NECESSITY OF DISASTER MAPPING UNIT IN SURVEY DEPARTMENT: THE CONTEXT OF 2015 GORKHA EARTHQUAKE AND DISASTERS IN NEPAL

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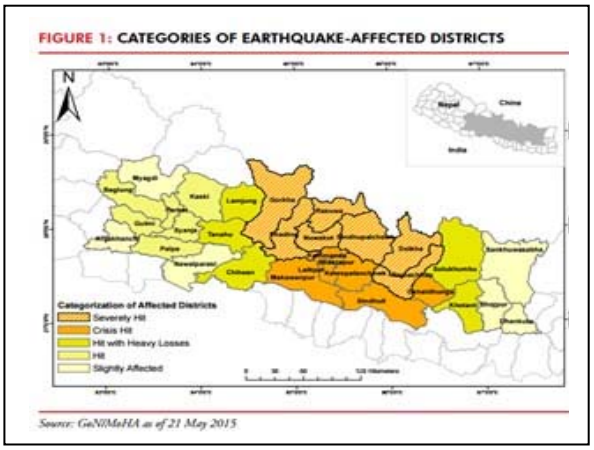
1 BACKGROUND

Last year Nepal witnessed deadly earthquake disaster on 25th April 2015. This severe earthquake measured 7.6ML with epicenter in Barpak, Gorkha district is the largest since the 1934 big earthquake, killed about 9000, other tens of thousands injured and become homeless, destroyed housing in Kathmandu and other 13 districts, damaged many World Heritage sites, and triggered deadly avalanches around the Mount Everest. 17 days later on 12th May another big earthquake of magnitude 6.8ML with epicenter in Dolakha district escalated the casualties and destruction. The highest number of fatalities have been reported from Sindhupalchowk followed by Kathmandu and Nuwakot districts. Thirty-one of the country's 75 districts have been affected, out of which 14 were declared 'crisis-hit' (see Figure 1) for the purpose of prioritizing rescue



and relief operations; another 17 neighbouring districts are partially affected. Nepal is particularly prone to earthquakes as it is sitting on the boundary of two massive tectonic plates – the Indo-Australian and Asian plates. Due to the collision and the ongoing convergence between the Indo-Australian and Asian tectonic plates that has progressively built the Himalayas over the last 50 million years.

Disasters occur almost every year in one part of the country or the other causing loss of life and heavy damage to physical properties. The earthquake of 2015, 1988, 1980, 1934 and the flood of Sunkoshi in 2014 in Sindhupalchowk the Mahakali river flood in Darchula in 2013, the flood of Koshi River 2008 July, were the most devastating disasters of Nepal. In this way, the country has been found to be a disaster prone country. Each year flood, landslide, fire, epidemic, avalanche and various other natural and manmade disasters cause the casualty of thousands of human lives and destruction of physical properties worth billions of rupees. The Figure 2 shows Nepal's disaster ranking in Global perspective.

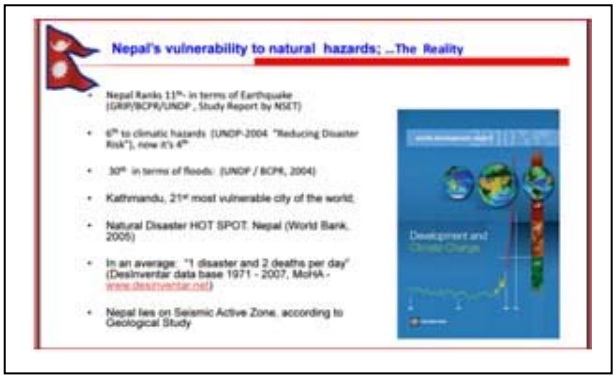


Figure 2: Nepal's disaster ranking in Global perspective

2 DISPLACEMENT OF EARTH SURFACE

Beside the damage to buildings and infrastructure, the altitude of the Kathmandu Valley has been elevated following the April 25 earthquake. Survey Department's study from 24-hour GPS survey over five control points on hills surrounding the Kathmandu valley four days after the devastating quake revealed horizontal displacements of 0.92m to 1.82m south west and elevated the surface by 0.63m to 1.16m. Even after this study, hundreds of aftershocks have been continuing. More than 425.aftershocks greater than 4 magnitudes have been recorded till the time of writing this article. So, this study doesn't reveal the complete picture of displacement. The positions of Nepal National Geodetic network is supposed to have been suffered greatly from this earthquake. A complete

revival of the network is a must. Survey Department, therefore, is facing a serious challenge to publish a new set of recalculated Post- earthquake coordinates of National Geodetic network.

Figure 3

S. No.	Station	Horizontal Shift	Vertical Shift
1	Nagarkot	1.82m Southwest	1.158m up
2	Phulchoki	0.92m Southwest	0.63m up
3	Bungmati	0.99m South	0.77m up
4	Swayambhu	1.64m Southwest	0.98m up
5	Kumari (Nuwakot)	1.71m Southwest	1.093m up

3 DISASTER RISKS IN NEPAL

Nepal is becoming a disaster hotspot, with natural hazards increasing over the past two decades. Flood, earthquakes, landslides and debris flows, epidemics, fires, droughts, storms, glacial lake outbursts, avalanches, hot and cold waves etc are among the disasters gripping the Himalayan nation with increasing intensity.

This earthquake and its continuing aftershocks are the results due to tectonic action and universal planetary action. Such activities are pronounced in the Himalayan region. The constant tectonic action of different degree has adverse effect on stability of earth surface and river course.

More than 800 people die annually in Nepal because of natural hazards (with almost 1 disaster 2 people deaths per day in average), 300 deaths due to floods and landslides alone, the UNDP report,2004 stated. According to the Report, Nepal ranks fourth in the world among climatic hazards, eleventh in terms of earthquake and thirtieth in terms of flood. It is increasingly recognized worldwide that the devastating effects of natural disasters is linked to shortcomings of development policies.

4 DISASTER PREPAREDNESS AND RISK MANAGEMENT IN NEPAL

The History of Disaster Risk Mitigation in Nepal is relatively short compared to the rest of the world. Only after 80's the people as well as the government have been aware of the potential risk and have been active in disaster risk mitigation. The Udaypur earthquake of 1988 was a major awakening for the country as well as for the people. The Government of Nepal declared 16 January as the National Earthquake Safety Day (ESD). Since then various projects were implemented and workshops organized to raise the awareness of the disaster risk in Nepal.

Since the realization of the effects of earthquake disasters on the population, various programs have been launched with considerable success for Peopleawareness. For these reasons, Nepal is boosting its disaster-preparedness activities between the government and aid agencies. In spite of some such activities, greater challenges remain. Aid workers focus concentrate on post-disaster response preparedness rather than pre-hazard situations. The preparedness had to be strengthened on a par with the frequency of the disasters intensifying every year.

5 EXISTING LEGAL AND INSTITUTIONAL SYSTEMS

The legal framework for disaster management started in Nepal with the Natural Disaster (Relief) Act promulgated in 1982. This Act allocated the responsibility for preparing and responding to disasters in Nepal to the Government. The Act, for the first time in history of Nepal, provided for a disaster management administrative structure in the country. The Act recognizes earthquake, fire, storm, flood, landslide, heavy rainfall, drought, famine and epidemics as disaster. Immediate rescue and relief works as well as disaster preparedness mitigation activities are governed by the Natural Disaster Relief Act 1982 of the Government of Nepal.

According to this Act, GON has Central Disaster Relief Committee (CDRC) in Ministry of Home under the chairmanship of the Home Minister in order to formulate and implement the policies and programs relating to the natural disaster relief work and to undertake other necessary measures thereof. Moreover, the Central Committee prepares specific norms of relief assistance to be provided to the disaster victims through the District Disaster Relief Committees. Figure 4 shows the current institutional arrangement.

Disaster Management has assumed great importance in recent times. The government has been doing a lot in disaster relief operations but now there is a need to focus also on pre-disaster and mitigation efforts. To handle the situation efficiently, we need to be well-

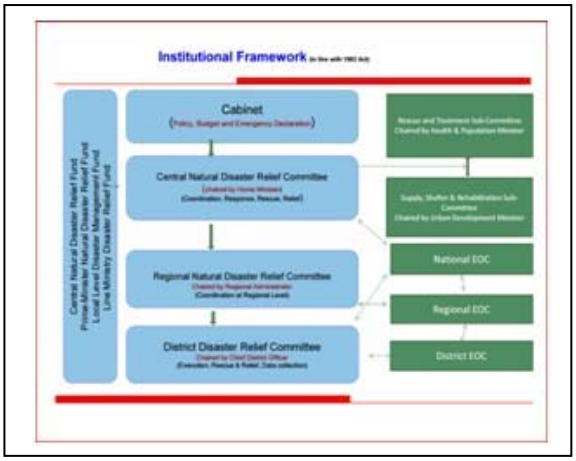


Figure 4: Institutional Framework

equipped with latest technologies for early warning system. It is unfortunate that disaster early-warning systems, except for weather forecasting, are not yet developed in Nepal to mitigate its impacts.

For an effective early warning system, it is needed to develop a scientific detection system to monitor changes in the physical environment. The system of hazard mapping, vulnerability assessment and risk analysis has to be developed.

There are basically three phases in Disaster Management:

- Pre-disaster planning and preparedness phase for Risk Reduction by Prediction and early warning,
- Post-Disaster Risk Reduction (DRR) Phase and
- Damage assessment and relief management Phase.

6 DISASTER RISK REDUCTION (DRR)

Disaster risk reduction (DRR) is a broad term that covers preventative measures to reduce the damage caused by natural hazards. Survey Department must be aware of the fact that the inability to access baseline data about the city and lack of capacity to handle a variety of new data hampers humanitarian response efforts. The creation of timely, accessible, geographic data is a critical need to establish evidenced-based DRR policies and programs.

Disaster Risk Reduction has major 5 modules, namely

- **Understanding disaster risks** - Providing a platform for seamless viewing of hazard maps. Disaster Managers could generate maps both at micro and macro level indicating vulnerability to different extents under different threat perceptions.
- **Understanding disaster impacts** - Comparison of Air Photos/satellite pictures taken before and after the Disaster. Locations remained unaffected or remain comparatively safe could be identified.
- **Assisting immediate responses** - Keeping maps up-to-date. Alternate routes to shelters, camps, and important locations in the event of disruption of normal surface communication could be worked out. Rescue workers from remote areas rely on maps in the planning of their operations. If maps don't show latest features, their smooth rescue work and evacuation operations might be significantly hampered.
- **Assisting information sharing** - Platform for Real-time Data Sharing. Locations suitable for construction of shelters, godowns, housing colonies, etc. can be scientifically identified.
- **Assisting recovery from disaster** - New mapping of the damaged areas initiates the recovery from disaster. Rehabilitation and post-disaster reconstruction works could be properly organized.

7 EXISTING TECHNICAL CAPACITIES

Nepal has a National Comprehensive Plan on Disaster Management. This plan emphasizes on improvement of national capacity for disaster management and institutional structures. This plan focuses on hazard mapping, risk assessment, vulnerability analysis and so on.

Nepal has a significant cadre of scientists, engineers, and professionals of allied disciplines, have conducted mapping of a variety of natural hazards at suitable scales, and have installed physical capacities for monitoring, analysis, and dissemination of user-friendly information to the public. Some representative examples of such capacities are:-

Department of Mines and Geology has Geological maps of entire country at 1:50,000 scale, Engineering geological maps at 1:10,000 scale for several cities, a network of 21 seismic stations capable for monitoring up to Magnitude 2 Richter earthquake,

Department of Hydrology and meteorology has countrywide hydro-meteorological stations, weather

monitoring tracking, analysis, forecast, and dissemination of information for public use.

Similarly, Department of Water Induced Disaster Prevention Technical Centre (DPTC), Department of Urban Development and Building Construction (DUDBC), Department ofSoil Conservation (DOSC) and The Department of Roads (DOR) have capacities of related manpower and research labs with concerned data.

8 ROLE OF SURVEY DEPARTMENT IN DISASTER MANAGEMENT ISSUES

Department of Survey has done mapping of the country at 1:25,000 and 1:50,000 scales, digital maps of VDCs, municipalities, aerial photographs at various scale, real-time operation of continuous GPS stations, access to latest satellite mapping and interpretation capacity.

Being a National Mapping Agency and a major constituent of the geospatial community, Survey Department should take the lead in applying geospatial information technology in disaster risk reduction. Geospatial information plays a key role in disaster risk reduction (DRR). Policy makers should have better understanding of the importance of geospatial information.

But disappointingly, the role of Survey Department, which is responsible for spatial information, is ignored in the Natural Calamity Act. Hence, Survey Department, has no official representation in this CNDRC. There is a strong link between natural hazards and environment as the hazards, especially those leading to disasters, are normally caused by sudden or systematic changes in the state of inner and outer earth's surface. Geodetic Survey Branch, Topographical Survey Branch and National Geographical Information Infrastructure Project (NGIIP) under Survey Department have archived GeoInformatics: Global Positioning Systems (GPS), Geographic Information Systems (GIS), Remote Sensing (RS) data. The employment of such data in Geomatic engineering technologies could greatly contribute to the decision support system for the effective Disaster Management. Negligence of such knowledge and practices make the Nepalese Disaster Management system poor and vulnerable.

Even though Survey Department is not given a mandate by Natural Disaster Relief Act, Survey Department had, with a profound filling of responsibility to the nation, provided Topographical maps of affected areas of 17 districts free of costs promptly to the rescue teams for planning rescue works during the 2015 earthquake. The data includes transportation, hydrography, VDC boundary and Place names. The department published useful Geoinformation and Post-Disaster web maps for free download in its website to facilitate rescue teams. Survey Department had also published an interactive web map in its website http://old.ngiip.gov.np/EARTHQUAKE2072/Earthquake.html with regular updated number of deaths and injured, number of damaged houses etc among other information.

An International Workshop on "Role of Land Professionals and SDI in Disaster Risk Reduction: In Context of Post 2015 Nepal Earthquake" was held, November 25-27, as a Joint Event of FIG Commission 2: Professional Education and ISPRS Technical Commission in collaboration with Nepal Institution of Chartered Surveyor and Nepal Remote Sensing and Photogrammetric Society with support from Survey Department. The workshop offered an excellent program covered the various aspects of spatial technologies and the role of spatial data infrastructure in the context of disaster risk reduction.

In view of the above situation, the amendment of the Natural Disaster Relief Act, 1982 is must to include related organizations like Survey Department and mandating (the role, functions, duties and responsibilities) of all the disaster management-related jobs should be re-specified. For lack of mutual understanding and dialogue between the agencies, duplication of work and delays in rescue and relief work have been experienced in the past. There is a need for close co-operation and mutual understanding among all the agencies concerned.

Since the role of mapping remain very critical for all stages of the disaster management cycle: prevention, mitigation, preparedness, response and recovery, Survey Department should expand the field of mapping and geo-spatial information production and proper use of these information for the disaster management. Survey Department should undertake the task of geo-spatial data generation (especially on the basis of satellite images), map making and contribute to evaluation of the disaster risks, reduction or mitigation of disasters by providing information of the land movements to various government/non-government organizations especially devoted to the field of disaster

management. Efforts of Survey Department alone may not be sufficient to generate required geo-spatial data and information required for disaster management. Survey Department should explore the possibilities of working with different national, regional and international partners working in the field of geospatial data and information for disaster management. The major roles to be played by Survey Department can be envisaged as follows:

8.1 Revival of National Geodetic Network and datum

National Geodetic Network and datum is a foundation of all kinds of mapping. So deformed Network should be adjusted. As Nepal lies on most active seismic zone, the crustal deformations caused by plate subduction will more or less always continue. Nepal cannot afford much time and money for every time revision of network by repeated field observations to all the control points. Recent earthquakes in Nepal has pushed Survey Department to develop a dynamic/semi-dynamic datum which will be based on the most current available ITRF and have the capacity to correct for tectonic deformation similar to that of Japan and New Zealand.

8.2 Providing Geospatial Information

National Mapping Agencies (NMAs) have been a sole provider of official or authoritative geospatial information in their countries. Survey Department, as NMA of Nepal should improve its mission by actively contributing to the disaster risk reduction through the applications of geospatial information technologies and the cooperation with relevant disaster management offices in the government. Disaster preparedness and rehabilitation works are humanitarian efforts to mitigate and rescue the affected people. Survey Department should take necessary actions to develop a policy to avail baseline geo-spatial data to the concerned organizations free of cost.

8.3 Developing Topographic Information

Mapping has become an integral part of a modern decision support system. Remote sensing and GIS provides a data base from which the evidence left behind by disaster that have occurred before can be interpreted, and combine with the other information to arrive at hazard maps, To make people's lives safer, SD should support disaster management by providing precise geospatial information about the natural characteristics of land to make more accurate evaluations of disaster risks.

8.4 Hazard Map Portal Site

SD should manage a one-stop service portal site, through NGII, which allows users to search and browse various hazard maps prepared by various agencies.

9 CONCLUSION

In light of the growing applications of geospatial information in disasters, the role of National Mapping Agency is becoming increasingly important in providing relevant and timely data in the right format to users. The importance of geospatial information technology at every phase of disaster cycle, enabling decision makers to prepare for and respond to disasters in a timely manner as well as assisting individuals in understanding potential risks and taking prompt actions in case of disasters must be recognized. Survey Department of Nepal, being a national mapping agency, should setup a disaster mapping unit for the sake of enhancing country's disaster mitigation efforts. It could work as a coordinating agency for various other institutions dealing with various types of disasters in the country so as to produce disaster hazard maps. Investment towards making use of the space technology is worth because improvement in instrumentation and time prediction will bring about reduction in disaster damages; and subsequently improved decision making in planning stages.

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