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APPLICATION OF GEOMATICS IN DISASTER MANAGEMENT OF MITHILA PLAIN

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ABSTRACT

The application of Geomatics presents the spatio-temporal perspective in the disaster management of Mithila Plain of North Bihar which is prove to different kinds of disasters like flood, drought, cyclone, earthquake etc. causing huge loss of human lives, properties, crops and infrastructure facilities. The main objectives of this research are to assess the loss and dangers caused by natural hazards and application of Geomatics, Remote sensing and GIS in natural hazard mapping and management for Mithila Plain. The term 'Geomatics' relates to the technology dealing with the character and structure of spatial and non- spatial information, its methods of acquisition, analogy and digital capture, organization, classification of qualification, analysis, management, display and dissemination as well as the infrastructure necessary for the optimal use of the information .

In this research the hypothesis has been elaborated and tested that if the speedy and accurate information pertaining to natural resources and natural hazards be procured with the help of Geomatics, the risk of natural disasters may be minimized in the disaster prone Area like Mithila Plain. Simultaneously there may be a better management of resources for sustainable development in the region.

KEY WORDS: Geomatics, G.I.S, Mithila Plain, Natural Hazard, R.S.

INTRODUCTION

Disaster, hazards, catastrophes, crises, risks and the like are some of the few parameters, which affect mankind in specific areas where these react as disasters of various magnitudes. The events that occur due to nature's fury of earth's turmoil become hazardous when they interact with man, his activities and environment. Every parameter of the biosphere, subject to seasonal, annual and sudden fluctuations, may constitute a hazard to mankind due to the fact that his adjustment to the frequency, magnitude and timing of their extremes are usually unpredictable. Risk of such nature to mankind in the physical environment is generally denoted as environmental hazards and when these hazards cross the tolerance power of human becomes disaster. Such hazards may be natural including earthquakes, droughts caused by irregularity of rain; or man-made like pollution of water, air and others due to technological progress and excessive harnessing of resources.

Mithila Plain of North Bihar is prone to different kinds of disasters like flood, drought, and cyclone, earthquake etc. causing huge loss of human lives, properties, crops and infrastructure facilities. The main objectives of this research project are to assess the loss and dangers caused by natural hazards and application of Geomatics, Remote sensing and GIS in natural hazard mapping and management for Mithila Plain Region of North Bihar.

STATEMENT OF RESEARCH PROBLEM

Geomatics has to be at the core of sustainable development efforts with specific utilities for organizing integrated spatial and non-spatial data bases using the GIS tools in a systematic manner . The spatial data -consisting of maps from remotely sensed data and also conventional sources would have to be input and organised on a standard cartographic references . The non-spatial data -consisting of numeric attributes in respect of socio- economic characteristics from census and other sources most of which would be on the administrative hierarchy of the region, say village- taluka -district ; ward municipality etc .

Natural, disasters like earthquake, flood and fire and now man-made disasters like building collapse due to faulty design and use of sub-standard material and terrorist attack can paralyse the city life and other structures and economy to a large extent. Contingency planning is necessary to meet such likely disasters. Appropriate spatial database showing the historic monuments, transport terminals, office complexes and other important places and transport network in their vicinity can help identifying the escape routes and rushing the relief measures by network analysis utilities normally available in a standard GIS software Package.

Scrutiny of development Proposals under the Development Control Regulations forms one more aspect of disaster management and planning. Automation of this time consuming process is extremely desirable. This can be attempted by constructing a suitable Except System i.e. a product of advanced researchers in the computer field called Artificial Intelligence. Proposed Except system will has GIS database engine storing spatial and attribute data and Inference Engine drawing upon the Development Control Regulations with suitable user-friendly from end tool to examine the proposal and produce remarks the basis of logical interpretation of the rules and regulations. Promotion of such efforts needs to be done on a primary basis. Hence, the main research problem is to present application of Geomatics in Resource and Disaster management.

The Study Area

For this research work, Mithila Plain has been selected as the study Area. The Mithila Plain is an important part of Middle Ganga Plain under the regional classification by Prof. R.L. Singh (1971) in his famous edited book 'India : A Regional Geography' As per the regional classification by Prof. R.L. Singh Mithila Plain roughly covers Darbhanga and Tirhut Division and Parts of Munger and Bhagalpur Divisions lying north of River Ganga.

s per Prof. V.N.P. Sinha: "Hemmed in between $25^0$13'45" N to $27^0$30'15" N latitudes and $83^0$19'50" E to $86^0$42'05"E longitudes on an area 26,761 km^2 Mithila plain is bounded by Nepal in north, Ganga river in south, Kosi river in east and Gandak river in the west, having the 283 km east to west length and 152 km north to south width. As per administrative division Mithila Plain includes roughly West Champaran, East Champaran, Sitamarhi, Sheohar, Muzaffarpur, and Vaishali districts of Tirhut Division; Madhubani, Darbhanga and Samastipur districts of Darbhanga Division; Begusarai and Khagaria districts of Munger Division and Naugachhia sub-division of Bhagalpur Division lying north of Ganga river.

Table 1.1: Mithila Plain : Demographic Characteristics, 2011

District	Pop. Growth	% of Total Area	Total Population % 2011	Density per km^2 (2011)	Rural Pop. % 2011	Urban Pop. % 2011	Sex Ratio (2011)
W. Champaran	28.89	5.55	3.78	750	89.96	10.04	906
E. Champaran	29.01	4.21	4.90	1281	92.15	7.85	901
Sheohar	27.32	0.37	0.63	1882	95.72	4.28	890
Sitamarhi	27.42	2.44	3.29	1491	94.42	5.58	899
Madhubani	25.19	3.72	4.31	1279	96.32	3.66	925
Darbhanga	19.00	2.42	3.78	1721	90.31	9.69	910
Muzaffarpur	27.54	3.37	4.60	1506	90.17	9.83	898
Vaishali	28.58	2.16	3.37	1717	93.35	6.65	892
Samastipur	25.33	3.08	4.10	1465	96.54	3.46	909
Begusarai	25.75	2.04	2.85	1540	80.81	19.19	894
Khagaria	29.46	1.58	1.60	1115	94.74	5.26	883

Source : Census of India, 2011 (Quoted from 'Bihar Ka Bhoogol', Sinha, V.N.P. et.al., 2014, p.378)

Some Geographers treat Mithila Region extending between Ganduk River in the west and Mahananda River in the east and, hence, they include the Kosi Division including Supaul, Saharsa and Madhepura districts and Purnia division including Purnia, Katihar, Araria etc. districts.

OBJECTIVES OF RESEARCH

The main objectives of this research project are to assess the loss and dangers caused by natural hazards and application of Geomatics, Remote sensing and GIS in natural hazard mapping and management for Mithila Plain Region of North Bihar and to popularize the Geomatics in the use of sustainable planning.

RESEARCH HYPOTHESIS

K**erlinger** (1986) defines hypothesis "as a conjectural statement of the relation between two or more variable. Hypothesis are always in declarative sentence form and they relate either generally or specifically variables to variables."

B.W. Tuckwan assumes that a hypothesis could be defined as an expectation about events based on generalization of the assume relationship between variables.

In this research project this hypothesis has been elaborated and tested that if the speedy and accurate information pertaining to natural resources and natural hazards be procured with the help of Remote Sensing, Geographical Information System (GIS), Global Positioning System (GPS) and Geomatics, the risk of natural disasters like floods, draughts, cyclones, earthquakes and landslides may be minimized in the disaster prone Area like Mithila Plain. Simultaneously there may be a better management of resources for sustainable development in the region.

APPLICATION OF GEOMATICS

Geomatics is gaining momentum in studies of geospatial and geoinformatics science. Now its application is spreading in different fields of life and society. The development of natural resources and keeping the natural and social phenomena in the normal tune of humanism is done through the use of

Geomatics. Applications areas of Geomatics include: The Environment, Land management and reform, Urban Planning, Infrastructure Management, Natural resource monitoring and development, Coastal Zone management and Mapping. Archaeological excavation and Survey for GIS applications and Disaster informatics for disaster risk reductions and response.

Natural resources are distributed spatially across large areas. The interactions between different natural resources and human beings who use and manage them are tremendously complex. Human population growth is taxing the earth's abundance as never before. This explains why natural resources professional were among the first to exploit computer technology for spatial data management and analysis . Modern techniques geographic information systems (GIS) provide incredible power for collecting and manipulating spatial data, and for communicating the results information to a variety of audiences. Massive quantities of natural resource related spatial data are readily available , and have fueled the explosion of GIS applications in natural management in many countries of the world . Responsibility of man to ensure that the way the resources are used today does not compromise their availability for tomorrow; this is a paradox. Man needs to use the resources in a way that enhances livelihoods of people today, and ensures that the resources remain to be used tomorrow, not just by the present generation but also by subsequent generations. Sustainability in this context involves successful management of resources for agriculture to satisfy changing human needs, while maintaining or enhancing the quality of the environment, and conserving natural resources. What mechanisms are available to ensure that natural resources are being used sustainability, and not destructively? That is a primary question for research.

METHODOLOGICAL APPROACH

For the research data collected from primary and secondary sources. Primary sources of data, collected from certain selected sample villages and obtaining the data from the flood affected, earthquake affected, drought affected families through questionnaire and schedules. Secondary sources of data, collected through by visiting to Remote Sensing Institute of Dehradun, New Delhi, Varansi, Pune and other related places and obtained Remote Sensing, GIS, GPS maps, data and other relevant things.

Data collected from primary and secondary sources have been tabulated and analysed with the help of statistical methods. Remote Sensing and G.I.S. maps have been procured and analysed with the help of internet and computers and relevant conclusion have been drawn for the upkeep and management of resources of the study area for sustainable development.

It is well known that flood is the most important, threatening and devastating natural disaster of North Bihar in general and Mithila Region in particular and hence, attempts have been made to scene application of Remote Sensing and GIS for flood management of Mithila Region.

Advancements in the remote sensing technology and the Geographic Information Systems (GIS) help in real time monitoring, early warning and quick damage assessment of flood disasters. A Geographic Information System is a tool that can assist floodplain managers in identifying flood prone areas in their community. With a GIS, geographical information is stored in a database that can be queried and graphically displayed for analysis. By overlaying or intersecting different geographical layers, flood prone areas can be identified and targeted for mitigation or stricter floodplain management practices. Remote Sensing can be very effective for flood management in the following way:

Detailed mapping that is required for the production of hazard assessment maps and for input to various types of hydrological models. Developing a larger scale view of the general flood situation within a river basin with the aim of identifying areas at greatest risk and in the need of immediate

assistance.Remote sensing and GIS technique has successfully established its application in following areas of flood management such as flood inundation mapping, flood plain zoning and river morphological studies

FLOOD INUNDATION MAPPING

Flood mapping during the flooding and flood plain mapping after the flood recedes is essential. One of the important information required is the nature and extent of the damage caused by floods in the flood prone areas. Satellite remote sensing provides synoptic view of the flood-affected areas at frequent intervals for assessing the progression and recession of the flood inundation in short span of time which can be used for planning and organizing the relief operations effectively. Remote sensing can effectively be used for mapping the flood-damaged areas. For mapping purposes, a pre-flood scene and a peak flood image would be compared to delineate the inundated area. Flood inundation maps can be used:

- To define spatial extent of flood inundation.
- To identify the worst flood affected areas.
- To evaluate impact of flooding on environmental concerns, such as, coastlines, forests, open space etc.
- To plan relief operation.
- To assess damage.

Flood Plain Zoning

Flood hazard zone mapping can be used as a means of non-structural flood control planning of the flood plain and for making policy decisions to regulate the flood plain development activities. Using historic satellite data combined with hydrological and close contour data, a flood hazard zone map can be prepared for flood prone basins.

River Morphological Studies

River morphology is concerned with the structure and form of rivers including channel configuration, channel geometry, bed form and profile characteristics. Various flood control structural measures such as construction of embankments, channel improvements, raising of villages, selective dredging etc. have been implemented in past to reduce the impact of the flood disaster on human life and property. It is essential to monitor the embankments regularly to identify the vulnerable reaches. Conventional methods of river survey is time consuming and expensive. Most of the flood prone rivers in India change their course after every flood wave eroding river banks. Satellite remote sensing based morphological studies are quite useful in following areas.

- To identify the changes in river course over a time period.
- To identify the erosion prone areas along the river course
- To study the efficacy of flood management structures

The river configuration and flood control works maps can be effectively used to identify the vulnerable river reaches and status of the flood control embankments/ spurs so that necessary measures can be taken accordingly to avoid breaches. The bank erosion maps can be used for planning bank protection works. The study of river configuration will be useful to understand the behavior of the river and can be used for laying physical models.

There is no simple or fool-proof solution to the problem. Various measures or a combination thereof, have to be adopted depending on the situation. For instance, the structural measures have worked well in Delhi (except in the unusually high floods of 1977 and 1978). On the other hand, in states

like Assam, although the structural measures have provided some protection, people have learnt to 'live with the floods'.

Satellite Remote Sensing and GIS techniques have emerged as a powerful tool to deal with various aspects of flood management in prevention, preparedness and relief management of flood disaster. They have greater role to play as an improvement over the existing methodologies. GIS is ideally suited for various floodplain management activities such as, base mapping, topographic mapping, and post-disaster verification of mapped floodplain extents and depths. Remote sensing and GIS techniques can replace, supplement or complement the existing flood management system. Extensive use of these technologies have great prospect in creating long-term database on flood proneness, risk assessment and relief management.

Research Recommendations

The natural hazards induced disaster management becomes, not only a human need, but a compulsion at its most. The present day dimension of disaster implication has expanded many folds both in terms of impact areas and intensity enhancement. This situation may be attributed not only to the lack of management. Pursuits but mostly due to coexistence of management pursuits with mismanagement or management follies. The greatest of the follies responsible for coexistence of management with mismanagement is rooted in the comprehension that disaster are all natural hazards-produced and they are fundamentally human-centric. It is not the natural activities that kill people and lead to colossal damages of the property, but it is the weak if infrastructure which has been created, created by us all around the sectors for achieving larger developmental programmes.

The management of natural disasters scripts the misfortune of mismanagement of regional economic development gains to putting pressure on economic costs. Besides, disaster losses include not only tragic death and losses of materials such as the loss of life, housing, infrastructure but also encompasses indirect effect such as the foreign production of goods, service caused by interruption in utility services, transport, labour supplies, suppliers, or markets, lives lost, social networks disrupted and capital investments destroyed. Post disaster management heavily draws up on fiscal funds meant for long-term developments plans. The issue of disaster management may not be, therefore, read along the acts of pursuing measures of prevention or control over occurrence of natural hazards. Disaster is not only the problem of disaster management per say it is a larger developmental issue for protecting development gaining and making regional development sustainable that is building a sustainable habitat, economy and society for the regional population.

The Mithila plain, an inseparable regional segment of North Bihar plain represents a typical case where strategies for manageable floods hazard-related disaster appear apparently imperative. It has already been emphasised that all the natural hazards, it is floods which cause enormous cause damage to the life and economy. The case of management seems more demanding with the experience that although quite significant flood management works have been in progress during recent years of past decades, it is reported that figures of damages in flood prone basins have increased gradually and prominently.

The formulation and adoption of management strategies with the help of Geomatics needed. Strategies follow certain broad principles and one intended to guide and coordinate the future courses of actions. The fundamental principle underlines that every deliberate action must be conceived and rehearsed in the realm of thought before it can be done. The facts of picturing goals and framing policies provide wings to fundamental principle of management strategy. The goals of floods management may inclusively represent a package of attempts towards :

- Modification in the course and extent of the floods,
- Modification in areas vulnerable to floods,
- Modification in the extent of vulnerability of the habitat, economy and society,
- Modification in the quantum of loss and damage,
- Prevention of danger or threats of disasters,
- Reduction or mitigation of risk contained in disaster.
- Ensuring safety and security against the severity of consequences of disasters.
- Enhancement in preparedness and capacity building to respond with the disaster events,
- Development of a prompt response system facilitating evacuation, rescue, relief, rehabilitation and reconstruction.

CONCLUDING REMARKS

In Mithila Plain floods are a natural phenomenon. Floods of varying intensity have been occurring in all the since time immemorial. However, the ever-increasing occupation of the flood-plains results in huge loss of life and damages, causing the floods to be termed as 'disasters'. The problem is intricate. The solution is equally intricate, if not elusive. The occupation of flood plains continues to increase due to rise in population and economic, industrial and other activities. Consequently, the flood damages also continue to increase.

There is no simple or fool-proof solution to the problem. Various measures or a combination thereof, have to be adopted depending on the situation. For instance, the structural measures have worked well in Delhi (except in the unusually high floods of 1977 and 1978). On the other hand, in states like Assam, although the structural measures have provided some protection, people have learnt to 'live with the floods'.

Satellite Remote Sensing and GIS techniques have emerged as a powerful tool to deal with various aspects of flood management in prevention, preparedness and relief management of flood disaster. They have greater role to play as an improvement over the existing methodologies. GIS is ideally suited for various floodplain management activities such as, base mapping, topographic mapping, and post-disaster verification of mapped floodplain extents and depths. Remote sensing and GIS techniques can replace, supplement or complement the existing flood management system. Extensive use of these technologies have great prospect in creating long-term database on flood proneness, risk assessment and relief management.

If the above recommendation for mitigation and management of disasters in Mithila Plain is followed in Toto the study reason may be relieved of the natural disasters in general and the flood disaster in particular ,and, only then the people of Mithila Plain may see a new horizon of progress and prosperity with sustainable development.

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