GEOSPATIAL TECHNOLOGY IN HUMANITARIAN MAPPING – A CASE STUDY OF KOSI RIVER FLOODS: 2008, INDIA

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Abstract:

Natural disasters are inevitable and it is almost impossible to fully recoup the damage caused by the disasters. But it is possible to minimise the potential risk by developing disaster early warning strategies, prepare and implement developmental plans to provide resilience to such disasters and to help in rehabilitation and post disaster reduction by using highly sophisticated Geospatial tools. In recent years Geographic information systems (GIS), global positioning systems and remote sensing have been increasingly used in humanitarian emergencies for hazard, vulnerability, and risk assessments; rapid assessment and survey methods; data and programme integration; programme monitoring and evaluation. The main use of Geo-spatial technology in these areas is to provide maps for decision-making and advocacy. India is one of the worst flood-affected countries, being second in the world after Bangladesh. The plains of north Bihar are one of the most susceptible areas in India, prone to flooding. A case study on Koshi River Floods: 2008 in Bihar helps to understand the utility of use of Geospatial technology during humanitarian emergencies for humanitarian organizations.

About the Author:

Presently working with International NGO Agency For Technical Collaboration and Development (ACTED is an independent international, private, non-partisan and non-profit organization that operates according to principles of strict neutrality, political and religious impartiality, and non discrimination. Based in Paris, France, ACTED is having 150 projects spanning 8 sectors of intervention; including emergency relief, food security, health promotion, economic development, education & training, microfinance, local governance & institutional support, and cultural promotion) as GIS Specialist (Responsible for GIS projects in India). Master Degree in Geography and PG Diploma in Remote Sensing and GIS. She has 9 years of professional experience with both national and international projects on Geospatial application.
Introduction:

Floods are among the most destructive acts of nature. World-wide, flood causes damage to agriculture, houses and public utilities amount to billions of dollars each year in addition to the loss of precious human and cattle lives. India is no exception as far as floods are concerned. Severe floods occur almost every year in one part of the country or the other causing tremendous loss of life, large scale damage to property and untold misery to millions of people. Floods mostly occur in the country during the south west monsoon period spread from June to September, though cyclonic storms are common during October to December.

Application of gis & remote sensing during humanitarian emergencies for flood management:

Advancements in the remote sensing technology and the Geographic Information Systems (GIS) help in real time monitoring, early warning and quick damage assessment during humanitarian emergencies. In flood management, Geospatial tool can assist the floodplain managers in identifying flood prone areas. In GIS, geographical information is stored in a database that can be queried and graphically displayed for analysis. In humanitarian mapping different thematic layers is being overlaid, for identification of flood prone areas and targeted for mitigation or stricter floodplain management practices. On the hand Remote Sensing data 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 for humanitarian agencies which is useful for them for decision making and advocacy.
  - Flood inundation mapping,
  - Flood plain zoning
  - 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 for 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 surveys are 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
Role of GIS & remote sensing in humanitarian mapping: a case study of Kosi river floods – 2008:

During humanitarian emergencies the immediate need is to relief and rescue. To undertake relief work in the flood affected area it is necessary to have better planning and management. In this scenario Geospatial tool is the best tool to understand the actual ground reality. This present study on humanitarian mapping by ACTED in joint collaboration with Sphere India during Kosi river flood has proved the effectiveness of this technology among the humanitarian world.

Kosi is a tributary of river Ganga which flows from Nepal to Bihar, its catchment area is approximately 69.300 Square Km. in Nepal. It traverses from the west of the Kanchanjanga Hills of Nepal to Bhimnagar and enters the plains of Bihar. Thereafter, it flows through the plains of north Bihar and joins the Ganga River near Kursela, after traversing for 320 km from Chatra. The Kosi River (The Sorrow of Bihar) is well-known in India for rapid and frequent avulsions of its course and the extensive flood damages it causes almost every year. The flow of river contains heavy siltation, resulting in changing the course during previous centuries in between Purnia district in the east and Darbhanga and Madhubani districts in the west. Owing to this, it becomes the cause of devastation in the whole of the north Bihar. In 1963 a barrage was constructed over the river to regulate Kosi. To check the lateral movement as well as for flood control, embankments on both sides of the river were constructed, five to sixteen km apart. Due to the flow of silt every year in the river Kosi the bed level of the river has become higher than the level of land outside the embankment.

Last year on 18th August, 2008 a breach occurred at 12th Km from Kosi Barrage. Widening the breach, the river started flowing in a new course. At that time the discharge of water was 1.66 lakh cusec in the new course as against only 25.744 cusec in the usual course. In this new course, the breadth of the river was 15 to 20 km and length was 150 km from north to south. The damage started occurring in approximately 3000 sq km area due to this new course of the river. Houses schools, roads, hospitals all were damaged due to the flow of the river. The total population of 33, 45,545 living in 993 villages of 412 panchayts 35 blocks of 5 districts was affected. A total of 239 humans and 1232 animals lives were lost.

**Humanitarian mapping**

**Step – I**

In humanitarian emergencies maps are required to visualize, understand, plan, coordinate and monitor a humanitarian crises and responses to it. To support the relief and rescue operation ACTED jointly with Sphere India did flood inundation mapping. Flood inundation maps are required to understand the extent of flooding. 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. In 2008 flood, Kosi River change its course. ACTED used pre and present MODIS data

- for zoning the flood affected area
- to identify the shifting of river course
- the detailed geographic extent of the crisis area
Flood inundation map help the agencies to select their intervention area based on the severity of the flooding in the affected area.

**Step – II**

In the second step, humanitarian agencies require information on the location of the relief camps to distribute relief items based on the need of the affected people. ACTED and Sphere identified and mapped the location of relief camp with relation to different zones of flood affected area. To prepare this map multiple thematic layers was used. Location of camp was shown by using point symbol and name of the camps including the no of people are staying there are shown in the map in tabular format. Information on camp locations was collected from local Government authority. Different thematic layers were overlaid to project in the map.

![Location of Relief Camps - Supaul District](image)

**Step – III**

In the third step humanitarian agencies require information on the response which means which agency is doing what and where. The response map is commonly known as 3 W map. 3 W map is one of the most important information for a humanitarian agency for decision making and further planning. 3 W map helps to develop coordination among agencies. ACTED prepared response map by overlaying different thematic layers and information on the agencies activities were shown in the tabular format.
Conclusion:

This study cite an example to the humanitarian world that geospatial technology act as a best decision making tool due to following reason during humanitarian emergencies

- good reference to understand the geography of a region where the agencies have no previous experience
- Planning → for a fast response to assessed needs & gaps
- Coordination → avoid overlapping/duplication of interventions by different actors
- Advocacy → helps in raising the profile of the crisis
- to create elaborate and effective Disaster Management Information System (DMIS)
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GIS Software Used: ARC GIS (ArcView) – 9.2