

The Role of Mapping in Disaster Management

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Abstract

Every year Nepal suffers from many kinds of disasters such as floods and landslides. In recent years, the increasing numbers of natural disasters in Asia like Tsunami and series of South Asian quakes are a matter of serious concern to us. At this crucial period, we should be conscious about our status of disaster management situation in Nepal. What will happen if a strong earthquake or any other natural disaster strikes Nepal, particularly in the capital city of Kathmandu? Though we cannot avoid disaster, but by implementing the effective prevention schemes, we can reduce damages from severity, if sufficient information for disaster forecasting is given timely. This paper attempts to evaluate the critical role of mapping for all stages of the disaster management cycle: prevention, mitigation, preparedness, response and recovery.

Introduction

Disaster is a sudden and accidental event that causes many deaths and injuries. Most disasters result in significant property damages. Common natural causes of disasters include earthquakes, floods, landslides, hurricanes, and tornadoes. Volcanic eruptions, fires, and avalanches rank among the other natural forces that sometimes create disasters.

Not all disasters are produced by the forces of nature. Many modern-day disasters involve accidents aboard passenger-carrying airplanes, ships, or railroads. Other "man-made" disasters can be traced to the collapse of buildings, bridges, tunnels, and mines, as well as to explosions and fires triggered by humans. War and terrorist events, which also cause death and destruction, are intentional rather than accidental, and therefore are not considered disasters.

In recent years, the increasing number of natural disasters in Asia that include Tsunami and series of South Asian quakes are a matter of serious concern to us. At this crucial stage, it is useful to make aware our status of Disaster Management situation in Nepal. What will happen if such a

strong earthquake or any other natural disaster hits Nepal, particularly in the capital city of Kathmandu? Hundreds of thousands of people will be buried and yet other thousands and thousands of people will be killed because of poor post-Disaster Management. Country will face severe panics of road blockade, failure of water supply system, medical services and food supply failure and eventually upsurging epidemic so on.

Disasters in Nepal

Natural disaster is common in Nepal. The country is geologically young and still evolving. Therefore landslides and earthquakes are common and frequent. Given its mountainous topography and the fact that the country comes under the spell of the monsoon every summer, flash floods, regular floods and flood- and earthquake-triggered landslides are also quite common.

Tectonic-induced disasters (Earthquake disaster) could be most catastrophic. The earthquake of 1934, 1980, and 1988 were the most devastating natural disasters, which not only caused heavy losses of human lives and physical properties but also adversely affected the development process of the country as a whole. A massive earthquake registered 7.9 on the Richter scale struck Nepal in Jan 1934. Thousands of peoples were killed and hundreds of thousands were left homeless. A powerful earthquake is said to strike Nepal every 80 to 100 years. As Nepal falls in most vulnerable seismic zone, geologists have warned that a major earthquake may strike at any time.

Water-induced disasters, e.g. Flood, Landslides etc. are most common natural disasters in Nepal. Besides, heavy precipitation, high wetness and steepness of watersheds contribute to flood magnitudes. Mainly, the middle hills are prone to landslides and the Tarai to flood and fire. Thus, flood, landslide and fire are the most frequent natural disasters in Nepal. These disasters occur almost every year in one part of the country or the other causing loss of life and heavy damage to physical properties. In July 1993,

Nepal experienced the worst recorded natural disaster in history due to two days of torrential rainfall in central Nepal. More than 1300 lives lost and over millions of property and infrastructure were destroyed.

Apart from that, the region is also quite vulnerable to disastrous hazards due to glacial lake outburst floods. Since a few years, Tsho - Rolpa Glacial Lake has been a burning issue and becoming potentially dangerous. Among the 2323 glacial lakes of Nepal, 20 glacial lakes are identified as potentially dangerous. A monitoring system for lakes with outburst risk should be established to avoid flood hazards.

It is a great challenge to the nation to protect infrastructure and property from frequent landslide and floods. Each year flood, landslide, fire, epidemic, avalanche and various other natural and man made disasters cause the casualty of thousands of human lives and destruction of physical properties worth billions of rupees.

Disaster Management in Nepal

Immediate rescue and relief works as well as disaster preparedness mitigation activities are governed by the Natural Disaster Relief Act 1982 of His Majesty's Government of Nepal. The Natural Disaster and Floods Division of the Ministry of Home Affairs is the central unit responsible for managing/coordinating emergency response.

Disaster mitigation efforts of the government so far are confined to rescue operation and post-disaster recovery. In the absence of information about the nature of flood events, exposure of life and properties and capabilities to cope with disasters, it is difficult to prepare and implement pre-disaster activities. Lack of information is a major constraint in implementing and coordinating the rescue and post-disaster management activities effectively.

So far there are no established guidelines in Nepal that facilitates policy and program development in disaster reduction and efficient response. The efficient exchange mechanism of relevant information to establish a central database is the most important factor to be encouraged. There is an urgent need to prepare a consolidated Natural Disaster Management Policy. There are still several fundamental unanswered questions before us. How to do? When to do? Who will do?

Role of mapping

Maps have been used for centuries as tools for providing detail information about the area concerned. The remarkable developments in computer technology, space technology and GIS applications in mapping during the recent decades have enhanced the design, quality and utility of maps. Subsequently these developments provided important tools for change analysis, programming and monitoring for results and impacts, and policy making agencies to address issues related to sustainable development more effectively. The results obtained through the use of satellite data have stimulated major environmental policy decisions around the world.

Maps are essential at all stages of the disaster management cycle: prevention, mitigation, preparedness, response and recovery. It is important to undertake a range of activities such as: risk assessment; scenario analysis or analysis of consequences; forecast and projection; dissemination of information; allocation of personnel, equipment and other resources; reaching relief personnel at various affected areas; damage assessment and so on. Maps play a critical role in all these activities. The role of mapping for disaster management can be analyzed with reference to the following phases:

Hazard assessment and vulnerability analysis

Hazard assessment and vulnerability analysis are fundamental to disaster management planning. It is necessary to identify geographical areas that are likely to be affected by hazards such as earthquakes, landslides and floods. Vulnerable and risky areas in the context of various types of disasters need to be identified and mapped with a view to planning of prevention, mitigation and emergency response measures. If we had geographical information systems, which link maps with database, it would be possible to have simulation models that can be useful at various stages. With the help of GIS, one can analyze disasters over time and space.

Mitigation and preparedness

Though we cannot avoid disaster, but by implementing effective prevention plans, its impact can be reduced through a proper disaster management, including disaster prevention (hazard and risk assessment, land use planning and legislation, building codes), disaster preparedness (forecasts, warning, prediction) and rapid & adequate disaster relief.

Mitigation measures will have to be taken in areas that are more prone to hazards like earthquake, cyclone, flood and drought. Maps and GIS can facilitate such activities. With the help of GIS, one can have a dynamic system of mapping. In other words, maps can be updated as soon as the linked database is updated. Based on the above analysis mitigation and preparedness activities can be planned.

Pre-disaster phase

During the pre-disaster phase (the period after a warning or an early warning of a disaster and before the actual occurrence of a disaster), scenarios can be analyzed and response measures can be planned with the help of maps and GIS. Evacuation routes can be planned and displayed for use by emergency managers. We take an example of a system of early warning of a flood. During the monsoon season, the rainfall situation is monitored closely. With the help of maps and GIS, it is possible to have a detailed assessment of areas with excess, normal and deficient rainfall.

Loss and damage assessment

The role of maps in loss and damage assessment does not need any emphasis. In the event of a disaster, the assessment of damage may have to be done in phases. Immediately after the disaster, questions are asked regarding the number of deaths, the number of injured persons, loss of property etc. With the help of GIS one can have broad and quick estimates of area, population and the vital installations affected. At a later stage when a detailed survey and damage assessment are carried out, the consistency and reliability of the data can be checked with the help of GIS based analysis.

Rehabilitation and reconstruction

Mapping is essential even during relief, rehabilitation and recovery phases after a disaster. In the event of a major disaster affecting vast areas and a large population, it is necessary to plan relief and rehabilitation activities with the help of maps. The task becomes easier and more systematic if maps are linked to database.

Roles of Remote Sensing and GIS as a Natural Hazard Management Tool

A complete strategy for disaster management is required to effectively reduce the impact of disaster, which is referred to as disaster management cycle. Disaster

management consists of two phases that takes place before disaster occurs, disaster prevention and disaster preparedness, a three phases that happens after the occurrence of a disaster i.e. disaster Estimation, relief, rehabilitation and reconstruction.

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, indicating which area is potentially dangerous. Using remote sensing data, such as satellite imageries and aerial photos, allows us to map the variabilities of terrain properties, such as vegetation, water, geology, both in space and time. Satellite images give a synoptic overview and provide very useful environmental information, for a wide range of scales.

Dynamic use of **GIS** integrated with **RS** provides useful measures towards disaster preparedness and to provide warning for the people to take initiative to evacuate people to the safe places in time and also planning for operational activities, immediately before, during and after disaster.

Finally, the impact of the disaster event leaves behind an area of immense devastation. Remote Sensing can assists in damage assessment monitoring, providing a quantitative base for relief operation. After that it can be used to map the new situation and update the database used for the reconstruction of an area. It can help to prevent the occurrence of such disasters again in future.

The multidisciplinary approach of the study is fully benefited by application of remote sensing and GIS techniques combined with field studies. The current scenario of Base map and related records in disaster management is as follows:

Base Map Preparation

Survey Department of Nepal has already prepared the topographical base maps covering the entire country. The scale of the maps for mountainous and tarai area is 1:25,000 and the map scale for Himalayan region is 1:50,000. Survey Department has also prepared a set of digital topographical data base from the topographical base maps. The department has also initiated updating of topographical maps with the help of satellite images.

Hazard Mapping

Hazard map and disaster data play an important role to predict and foresee the possible trends of likely disasters. So, hazard map and reliable data is the need of the day. The lack of meteorological and hydrological records in the country makes accurate projection of possible flood damage beyond our target.

However, recognition of the past damages and potential hazards are one of the key elements to be studied. The primary stage is to plot out the exact location and degrees of damages in the previous major disasters are to be recorded through interviews and field surveys. This information will enable us to suggest particular locations, and human activities of significant vulnerability, which are to be mapped and shared by the residents and researchers as a basis of discussion and learning toward strengthened protection of life and assets.

Nodal Point for Disaster Management

Survey Department is a member of Asia Pacific Regional Space Agency Forum (APRSAF). In 1995, APRSAF appointed the Survey Department as a nodal point for disaster management for Nepal. In this connection, Geoinformatics Center of Asian Institute of Technology (AIT), Thailand provided trainings to Staffs of Survey Department with the sponsor from Japanese Aerospace Exploration Agency (JAXA). The trainings so far provided are on study of Change in Urban Land use, Flood Disaster Mitigation and Earthquake Disaster Mitigation.

Concluding remarks

Persistent occurrences of earthquakes, floods, landslides and forest fires need to be studied using today's advanced technology to find effective preventive measures. Being a resource-poor country, Nepal faces a gigantic managerial task to provide adequate support to the natural disaster victims.

Nepal lacks organized data collection network, even though several governmental as well as non-governmental International agencies have been providing support for disaster victims from time to time. Despite all these provisions and assistance, there are many challenges for an effective disaster management system - such as system of hazard mapping, vulnerability assessment, risks analysis, low-level of public awareness, lack of cooperation and coordination, poor system of data collection and dissemination, remote and inaccessible topography.

There are no institutions that deal with hazard mapping for serious natural disaster threats in Nepal. Survey Department of Nepal, being a national mapping agency, should kick-off a disaster mapping unit to optimal utilization of its resources 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 improved decision making in planning stages.

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