Use of IT For Disaster Management And Mitigation

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ABSTRACT
Having vital location or map-based information at their fingertips could make the difference between life and death for rescue workers and emergency services working at the scene of a natural disaster. With the tropical climate and unstable landforms, coupled with high population density, poverty, illiteracy and lack of adequate infrastructure, India is one of the most vulnerable developing countries to suffer very often from various natural disasters, namely drought, flood, cyclone, earth quake, landslide, volcanic eruption, etc., which strike causing a devastating impact on human life, economy and environment. Though it is almost impossible to fully recoup the damage caused by the disasters, it is possible to
(i) minimize the potential risks by developing early warning strategies,
(ii) prepare and implement developmental plans to provide resilience to such disasters, and
(iii) mobilize resources including communication and telemicine services.

In this paper, an attempt has been made to highlight the role of information technology tools like the GIS and satellite communication and others in management of natural disasters in India. GIS can improve the quality and power of analysis of natural hazards assessments, guide development activities and assist planners in the selection of mitigation measures and in the implementation of emergency preparedness and response action. Remote Sensing, on the other hand, as a tool can very effectively contribute towards identification of hazardous areas, monitor the planet for its changes on a real time basis and give early warning to many impending disasters. Communication satellites have become vital for providing emergency communication and timely relief measures.

Another strand will study the issue of tracking, monitoring and navigation. This includes the use of GPS in car navigation and traffic and pedestrian modeling and management, which could be used to find the best routes from the scene of a disaster to the nearest hospital or in closing off roads around the affected area.

1. INTRODUCTION
It is a well known fact that natural disasters strikes countries, both developed and developing, causing enormous destruction and creating human sufferings and producing negative impacts on national economies. Due to diverse geo-climatic conditions prevalent in different parts of the globe, different types of natural disasters like floods, droughts, earthquakes, cyclones, landslides, volcanoes, etc. strikes according to the vulnerability of the area. India is considered as the world’s most disaster prone country. We have witnessed devastating natural disasters in recent past like super cyclones in Orissa in 1999, earthquake in Gujarat in 2001 and Tsunami in coastal states in 2005.

2. ROLE OF GEO INFORMATION TECHNOLOGY
Geo-information technology offers an opportunity to support disaster management: industrial accidents, road collisions, complex emergencies, earthquakes, fires, floods and similar catastrophes (for example the recent huge disaster with the Tsunami in South-East Asia on 26 December 2004). Access to needed information, facilitation of the interoperability of emergency services, and provision of high-quality care to the public are a number of the key requirements. Such requirements pose significant challenges for data management, discovery, translation, integration, visualization and communication based on the semantics of the heterogeneous (geo-) information sources with differences in many aspects: scale/resolution, dimension (2D or 3D), classification and attribute schemes, temporal aspects (up-to-date-ness, history, predictions of the future), spatial reference system used, etc[4].

3. ROLE OF INFORMATION TECHNOLOGY IN IMPROVING DISASTER MANAGEMENT
Information technology (IT) has the potential to play a critical role in managing natural and human made disasters. Damage to communications infrastructure, along with other communications problems exacerbated the difficulties in carrying out response and recovery efforts following Hurricane Katrina. To assist government planning in this area, the Congress, in the E-government Act of 2002, directed the Federal Emergency Management Agency (FEMA) to request the NRC to conduct a study on the application of IT to disaster management. This report characterizes disaster management providing a framework for considering the range and nature of information and communication needs; presents a vision of the potential for IT to improve disaster management; provides an analysis of structural, organizational, and other non-technical barriers to the acquisition, adoption, and effective use of IT in disaster; and offers an outline of a research program aimed at strengthening IT-enabled capabilities for disaster management.

4. CONTRIBUTIONS OF SPACE TECHNOLOGY TO INFORMATION NEEDS
Natural hazards cannot be prevented; however, their social and economic impacts can be reduced through the cost-effective use of appropriate technologies. A number of space-based technologies can contribute to the information requirements of the different phases of a disaster management programme and therefore offer significant potential for minimizing the impact of natural hazards[2].
A) SATELLITE METEOROLOGY
Meteorological satellites now monitor the Earth’s atmosphere, oceans and land surface in almost real time. The satellites provide data that are essential for the day-to-day-prediction of local and global weather and for supporting disaster management activities, such as the early warning of meteorological and hydrological hazards and the preparation of disaster situation reports. The meteorological data are also used for monitoring climatic changes phenomena. Even such short-term events as severe thunderstorms, with a life time of only a few hours, can be successfully recognized in their early stages, and appropriate warnings of the time and area of their likely maximum impact can be expeditiously provided to the general public.

B) MOBILE SATELLITE SERVICES
Mobile satellite services (offering voice, facsimile and data transmission, and paging) are one of the most effective means of communications in the event of disasters owing to several important advantages that they have over other means of communications: (a) they do not depend on the presence of an existing infrastructure, which may in any event be destroyed or damaged, (b) they are unaffected by ionospheric noise, (c) they are highly portable and can be set up and used anywhere easily and quickly, and (d) they are cost-effective.

C) NAVIGATION AND GEO-POSITIONING SYSTEMS
The Global Positioning System (GPS) and the Global Orbiting Navigation Satellite System provide position determination that is used for localization, tracking of equipment and vehicles, and emergency personal beacons. Such navigation and geo-positioning systems support a wide variety of activities related to disaster management.

Geo-positioning systems, in conjunction with data communications satellites, are used to track hazardous cargoes, including radioactive materials. With GPS ground receivers, it is also possible to detect relative ground motions as low as a few millimeters a year between points separated by hundreds of kilometers. Utilizing the maximum precision of GPS, scientists are able to monitor movements of tectonic plates and other seismic hazards. Such monitoring permits the assessment of earthquake risk. The data are also useful in predicting the eruption of volcanoes and the occurrence of landslides. GPS technology, in conjunction with complementary instrumentation, also allows the worldwide study of atmospheric water vapour and provides data needed for understanding potentially hazardous climatic phenomena[5].

D) INTERNET AND OTHER BROADBAND APPLICATIONS
Rapid growth in demand for Internet, multimedia and other broadband services has prompted the development of new broadband satellite constellations in both LEO and GEO. These services can now be used for disaster management. In some countries, the Internet already facilitates public access to map-based information that is useful in reducing vulnerability (e.g. maps showing the locations of flood-plain areas relative to planned building sites).

E) REMOTE SENSING SATELLITES
Remote sensing satellites provide data that have proved useful for a wide range of applications in disaster management. These include the mapping and monitoring of hydrological and seismic hazards, variables affecting climate and weather, land use, the extent of damage due to volcanic eruptions, oil spills, forest fires, the spread of desertification, and the forecasting of floods and droughts (see table 1).

F) GEOSTATIONARY TELECOMMUNICATION SATELLITES
Many geostationary satellite systems are used for main-route or back-up communications in telephony, video and data transmission. These systems play a key role in news gathering and broadcasting and can therefore contribute to increasing public awareness of disasters and to the mobilization of international support during emergencies.

5. AREAS OF I.T USAGE:

a). LANDSLIDES: Landslides constitute one of the major hazards that cause losses in lives and property. Landslides are one of the complex analyses, involving multitude of factors and need to be studied systematically in order to evaluate the hazard. The increasing computer-based tools are found to be useful in the hazard mapping of landslides. One of such significant tools for hazard mapping of landslides is Geographic Information Systems (GIS). A GIS is defined as a powerful set of tools for collecting, storing, retrieving at will, displaying, and transforming spatial data. One of the main advantages of the use of this technology is the possibility of improving hazard occurrence models, by evaluating their results and adjusting the input variables. An important aspect of landslide investigations is the possibilities to store, treat, and analyze spatiotemporal data that are available.

b). DROUGHT: GIS and Remote Sensing can be used in drought relief management such as early warnings of drought conditions will help to plan out the strategies to organize relief work. Satellite data may be used to target potential ground water sites for taking up well-digging programmes. Satellite data provides valuable tools for evaluating areas subject to desertification. Film transparencies, photographs and digital data can be used for the purpose of locating, assessing and monitoring deterioration of natural conditions in a given area.

c). EARTHQUAKE: GIS and Remote Sensing can be used for preparing seismic hazards maps in order to assess the exact nature of risks.

d). FLOODS: Satellite data can be effectively used for mapping and monitoring the flood inundated areas, flood damage assessment, flood hazard zoning and post-flood survey of rivers configuration and protection works.

e). CYCLONES: INDIA is a large country with a coastline of about 8000 km, which makes the country vulnerable to severe tropical cyclones arising in the Bay of Bengal and the Arabian
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Sea. Tropical cyclones are mostly characterized by torrential rain, gales and storm surges, causing massive loss of life and property. They also result in extensive damage to standing crops and loss of livestock. In the last five decades, government is making attempts to highlight the use of information technology in providing early warning systems for effective disaster management, especially in Andhra Pradesh, Orissa and West Bengal coasts, which are susceptible to such storms. It uses a number of communication channels like telegram, telefax and e-mails, etc. to communicate warning messages at appropriate levels.

Cyclone warning is done in two stages. At first a warning on ‘cyclone alert’ is issued 48 hours in advance of the expected commencement of adverse weather over coastal areas. The second stage ‘cyclone warning’ is issued 24 hours in advance.

f). TSUNAMI: Tsunami waves, which hit India for the first time on Sunday wreaking havoc across the southern coastline, are a known phenomenon in the Pacific Ocean region, which stretches from Chile in Latin America to Japan in East Asia. The waves are usually triggered by seismic disturbances -- coastal earthquakes, volcanic eruptions or undersea landslides - that jolt the ocean floor. Tremors under the sea displace ground surface, sending the water radically outward in concentric circles from its epicenter. The result is a deep wave, stretching from the sea's surface to the floor that travels horizontally at speeds of up to 500 miles per hour and reaches heights of 50 to 100 feet.

The Tsunamis that hit India on Sunday were caused by a massive earthquake on the Indian Ocean near Sumatra in Indonesia. Similar waves have hit six other countries, claiming thousands of lives.

The waves travel faster in deep water, rising further as they approach shore. In open sea, Tsunamis are only about a meter high, but when they reach a shoreline, they can be taller than a house and weigh millions of tones. Though the bottom of the wave is slowed down by the sharp elevation of the ocean floor near the coast, its top part keeps moving at the original speed. As a result, vast quantity of water piles up and finally crashes over the shore with amazing force, thus causing massive destruction.

CONCLUSION

It may be observed that advancement in Information Technology in the form of Internet, GIS, Remote Sensing, Satellite communication, etc. can help a great deal in planning and implementation of hazards reduction. For maximum benefit, new technologies for public communication should be made use and natural disaster mitigation messages should be conveyed through these measures. It is absolutely necessary to create awareness amongst the public as well as decision makers for allocating resources for appropriate investments in information technology. Awareness and training in Information technology in a much greater measure is required to develop human resources, particularly in the developing countries, who are chronically suffer from natural disasters.

The disasters usually occur in the well-defined areas, even though the community does not know the coping mechanism for the disaster. The disaster mitigation programs must be extensively taken up covering various aspects at national level to minimize the disaster damages. There should be a greater emphasis on development of new technologies in disaster mitigation. The disaster preparedness and awareness is the only effective way of mitigating the impact of future disasters.

FUTURE SCOPE

It focuses towards adopting technology that would minimize loss and environment effect due to disaster. Strengthening earthquake measurement stations, prepare hazard map, mapping, monitoring and preparedness of disaster prone area. Tenth development Plan has emphasized a need for environmental impact and natural disaster appraisal study of each infrastructure construction project .The path ahead is making rescue and relief reliable and effective and launches activities for public awareness.

REFERENCES