

Disaster Management Using Geographical Information System (GIS) Need of the Era

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ABSTRACT

Disaster management is very complex as it required tools and techniques to avoid such situations and reduce the impact of disasters since disasters most of the time are natural, and natural calamities cannot be avoided. This paper focuses on the necessity of geospatial technology for the controlling agencies to analyze the disaster situation and provide the necessary facilities to the citizen so that city will be ready to face the natural calamities well in advance and take precautionary measures by the local government. Geographical Information System (GIS) can be used; through this technology we can create disaster data. It is found out that many agencies doesn't have the property data for the analysis and hence decisions are not going in the right direction for managing the same. Geospatial technology enable the spatial distribution of the various features such as roads, rail, emergency services, fire stations, ambulance services, medical stores, exit routes, storm surge exposure, inflammable vegetation, hazardous material locations, nuclear power stations, refineries, fuel storage, flood plains, population density areas, slums mapping, etc. Using GIS effective, predictive analysis can be done and better performance of the citizen services can be tendered to avoid the impact of natural calamities or any other incidence

Keywords: disaster management, e-governance, g-governance, flood modelling, GIS, geospatial technology

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INTRODUCTION

Disaster and Disaster Management Frame Structure

This paper focuses on the necessity of geospatial technology to analyze and control the distractions from the disasters in the urban areas. Since the population of urban areas is increasing drastically and the facility is not up to the mark as the situation permits. The cities like Mumbai, Goa, Vishakhapatnam, Thiruvananthapuram, Kolkata, Hyderabad, Bangalore, and Delhi are with high density of population and may create a duster situation most of the time. It is been observed that agencies are not well equipped to handle the disaster situation and even they are unable to handle the post-disaster situations. The most dangerous is the

post-disaster situation, which impact with such severity that the affected community has to respond taking exceptional measures (Disaster Management Handbook, Carter N.W, Asian Development Bank1991, ISBN 978-971-561-006-3). A disaster can be called natural when the cause of such event is purely natural [1].

Disaster Management

- Avoid the disaster conditions prior to disaster.
- Awareness to the citizens about the facilities available.
- Awareness of citizen to handle the situation during disaster.
- Minimize the distractions if disaster occurs.

- Action during disaster conditions.
- Handle post-disaster situations.

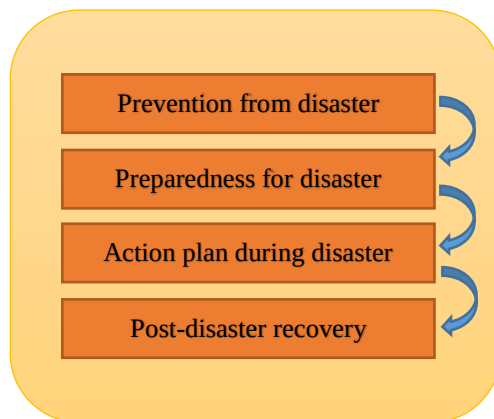


Fig. 1. Disaster management cycle
(Explains 4 steps of the disaster management frame structure)

Looking into the urbanization and migration of people from rural area to the urban areas for various reasons, the population of urban area is increasing day by day. Managing crowd is becoming very difficult in normal conditions. In disaster situation who is going to help the people in urban areas and how they will be prepared well in advance to handle the situations. Handling of disaster means not only helping during disaster and providing the solutions and taking care on timely basis.

Geospatial technology provides an extra decision power to the various departments in the urban areas such as urban local bodies (ULB), police, medical emergency services, transport agencies, etc. to handle situation (Figure 1).

Agencies need to plan to prevent and reduce the consequences of emergencies is greater than ever. Agencies have the collaborative responsibility to coordinate and facilitate multiple departments in planning, response and recovery

GIS AS A DECISION SUPPORTIVE SYSTEM FOR DISASTER MANAGEMENT

No disaster can be 100% avoided since it is a natural calamity such as flood, natural

fire, volcanic eruptions, earthquake, etc. Emergency can arise at any moment a man cannot predict, but as an administrator, a human can be prepared to face the incidence and reduce the impact of the disasters. In urban areas, major disasters are flood, fire, tree falling, building collapse, major accidents, etc.

What is the relevance of GIS in the disaster management, since this is purely location-based happening, hence geographic location is most important in decision-making? MIS will answer what is happened and GIS will give the answer where it is happened (Figure 2).

GIS is the powerful tool to visualize and locate the impact of the disaster if occurs in any moment [2].

What is GIS?

GIS is a Geographical Information System. (G+I+S)

G Means Georeferenced Maps (Spatial Data)

I Means Related Information (MIS) - Non-Spatial Data

S Means Systematic arrangement and delivery of information through technology (Software, Hardware, Peripherals, Telecommunication System and Awareness, Education)

GIS Data Creation.

The basic need for any of the GIS technology for disaster management is appropriate and up-to-date input data. For operations of GIS, along with information, the major input is the geo-referenced map data which can be generated using various inputs such as:

- Flood plain mapping
- Coastal zone mapping
- Fire station mapping
- Population density mapping
- Contour mapping
- Transportation system
- Hazardous area
- Nuclear power stations

- Power stations
- Administrative boundaries
- Dump yards
- Open and empty lands
- Emergency services locations (medical shops, hospitals, ambulance, police stations, private security agencies, SRP booths, para military camps, etc.)

How GIS Works

- GIS works on GIS software platform, in technical language. It is a three-tier and now a four-tier architecture.
- GIS software (ESRI, Intergraph, Geomatica, etc.)
- RDBMS–Oracle, SQL Server, etc.
- Operating systems – Windows for PC and Android / iOS for mobile apps)
- Georeferenced maps, latest satellite imagery
- MIS information of each layer as mentioned above. e.g. name, area, length, height, socio economic data, census data, etc.
- Hardware and peripherals – PC, mobile/ tablet, telecommunication systems, GPS, GPRS, printers, plotters, scanners, etc. [3].

Frontend is GIS software and backend is RDBMS. The front-end GIS software is customized as desired by the end user and lot many queries and reports and information can be retrieved from the database using Web applications or android mobile applications. In this case, no one required to be an expert in the GIS domain. GIS experts will deliver the user-friendly applications for end users.

How GIS Is Used by a Decision-Maker

Once the GIS database and complete system are ready, it must be useful for the decision-makers. The questions come what they will analyze from GIS.

- Incident mapping and susceptibility assessment and action plan
- Hazard zoning

- Disaster risk zoning.
- Disaster reduction planning support.
- Near real-time monitoring of affected areas and critical infrastructure at risk.
- Track damaged/ usable roads for accessibility
- Flood modeling for risk analysis
- Heat maps for risk mapping and analysis
- Suggestions to install base camps, rescue camps and medical camps for safe disaster management.
- Rapid identification of shelter and housing locations.
- Identifying shortest routes
- Quick and rapid action plan
- Route mapping for better rescue plans
- Surface water management plans
- Real-time mapping and modelling
- Change detection analysis using remote sensing pre- and post-data
- Time and resource management
- Social, physical and economic disaster impacts (Figure 3).

LIMITATIONS OF GIS TECHNOLOGY

No technology is proven 100% result-oriented and GIS is also not all above that. The above given predictive analysis is dependent of the input of accurate and updated data.

GIS can strongly support answering questions, but it is still human intellectual and predictive thinking that must make final decisions. Over-reliance and over-expectation from the technology coupled with shortage of proper GIS education and training and lack of good human judgment, intellectual, and critical thinking, else the end result can lead to terrible penalties. Most of the data is collected by either government agencies thru private organizations and it is time-taking and quite expensive, and for disaster management, time-series data is required which is a repetitive work and not a one-time job [4].



Fig. 2. Flood zone mapping.(Use of GIS by Decision makers, taken from Google)

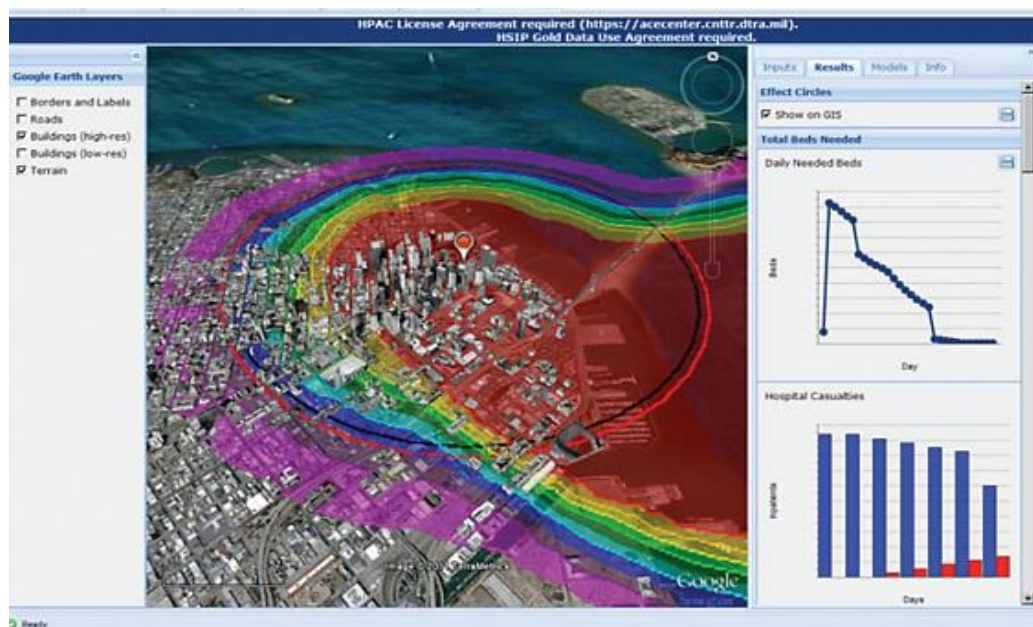


Fig. 3. Effective area using Plume and GIS base map. (Use of GIS by Decision makers, taken from Google)

INITIATIVES OF GIS TAKEN BY VARIOUS LOCAL BODIES IN INDIA

Municipal Corporation Greater Mumbai, Thane Municipal Corporation, Solapur Municipal Corporation, Municipal Corporation of Patiala, Town and Country Planning Department Chandigarh, Department of Forest, BBMP-Bruhat Bangalore Municipal Palike, Collectorate of Wardha District, PWD- Government of Maharashtra, Central Water Commission, City and Industrial Development Corporation(CIDCO), and many more government and private sectors are now

entering in the user of GIS for incipience management/disaster management [5].

CONCLUSION

GIS is an emerging next-gen technology. MIS is used by everybody in the industry. As expert, it is been observed that many organizations are practicing and implementing GIS is disaster management and used GIS and more other fields worldwide.

In India, young generation and technocrat administrators including government are encouraging. Hence administrators are

insisting on implementation of GIS as a mandatory reform where the scope of implementation of GIS becomes wide in the government sector.

Maharashtra government has defined implementation of GIS as a mandatory reform of SMART CITY. Thane and Mumbai corporations are using GIS for disaster management and various other aspects of planning for the city development. Hence GIS is an emerging trend in information technology for the new era and it could be re-named from e-governance to g-governance

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