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APPLICATION OF GIS IN FLOOD HAZARD MANAGEMENT OF MITHILA PLAIN

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ABSTRACT:
Flood is very common phenomenon of the Mithila Plain. Floods occur in a large scale in this plain. Flood disaster causing huge loss of human lives, properties, crops and infrastructure. However, we don't have any full proof preventive plan for this. With the technological advancement, now we can have relevant data and map with great accuracy and in less time. Instead of traditional methods and rescue programme we can have appropriate, preventive and long term scheme for the flood disaster management. This plan will be based on the natural hydrology of the river basins, adjustment in settlement pattern and constructive measures for the sustainable use of natural resources in the river basin. The paper focuses on the study of various possibilities for the alternative methods for flood management and their applicability in Mithila Plain. It is also examine the potential of GIS to meet the purpose.

KEYWORDS: *Flood Hazard, GIS, Mithila Plain, Remote Sensing.*

INTRODUCTION:

Floods are among the most destructive acts of nature. World-wide, flood damages to agriculture, houses and public utilities amount to billions of dollars each year in addition to the loss of precious human and cattle lives. In majority of cases, 'flooding' is caused by a river over-spilling its banks. This can be due to excessive precipitation, combined with inadequate channel capacity. Over-spilling can also occur due to obstruction in or aggradations of the river bed. Flooding can also result from inadequate water way at rail and road crossings, or when there are encroachments in the flood plain. Flooding can also occur at confluences of streams when the main river is in high stage and backs up into the tributaries and areas there about

The North Bihar plain especially Mithila Plain has experienced more frequent and more severe floods. The severity of flood is human induced, not only by taming river flow un-ecologically but also creating more vulnerability with unplanned and unsafe settlement and land use practices. Every year this plain gets inundated and the losses get increasing. It poses major developmental problem for the agrarian society and the increasing population and shirking resources in rural areas. The problem of unemployment and migration is becoming severe. It is more challenging in the North Bihar plain epecially in Mithila Plain where agriculture is main economic activity.

There are several policies in a line to eradicate or decrease the effect of flood disaster in this plain but like another programmes, the flood management measures have been insufficient as they degrade the river ecology. The major emphasis is given to structural measures, however they have been failed to meet the target. The change in river channel, siltation and increased erosion are some consequences directly related with occurrence of flood.

Recently the issue of sustainable development is the core of all the policies or planning. As unplanned and unsustainable resource uses are in practice, it requires long term planning. The alternative plan requires a proper integration of physical, socio-cultural, economic and demographic data. For this purpose, Geographical information system (GIS) enables the planner to forecast flood conditions and manage the river environment. As data management and map representations tools of GIS helps in exploring new options. Its integration with Remote Sensing, GPS, Cartography, photogrametry civil engineering, data base management systems, earth science enhance the ability for preparing flood hazard map and forecasting. Besides its constraints like technological knowledge requirements, hardware and software requirements, GIS can be very useful to minimize flood hazard in this plain.

MITHILA PLAIN: A GEOGRAPHICAL PERSPECTIVE:-

Mithila plain is consist of the flood plain of rivers descending from the Nepal Himalayas to the Ganga in the South. This plain is described as the Playground of rivers. Its low elevation above sea level, moderate to heavy rainfall concentrated within the monsoon months, huge catchments in the Himalayas combine to make the region vulnerable to severe flood annually. The most important flood producing rivers are the Kosi, the Ghaghra river, the Gandak, the BurhiGandak, the Bagmati, the KamlaBalan and the Adhwara. The Ghaghra and the Gandak, make a natural barrier between the eastern UP and North Bihar. Though the eastern boundary does not coincide with the Mahananda, it follows it for some distance. The mighty Ganga forms the Southern boundary and the base level for the region.

The history of flood in this region is as old as the region itself. In this region flood of normal magnitude occurs almost every year, but severe floods recorded periodically like flood in 1901, 1902, 1904, and 1906. The floods in 1954 were serious in Mithila Plain. Since then floods were also usually severe in 1956, 1960, 1962, 1965, 1967, 1972, 1975, 1978, 1984 and the floods of 1987, 2004, and 2008 break all the previous records. The fluvial process in the main river system of Mithila Plains is always been dynamic and associated with the geomorphologic features and geological history of the region. These dynamic fluvial processes have been associated with erosional and depositional processes along with oscillation of the river courses in this region. Kosi has sifted 112 km. west ward during last 20 years. The Kamla Balan is moving eastward also. The main problem of the flood in this basin is heavy spilling and consent changes in its course. The principle victims of the river are the districts of Madhubani and portions of Darbhanga and Samastipur. Since the beginning of the century the river has sifted its channel several times and has migrated eastwards of 40 kms. contrary to the westward movements of the Kosi.

The role of topography is the foremost for the phenomenon of floods in North Bihar. Topographically the whole of Mithila Plain except the north western hilly tract is almost a dead level surface. The water heads between streams do not seem to exist because during the floods the flood waters of different river basins intermingle. The entire Mithila Plain appears as an inland sea in which rivers descending from Himalayas pour their water. However, the invisible gradient is reflected by the

alignment of the river courses which is generally North West to South west. But an abrupt change in gradient take place where the rivers enter the plains. The change forms a very steep gradient in the mountain to almost zero in the plain result into spilling of flood water from the beginning of monsoon rains.

Another effect of the flat gradient is that the streams or rivers have extreme meandering courses which further reduce their capacity to hold the runoff between their banks. As a result there is a constant tendency of the streams to change their courses by cutting across the meanders during the floods.
Important land use in this plain is producing food grains as it is necessary for the subsistence of human beings. Per capita of land is reduces because of rapid growth in population and partly due to land being put to alternative uses. More and more intensive agricultural practices are becoming the order of the day. Rivers are life veins for the economy for the plain. Due to frequent floods, it poses a developmental challenge. Despite floods occur almost every year, we have not a proper plan to minimize loses.

EXISTING FLOOD HAZARD MITIGATION MEASURES:-

For flood mitigation measures, structural approaches have been given prime importance in India. These measures require engineering ability and bulk investment to modify the natural flow of the river. Investment is in bulk in different projects like to build dams, reservoirs, embankments. These projects predicted to control the flood. But our ability to manipulate nature from catastrophic flood is limited. Structural measure often degrades the natural hydrology of the river. While planning for structural measures the river ecology and other natural resources are hardly taken into account. But it is well shown that these structural measure increases the flood frequency and vulnerability.

Now a day due to the traditional measures the loss on human lives and infrastructure or economy increases. These damages in turn have been aggravated by the complete lack of flood awareness of the mass people and lack of knowledge and will to minimize the immediate loss posed by flood. The present approach has many drawbacks.

1. Planning is based only on problems solving attitude, problem understanding attitude is missing.
2. Present approach is curative instead of preventive.
3. Natural flooding process ignored and they are moreover wait and see kind of manifestation.
4. Emphasis on short term relief measures.
5. Structural measures do not change the behavior of individual or collective human; they create lack of awareness of risk in affected population.
6. Planning for flood risk area only. This increases further demand of flood proofing structure in river basins.

   The role of GIS and Remote Sensing in existing flood mitigation procedure is very limited. Despite our technological ability we have very few example of flood management using these tools. Hardly hazard maps are created and decision has been taken accordingly. Land priority maps one not created for the flood plain. Even in prediction and emergency actions, our planners use conventional and time consuming methods.

NEED OF ALTERNATIVE PLAN:

The experience say that the structural mitigation measures are failure to control the flood situation and due to increasing trend of population the vulnerable individual to flood also increasing day-by- day. The frequency of the flood is generally annual, thus problem persist with not much change in the situation. An alteration plan must be needed for the better planning for flood disaster management in this Mithila Plain.

The Mithila Plain is densely populated and none of structural measure can change the flood situation in this region. This regular flooding compelled we to think something different from structural measure that is non- structural measures. Intensive land use and population pressure requires the fundamental shift in thinking. It includes change in settlement plan, land distribution and interdisciplinary

approach to go ahead with development and preserving river ecology hand in hand. Government involvement directly requires in the planning process for an alternative plan. This plan would be based on study of the floods and flooding on a basin wide scale, and accordingly, further trans-basin co-operation. Its more focused on reduces flood related risks. Now the time will come to integrate the ecological value and flood control measures to active disaster free society and sustainable ecological values.

To achieve the aforesaid goals it is necessary:

- To take action on a micro to macro level.
- To establish contribution from the side of water management, master planning and urban development, nature protection, agriculture and forestry, public and private enterprises.
- To start to think that floods are related with a range of land use, water resource and environmental problem rather than simply an engineering problem.
- To be ready for the change in conventional method and fundamental approach to adopt long term and more effective flood mitigation plan.

Now the era of water development is over and water management era ready to meet the sustainable solutions of flood hazard.

GIS and Remote Sensing for Alternative Mitigation Measures:

To mitigate the flood disaster both short term and long term planning is required. GIS and Remote Sensing can play important role at all levels of plan formulation and implementation for alternative measures.

Distributed hydrologic modeling at the scale of large river basin is a very useful tool to understand the causes of floods. Physically based modeling for the large river basin requires large input data and man power which is time consumable and there is much more chances of irregularity. Therefore, a GIS is a very useful tool to model because of its advantages of data storage, display and maintenance.

With the network of meantime monitoring, India has better facilities to integrate various information and quick assessment of flood. The data from diverse background are required to construct flood hazard map, land development priority map for long term adjustment plans. High resolution satellite images, real time weather monitoring and spatial analysis using GIS tools, enable planners to have comprehensive data base for the purpose. Indian Remote Sensing (IRS) satellite series are very useful for the flood information and can be use to estimate the inundated area. Data from National Oceanic Atmospheric Administration (NOAA) also can be use for the purpose.

The North Bihar Plain especially Mithila Plain where the stress is increasing over the land, the proper attention is required for the natural resource management, which will go simultaneously with flood mitigation measures. To meet this purpose, conventional and new methods like GIS, RS data integration is required. This integration provides a digital representation of hydrological characteristics, socio- economic structure, natural resource potential and inherent development problem of the river basin. The spatial impact of alternate plan can be evaluated with the use of GIS for the selection of appropriate development plan.

GIS oriented system handle the flood forecasting services. This includes:

1. Real time data base management including telemetric collection.
2.Real time collecting and manipulating spatial data and for communicating the result information to a variety of audience.
3. Real time forecasting of water level and flood extent.
4. Post-processing of results and formulation of flood warning.

5. Dissemination of flood warning and flood information to end users through media.

Continuous monitoring and GIS analysis can help decision support system for flood plain planning. For the management of flood disaster both the structural and non structural measures both are needed. Structural measures are those which involve the construction of engineering works such as reservoirs, dams, embankments, drainage channel, bridges, and other infrastructural developmental works. As indicated earlier, an increasing stress is now laid on the non structural measures.

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 etc.

1. Flood plain management:-The best thing would not to occupy the flood plain but in this densely populated region it is not possible. Floods are both blessing and curse. Proper flood plain management helps in reducing the curse while retaining the blessing.
2. Flood plain zones:-Flood plain zoning is the process of classification of areas liable to floods of different frequencies in vicinity of a river. Using historic satellite data combined with hydrological and close contour data, a flood hazard zone map can be prepared for flood prone basins.
3. Flood inundation mapping:-Mapping of flooding area during flood as severe affected area and mild affected area is needed for the planning for relief works and for future planning and effect on environment.
4. Existing flood control vulnerability identification.
5. Analysis of river morphology and channel management:-By this we can study the changes in the river course over a time, to identify the erosion prone area along the river course, to study the efficacy of flood management structure.
6. Flood forecasting.
7. Flood damage assessment.
8. Rehabilitation and land reforms.
9. Flood proofing.
10. Disaster management.
11. Flood insurance and etc.

These measures must be taken in view for preparing of flood disaster management in longer term. The capability to handle large set of data, time efficiency and visual presentation are some advantage of the GIS techniques, which makes it appropriate for regional planning. Flood conditions also provides a golden chance to execute the land reforms, which has not done properly till now. Thus long term perspective have long lasting positive impact on society also.

REQUIREMENT AND CONSTRAINTS :

Though GIS provides a suitable platform for data integration and it is appropriate for planning purpose, there are some requirements and constraints, while using GIS for flood mitigation planning in North Bihar specially in Mithila Plain. These are:-

1. Lack of knowledge- This is a new branch of science and a complex subjects which requires high level of scientific knowledge for data collection and processing. But the region is illiterate in this field.
2. Lack of suitable Equipments- There is lack of economic resources in North Bihar plain. The computer based mapping is not feasible in that condition.
3. Organization and co-ordination- A proper organization is required for a long term planning in this region. Coordination between various departments is needed but still it is not seen in even the disaster time.
4. Data collection and Data accuracy- The accuracy of data is depends on the skilled persons which lacks here and also the data is manipulated by the administration and even by the state government.
5. Political will- The most important factor is political will, GIS researches are very rich in country but due to lack of awareness at political level plans are still plans.

CONCLUSION:

The proper planning is required for the Mithila Plain to eradicate the losses caused by catastrophic floods regularly. The structural measures are not coping with the flood disaster in this region, so that another method mean non structured measures based on the GIS and Remote Sensing is required for the long term planning. The alternative plan is also based on the study of river hydrology and human socio-economic behavior. Further spatial and statistical analysis can suggest the appropriate land use in flood plain. The land use planning should be based on hazard maps and proper allocation of natural resources.

For using of GIS technology in the region we should also ensure the feasibility in existing socio economic condition and administrative behavior. The alternative plan requires a massive change in the thinking of policy makers and a committed and positive political will.

Flood plain may be used in such a manner that the benefits of using them would exceed the damage due to the floods.

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