring resilient societies and infrastructure which can be based only on the foundations of safety and sustainability woven into framework of infrastructure development and people's aspirations. A series of efforts are required at the local level to integrate community level risk reduction and preparedness into local development planning and investment processes.

The escalation of hazard risks poses serious threat to sustainable development and poverty reduction measures undermining the development gains of decades. The post-disaster period, therefore, is the most appropriate time for introducing disaster risk reduction measures for ensuring sustainable development. It also suggests that risk reduction and adaptive planning measure needs to be incorporated into development programmes and should not be seen as distinct set of activities.

- Mainstreaming disaster risk reduction in recovery and development process is very much important in Uttarakhand' development efforts. Legal and policy framework needs to be developed to avoid construction on unstable slopes. There is a need for a comprehensive policy and legislation for River Bed Mining. Encroachment in river beds must be strictly prohibited and the existing encroachments need to be evicted on priority.



Figure 6.20: Houses constructed along the river course are vulnerable.

- Recent disaster demonstrated serious social and economic setbacks to development and poverty reduction programs. Disaster risk has accumulated as a result of development choices and decisions made without consideration of disaster risk.'
- Disaster proof' development has the capacity to transform vicious spirals of failed development, risk accumulation and disaster losses into 'virtuous spirals' of development, risk reduction and effective disaster response.



Figure 6.21: Risk is intensified if development is not disaster proof.

- Development programs can be designed to decrease the susceptibility to hazards and their consequences. Sustainable development requires consideration of the economic, environmental and social factors in decision making to deliver the right policies now and enable others to do the same in the future.



Figure 6.22: Sustainable development in hilly areas needs to be addressed

- Alternate energy options may be further explored for the Himalayan Region to reduce the pressure of environmental and other side effects of hydro-power development. However, this has to go hand in hand in making hydropower energy systems safer and sustainable by integrating disaster risk reduction strategies into hydropower strategies.

Capacity Building

Disaster risk is increasing with the vulnerability of land and communities as consequence of unsustainable development practices, such as encroachment into high-risk areas owing to, inter alia, rapid urbanization, construction of unsafe shelters, pollution, loss of ecosystems integrity and land degradation. Capacity building initiatives should facilitate effective implementation of disaster risk reduction programmes which should include the capacity building of trainers, policymakers and other key stakeholders. Important aspects for capacity building are following :

- Disaster management capacity building needs to focus on integrating land-use planning, ecological sustainability, tourism, livelihood, infrastructure and natural resources along economic and developmental needs at local levels. Training modules need to be developed and implemented targeting district/tehsil and local bodies in this regard.

- There is a need to enhance the local level preparedness and risk mitigation understanding. Cadre of trained professionals and trainers for generating further mass awareness needs to be included in the recovery strategy.

- The training and capacity building strategy needs to take advantage of latest and popular technologies like mobile and internet, ham radio, and other



Figure 6.23: Community awareness programmes to be conducted regularly

modes and means of risk communication, social mobilization, coordination and managing law and order during such emergencies.

- Institutional and legal framework development, making legal and regulatory changes to enable organisations, institutions and agencies at all levels and in all sectors to enhance their capacities. Adoption of traditional and global best practices and technologies may be useful in reduction of disasters.

- Laying emphasis on table-top exercises, simulations, mock drills and development of skills to test the plans. There is a need for capacity analysis of different disaster responder groups at State, District, and local levels.

- A realistic National Capacity Development Programme, commensurate with the intensity and extent of the hazards in India needs to be evolved and implemented, keeping in view the available resources with blended focus on integrating different approaches of disaster risk reduction, viz. engineering based, command system based, ecosystem based approach (ecoDRR) and community based DRR.

- Disaster management planning and organizational preparedness – This includes the ability to predict and plan for disaster risks in order to mitigate possible impact on vulnerable communities, and to respond to and effectively cope with their consequences. It also includes ensuring sufficient capacity in skilled human resources, financial and material capacity for effective disaster management.

- Community preparedness and disaster risk reduction – This relates to increasing self-reliance of individuals and communities to reduce their vulnerability to disasters, to improve their livelihoods and to raise public awareness on risk reduction.

- Disaster response and recovery – This includes improving the disaster response capacity to meet the immediate needs of people affected by disasters, and improving the capacity to restore or improve pre-disaster living conditions and reduce the risk of future disasters.

Glossary

Aggradation: Process of raising a land surface by the deposition of sediment.

Anganwadi: The word means "courtyard shelter". It is a part of the Indian public health-care system. Anganwadis were started by the Government of India in 1975 as part of the Integrated Child Development Services program to combat child hunger and malnutrition. A typical Anganwadi centre also provides basic health care in Indian villages.

Bhabar: Bhabar is the region south of the Lower Himalayas and the Siwalik Hills. It is the alluvial apron of sediments washed down from the Siwaliks along the northern edge of the Indo-Gangetic Plain.

Capacity Building: The process by which people, organizations and society systematically stimulate and develop their capacities over time to achieve social and economic goals, including through improvement of knowledge, skills, systems, and institutions.

Char Dham: It is an important Hindu pilgrimage circuit in the Indian Himalayas. Located in the Garhwal region of the state of Uttarakhand the circuit consists of four religious sites - Yamunotri, Gangotri, Kedarnath and Badrinath.

Cloudburst: Rain storm of great intensity usually over a small area for a short duration.

Coping capacity: The ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters.

Dandikathi: It is local word used for palanquin bearers who carry pilgrims and goods up the steep slopes.

Deforestation: Removal of a forest by human activity.

Dham: A hindi word used to indicate a religious site.

Disaster: A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Disaster Management: A continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary or expedient for:-

(i) prevention of danger or threat of any disaster;

(ii) mitigation or reduction of risk of any disaster or its severity or consequences;

(iii) capacity building;

(iv) preparedness to deal with any disaster; prompt response to any threatening disaster situation or disaster;

(v) assessing the severity or magnitude of effects of any disaster;

(vi) evacuation, rescue and relief; and

(vii) rehabilitation and reconstruction.

Disaster Risk Management: The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.

Disaster Risk Reduction: The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Doppler Radar: A tracking system that uses the Doppler effect to determine the change in the frequency, movement and location of sounds, objects, waves of light, storms and other weather elements.

Early Warning System: The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.

Emergency Operations Centre (EOC): The physical and/or virtual location from which strategic decisions are made and all activities of an event/incident/crisis are directed coordinated and monitored.

Forecast: Definite statement or statistical estimate of the likely occurrence of a future event or conditions for a specific area.

Flash Flood: Very fast rise and recession with characteristics of small volume flow and high discharge, which causes high damage because of suddenness and force.

Floodplain: Area susceptible to inundation by a base flood including areas where drainage is or may be restricted by man-made structures which have been or may be covered partially or wholly by flood water from the base flood.

Gangotri: It is a hindu pilgrim town in the Uttarkashi district of Uttarakhand which is the origin of the River Ganga. It is one of the four sites in the Char Dham pilgrimage circuit.

Geographic Information System (GIS): A computer system for the input, editing, storage, retrieval, analysis, synthesis, and output of location-based (also called geographic or geo-referenced) information.

Geomorphology: Geomorphology is the study of the character and origin of landforms, such as mountains, valleys, etc.

Geological Hazard: Geological process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Geosynthetic: A textile like material used in soil reinforcement along with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project, structure or system. It is usually comprised of polypropylene, polyester or polyethylene.

Geotextile: A textile-like material used in soil drainage and reinforcement applications. It is usually comprised of polypropylene, polyester or polyethylene and may be natural fibre or non-natural fibre.

Gurudwara: Place of worship for Sikh community in India.

Ham Radio: is a two-way communication system allowing users to put their voice on-the-air to be listened into and at the same time replied back by their fellow radio operators around the world. In the event of any large scale disasters when the conventional modes of communication like telephone and mobile phones don't work, they can still communicate with each-other using their personal two-way radios. Ham radio users may also volunteer with their portable radios to set up emergency communication network in the disaster affected areas.

Hazard: A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Hazard Mapping: The process of establishing geographically where and to what extent particular hazards are likely to pose a threat to people, property, or the environment.

High Risk Areas: Geographical areas which fall under seismic zones III, IV and V, which are vulnerable to potential impact of earthquakes, landslides, rock falls or mudflows.

Hydro-meteorological Hazard: Natural processes or phenomena of atmospheric, hydrological or oceanographic nature, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hydro-meteorological hazards include tropical cyclones (also known as typhoons and hurricanes), thunderstorms, hailstorms, tornados, blizzards, heavy snowfall, avalanches, coastal storm surges, floods including flash floods, drought, heat waves and cold spells.

Khadi Gramodyog Board: Statutory bodies formed by the state governments within India, set up for the purpose of promoting Khadi and Village Industries in their respective states. (Khadi is a term for handspun and hand-woven cloth made out of cotton.)

***Kuchha* House:** Houses made from mud, thatch, or other low-quality materials are called katcha houses.

Landslide: Landslides are downward and outward movement of slope materials such as rock debris and earth, under the influence of gravity.

Landslide Dam: When landslides occur on the slopes of a river valley, the sliding mass may reach the bottom of the valley and cause partial or complete blockage of the river channel. This accumulated mass of landslide debris resulting in blockage of a river is commonly termed as landslide dam.

Landslide Hazard Map: Map of spatial and temporal extent of landslide hazard. It indicates those areas that are, or could be, affected by landslides, assessing the probability of such landslides occurring within a specific period of time.

Land-use Planning: The process undertaken by public authorities to identify, evaluate and decide on different options for the use of land, including consideration of long term economic, social and environmental objectives and the implications

for different communities and interest groups, and the subsequent formulation and promulgation of plans that describe the permitted or acceptable uses.

Mitigation: The lessening or limitation of the adverse impacts of hazards and related disasters.

Mudflows: A fast flow of a mixture primarily of the smallest silt and clay particles oversaturated with water. A mudflow has the consistency of newly mixed concrete.

Nagar Parishad: A nagar parishad or city council is a form of an urban political unit in India comparable to a municipality.

Nagar Palikas: In India, a Nagar Palika is an urban local body that administers a city of population 100,000 or more.

Non-Structural Measures: Any measure not involving physical construction that uses knowledge, practice or agreement to reduce risks and impacts, in particular through policies and laws, public awareness raising, training and education.

Palikas / Parishads: Civic bodies for local government at District level

Palaeo channel: A palaeo channel is a remnant of an inactive river or stream channel that has been either filled or buried.

Panchayats: Civic bodies for local governance at village level

Patwaris: Patwaris are government officers of revenue department who keep records regarding ownership of land.

Preparedness: The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.

Prevention: The outright avoidance of adverse impacts of hazards and related disasters.

Public Awareness: The extent of common knowledge about disaster risks, the factors that lead to disasters and the actions that can be taken individually and collectively to reduce exposure and vulnerability to hazards.

***Pucca* House:** Cement concrete house made with high quality materials throughout, including the floor, roof, and exterior walls.

Reconstruction: The restoration and improvement, where possible, of facilities, livelihoods, and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors.

Recovery: The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors.

Rehabilitation: It refers to actions taken in the aftermath of a disaster to enable basic services to resume functioning, assist victims' self-help efforts to repair physical damages, revive economic activities; and provide support for the psychological and social well-being of the survivors.

Resilience: The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

Response: The provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected.

Retrofitting: Reinforcement or upgrading of existing structures to become more resistant and resilient to the damaging effects of hazards.

Risk: The combination of the probability of an event and its negative consequences.

Sarovar: A pond or lake.

Structural Measures: Any physical construction to reduce or avoid possible impacts of hazards, or application of engineering techniques to achieve hazard-resistance and resilience in structures or systems.

Sustainable Development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Tera*i:* The Terai is a belt of marshy grasslands, savannas, and forests located south of the outer foothills of the Himalaya, the Siwalik Hills, and north of the Indo-Gangetic Plain of the Ganges, Brahmaputra and their tributaries.

Vulnerability: The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

Yatra: The word 'Yatra' means travel, usually travel related to 'Spiritual Places'.



Kedarnath temple and its surroundings - 50 years ago



Kedarnath temple before and After Disaster 2013

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