APPLICATION OF REMOTE SENSING AND GIS IN DISASTER MANAGEMENT

During the disaster prevention stage, GIS is used in managing the huge levels of data required and hazard assessment. In the disaster preparedness stage, it is a tool for planning evacuation routes, designing centres for emergency operations, and for the integration of satellite data with other relevant data in the design of disaster warning systems. In the disaster relief phase, GIS, in combination with GPS, is extremely useful in search and rescue operations in areas that have been devastated and where it is difficult to find one's bearings. In the disaster rehabilitation stage, GIS is used to organise the damage information and post-disaster census information and in the evaluation of sites for reconstruction. Natural hazard information should be included routinely in developmental planning and investment projects preparation. They should include cost/benefit analysis of investing in hazard mitigation measures and weigh them against the losses that are likely to occur if these measures are not taken. GIS can play a role at the following levels:

National level
State level
District level
Block level
Ward or village level
Site investigation scale

Disaster management

The application of remote sensing and GIS has become a well developed and successful tool in disaster management, as we have our location observation programmes and the requisite for hazard mitigation and monitoring rank high in the planning of new satellites. GIS allows for the combination of different kinds of data using models. It allows for the combination of the different kinds of spatial data with non-spatial data, attribute data and use them as useful information in the various stages of disaster management.

Various disasters like earthquake, landslides, flood, fires, tsunamis, volcanic eruptions, and cyclones are natural hazards that kill lots of of people and destroy property and infrastructure every year. The rapid increase of the population and its increased concentration, often in hazardous environment, has escalated both the frequency and severity of natural disasters. Among the tropical climate and unstable land forms, coupled with deforestation, unplanned growth propagation non-engineered constructions which make the disaster prone areas sheer vulnerable, slow communication, poor budgetary allocation for disaster prevention, developing countries suffer more or less unceasingly by natural disasters.

Disaster mapping

Disaster mapping is the drawing of areas disturbed through excessive natural or manmade troubles resulting in loss of life, property and national infrastructures. It is normally possible to define the area affected by the disruption. The delineation can occur through the use of ground-based observations or through the use of remote sensing devices such as aerial photographs or satellite images. From the information gathered, it is possible to map the effected areas and provide information to the relief supplying groups. Disaster mapping is a tool for assessing, storing and conveying information on the geographical location and spread of the effects, or probable effects of disasters. The difficulty with traditional manual maps is

that they are tedious and time consuming to prepare, difficult to update and inconvenient to maintain. Remote sensing is emerging as a popular means of map preparation while GIS can be used for storage, analysis and retrieval. Under remote sensing techniques, maps can be prepared using satellite data or aerial photographs and then digitised and stored on computers using GIS software. Disaster maps generally show risk zones as well as disaster impact zones. These are marked areas that would be affected increasingly with the increase in the magnitude of the disaster. These could include landslide hazard maps, flood zone maps, seismic zone maps, forest fire risk maps, industrial risk zone maps etc.

Landslides

Landslide hazard zone mapping involves a detailed assessment and analysis of the past occurrences of landslides in conditions of their location, size and incidence with respect to various geo-environmental factors that cause landslides and mass movements. Landslide hazard zonation map included a map separating the draw out varying degrees of predictable slope stability. The map has an inbuilt factor of forecasting and hence is of probabilistic nature. Depending upon the methodology adopted and the comprehensiveness of the input data used, a landslide hazard zonation map is able to provide help concerning some or all the following individual factor maps:

Landslide location
Slope steepness
Landuse/ landcover
Geology or lithology
Density of drainages
Rainfall

Preparation of an inclusive landslide hazard zonation map needs intensive and continued efforts. A huge quantity of data on lots of variables covering large slope areas has to be collected, stored, sorted and evaluated. Finally, the level of risk sliding has to be assessed and zonation maps prepared. The use of aerial photographs, satellite images and adoption of remote sensing techniques helps in the collection of data. For storage, retrieval and analysis, adoption of computerised techniques would be useful.
Hazard zonation maps have different uses. Some of them are as follows:

Preparation of development plans for cities, dams, roads, and other development works
General purpose master plans and land use plans
Discouraging new development in hazard prone areas
Selection of best activity pattern based on risk zones
Quick decision making in rescue and relief operations.

Earthquakes

Earthquake data collected by the National Seismic Telemetry Network for the past one hundred years was analysed using a computer. Epicentre parameters were resolute. Most of the epicentres tend to cluster along the plate boundary where the Himalayan Collision Zone was formed. The epicentre maps are used to prepare seismic hazard map. Seismic zoning map is in the code for designing earthquake resistant structures. Apart from the earthquake data, geological factors, structural design, soil data etc., are used to prepare building codes. These codes are used to design earthquake resistant structures in the region. Up-gradation of this code is a continuous procedure. The building code is assessed from time to time. The different zones point to vulnerability from seismic turbulence and help in

reviewing the vulnerability probable.

The state of Sikkim experiences earthquakes at a relatively high frequency on the seismic hazard zonation map under zone IV. All districts of Sikkim lie in zone IV. The earthquake risk or possible damage is due to a combination of seismic hazards, vulnerability of the built surroundings and the exposure. The damage during recent earthquakes in India has demonstrated the need for seismic risk assessment that is able to forecast the consequences of earthquakes. A comprehensive earthquake risk assessment for Sikkim has been performed for seismic intensity obtained from the micro-zonation of the state.

Search and rescue

Search, rescue and evacuation procedures are carried out immediately after disaster strikes a certain area. These are major operations, usually performed by local volunteers, voluntary organisations and district and state agencies. If the condition worsens and these groups are not able to control the situation, then the army has to be called in. The basic aim of all such operations is to ensure the survival of the maximum possible number of victims. A plan is worked out with the help of local people through aerial surveys and appropriate steps are then taken by the various teams involved to carry out the operations. Besides bringing material relief, the aim is also to control panic and confusion and to provide moral support. Search and rescue, frequently known as SAR, is the process of identifying the location of disaster victims who may be trapped or isolated and bringing them to safety and providing them with medical attention. Search and rescue generally involves local people who are well versed with the local terrain and can be instrumental in searching and accessing trapped victims. After the search, rescue and evacuation, some essential steps are required in order to provide relief to the evacuees. Prime amongst these are:

Shelter
Food
Communications
Clearance and access
Water and power supplies
Temporary subsistence supplies
Health and sanitation
Public information
Security
Construction requirements
Disaster welfare inquiry

Methods and techniques

In the present context, due to scientific advances, it has become easier to carry out these operations efficiently. Studies have helped in making it possible to forecast and simulate disaster occurrences with regard to specific locations - helping in the initial stages of search and rescue operations. Techniques like satellite imagery and GIS help to identify areas that are disaster prone, zoning them according to risk magnitudes, inventory populations and assets at risk, and simulating damage scenarios. These tools are even useful in managing disasters as they provide instant access to information required in management decisions. Modern communication systems have also proved very useful, particularly in search and rescue operations. They not only help in providing warnings before the disaster, but also help in creating awareness which helps in reducing panic, confusion and mental stress. A communication network system helps in establishing contacts between relief teams which, with better central coordination, can work more efficiently.