Modern Cartography in Aid of Disaster Management

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India has the highest occurrence of natural disasters in south-east Asia with about 85 percent of the country liable to be affected by one or the other disaster viz avalanches cyclone, drought, earthquake, flood, landslides, etc. There are also many environmental hazards, spontaneous or human-induced related to the natural forest or soil cover or over-exploitation of agricultural land. Of these about 63 percent of the total agricultural area is drought prone, while area devastated by annual or flash floods is estimated to be about 12 to 15 percent of the area. The long coastline and the coastal areas are exposed to one or two pre or post monsoon cyclones every year. More than 50 percent of India's geographical area is vulnerable to seismic or geodynamical activity of varying intensity. An area of 2,000 sq. km in the Himalayas in different locations is exposed to snow avalanche hazards. These natural hazards are so frequent and so devastating that these affect the economic development. Social stability gets severely disturbed and inflicts untold human miseries leading to health hazards. Although the occurrence of such disasters cannot be prevented or regulated, the proper application of scientific knowledge based on past experience can minimize the economic and health consequences of the population.

Due to severe drought in 1987, India's entire population was affected due to severe shortages of food grain production and water scarcity leading to economic hardship. This was followed in 1988 by a large scale devastating floods in major flood-prone basins in the country.

The natural hazards can be listed as avalanches and landslides in Himalayas, cyclones in coastal areas, drought in rain-scarcity areas, earthquakes in seismic and tectonic activities affected areas and floods in heavy rainfall area. While satellite communication has improved significantly the possibility of real-time dissemination of information and early warning system, earth observation satellites enable continuous monitoring of atmospheric as well as earth surface parameters attributing to natural disaster phenomena.

Space technology, combined with satellite remote sensing and related use of information technology, PCs and many software packages provide the modern cartographers with more accurate and faster methods of map-making to depict the physically devastated areas- all of which assist in early warning systems, estimates of occurrence, likely damages and loss of lives, impact assessment, damage assessment, quick dissemination of disaster information to the people of the country and the world and to the government and international agencies for decision about early support and relief for disaster mitigation measures.

India is one of the two countries of the world, which uses space technology for near-real-time monitoring of drought, cyclone and flood as a national programme and thus provide the modern cartographers with the latest technological tools to assist in disaster management. India faced a severe drought in 1987. India's entire population was affected due to severe shortages of food grain production and water scarcity leading to economic hardship. This was followed by a large scale devastating floods in 1988. Since then major technological programmes have been launched by the government of India including space technology and information technology for monitoring and quick appraisal of drought and flood damages.

Jurio and van Zuider of National University of Comahue, Argentina and of ITC, The Netherlands respectively, reported a study of use of remote sensing (RS) and geographical information system (GIS) for desertification analysis in north-west Patagonia, Argentina (1998). Betts and DeRose reported the use of digital elevation model constructed from aerial photographs, as a tool for measuring gully erosion in New Zealand (1999). Studies were spread over 14 to 33 years, and concluded that this method resulted in considerable cost saving and added efficiency compared to ground methods. Shrimali, *et al,* 2001 reported a study of prioritising erosion prone areas in hills using RS with GIS in the Sukhna lake catchment, Shivalik hills near Chandigarh. Spillage of oil in coastal waters can be a catastrophic event causing damage to the environment and economy of the area affected. Marghany, 2001 reported the use of RADARSAT images and two types of algorithm (Lee and Gamma) for oil spill detection based on texture analysis and concluded that the use of RS helps in speeding up oil spill information and at a lesser cost but more accurately.

Chakraborti, 1999 reported drought damage assessments using coarse resolution NOAA - AVHRR and IRS-1C & ID WiFS sensor data both at district and sub-district level. He reported that agriculture drought assessment can be best done by the use of infrared and red bands of NOAA-AVHRR, combined with satellite laser ranging. Shrestha, 1999 reported the use of GIS for land degradation assessment in the middle Himalayan mountain of Nepal. A watershed belonging to Likhu Khola river was studied which concluded that human intervention leads to soil erosion and degradation. Rautela, *et al*, 1990 carried out studies of Kali, Kaliganga and Madhya Mahashwar river valleys in Garhwal Kumaun Himalaya, Uttaranchal, landslide hazard zonation using GIS analysis supported by field check. They concluded that such studies help in timely soil conservation programmes in the watersheds.

A few cases of national and international studies of natural and human induced hazards using remote sensing, geographical information system, PCs and GPS have been reported above. It is proved beyond doubt that the RS and GIS based methods using space technology has placed a new tool in the hand of modern cartographers to assist in disaster management. It is therefore, recommended that the modern cartographers may be trained in this new space technology assisted by information technology to be of greater service to the society and nation.

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