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Assessment of Role of GIS for Natural Disaster Management : A Critical Review

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Abstract: In recent years, Remote Sensing and Geographical Information System (GIS) technologies has been the object of considerable interest to all bodies concerned with space and in particular emergency services and disaster management. In this paper we, address the issues regarding contemporary works on role of GIS in disaster Management. This paper is a review of some interesting and milestone research work carried out so far on the context of disaster management .

Keywords: GIS, RS , Disaster Management

I. INTRODUCTION

The field of earth observation (EO) has seen remarkable development over recent time owing to the increasing quality of the sensor technology and the increasing number of operational satellites launched by several space organizations and companies around the world. The growing number of applications of the available remote sensing data is in turn feeding the appetite for new and improved technologies. While remote sensing (RS) made enormous progress over the last years in terms of better resolution, data accessibility and public attentiveness, a vast majority of applications rely on basic image processing concepts developed in the 70s per-pixel classification of data in a multi-dimensional feature space [1]. Since the first Landsat Multispectral Scanner System (MSS) was launched in 1972, which began the modern era of land remote sensing from space, large volumes of satellite image data have been collected, which are invaluable to many applications including environmental assessment and monitoring, agriculture, renewable natural resources, and mapping [2].

Aerial imagery has been one of the standard data sources for geographic information systems (GIS) for more than three decades. Most spatial features in GIS (such as man made objects) can be extracted automatically from images. Road data in GIS are of major importance for applications such as traffic control, transportation flow analysis, vehicle navigation, travel guidance, and fire or medical emergency services. Building data in GIS are also important for security purpose. Therefore, acquisition of accurate and up-to-date road network information building extraction from aerial imagery is necessary. Automatic road extraction from digital imagery has been a major research focus in the photogrammetric and computer vision fields for more than two decades. Open Arial images particularly of cities, fields typically contain geometric figures depicting, buildings, roads, field boundaries, and car parks. Now to recognize those real objects from such images it needs a mechanism which will recognizes geometrics figures of such objects from the imagery. This information is very valuable particularly in measurements, population densities, etc type of statistical data.

II. ANALYSIS & DISCUSSIONS ON GIS

Geographical Information System is a computer based information system that enables capturing, modeling, manipulation, retrieval, analysis, and presentation of geographically referenced data, It is a facility for preparing,

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presenting, and interpreting facts that pertain to the Surface of the earth. Innovations in technology have made it easier in the last decade to reduce disaster risks and plan for the future. The internet combined with technologies, such as Geographic Information Systems (GIS), now makes it possible to better understand and communicate the social and physical complexities of disasters. Technology is a valuable tool that has the potential to transform the way we work, and it also can deliver cost efficiencies, increase transparency, and make an organization more relevant to what is happening around the world in real time. Today, the world faces many challenges: climate change, famine and drought, global epidemics, violent conflict and persistent poverty. Technology such as GIS offers the possibility of visual analysis and allows us to see political boundaries, population trends, and socioeconomic differences. It also offers us the ability to acquire and verify facts. Using GIS technology we can analyze and see where natural disasters have previously occurred and how they have impacted the landscape. We can also try to predict where a natural disaster is most likely to occur."

By understanding where disasters happen, the international community can develop new and more efficient methods to reduce future disaster risks. Natural disasters are the outcome of many complex geophysical characteristics and the related social circumstances that are subjected to a hazard. The hazards may be meteorological in origin such as cyclones, severe storms, droughts and blizzards, or may be earth processes such as earthquake, volcanic eruptions, tsunamis, etc., or a combination of both as in the case of floods. All these events are location dependent in the sense that a hazard is aggravated by the geological, topographical and land cover at the location of the hazard. Similarly, natural hazards turn into disasters when they affect societies. The degree of damage is dependent on the population density, infrastructure and means available for mitigation such as flood control dams and evacuation facilities. The strength of GIS lies in the ability to represent the real world situation closely with layers of information (maps) that can be combined in a predetermined manner to identify the impacts of a natural hazard through the introduction of hazard dimension. In the case of floods, the hazard information is represented as water height, velocity and the flood duration distribution over the catchment. Combining this information with population distribution helps identify people at risk, with road network shows available or passable roads for evacuation and relief, with hospitals and emergency facilities in planning response and relief and with the property distribution in estimating damage. In the case of earthquakes, this information could be ground shaking intensities due to an earthquake, which again can be combined with population, housing and infrastructure information to assess disaster impact and plan response and relief strategies. GIS has developed substantially over the past decade with the advent of large-volume data handling capabilities that facilitates synthesizing information from many different data sources. Disaster reduction discipline has benefited largely from these developments in risk map preparation, damage assessment and modeling for forecasting and planning. The next section briefly describes the current status and use of GIS in disaster reduction

III. ASSESSMENT OF GIS FOR NATURAL DISASTER IN THE CONTEXT OF REVIEWED LITERATURE

The cited references are excellent work on GIS for Disaster management. We personally feel that an elementary reader must read them as basic material on GIS. Its observed in these works that the natural disasters are inevitable, and it is almost impossible to fully recoup the damage caused by the disasters. But it is possible to minimize the potential risk by developing disaster early warning strategies, preparing and implementing developmental plans to provide resilience to such disasters, and helping in rehabilitation and post disaster reduction. Space technology plays a crucial role in efficient mitigation and management of disasters. The role of remote sensing and Geographical Information System (GIS) in evolving a suitable strategy for disaster management and occupational framework for their monitoring, assessment and mitigation, identifies gap areas and recommends appropriate strategies for disaster management using these technologies. 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, viz. flood, cyclone, earthquake, forest fire, drought, etc. Asia tops the list of casualties due to natural disasters. Space technology plays a crucial role in efficient mitigation of disasters. Communication satellite provides disaster warning and relief mobilization, Earth observation satellite provides required database for pre disaster preparedness programmes and post-disaster preparedness programmes. They provide

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comprehensive, synoptic and multi temporal coverage of large areas in real time and at frequent intervals Forest fire has deadly threatened human lives, fortune and ecosystem. The main reason for this is limitation of traditional method and no more scientific way to predict these disasters. We feel that the fatal damage by forest fire could be reduced if there are suitable predictions and rapid provision against forest fire using GIS. This GIS is most perfect way for forest fire forecasting as Forest fire had a movement in both spatial and temporal. GIMS (Geographical Information and Modeling System) was installed for a management of Forest Fire, which could assign a part by telling the shape of forest fire in real time and help managers of forest fire to take best decision against these disasters.

Remote Sensing and GIS can be a very useful tool to complement conventional methods involved in Disaster Management Mitigation of natural disaster management can be successful only when detailed knowledge is obtained about the expected frequency, character, and magnitude of hazard events in an area [1] [2]. Although, natural disasters have shown in the last few decades a drastic increase in magnitude and frequency, it can as be observed that there has been a dramatic improvement in technical capabilities to mitigate them [3]. The use of 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, from entire continents to detail of a few meters. Many types of disaster, such as floods, droughts, earthquakes, etc. will have certain precursors that satellite can detect. Remote sensing also allows monitoring the event as it occurs. From the vantage point of satellite we can consider, plan for and operationally monitor the event. Indeed, a complete strategy for disaster management is required to effectively reduce the impact of natural disaster, which is as referred to as the disaster management cycle [4]. Disaster management consists of two phases taking place before the disaster occurs, which are disaster prevention and disaster preparedness, a three phases taking place after the disaster occurs, which are disaster relief, rehabilitation and reconstruction:

1. In the disaster prevention phase, GIS is used to manage the large volume of data needed for the hazard and risk assessment.
2. In the disaster preparedness phase, it is a tool for the planning of evacuation routes, for the design of centers for emergency operations, and for the integration of satellite data with other relevant data in the design of disaster warning systems.
3. In the disaster relief phase, GIS is extremely useful in combination with Global Positioning System in search and rescue operations in areas that have been devastated and where it is difficult to find ones bearings.
4. In the disaster rehabilitation phase, GIS is used to organize the damage information and the post-disaster census information, and in the evaluation of sites for reconstruction. Hence, GIS is a useful tool in disaster management if it is used effectively and efficiently.

IV. CONCLUSION

The increased availability of Remote Sensing data and GIS during recent decades has created opportunities for a more detailed and rapid analysis of natural hazards. Disaster Management can be very efficiently and cost effectively handled by using innovation in the technology. Highly sophisticated and effective Disaster Management systems can be develop accordingly which are basically GIS based. This can help us to reduce the casualties and damages caused by disasters.

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