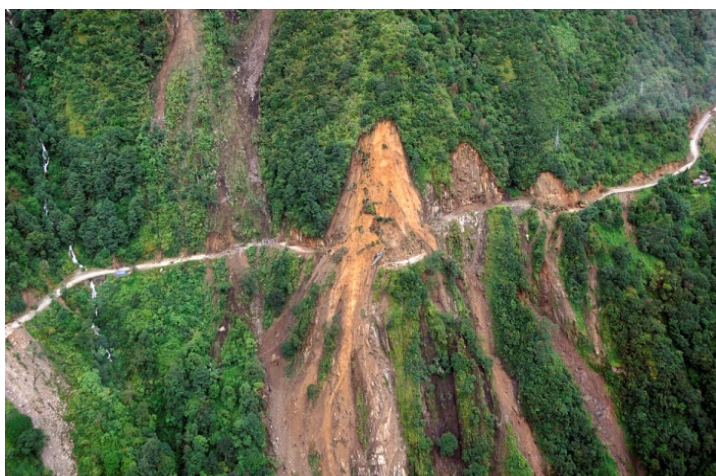


SIKKIM EARTHQUAKE (2011)- RECONSTRUCTION STRATEGY



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To
The Ministry of Home Affairs
Government of India

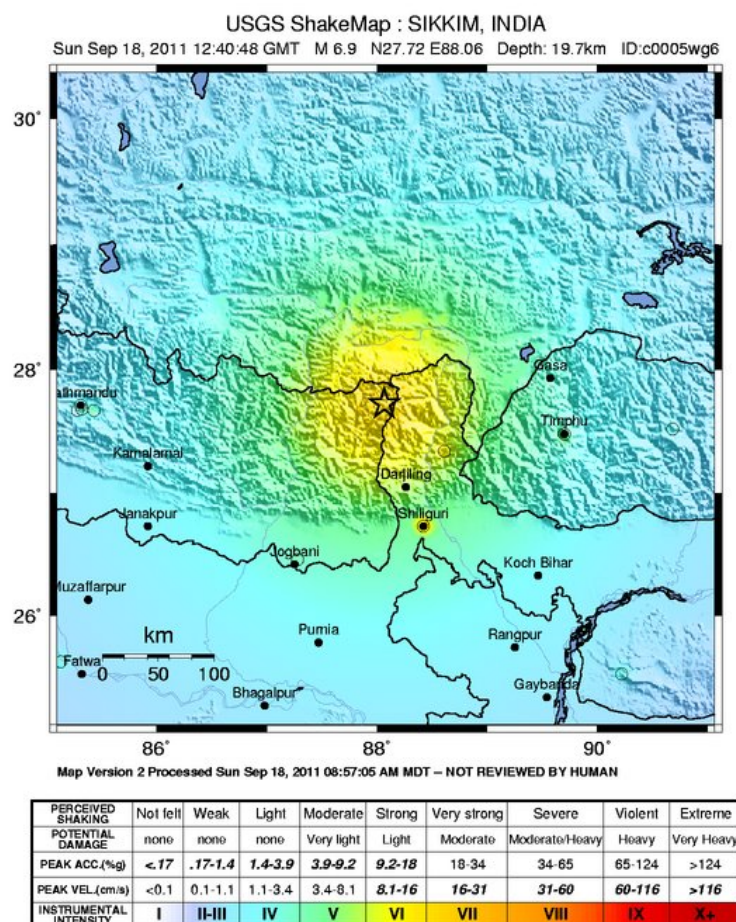


Towards a disaster free India

NATIONAL INSTITUTE OF DISASTER MANAGEMENT
Ministry of Home Affairs, Govt. of India,
IIPA Campus, New Delhi 110 002

SIKKIM EARTHQUAKE 2011- RECONSTRUCTION STRATEGY

This report has been prepared by Dr Chandan Ghosh, Professor & Head, Geohazards Division, NIDM, based on the Post-Sikkim earthquake site visit along with Dr Surya Parkash, Associate Professor, NIDM followed up by one day consultation workshop held on Feb 09, 2012 at NIDM, involving all those experts/stake holders in the post-Sikkim earthquake response, relief, damage/loss survey and reporting.



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Foreword

The Sikkim earthquake has created an unprecedented situation, affecting the country's two hill states as well as their economic and developmental activities. National Institute of Disaster Management (NIDM) deputed Dr. Chandan Ghosh, Professor and Head and Dr. Surya Parkash, Associate Professor, Geohazards Division, to document the $M_w 6.9$ Sikkim Earthquake that struck on Sunday, 18 September 2011, at 18:10:48 hrs (IST). The team carried reconnaissance survey of the affected areas from 21 to 25 September 2011 and held interactions with officials from the State and Central Government Agencies, armed forces, communities, NGOs and civil societies involved in the relief and rescue operations. The team mainly noted the extent of damages incurred to buildings, roads and infrastructures; response mechanism and relief measures being adopted, emergency control room operation at the district head quarters, in addition to media and press briefing to tackle the situation on emergency basis.

Post-Sikkim Earthquake damage assessment has brought the attention of the disaster managers of the country of the different sectors, i.e., governance, the environment, disaster risk management, social sectors, infrastructure-related sectors, the production sector, a macroeconomic analysis, and cross-cutting sectors (youth, gender, vulnerable persons, employment). The instability induced in the hill slopes due to the earthquake has certainly enhanced landslide vulnerability of the state and it is going to be a cause of major concern during the ensuing monsoon.

Disaster mitigation efforts need to be directed towards the identification of vulnerable regions, with emphasis on preventive steps as well as for planning relocation of settlements wherever necessary. This low perception of earthquake risk and ignorance of the real structural resistance of buildings appear to have inhibited the individual and collective propensity to develop emergency management plans. This situation was further exacerbated by the lack of clear and forthright communication from the India Meteorological Department about the impossibility of precisely predicting earthquakes and about the risks posed by many of the state capital's vulnerable buildings.

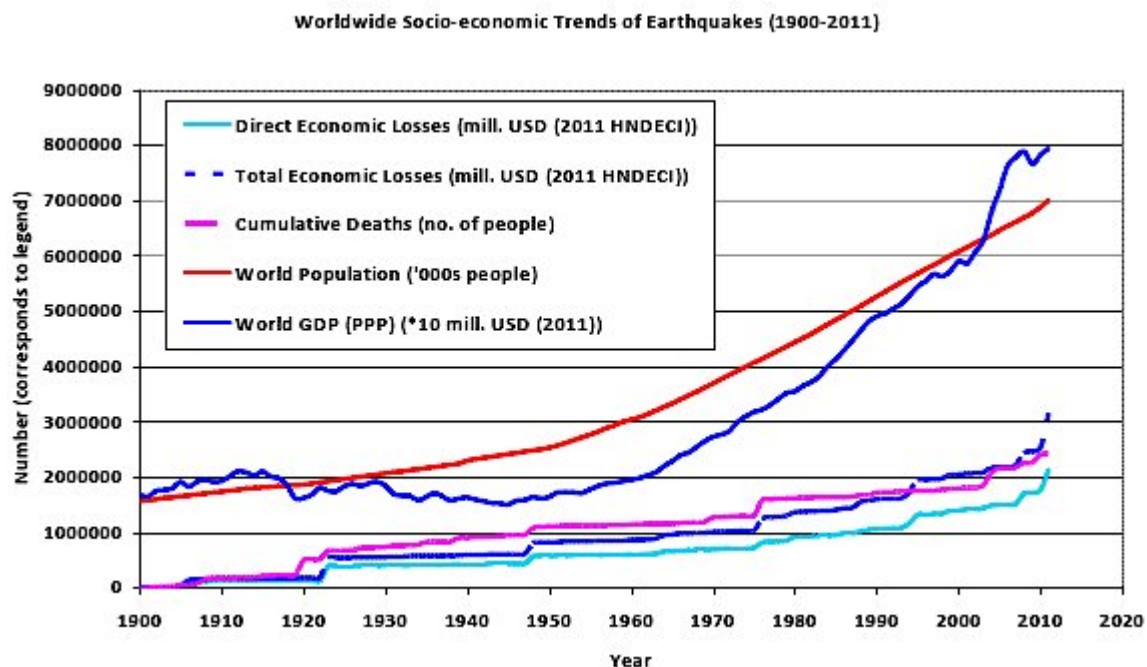
The government formed various themed teams, which had the responsibility of collecting and collating information on damage, losses, the impact of the earthquake on human development, and post-disaster needs for reconstructing and rebuilding the state of Sikkim. Based on the expert's recommendation an action plan for the identification of needs for recovery and rebuilding the state in the short term (12 months), medium term (3 years) and long term (5 years).

NIDM conducted one day workshop on Feb 9, 2012 to ensure pulling together information into a single, consolidated report detailing information on the physical impacts of the earthquake event, the economic value of the infrastructure and social damages, physical and economical losses, the human impacts as experienced by affected populations, and related early and long-term recovery needs and priorities. The aim of the workshop was to bring all professionals having direct exposure of working in the earthquake affected region and policy makers on one platform, so that lessons learnt from Sikkim earthquake are discussed and documented. The outcome presented in this proceeding is expected to facilitate in managing future disasters more effectively.

Dr Satendra
Executive Director

Executive Summary

Earthquakes are inevitable and human persistence for resilient livelihood would continue as long as civilization exists. According to CATDAT, over 12300 earthquakes show over 8.49 million deaths since the beginning of earthquake records. Earthquakes in the last two centuries have already caused approximately \$3.14 trillion (2011 HNDECI-Adjusted int. dollars) damage (of this around 20% has occurred in 2011, mostly due to Tohoku earthquake, Japan). It is often reckoned that earthquakes do not kill, the vulnerable buildings do. Collection of building damages for historic earthquakes demonstrates the vulnerability of traditional building stocks such as masonry, adobe and poorly constructed reinforced concrete. However, given the population upsurge around the world, there has been a significant reduction in loss of life due to earthquakes compared to what should be expected. This has come through a combination of country development, implementation of better building practice to resist earthquake forces and a more stable world, allowing for earthquake insurance and protection of financial assets. Taking the case of Sikkim earthquake-2011, in which more than 34000 building damaged and more than 400 landslides occurred, the total estimated loss is approximately \$1.7 billion US. In addition about \$200 million US damage was caused in Tibet (China), and slightly higher in Eastern Nepal in addition to losses in Bhutan with around 6000 buildings damaged.



[Cumulative deaths and economic losses related to global 2011-dollar GDP (PPP) and population, (source Daniell et al, CATDAT -2011)]

What is of utmost importance?

It is not a post-earthquake discovery that Sikkim lies in the severe seismic zone of India. We also know for decades that its fragile mountains are highly vulnerable to other types of geo-hazards, such as landslides, thunder storm, besides earthquakes. Damage assessment has been done by no. of agencies, more than 20 expert teams visited affected areas in various capacity yet but there is as such no authentic comprehensive report made available. Some reports are made with tables and no., without any classified map. Therefore, it is not possible to have correct estimate about the damage and loss.

What could be done in Sikkim?

While planning for reconstruction strategy it is important to go for sustainable management of natural resources by consolidating institutional and individual capacities in human, technical, physical, and financial terms in order to ensure effective, integrated management of the earthquake affected areas. In order to rebuild Sikkim and adjoining region, consider the following steps in tandem with the prospective ongoing infrastructural development projects:

1. Allow people to evolve their own plan, certainly with some restrictions in reference to the seismic and landslides safety.
2. **Build risk and disaster management measures into the (re)construction process** for all sectors (i.e. building code, insurance, consolidation and maintenance budget, contingency and operational continuity plans).
3. Prepare IEC materials including brochures for each one of the technical option and the cost, so that awareness could be raised among people.
4. Hands-on training program of the local building artisans is an activity that simply cannot be done away with, while demonstrating various options. Even for the RC construction this is a must because most of the damage recently seen could have been averted if the construction was properly carried out.
5. Re-draw up a regional development plan (planning, sectorals, building and zoning standards) and strengthen the capacities of the local authorities in terms of land use and development.

Finally a systemic, technical, and human measures must be put in place to accompany the reconstruction process by reducing the ecological footprint as much as possible and aiming for sustainable development.

Developing a disaster-resistant and secure community in the earthquake affected region of Sikkim and West Bengal, by keeping community as a key player in the recovery efforts; using all available resources not only for restoration, but also for reconstruction within a time frame of 3 years

Following the Mw6.9 earthquake in the Sikkim-Nepal border region, the state government has to set forth the following items on emergent basis:

Lifestyle support for victims

Maintaining temporary housing, providing public housing, housing reconstruction support, improving mental health care and health of victims, etc.

Prompt restoration of public works facilities and public utilities

Restoration of roads, waterworks, power supply and sewage, electricity, gas and communication, urgent restoration and countermeasures for landslides

Restoring administrative functions of the damaged habitat and heritage establishments

Maintaining public facilities, securing personnel, recovering public documents, restoring work foundation, support to community development, giving requisite technical support for damage assessments and documentations

Disposal of disaster waste

Removing disaster waste to primary temporary scrap yard, transferring waste to secondary temporary scrap yard and disposing of it safely

Securing educational environment

Restoring school facilities, strengthening personnel system, ensuring school entry of young victims, mental health care and means of transportation to and from school

Securing health, medical treatment and welfare

Securing health of the victims, maintaining a medical treatment and medical supply provision system, and supporting the elderly and children who lost a parent

Securing employment and living expenses

Supporting employment maintenance for stricken companies, securing employment and living expenses for victims

Early recovery of the agricultural, forestry products industries

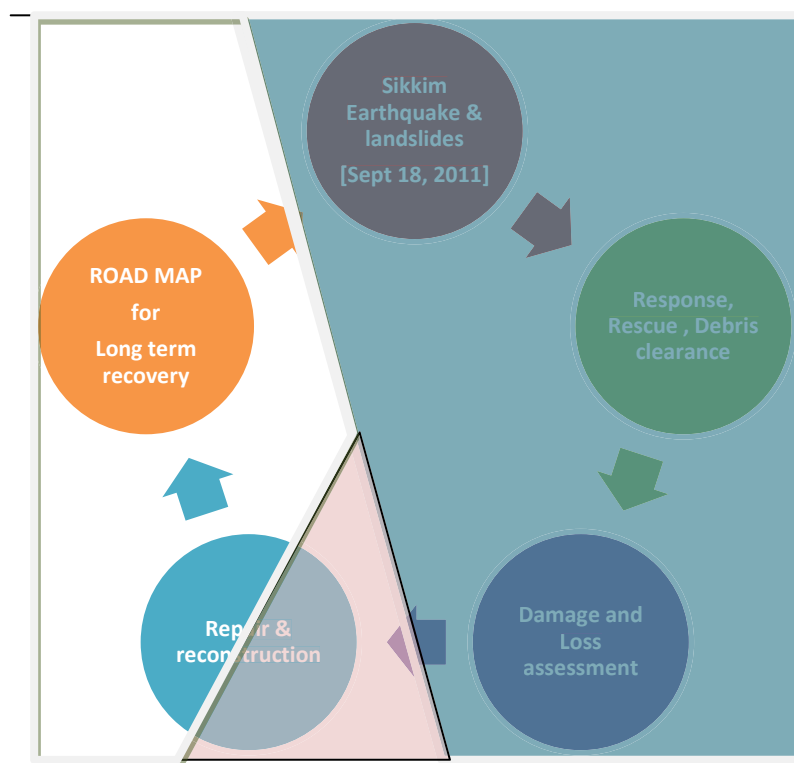
Restoring the production base of agricultural, forestry products industries by removing debris, supporting the resumption and reconstruction of businesses and constructing a stable supply system

Reconstruction of the commerce and industry

Supporting the resumption of businesses with temporary stores, factories and other facilities, supporting the restoration and maintenance of stores, factories, etc. and supporting general finance and operations

Rebuilding a safe and comfortable regional society

Restoring fire safety and disaster prevention functions, restoring disaster prevention facilities, re-examining disaster prevention system, restore and strengthen functions of police facilities and rebuild a safe and comfortable regional society



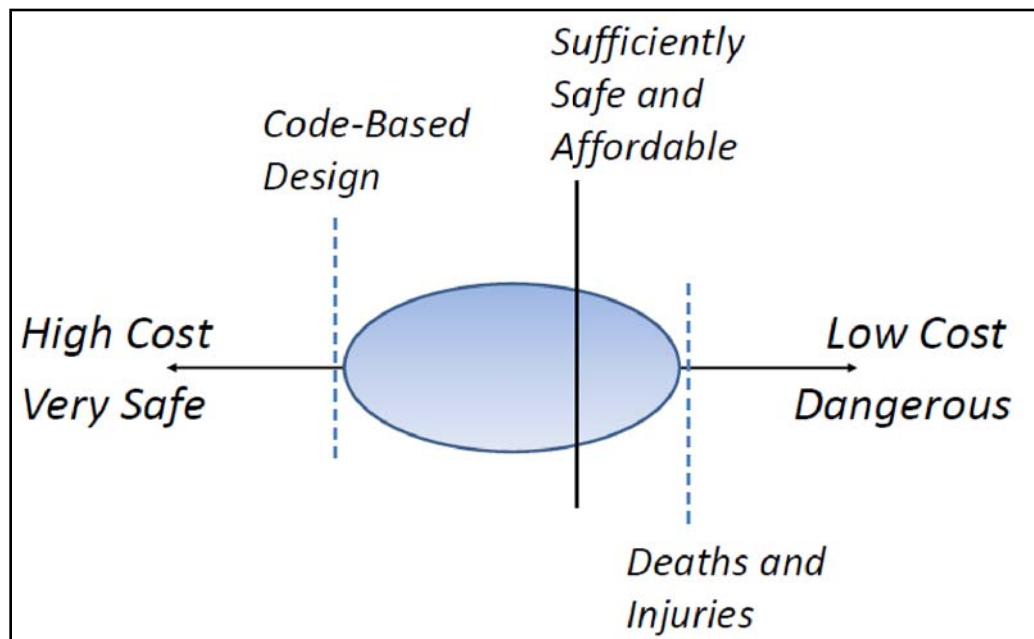
INTRODUCTION

The reconstruction of the Sikkim earthquake affected area aims at the “**build back better**” solutions that must be:

- Technically sound
- Financially viable
- Environmentally sustainable
- Disaster resilient and
- Culturally acceptable

The affected people require a number of other services, e.g. children must have safe schools to attend, homeowners and businesses require access to critical infrastructure (communication, electricity, water, sewerage, transportation, gas, etc), tourism, which is the most attractive option in the region, needs immediate restoration and workers for the Hydroelectric power projects sites, which is yet to gain pace, access to their livelihood. The “**building back better**” syndrome depends on much more than the stability of that structure alone, specially when they are lying on steep slopes.

The reconstruction takes care to improve the conditions of those affected in ways that might not otherwise be possible given legal, financial, or technical ramifications. These improvements extend not only to disaster risk reduction, but also with regards to economic revitalization, better awareness/capacity building, and modernization of the physical and social infrastructures.



The Fateful Sunday – Sept 18, 2011

On Sunday, 18 September 2011 at 6:11PM (local time), a Mw 6.9 earthquake with an epicenter located near the Sikkim-Nepal border region (27.723°N, 88.064°E), killed 77 people, including 16 at the Teesta Stage III Hydroelectric power project site, injured 719, left thousands homeless, and temporarily displaced many and also caused substantial loss to livestock. It was widely felt in all the North Eastern states of India, West Bengal, Bihar, Uttar Pradesh, Haryana, Rajasthan, including capital city Delhi. National Highways, State Highways including the rural connectivity in the Chungthang, Lachung and Lachen area have been snapped. Several aftershocks accompanied with incessant rainfall were causing further distress in the relief and rescue operations. Wide scale damages were reported from neighboring countries like Nepal, Bhutan, Tibet and Bangladesh. The instability induced in the hill slopes due to the earthquake has certainly enhanced landslide vulnerability of the state and it is going to be a cause of major concern during the next monsoon.

Disaster mitigation efforts need to be directed towards the identification of vulnerable regions, with emphasis on preventive steps as well as for planning relocation of settlements wherever necessary. This low perception of earthquake risk and ignorance of the real structural resistance of buildings appear to have inhibited the individual and collective propensity to develop emergency management plans. This situation was further exacerbated by the lack of clear and forthright communication from the India Meteorological Department about the impossibility of precisely predicting earthquakes and about the risks posed by many of the state capital's vulnerable buildings.

Objectives

The Sikkim Earthquake Reconstruction aims for a comprehensive multi-sector program, through provision of housing, social amenities, infrastructure, and livelihood support, based on sustainable economy and ecology in consonance with the broad guidelines of NDMA and with financial assistance from central and state government.

The broad objectives are described as follows:

- Re-Build, retrofit, repair and strengthen damaged houses for the people, and public buildings affected by the earthquake through application of earthquake-resistant technology (ref. various BIS codes, NDMA guidelines, etc.).
- Revive the local economy by providing assistance for agriculture, industries, small business, and handicrafts, and regenerate livelihood for the people.

- Rebuild and upgrade community and social infrastructure, improve education and health system, and strengthen social protection measures for weaker sections of the population.
- Provide health support to the people injured by the earthquake on a long-term basis and psychological counseling for the people traumatized by the earthquake.
- Restore lifeline infrastructure of transport networks and utility infrastructure of power and water supply, and reduce their vulnerability to natural disasters and landslides.
- Support gender empowerment through involving women at all stages in the reconstruction program implementation.
- Provide support for the children affected by the earthquake, and alleviate social deprivation through an integrated nutrition and education strategy.
- Implement a comprehensive disaster management program, improving the disaster preparedness and emergency response capacity of the government to deal with different types of disasters.
- Reduce vulnerability through long-term mitigation programs aimed at watershed management and landslides mitigation, and improve people's resilience and food security through diversification of sources of income-generation and asset building.

Damage scenarios

Extensive damage and loss of public infrastructure was reported in the following sectors all over the State:

1. Transportation infrastructure comprising of roads and highway networks, bridges, tunnels, culverts, retaining walls and village footpaths.
2. Energy infrastructure in the form of power generation plants, electrical grid, substations and transformers
3. Water management infrastructure comprising of drinking water supply, drainage systems, irrigation systems and flood control systems.
4. Governance infrastructure of government offices at the village, block, district and state level, military infrastructure along with residential buildings.
5. Social infrastructure including the health care system, education and research system and social welfare system primarily Integrated Child Development Services.
6. Economic infrastructure comprising of marketing hubs, manufacturing centers, agriculture, horticulture, animal husbandry, forestry and fisheries infrastructure.
7. Recreation infrastructure like community halls, playgrounds, sports complexes etc.
8. Cultural heritage infrastructure like historic monasteries, chortens shedas (monastic schools), archaeological sites, temples, churches etc.

Lessons from Sikkim Earthquake – status check

- *The M6.9 earthquake caused extensive damage to buildings, road infrastructures and created long term impact on the viability of extensive hydroelectric power projects in the region.*
 - o When and how effectively earthquake information from India Meteorological Department, New Delhi, reached to the state capital Gangtok? Despite having more than 30 seismic stations in the NE region, any strong motion seismograph obtained so far?
 - o What extent the seismic hazard profile of the state is understood by the policy makers?
 - o To what extent seismic microzonation maps prepared in 2006 are concerned to the damage scenario observed during? Any verification with the site response map prepared under DST project?
 - o Do BRO has been able to gain enough expertise in the landslides mitigation and maintenance?
- *Damages were substantial even with seismic intensity V-VII affecting hill area settlement even beyond 100km from the epicenter*
 - o Any check on the type of constructions taking place in the state with respect to seismicity?
 - o Vulnerability of buildings lying the steep slope?
 - o How many building collapsed after the earthquake and how many have been demolished so far?
 - o Who will pay for the repairs and reconstruction?
 - o How damage and loss assessment carried out?
- *It has caused extensive damage in the rural area, including Buddhist monasteries and heritage establishments where earthquake resistant measures as per seismic code of the country are hardly discernible.*
 - o To what extent buildings and roads in the rural sector evaluated?
 - o How these areas will recover? Any special grant from the central ministry based on damage survey by experts?
- *How does the state government decide what to save, what to demolish and what to finance and in what manner?*
 - o Is there an accepted policy to allocate work force and finance?

- o To what extent national guideline on earthquake Management (2007) applicable in the reconstruction strategies?
- o Any policy on the implementation of building bye-laws, development control rules and national building code (2005)
- *Nonstructural damage is costly and affects business recovery*
 - o Other property damage, there have been set backs to livelihood – any assessment made by any recognized agency so far?

Table 1: List of damages due to Sikkim earthquake and taking a perspectives of the damage and loss estimate done so far (**Source: adapted from Department of Land revenue and Disaster Management**)

Loss and Damage	Number	Remarks
Human Lives lost	60 – Sikkim, 11- West Bengal, 6- Bihar	Compensation declared by state and central Govt. – Any psychosocial check on the status of the families directly and indirectly affected in all the 3 states?
Injured	710	Type of injuries, name of the hospitals and details of those that shifted to other hospitals outside the Sikkim state?
Houses	34159	Types and category of damages with photo/video footage, quick and detailed damage assessment survey format, spatial mapping and representation in GIS, decision regarding demolition, repair methodology suggested, experts involved in the decision making, compensation paid to private owners, etc...?
Government Buildings	1255	Type of damages with photo/video footage, reason for such damages, construction history, damages to those that have been retrofitted after Feb 2006 earthquake, decision making process for demolition and retrofitting, demolition exercise, cost projected, etc...?
Cattle Lost	525	List of those owners and effect on their livelihood, compensation,...?
Sheep, Goats, Pigs	808	Same as above

Sikkim Earthquake -2011 – Reconstruction Strategy

lost		
Agriculture crops	7500 Hectares	List of those along with maps – before and after the earthquake, compensation, ...?
Roads Damaged	3230kms	Quantity estimates available with PWD and BRO, estimation of total debris handled by BRO and other organizations, methodology used for loss estimate, detail survey of the terrain, ..?
Village footpaths	1596	Same as above
Bridges/Culverts	8135	List and their location in the map, loss estimates, photo/video footage, effect on the communication, effect on the road hydroelectric project construction, plans for reconstruction, budget?
Water Supply schemes	1529	Location and types of damages, man power deployed, effort made during relief and rescue phase, expenditures incurred, repairs done so far, etc...? Reconstruction of village level facilities like storage systems; water distribution networks; water pipeline transmission systems; and upgradation of pumping and captive power generation system??
Minor Irrigation Works	204	Photo/video footages of the damages, location in the map, repair done so far and measures devised for sustainability...?
Flood Control Management works	533	Same as above
Power Infrastructure	Major Damage	Any categorization of damage and loss in terms of revenue loss and cost incurred for reinstatement, future implication for disaster resilient measures built into the system, etc...?
Schools	759	No. of students affected, damage types and categorization, vulnerability of other schools and expected damages, repair and reconstruction costs incurred so far and project cost, etc. ..?

		Steps taken so far in the reconstruction and repairs of damaged school/colleges/ Technical institutions with improved facilities, etc...?
Hospitals	377	Damages observed and their category, types of hospitals and emergency patients being treated, etc...?
ICDS (Anganwadi)	875	Types of damages, intensity felt, types of materials used, etc. ..?
Historic Monuments, Monasteries and Religious Institutions	259	Category of damage, analysis of damage scenario, repair and strengthening measures taken so far, agencies involved, amount incurred, etc..?
Gram Panchayat Offices	60	Same as above
Village level co-operatives	49	Same as above
Rural product Marketing Centres	8	Same as above

The State estimated a loss to the tune of Rs 7425 crore and sought a relief of Rs 6890 crore.

Expected Recovery Outcomes

Recovery planning must assume a holistic stance considerate of the wider spectra of recovery functions, rather than considering the construction of each unit or block in isolation. Every decision that guides the housing decision, as addressed in the multitude of issues featured decision carries implications planners must weigh against the possible benefits that might be achieved. All decisions should strive to meet or at least approach a core group of target outcomes, which might include any of the following:

1. **Permanence:** Displaced victims are able to return to or otherwise secure permanent housing
2. **Risk Reduction:** Housing units that are repaired or replaced adequately account for future hazard risk in design, construction, and materials
3. **Viability:** The housing solution is one that ensures access to appropriate wraparound services required by occupants to lead a practical and practicable living (e.g. access to livelihoods; availability of food and water; access to markets,

utilities, and transportation; access to religion and religious facilities; existence of a community)

4. **Independence:** Housed victims are able to achieve self-reliance and sufficiency in restarting normal life
5. **Cultural Sensitivity:** The culture of the affected population is protected and reassured with more resilience and lesson sharing
6. **Community Input and Acceptance:** The wishes of the affected population are heard, understood, respected, and incorporated in the national recovery strategy
7. **Cost Effectiveness:** Housing solutions should not put governments, communities, or individual residents in crippling financial circumstances.
8. **Progressive:** Ongoing long-term development progress is maintained, and long term community goals are not sacrificed for short-term individual benefits

Importance of Damage survey – first few days

Immediately after and during the first few days after the earthquake, thousands of buildings may result damaged, while new shocks can still occur. Therefore, it is to carry out as quickly as possible the evaluation of building safety in order to identify which buildings are safe or not for immediate use (or for entering them) mainly against subsequent aftershocks. Furthermore, the area affected by heavy damage can be so extended that expert engineers are always insufficient to make all building safety evaluations within a limited timeframe. The success of inspections depends upon the manner it has been designed and planned in advance. This early data are necessary to emergency assistance, local disaster statement, external aid requesting, and for organising rapid building inspections. The important short-term operations are:

1. Identification of hazards for safety of search and rescue operations
2. Inspection of emergency facilities and all the affected buildings and posting them as to their safety.
3. Identification of hazards associated with damaged buildings and their removal or temporary securing for safety use of streets adjacent to those buildings.
4. Identification of those buildings that require emergency shoring up to avoid collapse.
5. Identification as soon as possible all buildings that are safe to use and temporary shelter sites to serve as temporary housing.

Lessons re-learned

earthquakes are not new to the Sikkim; its history is teeming with deadly tremors. The previous earthquake struck the area on 14 February, 2006 killing 3 people and causing significant damages to the buildings in Gangtok. If the impact of future earthquakes is to be effectively reduced, seismic hazards need to be addressed on several different timescales. On the timescale of decades, land use regulations and building codes need to be improved. The technological and scientific advances of the recent past have undeniably improved both materials and construction techniques, which, in conjunction with a greater understanding of seismic risks, have enhanced human resilience to

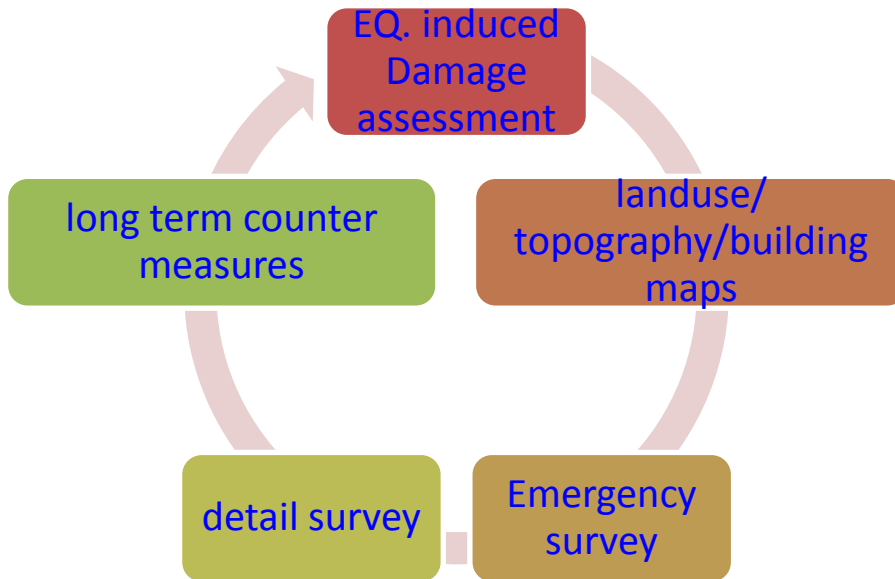


earthquakes. New seismic risk assessment and mitigation measures such as structural retrofitting and strengthening, along with community based awareness programs, have proved to be pivotal factors in reducing the effects of earthquakes worldwide. Unfortunately, the application of these safety methods is often inconsistent and not a high priority, especially at the level of local communities, families, and individuals. More than 20 expert teams, including NIDM, visited Sikkim and adjoining affected areas following the earthquake. Though the life loss was not much, the impact of this earthquake in terms of a) direct and indirect economic loss to nation, b) expenses to be incurred for mass scale reconstruction and rehabilitation measures, c) affecting tourism industry, d) setback to developmental perspectives of the affected area. It was realized that closely coordinated efforts between academia, governments, community based organizations, civil defense and private companies are essential for effective earthquake mitigation. In addition, it is urgently required to promote user education and close coordination efforts between various organizations with a rapid and reliable earthquake information system during major earthquake.

Earthquake Forecasting Exercise – IMD to come upto people's expectation

India Meteorological Department (IMD) is the nodal agency of Government of India responsible for monitoring seismic activity in and around the country. The operational task of the department is to quickly estimate the earthquake source parameters immediately on occurrence of an earthquake and disseminate the information to all the user agencies including the concerned State and Central Government agencies responsible for carrying out relief and rehabilitation measures. The earthquake information is also transmitted to public information channels, press, media etc. and posted on IMD's Website. An Earthquake Operational Centre is functioning on a 24X7 basis at IMD Headquarters in New Delhi, which has the operational responsibility of keeping a round-the-clock watch of seismic activity in and around the country. The responsibilities of the Centre include retrieval of waveform data from remote field stations either in real time or through VSAT / dial up communication facilities, data analyses and quick dissemination of earthquake information to various user agencies including State and Central Government departments dealing with relief and rehabilitation measures. Despite having more than 30 seismic stations deployed in the NE region of India, no Indian organizations, including IMD, could bring out any forecasting message to the Sikkim State administration. IMD website carried information about the Sikkim earthquake much later than the USGS website, which corroborates that Indian seismic research involving more than 17 national organizations, have to do a lot by keeping in mind with the advancement made by Japan, Taiwan and USA.

Recent advances in seismic sensor technology, data acquisition systems, digital communications, and computer hardware and software make it possible to build reliable real-time earthquake information systems. Such systems provide a means for modern urban regions to cope effectively with the aftermath of major earthquakes and, in some cases, they may even provide warning, seconds before the arrival of seismic waves (Kanamori, et al, 1997). Today, real-time systems are capable of providing basic earthquake information within minutes, and in the future this could be reduced to tens of seconds. In some cases, facilities will receive this information even before ground shaking begins (early warning). This may allow for clean emergency shutdown or other protection of systems susceptible to damage, such as power stations, transport and computer systems. Moreover, quantitative measures of building performance in earthquakes can only be achieved if shaking during damaging earthquakes is recorded with spatial density sufficient to characterize the ground motion. Several real-time earthquake information systems have been developed in Japan, Mexico, Taiwan and the United States.



Landslides

The National Highway-31A has suffered landslides at over 21 places, over a cumulative length of 700 meters. The damage of road from Gangtok to Nathula (61 kms) was made operation by 2nd October 2011. The third important road in Sikkim which is affected badly is North Sikkim Highway from Gangtok to Chungthang (95 kms). About 400 meters of road-formation has been damaged due to 16 landslides. Restoration of this road too was likely to take some time. Damage potential of slope protection measures being used in service so far needs evaluation and efficacy of the existing conventional earth retaining structures such as gravity retaining wall, cantilever wall against earthquake induced vibration needs performance check. BRO (GREF), PWD officials must be encouraged to open a research and development wing on the application new technologies in the landslides mitigation.



Vulnerable establishments

Ongoing road widening operations exposed several portions vulnerable to rainfall induced slides, which was got aggravated by earthquake vibrations of intensity VI. Drainage facilities, which is termed as arterial components of hill road safety, are found either inadequate or went beyond effective scope of regular maintenance. The conventional breast walls and gravity type stone masonry walls with mostly ineffective weep holes need revaluing of their efficacy and expenses incurred against modern technology in the slope stabilization.

The earthquake damaged thousands of houses and public buildings, destroyed infrastructure including roads and bridges and temporarily cut off electricity and telephone landline connections. It also caused multiple landslides cutting road access to many of the affected populations. This earthquake cause shaking intensity of VI in the

populated area of district towns Sikkim and adjoining area, which has exposed the type of vulnerabilities of roads on hill slopes as well as portending scenarios of road widening works, multi-storey buildings juxtaposed on steep slopes with little or no breathing space and dwindling lifeline infrastructures in hilly terrain. Demolition efforts in the few collapsed buildings in Gangtok has ushered new challenges to the Sikkim Govt.





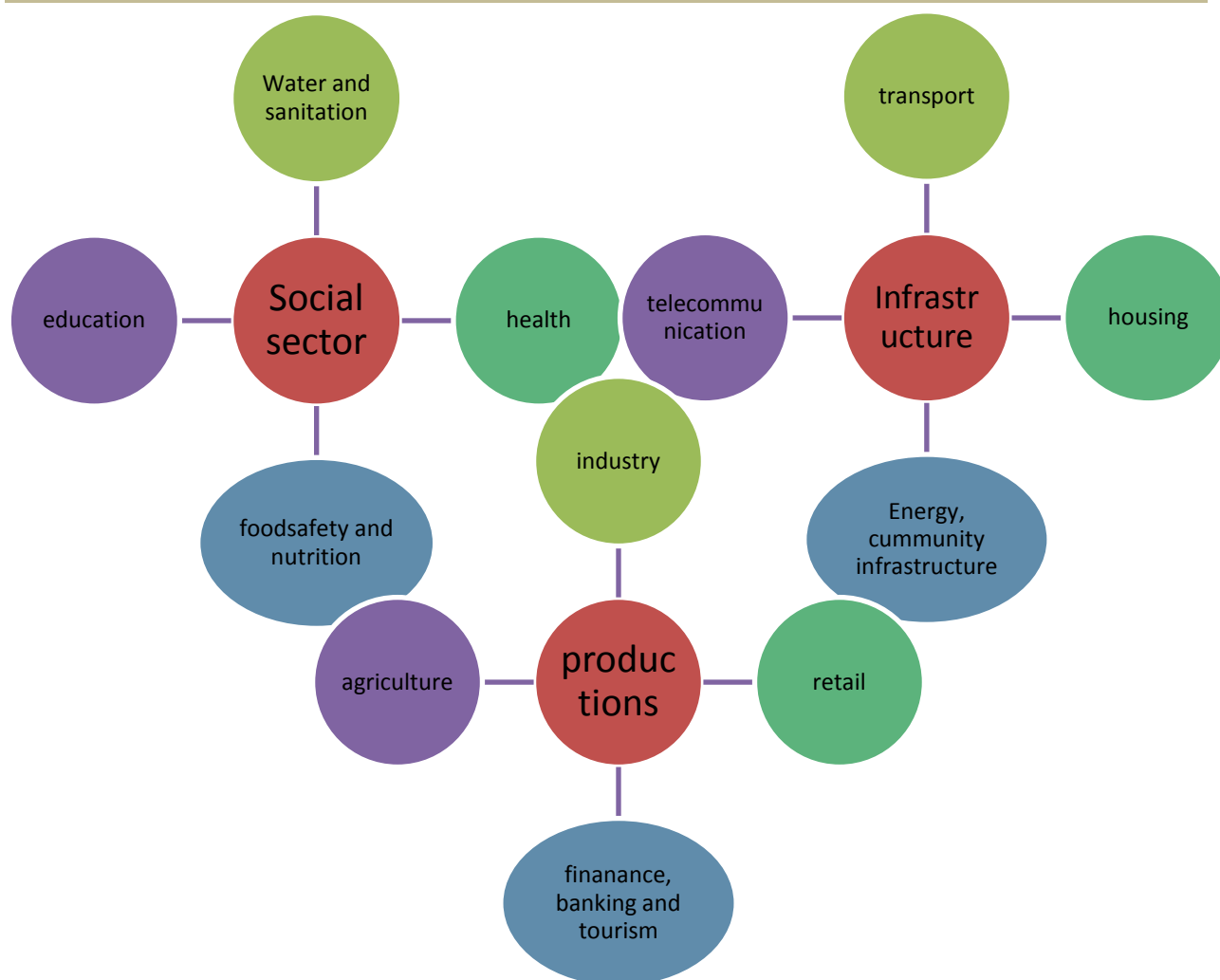
Life loss and building collapse

The epicenter of moderate earthquake was eventually 68 km away from state capital Gangtok. The degree of damage was quite significant in the last earthquake of Feb 2006. While granting permission to build Multi-storey buildings the relevant government department such as UD&HD, in Gangtok, even doesn't require the involvement of a qualified structural engineer. Structural drawings even if given in the sanctioned plan, there are hardly any field check by structural engineer towards proper ductile reinforcement. So the homeowner, who is suppose to have no idea about earthquake engineering or ductility requirements as per seismic zone IV, constructs his house only with a grid of columns and beams. Such houses with uniform stiffness and frames on regular grid behaved well in the moderate-intensity Sikkim earthquake, but they may not do so if the quake is a high-intensity one with duration more than 30 seconds or so. Those buildings that had an open or soft storey have high potential for collapse or had severe structural damage.

Damage, losses, economic impact, and needs were estimated in the following manner (PDNA, Haiti, 2010):

- Damage is estimated at the replacement value of physical assets wholly or partly destroyed, built to the same standards as prevailed prior to the disaster;
- Losses are estimated from the economic flows resulting from the temporary absence of the damaged assets;
- From the damage and losses, the disaster's impact on economic performance, employment, and poverty can be assessed;
- Needs take into account the activities of recovery, reconstruction, and setting up the Sikkim State back to developmental paradigm.

Category of damage assessment



Category needs following a disaster



Psychosocial care service provision

Psychosocial care is essential for all the population experiencing a disaster. People differ only in terms of the degree of support needed. A reflection of this recognition of the need and improvement with care is seen in the disaster care policy of many countries. International organisations like the WHO (see box), Red Cross, etc., have also identified this component of care as essential in their activities. It is a holistic approach to rehabilitation. Psychosocial care provide a vivid and moving account of the experiences of survival and bereavement under different types of conditions faced in hilly terrain, which remained inaccessible more than a fortnight. NIDM and AIDMI propose to summarize the most up-to-date thinking about the psychological effects of disaster, and describe the therapeutic strategies available for treating victims with persistent problems, emphasizing the welfare needs of staff involved in rescue and support.

The three aspects of psychosocial assistance in disaster care are:

- Helping the affected persons to recognise and understand the disaster experience and the changes that they experience in their body and mind.
- Decreasing the physical and psychological effects by listening, encouraging relaxation and externalisation of interests and activities.
- Giving practical support to rebuild their shattered lives in areas of housing, work, health and community life.



Figure 4 Medical care given to those private labourers, mostly working for the Teesta Hydroelectric Power Project- stage III in the Chungthang area, North District, Sikkim, who were forced to walk for 3-4 days to reach Mangan, HQ-North District and were waiting free bus service to Siliguri on 24th Sept, 2012.

Recovery framework

Post Disaster Damage and Needs Assessment and Recovery Framework (**PDNA/RF**) for the Sikkim Earthquake is to be carried out by a specialized team. It will ensure pulling together information into a single, consolidated report detailing information on the physical impacts of the earthquake event, the economic value of the infrastructure and social damages, physical and economical losses, the human impacts as experienced by affected populations, and related early and long-term recovery needs and priorities. Post-Disaster Damage Needs Assessment (PDNA) works in two motives: (i) the valuation of physical damages and economic losses; and, (ii) the identification of human recovery needs based on information obtained from the affected population.

The Recovery Framework provides decision makers, especially governments, with an operating envelope to allow sectoral proposals to be incorporated in a national plan and, as often as possible, integrate response options across sectors. The ultimate goal of recovery managers is that the sectors' outcomes, when achieved, contribute to and ensure the overall intended recovery outcome, i.e., that the affected area recovers effectively and that people, families, businesses, and public officials find it a safe and attractive place to live, invest, and prosper.

Road ahead – one day workshop at NIDM on February 9, 2012

Every disaster along with posing new challenges also provides opportunity to learn from. There is great demand to replicate lessons learned from past disasters to mitigate the ensuing ones. While recovery operations in various sectors are in progress in the

affected area, it would be worthwhile to synthesize all experts' comments, feedback and suggestions in the form of a guiding road map.

It was an effort to ensure pulling together information into a single, consolidated report detailing information on the physical impacts of the earthquake event, the economic value of the infrastructure and social damages, physical and economical losses, the human impacts as experienced by affected populations, and related early and long-term recovery needs and priorities.

The aim of the workshop was to bring all professionals having direct exposure of working in the earthquake affected region and policy makers on one platform, so that lessons learnt from Sikkim earthquake are discussed and documented. The outcome is expected to facilitate in managing future disasters more effectively.

AIM of the Workshop:

- To synthesize all experts' comments, feedback and suggestions in the form of a guiding road map
- To develop roadmap for disaster resilient/ sustainable livelihood

Background

NIDM organized a one-day brainstorming national workshop on 9 February 2012 at its premises in Delhi. To synthesize different experts' comments, feedback and suggestions for formulating guiding road map for recovery, rehabilitation and redevelopment of the affected area. The workshop attempted to bring all stakeholders who have worked during the post earthquake operations and involve planners, policy makers and decision making authorities for documenting the lessons learnt based on the their experience with the situation after Sikkim earthquake. The workshop focused mainly on

- The response, relief, rehabilitation operations by agencies such as National Disaster Response Force (NDRF), Army, Air Force, Indo-Tibetan Border Police (ITBP), Army, State Police, Civil defence, NGOs and other volunteers
- Restoration of lifeline facilities in the affected areas by concerned State Government Line agencies, Border Roads Organization, Teesta Urja, Public Sector Units and others
- Damage and loss assessment survey conducted by expert teams set up by Ministry of Home Affairs, Ministry of Urban Development, Ministry of Rural Development, National Disaster Management Authority and agencies of the State Government. The teams included experts from IITs, IIRS, TISS and others.

Following successful conduction of one day brain storming workshop on Sikkim Earthquake-2011, it's now time to collate all the information in a comprehensive

document. The workshop had 3 sessions – 1) response & relief – 4 speakers, 2) on damage survey, tools & technique – 5 speakers, 3) Awareness & psychosocial care – 4 speakers. The workshop was inaugurated by Prof. H.K. Gupta, Hon'ble Member, NDMA. In his speech Dr Gupta highlighted about the Indian expertise on earthquake early warning and dam-reservoir induced seismicity. He also welcomed sincere suggestions from the experts based on lesson learned from Sikkim earthquake.



As guest of honour Maj General S. Ravishankar, Director General, Border Roads Organisation, offered all help and logistics in solving landslides problems in the border states. He has mentioned the valorous role played by the BRO(GREF) in the aftermath of Sikkim earthquake and expects more technological intervention from Indian scientific and technological Diaspora. Shri A.K. Singh, DC-South District, Sikkim, shared his experience during post earthquake. He described how EOC was created in his residence and how his team helped in the facilitation of traffic during emergency operation.

The workshop was attended by 70 plus participants during the inaugural function. Dr. H.K. Gupta, Hon'ble Member NDMA was the Chief Guest in the workshop and Lt. Gen. S. Ravi Shankar, DG BRO was Guest of Honour. The other dignitaries present during the workshop included Brig. Rajiv Sawhney – Chief Engineer, BRO at Gangtok; Shri A.K. Singh – District Magistrate, South District of Sikkim. 12 presentations were made during the 3 technical sessions held after the inaugural function in the conference room of SAARC Disaster Management Centre (SDMC), Delhi. The session-1 focused mainly on immediate response to the Sikkim earthquake by Government of Sikkim, NDRF, BRO, Army, NDMA, NIDM and MHA. Session-2 focused on damage assessment tools and technology and presentations were made by UD&HD-Sikkim, Indian Institute of Remote Sensing and Teesta Urja. The last technical session focused on psycho-social issues related to disaster management in which 3 presentations were made by DSSW-Delhi University, SPHERE and ANI. The workshop concluded in the presence of Brig. Rajiv Sawhney, Chief Engineer, BRO; Dr. Satendra, ED NIDM; Prof. Chandan Ghosh, Head

Geohazards Division; and Dr. Surya Parkash, Associate Professor, NIDM. List of participants and workshop photos are given in Annexures.

Session -1 was devoted to:

- Immediate response & relief management – data base of damages and loss
- Search, rescue, relief measures and operation of EOCs – gaps and scope for betterment
- Sorties and Aerial operations – critical issues
- Vulnerability mapping of existing establishments by RVS and site specific testing/evaluation
- Debris removal and restoration of traffic
- Training and capacity building of BRO(GREF) officials in landslides mitigation technology – after all removal of whose “debris”
- Loss and Damage assessment framework and repair/retrofitting strategy
- Reconstruction planning and strategies for long term recovery

Session-2 was devoted to:

- Training and capacity building of BRO(GREF) officials in landslides mitigation technology – after all removal of whose “debris”
- Loss and Damage assessment framework and repair/retrofitting strategy
- Reconstruction planning and strategies for long term recovery
- Space technology for hazard mapping and landslides damage assessment – for EQ. active fault mapping is special than “Spatial” mapping
- Demolition of collapsed building Gangtok-issues of organised decision making
- Infrastructure damages and restoration measures
- Landslides induced damages in Sikkim and North Bengal and strategies for effective mitigation measures

Session-3 was devoted to:

- Socio-economic and psychological impacts due to Sikkim earthquake – loss in tourism, etc.
- Redefining community response and role of NGOs - coordination, integration, DRR...
- Emergency communication, inter-agency coordination and DM information protocol
- Role of local print media, TV and other communication

GAPS identified during workshop:

- Logistics problems for movement of NDRF team to the affected site on emergent basis
- EOC – operation – system exists but not implemented
- Awareness – during, after – mock drill
- Heritage buildings devastated
- Landslides – inventory map not ready
- Communication not upto the mark in times of emergency – still dependent on individual interests and efforts
- Dealing with nonstructural components – lots more awareness drive required

During workshop more than 70 delegates took active part and shared their opinion in the following lines:

Strategy

- Measures for systematic damage as well as vulnerability assessment survey along with suggestive timelines for carrying out specific task of repair, retrofitting and rehabilitation framework.
- To develop a plan of action for the rehabilitation and reconstruction for the affected area based on above study and implement it through various agencies.
- Development/upgradation of Indian standards and guidelines dealing with earthquake resistant design of buildings on slopes, landslides and rock fall protection measures by modern techniques such as geosynthetics reinforced earth, soil nailing, anchored earth, geonetting, bioengineering, etc.
- Vulnerability assessment exercise for all Hydroelectric power generation project in the NE.
- Psychosocial rehabilitation needs to culminate into disaster mental health and be integrated with the district mental health programme in the ensuing Plan.
- There should be policy and field level interventions to address the special needs of people affected by conflicts and/or forced to migrate
- Detailed survey of the affected areas should be made to assess impacts on **physical, socio-cultural, psychological, economic and environmental aspects**. This survey may be done by NIDM/NIMHANS under PDNA (Post Disaster Need Assessment) team.

- Rigorous training **of masons and certification** ensuring higher wage for them to be carried out with utmost priority. Updating and drafting town planning, construction standards, and zoning plans; informing and awareness-raising of the population about construction standards; repairing and strengthening of cracked walls; incentives for owner driven retrofitting of selected buildings.
- **National building code - 2005**, relevant BIS codes, NDMA guidelines on earthquake management to be made compulsory
- **Portending future** of existing built establishments in the highly populated areas to be investigated and new land usage policy to be initiated keeping in mind of the earthquake and landslides hazards

Area of intervention

The guidelines for priority interventions are situated in 4 areas: (i) knowledge of hazards (natural and others), (ii) clarification of the roles and responsibilities of the main public and private participants (legal framework, standardized tools, etc.), (iii) the organizational and operational capabilities for preparation and response of the sector ministries and specialist bodies (e.g. fire service, SDMA, EOC, DM committees), (iv) sectoral capabilities in risk analysis, planning, and monitoring/assessment for the protection of physical capital.

- Preparation of remedial measures for all building surveyed by Sikkim Govt along with cost and time allocation
- Special report on the retrofitting of a private building at Singtam, Ringjhim monastery at Mangan, Rumtek Monastery, Govt. secretariat building, Police HQ. at Gangtok, state guest house at Rangpo.
- Training of BRO (GREF) engineers on the modern technology of Landslides mitigation measures by bio-engineering, soil nailing, geosynthetics and geonetting etc.
- Measures for systematic damage as well as vulnerability assessment survey along with suggestive timelines for carrying out specific task of repair, retrofitting and rehabilitation framework. Experts team to be formed by involving various national agencies/companies/ organisations in coherence with the aims and objective of Govt. organs such as NDMA, NIDM, MHA and state govt. agencies.
- Development/upgradation of Indian standards and guidelines dealing with earthquake resistant design of buildings on slopes, landslides and rock fall protection measures by modern techniques such as geosynthetics reinforced earth, soil nailing, anchored earth, geonetting, bioengineering, etc.
- Vulnerability assessment/RVS exercise for all Hydroelectric Power generation project in the Sikkim and adjoining region.

- Strategies for pre and post event data collection and further instrumentation of the affected area for understanding unique tectonic features by reputed Indian organisations such as NGRI, GSI, IMD, NEIST, WIHG, IIG, IITs.
- Establishment of more no. of **earthquake and landslides resilient Helipads** in the Seismic Zone-V area (covering 12% of Indian land mass) and provision of satellite and WLL telephones with defined emergency communication protocol
- Establishment of a forum **for inter-changing of ideas and views** pertaining to earthquake risk mitigation, capacity building of mason, architect, engineers, town planners, contractors and other stake holders
- The **performance check of the existing conventional earth retaining** structures such as gravity retaining wall, cantilever wall against earthquake induced vibration. **A brain storming workshop** for all those organizations involved in the hill road construction and maintenance highlighting efficacy of modern techniques based on the on-site assessment of damage patterns and mitigating them through a pilot-project along NH31A.
- **Workmanship, supervision, and construction** methods must be revised in the form of strict regulation and implementation drives. Thus, strict adherence to prescribed standards, of construction materials and processes is essential in assuring an earthquake resistant building.

Road map – long term implications and strategies

1. **Seismic microzonation** of Sikkim state, which was carried out under DST funding in 2006, requires status monitoring and road map with particular motivation towards their practical application in the new construction and land use planning for the entire state and similar exercise to be extended to all seismically high risk areas in North east.
2. **National** network of seismic instrumentation, strong motion recording and data processing in the NE region – need for upgradation, R& D for effective early warning system (EWS) in the NE region. Despite having more than 34 seismic stations in place in the NE region, country is yet to bring out rational earthquake information dissemination through information media for common public.
3. **Seismological data** so far being collected at IMD, New Delhi needs up gradation to their quality and acceptability across the world, which is possible only when these limitations shall be highlighted in the Indian scientific Diaspora.
4. To frame strategies to **construct and maintain major hospitals, school buildings** and public amenity building for storage of essential life saving materials (food, medicine), community halls, equipments and machinery for removal of

damaged material, using disaster resistant technologies of a higher order, so that these buildings not only serve as good examples of disaster resistant technology but also could be **utilised as relief shelters** providing the necessary emergency support facilities.

5. **Portending future** of existing built-establishments in the highly populated areas to be investigated and new land usage policy to be initiated keeping in mind of the earthquake and landslides hazards
6. **National building code - 2005**, relevant BIS codes, NDMA guidelines on earthquake management to be made compulsory. A documentary of the process of earthquake resistant construction may be made and the same be distributed to all districts, town, Panchayat, etc. Each district/Taluka/block must have a typical building showing **all earthquake resistant** features.
7. Rigorous training **of masons and certification** ensuring higher wage for them to be carried out with utmost priority.
8. **Techno-legal and techno-financing regime** should be brought in to ensure that all public funded housing and buildings and construction, be it for health, education, industry, community amenities, etc. be only built with disaster resistant construction features. Further, public financing institutions for housing and infrastructure development be advised to extend financial assistance to projects from States only when disaster resistant construction features are introduced in the proposed housing and building construction programmes. Earthquake induced damage potential on the **Hydropower projects** in the Sikkim state required to be evaluated by a special team.

Recovery strategy

Constructing a disaster-resistant community development model

The state government plans to promote a disaster-resistant urban plan designed to incorporate ideas for landslides countermeasures such as flatter ground relocation, separation of workplace and residential area and the establishment of multiple landslides prevention variers, and promote an urban plan that maximizes the lessons learned from this earthquake.

Rebuilding state's agricultural and forestry products industry

For the purpose of rebuilding and developing the state's industry, the state government will re-examine damaged areas, including the legal system, structure

of operations and the state of the vulnerability from hazards other than earthquake and will promote the creation of a disaster safe industry

Building progressive agricultural and forestry industries

While coordinating land usage, the state government will make plans to improve agricultural output through agricultural land integration, large scaling of operations and transitions of crops planted. In addition, the agri-business will be proactively developed for the revitalization and reconstruction of a competitive agricultural industry. There will also be plans to move along the rapid reconstruction of the fruit preservation industry and revitalize a proactive forestry industry.

Rebuilding the manufacturing industry

The state government will move ahead to support prompt reconstruction of the manufacturing industry and to further attract automobile-related industries. Plans will also be carried out to integrate and promote new industries that will lead the next generation, reconstruct the grand design for the manufacturing industry that will maximize the region's unique features and create an industrial structure that will balance primary to tertiary industries.

Revitalizing attractive tourism industry in the region

The state government has to plan to transmit tourism information, restore and enhance the transportation infrastructure, implement tourism campaigns such as Destination Campaign, strengthen the response to inbound tourism (attracting overseas tourism) and construct a new tourism route. The state government has to carry out efforts for tourism recovery by maximizing the experience of the disaster and revitalizing the attractive State tourism industry.

Reconstructing the health, medical and welfare fields together with community development plan for entire region

The state government needs to promote the rapid restoration of medical and welfare institutions and the reconstruction of the health, medical and welfare distribution system throughout the entire region along with the community development plan. Furthermore, The development of a regional community where people of all ages can live comfortably will be promoted based on the lessons learned from the location of affected facilities, the importance of an extensive medical system and the importance of the collaboration among regional communities.

Promoting disaster-resistant built environment

In conjunction with the promotion of a disaster-resistant, multiple transportation network and the coordination of a shift towards and high certainty disaster information collection and transition system, the state government will propose to the central government the establishment of a central, extensive disaster prevention hub and the maintenance of a national alternative crisis management function.

Developing human resources of the future

The prefectural government will promote the maintenance of the educational environment in the affected areas and improve mental care for children and disaster prevention education. While utilizing the lessons learned from this earthquake disaster, which also allowed the children to recognize again their relation with others and the society, the state government will further carry out efforts in the prefecture's "education of the will" and promote the development of human resources that will support the development of this country and region.

Building financial resources, systems and cooperative framework to support recovery efforts

The state government may propose to the national government new financial resource measures and the establishment of a "Special Sikkim Recovery Zone" based on the events of the earthquake disaster. Because the affected areas cross over many states with widespread damage, the state government may also establish a collaborative system that goes beyond the borders of the devastated states and local municipalities

Cardinal issues

1. Though the state got first attention in the seismic microzonation more than 6 years back, the implication of the same for risk evaluation have not been tried. The vulnerability aspects of the building stock in Sikkim has not been studied so far.
2. Multi storeyed houses are common in Gangtok as also other urban / proto - urban areas. Limitation of land availability, particularly in urban / proto - urban areas is observed to force people to opt for vertical expansion so as to meet the growing demand. These multi storeyed houses are however observed to be built with scant regard to earthquake safety.
3. Inappropriate drainage measures, particularly in the urban areas including Gangtok is observed to have resulted in slope instability and ground subsidence related problems.
4. Earthquake induced landslides multiplied the problems of the people engaged in relief and rescue works. Surface connectivity with many far flung areas was cut off

due to landslides. Many areas could not even be approached by air due to the bad weather conditions after the earthquake.

5. Due to severe landslides road communication was worst affected and more so with the telecom services. There were many areas that were totally cut off from the State capital Gangtok and relief supplies and workers could not be sent to these areas. It is therefore, required that satellite communication devices be provided to government functionaries at Block / Tehsil level.
6. Helipads in the Chungthang area, which were mostly used for strategic purposes, got severely affected during earthquake. The need for the more helipads and the helicopters was felt during relief and rescue work. The exact coordinates of helipads and other potential emergency landing sites delayed effective response on the aftermath of the earthquake.
7. Even though NDRF team from Gaziabad was quickly flown in to Bagdogra within twelve hours of the earthquake there was lack of coordination with the State authorities and NDRF could reach Gangtok in another 24 hours – **Protocol for emergency services to be streamlined.**
8. Earthquake rendered a number of multi-storeyed building, including tashling Secretariat, Govt. press house, in a very vulnerable state. These buildings are located in densely populated areas and are required to be demolished in view of the threat these pose to neighbouring structures. The State however, does not have adequate know how and technical expertise required for demolishing these unsafe buildings – A company from Hyderabad was hired for the demolition in October 2012. **Though more than 50 buildings were initially identified for demolished, only few of them being dismantled so far.**

Reconstruction plan

Urban and commune infrastructure

- Set up a fund for rebuilding urban, rural, heritage and community infrastructures.
- Support the national authorities and strengthen the institutional framework of the local authorities for rebuilding and maintaining structures.
- Strengthen the role and capability of local community organizations and civil society for reconstructing the community infrastructures.
- Strengthen the capacities of public and private construction companies and recapitalize them for reconstruction, with a view to adapting to new techniques and building regulations.

Housing

- Set up a fund for rebuilding housing.

- Set up a fund for improving safety in order to take account of the risks associated with the locations of vulnerable districts.
- Regulate the land use situation.
- Provide training in construction techniques which take the various risks into account.

Transport

- Assess the sector's needs in human and physical resources and strengthen the capacities of the state functionaries and the capacity of the private sector.
- Re-establish the highway and urban road network to a state equivalent to that prior to the earthquake.
- Take the risks into account in designing and maintaining the transport system.
- Settle the populations in the affected areas other than through basic investments and highly labour-intensive works.

Power

- Complete short-term repair work in order to ensure a minimum of service to the population.
- Increase the degree of coverage of the population and respond to the needs of the development hubs, taking migration and risks into account,
- Update the legal and regulatory framework related to impact of building collapse and demolitions

Telecommunications

- Complete the recovery of the public telecommunications infrastructure.
- Conclude the process of adapting the legal and regulatory framework.
- Train managers and set up EOC facilities for children, young people, and the public administration.

Implementation Strategy (adapted from Gujarat Earthquake Lessons)

The implementation strategy, which harmonizes the emergency nature of reconstruction program with a strong emphasis on community participation and seismic safety measures against mountain settlements. The main elements of the implementation strategy are as follows:

a. *Carry out an in-depth damage assessment:* The Government has to undertake a comprehensive damage assessment of all the houses, public buildings and infrastructure in the earthquake-affected areas. The damage assessment will provide a more accurate account of the rehabilitation needs, and form the basis of a large-scale engineering and building strategy.

b. *Conduct a social impact assessment survey:* The Government has commenced a longitudinal social impact assessment of the earthquake. It will provide a benchmark of vulnerability at the household and community level, and suggest measures, which will help communities to cope with, and recover from the disaster.

c. *Set up a Public-Private partnership:* The Government recognizes the strength of private sector and NGOs in the state in dealing with the enormous challenges of reconstruction. A broad-based partnership with these important institutions of civil society, based on trust and reciprocity, has been an integral feature of the rehabilitation program.

d. *Encourage owner-driven and hazard-resistant construction:* The Government has to actively promote owner-driven construction, with the application of seismic-resistant technology. It will involve communities in the actual process of construction, and instill a sense of security and confidence among them, which is extremely important for their social and psychological recovery. It will also expand the local knowledge base and capacity for implementing a program of this magnitude.

e. *Establish community participation mechanisms and facilitate decision-making at the community level:* The Government has to value the crucial role to be played by formal and informal processes of community participation at the level of villages and urban centers and to encourage these processes, which enable communities to take their decisions regarding reconstruction and development within the broad rehabilitation policy framework and ensure accountability and probity in the implementation.

f. *Disseminate information about the rehabilitation program and people's entitlements:* The Government has to organize an active campaign of information dissemination

regarding different packages of assistance and the peoples' entitlement. It recognizes the importance of community outreach for application of hazard resistant technology in construction and active participation of people in the rehabilitation program. The Government also needs to involve the elected representatives, media, and academia in the rehabilitation program through outreach and education programs.

g. Emphasize social and community development and gender empowerment: The Government has to integrate a strong component of social and community development in the rehabilitation program. It places the reconstruction program right in the context of development and empowerment. It also recognizes the importance of women's participation in the program as a crucial indicator of the peoples' ownership of the program.

h. Constitute the Sikkim State Disaster Management Authority (SSDMA): The Government has to activate the SSDMA, under the chairmanship of Chief Minister, especially for implementing the massive earthquake rehabilitation program. The Vice-chairman for SSDMA must be appointed from strong academic, professional and policy making background.

The main functions of SSDMA:

- To coordinate and implement the reconstruction and rehabilitation program comprising the components of housing, infrastructure, economic and social rehabilitation, and other related programs.
- To become instrumental in the implementation of landslides mitigation measures in coordination with Border Roads Organisation
- To maintain the standards of quality in the program implementation and establish mechanisms of accountability and transparency in the decision-making process.
- To manage and administer the Sikkim Earthquake Rehabilitation and Reconstruction Fund.
- To raise and mobilize resources from external agencies and national sources for the implementation of the reconstruction and rehabilitation program.
- To prepare and implement disaster management plans at the village, district, and state level, and ensure effective coordination with the state agencies and NGOs.
- To support all the programs which relate to disaster risk reduction and mitigation at the individual and community level.
- To support research, training and capacity-building programs in the government and non-government sector in all aspects of disaster preparedness and response
- To become instrumental in the establishment of "Himalayan Institute of Disaster Mitigation and Management" at Gangtok.

Recommendation & Conclusions

The state government must ensure participatory processes in its strategic planning, policy formulation, and project implementation in respect of housing, social and economic rehabilitation. All the members of the community get full opportunity to participate in the Consultative process at the level of community or village and their proposals and plans for housing, social and economic rehabilitation must be reflected in the village rehabilitation plan.

Based on the field survey and consultation workshop organized at NIDM, following recommendations are made:

1. The Sikkim earthquake Rehabilitation and Recovery has to be envisaged through a participatory and inclusive process by involving the professional organizations, such as NBCC, L&T, EPIL, ECC, CBRI, CRRI, IITs, Corporate bodies, such as FICCI, IE(I), ECI and the local community.
2. The interaction and exchange of information among individuals and between experts of disaster prevention and citizens play an important role in disseminating disaster knowledge and fostering individual and collective risk consciousness. Greater efforts should be made to educate and train engineers, architects and masons in earthquake risk management, both with class room and field activities. Education programs about risk that are aimed at children may be more important than those aimed at adults in the effort to foster disaster-resilient communities, because children play a role in educating adults through school-knowledge transfer at home.
3. Acknowledging a state of vulnerability to earthquakes is the first step toward creating a productive public discourse on earthquake risk, fostering a culture of safety capable to reducing people's exposure to risk, and designing a safer built environment suited to local seismic hazard.
4. Majority of the buildings in Gangtok are made of a reinforced concrete frame with hollow clay brick infill. In many such buildings, usually 4 to 6 stories high, the ground floor is devoted to garages, retail shops, or office that have open-plan floors and are thus more vulnerable to soft-story failure. It is recommended that both State and District Disaster Management Authorities be empowered to manage the various issues concerning disaster management.
5. Improvisations on traditional construction techniques with incorporation of modern building construction practices can help reduce earthquake vulnerability of the building stock of the state'
6. Due to the extreme complexity involved in earthquake processes, reliable short-term prediction is not possible at present. Even if such prediction should become possible in near future, large earthquakes ($M > 6$) in densely populated urban areas are likely to cause extensive damage and disruption to society. To minimize the immediate

impact of large earthquakes in such areas, a strategy of taking full advantage of recent advances in seismology, GPS sensor, high speed computer and telemetry technologies for developing rapid and reliable real-time earthquake information systems has to be developed involving all leading organizations of the country.

7. Despite improvements in engineering designs of individual structures, modern urban and suburban areas as a whole are more vulnerable to earthquakes than ever.

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Annexure-I

National Workshop on DOCUMENTATION OF SIKKIM EARTHQUAKE 2011 Day: Thursday; Date: 9 February 2012, Venue: Ground floor Conference Hall, NIDM, New Delhi – 110 002		
9:00 -10:00	Registration	
	Inaugural function	
10:00-10:05	Welcome address- ED-NIDM	
10:05-10:10	About the Workshop- Chandan Ghosh, NIDM	
10:10-10:15	Address by - Arvind Kumar , Principal Secy-Sikkim, Sikkim	
10:15-10:20	Address by - S. Ravishankar , DG, BRO	
10:20-10:40	Address by Chief Guest- H.K. Gupta, Member NDMA	
10:40-10:45	Vote of thanks - Surya Prakash, NIDM	
10:45-11:15	High Tea/coffee break	
11:15-13:00	Session -1: Immediate response	Chair: G. Padmanabhan , UNDP, Rapporteur: Arun Sahdeo ,
(presentation 15 mins/lec)	Lec-1: Documentation framework of Sikkim Earthquake — C. Ghosh , NIDM Lec-2: Immediate response & relief management – A.K. Singh , DC-South Dist., Sikkim Lec-3: Search, rescue and relief measures – J.P. Yadav , NDRF Lec-4: Landslides Debris removal and restoration of traffic – Rajiv Shawney , BRO (GREF), Gangtok	
13:00-14:00	Lunch break	
14:00-15:30	Session – 2: Damage assessment tools and technology	Chair: Shailesh K. Agarwal , BMTPC; Rapporteur: Surya Parkash , NIDM
(presentation 15 mins/lec)	Lec-5: Infrastructure damages and restoration measures in the North Bengal – Keya Mitra , BESU, West Bengal Lec-6: Structural Damage assessment and vulnerable establishments – D.K. Paul , IIT-Roorkee Lec-7: Reconstruction planning and repair/retrofitting strategy – Uday Bhanu Pattanayak , EFNRA Consultants, Delhi Lec-8: Space technology for hazard mapping and damage assessment – P.K. Champathi Ray , IIRS, Dehradun Lec-9: Impacts on Hydel Power Projects in Sikkim – V.K Bahuguna , Teesta Urja Limited	
15:30-15:45	Tea/coffee break	
15:45-17:00	Session -3: Awareness & Psychosocial issues	Chair: Surinder Jaswal , TISS, Mumbai, Co-Chair: Santosh Kumar , NIDM, Rapporteur: Sujata Satapathy
(presentation 15 mins/lec)	Lec-10: Socio-economic and psychological impacts – Mihir Bhatt , AIDMI, Lec-11: School safety and livelihood restoration - Neera Agnimitra , DSW Lec-12: Community response and role of NGOs – Vikrant Mahajan , SPHERE Lec-13: Emergency communication and information protocol– JP Mishra , MHA Lec-14: Role of print media and TV – Karma Paljor , IBNLive.com	
17:10-17:40	Valedictory function	Chief Guest: R.K. Bhandari , Guest of Honour: Rajiv Shawney , BRO Address by session Chairs Salient observation and road map : C. Ghosh ED-NIDM: Concluding remarks Vote of thanks: Prabhakar Rai , Sikkim



GOVERNMENT OF INDIA

National Workshop on
**DOCUMENTATION OF
SIKKIM EARTHQUAKE - 2011**

9 February 2012, NIDM, New Delhi

Organized by



National Institute of Disaster Management
Ministry of Home Affairs, Government of India

CONFERENCE HALL
GROUND FLOOR





















Annexure - 2

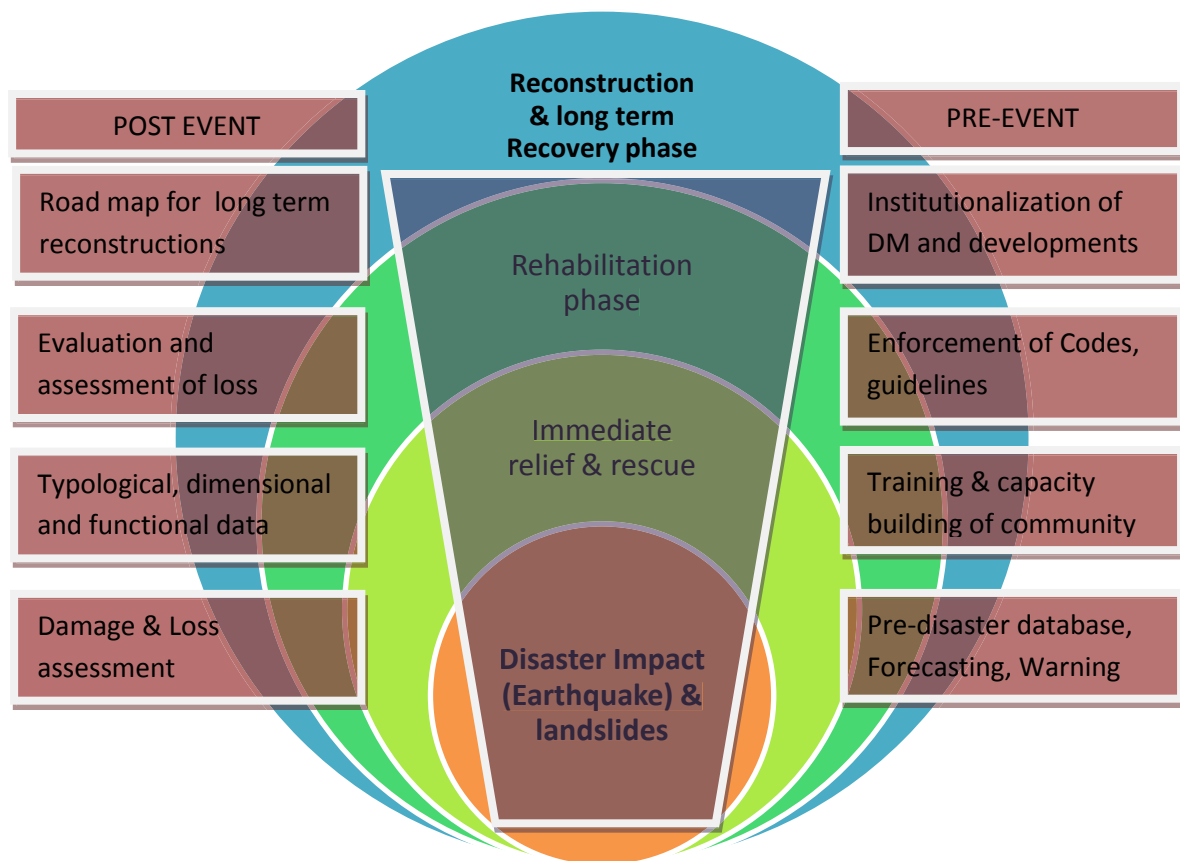
National Workshop on
Documentation of Sikkim Earthquake-2011
NIDM, Gr. Floor conference Hall, 09 February, 2012

S.No.	Name	Phone No.	Email ID
1.	A.K. Singh, DC-South Dist., Sikkim	09434201222	dmndmchi@gmail.com
2.	Abha Mishra, UNDP	9810047742	abha.mishra@undp.org
3.	Ajit Kumar, Radiance Media	9810340311	Ak.radiancemedial@gmail.com
4.	K J Anandha Kumar, NIDM		kjanand@gmail.com
5.	Amir Ali Khan	9810352182	alikhnamir@gmail.com
6.	Anirudha Roy, Navayuga	9999700936	aroy@navayhaga.com
7.	Anshu Sharma, SEEDS, Delhi	9810066976	anshu@seedsindia.org
8.	Arun Sahdeo, Consultant, NIDM	9868277276	arun.sahdeo@gmail.com
9.	Chandan Ghosh, Professor, NIDM	9968668503	cghosh24@gmail.com
10.	D.K. Paul, Professor, IIT-Roorkee	9897065522	dpaulfeq@iitr.ernet.in
11.	Devesh Walia, NEHU	9436163641	deveshwa@gmail.com
12.	Shiv Dutt Sharma, ICE	09810632054	shivdutt_sharma@rediffmail.com
13.	G. C. Khanal, Sikkim	09434137226	kanalgc@gmail.com khanalgc@yahoo.co.in
14.	Santosh Kumar, Professor, NIDM		profsantosh@gmail.com
15.	Hari Kumar, GHI	9810600821	hari@geohaz.org
16.	J.P. Yadav, Commandant, NDRF,	9968610011	Jpyadav1960@yahoo.com
17.	Jagbir Singh, Professor, DCRUST	9868772233	drjagbirs@gmail.com
18.	Karma Paljor, CNN-IBN.Live	9810405614	karma.paljor@network18online.com
19.	Keya Mitra, Professor, BESU, WB	9831766596	keyamitra@gmail.com
20.	Kishor Kumar, Scientist, CRRI	9811211512	kishorhrm@gmail.com
21.	M.K. Singh	9968300976	singhmrigendra@gmail.com
22.	Neera Agnimitra, DSW, DU	9810460055	neeraagnimitra@gmail.com
23.	Col P.K Pathak, Consultant, NIDM	9868915760	Prabod_Pathak@yahoo.co.in

Annexure - 2

24.	P.K. Champathi Ray, IIRS, Dehradun	9412057327	champati_rag@iirs.gov.in
25.	Parveen Choudhary, DDMA	9310749504	praveenchowdhary@rediffmail.com
26.	Pawan Kumar, TCPO New Delhi- 110002	09013006261	pawan612@gmail.com
27.	Prabhakar Rai, Sikkim	09434179141	rai.praksis@gmail.com
28.	R.K. Bhandari, Former Director, CBRI	09810345123	raymee@yahoo.com
29.	Rajiv Shawney, Chief Er., BRO	09434713601	sawharajiv@gmail.com
30.	S.K. Dua, DDMA	09811033928	suresh_july@hotmail.com
31.	Surinder Jaswal, Prof. and Dean, TISS	09819172668	suriyas@tiss.edu
32.	V.K. Sharma, Professor, IIPA	9818961977	profvinod@gmail.com
33.	Varun Joshi, IP University	9971122817	varunj632yahoo.com
34.	P. K. H. Singh, BRO	09434051272	praveenvashmi2003@yahoo.com
35.	Surya Parkash, NIDM		suryanidm@gmail.com
36.	R. S. Dattatrayam, IMD	9868109671 011-4611305	dattatrayam_rs@hotmail.com
37.	R. Kancharla	9818792326	r.kancharla@savethecludreu.in
38.	Amit Bose, DDF Consultants	9810582710	amitkbose@sify.com
39.	Pratima R. Bose, DTU	9818225427	prbose@sify.com
40.	J. P. Mishra, Director, MHA, DM	011-24622543	Dirdm4@ndma@nic.in
41.	J. N. Singh, Awake India Foundation	09013861868	awakeindia@rediffmail.com
42.	Capt MB Aserker (IAF)	9560611536	mahesh_aser@yahoo.com
43.	V.K. Bahuguna, Teesta Urja Ltd.		
44.	Uday Bhanu Pattanayak, EFNRA Consultants		
45.	Vikrant Mahajan, SPHERE		
46.	G. Padmanabhan, UNDP		
47.	H.K. Gupta, Member, NDMA		
48.	Shailesh K Agarwal, ED-BMTPC		
49.	J.P. Yadav, NDRF		
50.	Mihir Bhatt, AIDMI, Ahmedabad		
51.	S. Ravishankar, DG, BRO		
52.	Sujata Satapathy, NIDM		

Sikkim Earthquake 2011 – Reconstruction Strategy



Post-Earthquake Measures

- Overall economic loss and funding reqd. for reconstruction
- Risk transfer and Risk Financing
- Institutionalization of Response and Recovery
- Impact on the development prospects and building-back-better
- Prevention and emergency management
- Impacts on physical, socio-cultural, psychological, environmental aspects
- Vulnerability assessment and demonstration of pilot projects in earthquake and landslides mitigation