The Role of NGII in Disaster Management and Mitigation Program

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Abstract

Disaster is a sudden, accidental event that causes many deaths and injuries. Spatial data and related technologies such as Geographical Information System (GIS), Global Positioning System (GPS), remote sensing, have proven to be crucial for disaster management in such a way that without spatial data, one can not expect effective and efficient disaster management Although spatial data can facilitate disaster management, there are substantial problems with collection, access, dissemination and usage of required spatial data for disaster management. If each of the involved organizations in disaster management community collects some part of required spatial data for disaster response during their everyday business and emergency situation, required spatial data will be available to all participants.

Sharing information between involved parties in order to facilitate coordinated disaster response operations is another challenge in disaster management. This includes the development of a prototype web-based system which can facilitate sharing, access and use of data in disaster management and especially disaster response. Geospatial data are the initial input for GIS and Emergency Response Modeling and Simulation Systems. In an emergency situation, different organizations become involved in disaster response.

Survey Department, along with several other departments of Government of Nepal, jointly conducted several studies related to different types of disasters and their impacts. Survey Department has taken a lead in the creation of a National Geographic Information Infrastructure (NGII) in Nepal to share Geographic information. The mission of the programme is to strengthen planning and resources management through the development of geographic information infrastructure for the access of Geographic and attribute data for planning and decision making. Access to metadata information for all available geographic and related data could only assist in such initiatives.

Introduction

Disaster, a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources (ISDR, 2003)

Most disasters also result in significant property damage. Common natural causes of disasters include earthquakes, floods, hurricanes and typhoons, and tornadoes. Tsunamis (known as tidal waves), volcanic eruptions, wildfires, and landslides 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 unintentionally triggered by humans.

Disasters interrupt the societies by claiming lives, creating victims, and destroying infrastructures and houses. By striking disasters, funds and budgets that have been assigned for development purposes are diverted to responding to disaster and recovering the quality of life to its normal. Disasters have also negative impacts on environment as they affect natural resources. Basic concept of GDI is "Information should not only exist" rather users should know about its existence, usefulness, and way to access it. Without spatial data, one can not expect effective and efficient disaster management.

With this in mind, appropriate management on disasters can contribute to reducing its negative impacts on development activities. With other talk by facilitating disaster management, achievement of sustainable development can be facilitated for nations and societies. It has already been proven that spatial data can considerably facilitate disaster management because most of the required information for disaster management has spatial nature

It is suggested that Geospatial Data Infrastructure (GDI) as an initiative in spatial data management can be an appropriate framework and a web-based system can be an appropriate tool for resolving current problems with spatial data. In other words, using GDI as a framework and a web-based system as a tool disaster management can be facilitated which contributes to facilitating achievement of sustainable development.

Resolving the problem with data for Disaster Management

Different organizations (such as Fire, Medical and police departments; Red Cross Society; and Utility Companies) collaborate in disaster management activities due to diversity of disaster response operations. Inter-organizational coordination of disaster response operations and controlling the emergency situation is generally conducted through Emergency Operation Center (EOC) where the representatives of involved organizations are gathered. Due to dynamic nature of emergency situation, required data for disaster response should be collected regularly in order to be available for decision-makers. This is achieved through partnership and collaboration between organizations in production and updating spatial datasets. If each of the involved organizations in disaster management community collects some part of required spatial data for disaster response during their everyday business and emergency situation, required spatial data will be available to all participants (Mansourian et al, 2004 and Rajabifard et al 2004). The required datasets should also be accessible for decision-makers (involved organizations and EOC) to be utilized for planning and decision-making purposes. This is achieved if collected data by each of the participants in data collection to be shared to wider disaster management community.

In addition, the required datasets need to be easily integratable with each other and interoperable with decision-makers' systems for real-time use. This is achieved by utilization of appropriate standards and specifications for data collection and sharing.

The NGII concepts seeks to support the sharing and optimal use of data in the national context by means of a set of standards, such as national spatial reference system, a national topographic template, a national elevation model, other standardized spatial data set of national scope like geographical names, administrative boundaries, etc and certain thematic data sets like soils, hydrology, vegetation, population, etc and metadata standards, to describe in a consistent way each of the NGII holdings. A GDI is therefore encompasses the networked geospatial databases and data handling facilities, the complex institutional, organizational, technological, human and economic resources that interact with one another and underpin the design, implementation facilitating the sharing, access to, and responsible use of geospatial data at an affordable cost. With this in mind, Geospatial Data Infrastructure (GDI) can be used as an appropriate framework that facilitates the availability, access and usage of spatial data for disaster management. The role of spatial information and related technologies in disaster management has been well-known worldwide. One of the challenges concerned with such a role is access to and usage of reliable, accurate and up-to-date spatial information for disaster management. This is a very important aspect to disaster response as timely, up-to-date and accurate spatial information describing the current situation is paramount to successfully responding to an emergency. This includes information about available resources, access to roads and damaged areas, required resources, required responding operations, etc., and should be available and accessible for use in a short period of time. Sharing information between involved parties in order to facilitate coordinated disaster response operations is another challenge in disaster management.

Disaster management

Disaster management is a cycle of activities (Figure 1) beginning with *mitigating* the vulnerability and negative impacts of disasters, *preparedness* in responding to operations, *responding* and providing relief in emergency situations such as search and rescue, fire fighting, etc., and aiding in *recovery* which can include physical reconstruction and the ability to return quality of life to a community after a disaster. The employment of recent advances in spatial data management and Geomatic engineering technologies in disaster management, including Information Communication and Technology (ICT), Geographical Information Systems (GIS), Remote

Sensing (RS), and Global Positioning System (GPS), has considerably improved disaster management through facilitating data capture, integration and analysis. The integration of such technologies with each other and with other technologies such as decision support systems (DSS), the world-wide-web and simulators has created more effective disaster management. Spatial data and GIS have proven crucial in preparing for, mitigating, detecting, responding to, and recovering from natural and technological disasters (Amdahel, 2002). Without spatial data one cannot expect effective and efficient disaster management, as spatial data are the initial input for GIS and Emergency Response Modeling and Simulation Systems (ERMSSs). On the other hand studies have revealed that there are substantial problems in the way in which disaster-related spatial data are gathered, displayed, accessed, and disseminated (SNDR, 2002).

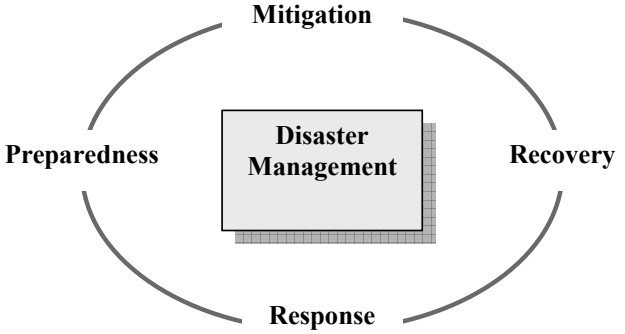

Figure-1

The response to the September 11 emergency situation was an example of the wide utilization of spatial information and related technologies in effective and efficient disaster response. It also highlighted different issues regarding access to spatial information as well as the applicability of available information in systems, as reported by Donohue (2002) and Letham (2001).

Providing information for disaster response

In an emergency situation, different organizations become involved in disaster response. Agencies such as fire-fighters, red-cross, medical emergency departments and police departments undertake emergency response within their everyday activities. Other organizations like utility companies however are only called upon in certain emergency situations. These agencies, organizations and departments must be prepared to provide training and other required resources such as spatial data when the need arises.

These organizations are logically the producer and updater of datasets during their everyday business and during an emergency situation. If the results of such data production and updating efforts are physically recorded in appropriate databases, the required data/information for disaster response is always available to the producer. If this information is shared and exchanged, then datasets are accessible to the wider emergency management community. In order for this data exchange to occur however, appropriate data standards and interoperability models need to be implemented by stakeholders so that information can be utilized within different systems. This brings the concept of partnerships in spatial data production and sharing to the fore.

The responsibility of maintaining information should be shared between different organizations based on:

- appropriate and accepted policies;
- appropriate standards for the production of data;
- the training of people to work with these datasets;
- the establishment of appropriate network and software tools for exchanging and sharing information/data; and
- appropriate policies for accessing and using data/ information

These components can aid and contribute to the development of a proper disaster response environment.

There is a need for an appropriate framework which recognizes the relationships between each component including the effect that the components have on each other, external factors affecting each component, as well as the internal elements of each component. For example regarding policies, it is necessary to understand what policies are required, who the policy makers are, what internal or external factors affect policy making, the effect that the polices have on the other components,

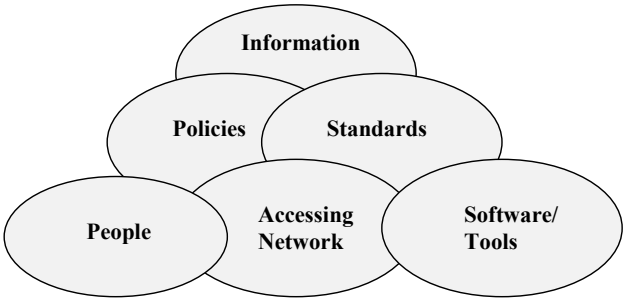

Figure - 2

Figure 2, describes the required components as discussed above for having spatial information ready for access and use.

Role of NGII/GDI in disaster management

Geospatial Information is information concerning objects or phenomenon that are directly or indirectly associated with a location relative to the Earth. (www.iso.org). Survey Department, NEPAL a national mapping organization (NMO), should gradually change its role of providing surveying and mapping services in the country to assuming a lead role in regulating the national mapping activities including development of environment for meaningful sharing of geospatial information at large ie, from production to regulating and coordination agency (Kayastha 2003 b).

The growing need to organize data across different disciplines and organizations and also the need to create multi-participant, decision-supported environments has resulted in the concept of Geospatial Data Infrastructure (GDI). GDI is an initiative intended to create an environment that will enable a wide variety of users to access, retrieve and disseminate spatial data and information in an easy and secure way. In principle, GDIs allow the sharing of data, which is extremely useful, as it enables users to save resources, time and effort when trying to acquire new datasets by avoiding duplication of expenses associated with generation and maintenance of data and their integration with other datasets. GDI is also an integrated, multi-leveled hierarchy of interconnected GDIs based on collaboration and partnerships among different stakeholders. With this in mind, many countries are developing GDIs to better manage and utilize their spatial data assets by taking a perspective that starts at a local level and proceeds through state, national and regional levels to the global level. These activities have resulted in different models being suggested for facilitating GDI development. As illustrated in Figure 3, an GDI encompasses the policies, access networks and data handling facilities (based on the available technologies), standards, and human resources necessary for the effective collection, management, access, delivery and utilization of spatial data for a specific community.

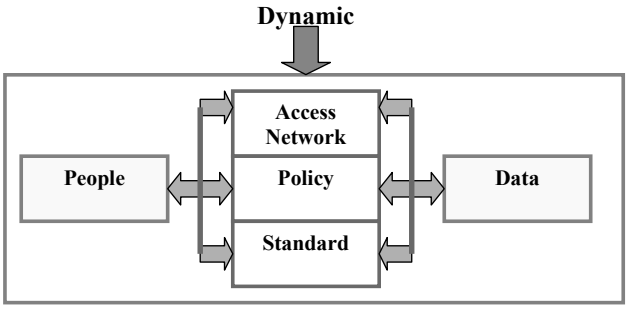

Figure 3: GDI Components

Viewing the core components of GDIs, Rajabifard *et al.* (2002) suggested that different categories of components can be formed based on the different nature of their interactions within the GDI framework. Considering the important and fundamental role between people and data as one category, a second category can be considered consisting of the main technological components: the access networks, policy and standards. The nature of these two categories are very dynamic due to the changes occurring in communities (people) and their needs, as well as their ongoing requirement for different sets of data. Additionally, with the rapidity with which technology develops, the need for the mediation of rights, restrictions and responsibilities between people and data are also constantly subject to change. This suggests an integrated GDI cannot be composed of spatial data, value-added services and end-users alone, but instead involves other important issues regarding interoperability, policies and networks. According to this view, anyone (data users through producers) wishing to access datasets must utilize the technological components.

Therefore, it is proposed that GDI as an information infrastructure can be an appropriate framework in bringing the disaster response components together and facilitating decision-making for disaster management as illustrated in Figure 4. By designing an GDI model for a disaster management community, and by utilizing relevant information and communication technologies (ICT) in disaster management, it is possible to have better decision-making and increase the efficiencies and effectiveness of all level of disaster management activities from mitigation to preparedness, response and recovery phases.

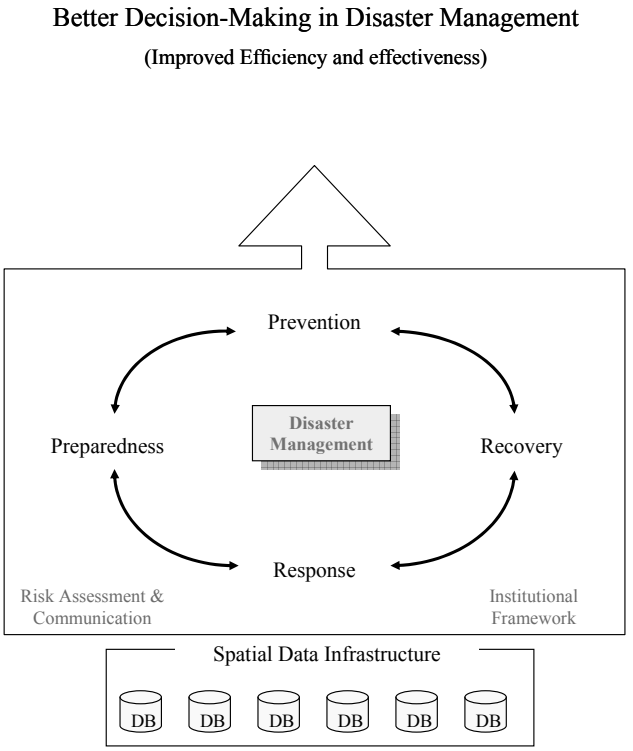

Figure 4: GDI to Facilitate Disaster Management

CONCLUSION

Spatial information and information communication technologies are the important elements in disaster management which has been well-known worldwide.

Not a single agency can collect, update, hold and disseminate data. With this in mind, the paper first addressed the role of GDI as a framework for facilitating disaster management. The NGII platform under development in Nepal is one such platform for interagency networking and data sharing. It is argued that the design and implementation of an GDI model as a framework and consideration of GDI development factors and issues can assist the disaster management agencies in such a way that they improve the quality of their decision-makings and increase their effectiveness as well as efficiencies in all level of disaster management activities from mitigation to preparedness, response and recovery phases. The result of such quality decision-making in disaster management then can directly contribute to the sustainable development of the community in terms of social, economical and environmental development. NGII, Survey Department should also take leading role to address the nation's important issues like supporting on disaster mitigation and management activity.

References

Amdahl, G. (2002). Disaster response: GIS for public safety, Published by ESRI, Redlands California.

Donohue, K. (2002). Using GIS for all-hazard emergency management,

Letham, G. (2001). GIS database development for New York WTC recovery efforts,

Rajabifard, A., Feeney, M., and Williamson I.P. (2002). Future Directions for the Development of Spatial Data Infrastructure, Journal of the International Institute for Aerospace Survey and Earth Sciences, ITC, Vol. 4, No. 1, The Netherlands, PP 11-22.

SNDR (2002). A national hazards information strategy: reducing disaster losses through better information, National Science and Technology Council, Committee on the Environment and Natural Resources, Subcommittee on Natural Disaster Reduction (SNDR), Washington, DC, April

Chhatkuli, R. R. (2002); National Geographic Information Infrastructure Program to Support National Geographic Information System in Nepal, Nepalese Journal on Geoinformatics, Number 1, May-June 2002

Kayastha D.M., Chhatkuli R.R.; 'Survey Department and Context of Geographical Information Infrastructure' SD Colloquium, 2005

Chhatkuli R.R. / Baral T.N./ Karki S./ Dhakal S.K.; Geo-disaster Mitigation and Importance of National Geographic Information Infrastructure Programme in Nepal; paper submitted for International Symosium on Geo-Disaster, Infrastructure Management and Protection of world Heritage Sites; Nov 2006

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