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Management of Floods in Flood Prone Regions of Eastern Uttar Pradesh

Mohammad Usama

Assistant Professor, Department of Environmental Science, Integral University, Lucknow, India

Abstract: Physio-geographic and climatic conditions along with land characteristics makes India one of the most disaster prone countries of the world exposed to different kinds of natural disasters like cyclones, floods, earthquakes, famines, drought, and landslides which are responsible for loss of life and damage to property. Amongst natural disasters flood is one such calamity that is highly recurring event in entire India especially in the state of Uttar Pradesh. Some of the major rivers which create floods in the State are the Ganga, the Ghaghra, the Yamuna, the Ramganga, the Gomti, the Rapti, the Sharda, and the Gandak. Eastern districts of Uttar Pradesh are the most vulnerable to floods in comparson to the western districts and central region .The recurrence period of highly deficient rainfall in Eastern Uttar Pradesh has been calculated to be around 6 to 8 years whereas in Western U.P. it is 10 years. The geographical area of the State is 240.93 lakh hectares and in it about 73.06 lakh hectares is flood prone. According to the Irrigation Department's estimate, protection from floods could be given to only 58.72 lakh hectares annually. This paper deals with chronically flood prone region of eastern Uttar Pradesh "Ballia district" with the risk posed by river Ghaghara and the various structural and non- structural measures adopted for management of floods in these regions. Nowadays space technology too, plays an important role in assessing and monitoring about damage caused by floods and its mitigation measures required for effective flood management.

Keywords: Flood prone regions, Eastern - Uttar Pradesh, Structural - Non-Structural measures, Physio-geographic condition.

I. INTRODUCTION

India, being a peninsular country is surrounded by the Indian Ocean, Bay of Bengal and Arabian Sea is quite prone to flood. According to the report of Geological Survey of India (GSI), 12.5% area of the country is flood prone.The country receives an annual precipitation of 400 million-hectare meters. Of the annual rainfall, 75% is received during four months of monsoon (June to September) and, as a result, almost all the rivers cause heavy floods during this period. Sediment deposition, drainage congestion and synchronization of river floods with sea tides in the coastal plains increases the flood problems. Rashtriya Barh Ayog attempted in 1980 to quantify the area vulnerable to floods at 40 m.ha for the country. Average area affected by floods annually is about 8 million hectares. It has been estimated that 59 lac ha area can be protected by way of flood protection works.

For geographical or seismic reasons, extensive areas in the flood plains of the Ganges and the Brahmaputra river systems continue to remain chronically flood prone. For these reasons, most of the chronically flood prone areas lie in the five States of Uttar Pradesh, Bihar, Assam, West Bengal and Orissa. Bahraich, Gonda, Basti, Ballia, Kushinagar, Siddarthnagar and Ghazipur are most flood-affected districts of eastern Uttar Pradesh (Singh, Gyaneshwar, 2009). Space technology has now emerged as one of the most powerful tool for decision making in flood disaster management and happens to be a critical source of information on flood inundation, progression/ recession and damage assessment. Various satellites having sensors operating both in the optical as well as in the microwave range of the electromagnetic spectrum at different spatial resolutions can be used for obtaining valuable information on flood affected/waterlogged areas (G.S.Purba, Biswajit Chakravorty, Mukesh Kumar). Satellite images provide vital information required by the decision makers at different phases in flood disaster cycle i.e. pre flood (preparedness), during flood (relief and rescue operations) and post flood (mitigation measures).

A .Flood Hazard Vulnerability in UP:-

- Annually about 27 lakh hectare land affected by floods.
- 432 crores of rupees is the estimated annual economic loss due to floods.
- The return period of highly deficient rainfall in Eastern Uttar Pradesh has been found to be 6 to 8 years and about 10 years in Western Uttar Pradesh.

Figure 1: - Flood Prone Areas of India (Source: - www.mapsofindia.com)

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B. Flood prone areas in India:-

Though the north-Indian plains prone to flood more, the "India flood prone areas" can be broadly categorized in three divisions:

- Ganga Basin
- Brahmaputra and Barak Basins
- Central India and Deccan Rivers Basin

C. Ghaghra River (Karnali) :-

Ghagra is one of the major rivers of the northern India originates near the Manasarowar Lake in Tibet. It is one of the important tributary of the river Ganges covering a length of 1080 km and its total catchment area is 127,950 sq km. Rapti, Little Gandak, Sarda and Sarayu are the major tributaries of this river.

D. Causes of Flood in Uttar Pradesh:-

The climate of Uttar Pradesh is subtropical and changes in weather conditions occur with change in location and seasons. Rainfall in the plains is heaviest in the east and decreases towards the north-east.

Uttar Pradesh (districts)	Annual Rainfall (mm)	Causes of floods
Eastern districts	1000-2000	Heavy rainfall, low flat country, high subsoil water level and the silting of beds
Western districts	600-1000	Poor drainage

Table 1:- Causes of Floods in state of Uttar Pradesh

About 90% of the rainfall occurs during the southwest monsoon which last from June to September causing heavy damage to agriculture, life and property mostly in the eastern part of the state, where the rivers originating from Himalaya flow with a very low north-south gradient. The Major Flood Prone Rivers are Ganga, Jamuna, Gomti, Ghaghara, Ramganga, Sarda and Rapti.

Flood affected regions of Uttar Pradesh :-

Flood Affected Regions	Area (lac ha)	Affected Regions
Western Area	35.42 lac ha	Mathura, Agra, Bulandshahar &Badaun
Eastern Area	23.71 lac ha	Gorakhpur, Deoria, Basti, Mau, Balia, Santkabir Nagar, Siddharth Nagar, Maharajganj, Kushinagar, Azamgarh, Gonda & Bahraich
Central Area	6.41 lac ha	Lucknow, Sitapur, Hardoi, Barabanki, Raebareli
Bundelkhand Area	7.60 lac ha	Jalaun, Hamirpur & Banda
Total Flood Affected Area	73.06 lac ha	All Flood Affected Areas of Western, Eastern, Central & Bundelkhand Uttar Pradesh

Table 2:- Flood Affected Area in Uttar Pradesh (Source: Uttar Pradesh, Irrigation Department)

II. EXPERIENCE AND CASE STUDIES

In the Eastern Uttar Pradesh districts like Gorakhpur, Deoria, Basti, Santkabir Nagar, Siddharth Nagar, Mau, Maharajganj, Kushinagar, Azamgarh, Balia, Gonda & Bahraich are severely affected by floods. In this paper we are focusing on devastation caused by river Ghaghra in Ballia district of Eastern Uttar Pradesh**.** If the river is Ghagra (Ganga-Brahmaputra-Meghna basin), they are following flood forecast sites:- Ayodhya (district Faizabad), Chhapra (Saran), Darauli (Siwan), Elginbridge (Barabanki), Gangpur Siswan (Siswan), Turtipar (Ballia).

III. STUDY AREA

Ballia district is the easternmost part of the Uttar Pradesh state and borders on Bihar State. It comprises an irregularly shaped tract extending westward from the confluence of the Ganga and the Ghaghra, the former separating it from Bihar in the south and the latter from Deoria and Bihar in the north and east respectively. The boundary between Ballia and Bihar is determined by the deep streams of these two rivers. The district lies between the parallels of 25º33' and 26º11' North latitudes and 83º38' and 84º39' East longitudes.

IV. METHODOLOGY

The methodology adopted for identification of chronically flood prone areas is "Report on the Development of Chronically Flood Affected Areas of Nation committee on development of Backward Areas" published in 1981 by planning Commission Government of India, New Delhi. Following criteria's are used for identification of the chronically flood prone areas:-

(i) Flood frequency of at least once in three years,
(ii) Flood duration of at least 7 days period at a stretch,
(iii) Flood depth of more than the standing paddy
(iv) Flash floods with strong current liable to uproot plants even if the duration is less than 7 days.

From the last ten years flood record available with Uttar Pradesh Irrigation Department, flood prone areas formed by Ghaghra river in Eastern Uttar Pradesh were identified. For detailed identification of flood prone areas and areas under risk of damage from floods web based (Geographical Information System) framework 'SRISHTI' has been used which is designed by National informatics centre, Uttar Pradesh.

V. RESULTS & DISCUSSION

Ballia district comes under chronically flood prone area as last ten year record from 1998 - 2007 shows that river Ghaghra has crossed the danger level of 64.01, ten times and brought large scale destruction in Ballia region .So, this region can be recognized as chronically Flood Prone area. River: - Ghaghra, Gauge position:-Turtipar, Danger level: - 64.01 For assessing the areas which are at risk from floods from river ghaghra and in proper flood management in Ballia district images from Srishti (GIS) framework like its base map, landuse pattern, geo-morphological condition, drainage pattern, road, rail track, canal etc provide useful help.

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Year	Flood Water (Ghaghra River) District Ballia (Turtipar gauge)
1998	66.00
1999	64.64
2000	64.50
2001	64.41
2002	64.28
2003	65.01
2004	64.84
2005	64.24
2006	64.30
2007	65.04

Table 3: - Showing Year (1998-2007) Maximum Water Level.
(Source: Uttar Pradesh, Irrigation Department)

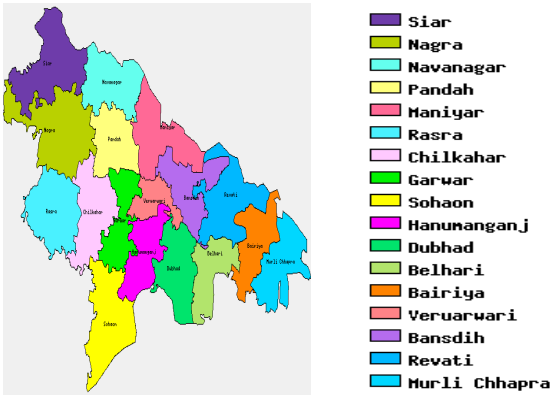

Figure 2: - Base Map of Ballia District Blockwise

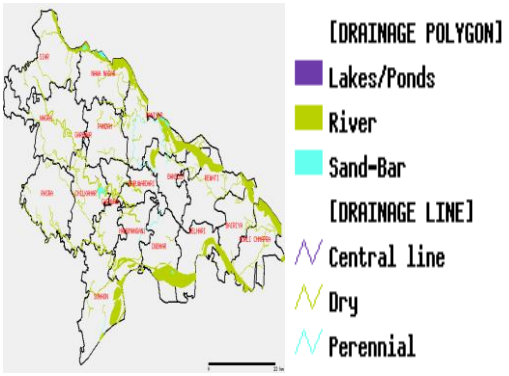

Figure 3: Drainage Line and Polygon (Ballia District)

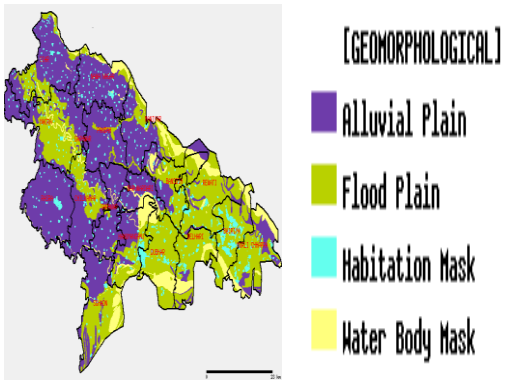

Figure 4: Geomorphological Condition (Ballia District)

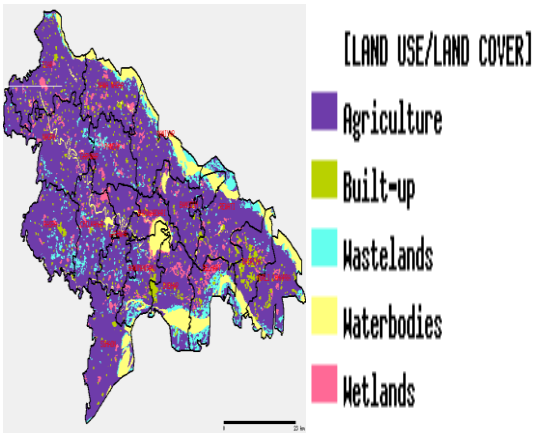

Figure 5: Land use (Ballia District)

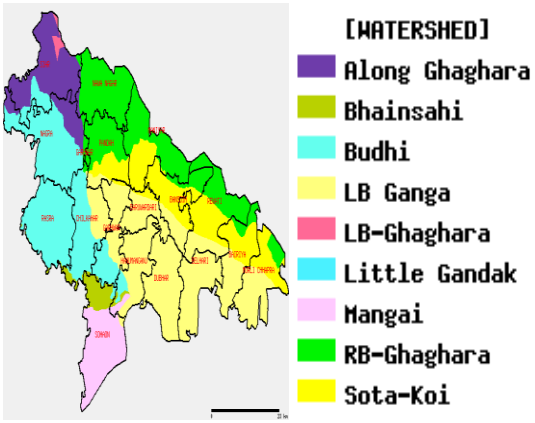

Figure 6: Watershed area (Ballia District)

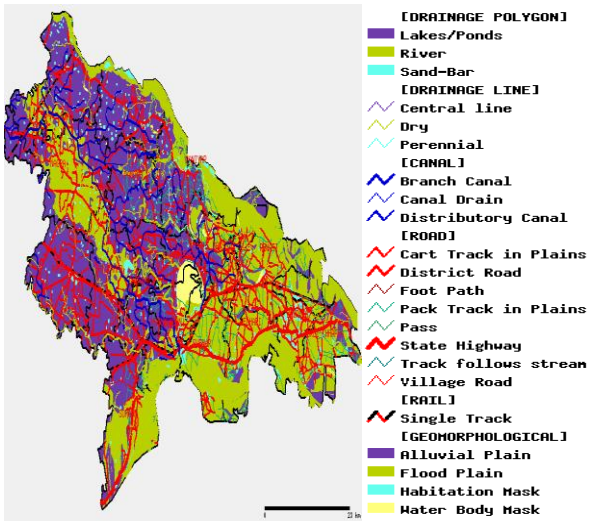

Figure 7: Map showing Geomorphology, Road, Rail track, Canal, Drainage line & Polygon (Ballia District)

VI. FLOOD MANAGEMENT AND MITIGATION IN UTTAR PRADESH

Uttar Pradesh has 294.36 lac hectares land out of which 73.36 hectares is flood prone area. Main flood management programmes so for undertaken in the State are improvement of drainage, afforestation, embankment construction, building reservoirs, and detention basins etc.

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Modification of susceptibility to flood damage through flood forecasting and disaster preparedness. The improvement of river channel is done by increasing the discharge carrying capacity by straightening, widening and deepening. The construction of by pass and diversion channels to carry some of the excess floodwater away from the protected areas. There are 36 marginal embankments on river Ghaghra covering an area of 371.4 Km benefiting 17, 5925 hectares.

Expected Area to get protected from Flood	58.72 lac ha
Constructed Drain (Total)	40225.38 km
Trunk Drains	7081.80 km
Other Drains	58.72 lac ha

Table 5:- Detailed of constructioned Drains for Drainage
(Source: Uttar Pradesh, Irrigation Department)

Realizing the need of vulnerability mapping, as a vital tool for disaster preparedness, the State Irrigation Department has, with the help of UP Remote Sensing Application Centre (RSAC-UP), has started using satellite data for mapping and monitoring flooded areas, bank erosions, embankments, status of water bodies, course of flow of rivers etc; in short, zoning of flood hazard, after flood survey of river configuration, flood routing, protection works and assessment of damage.

Table 6 :- Restoration of Capacity of Trunk Drains & Flood Protection (Source: Uttar Pradesh Irrigation Department)	
Total Length of Drains	40225.38 km
Total Length of Trunk Drains	7080.80 km
Other Drain	33144.58 km
Length of trunk Drains restored upto year 2000-2001	1582.60 km
Progress of Restoration of capacity of trunk drains up to 5/2001.	140.00 km

VII. FUTURE SCOPE OF RESEARCH

Future scope exists in management of floods in the following areas:-

- We can suggest possible areas where in future settlements should be avoided being in flood prone area.
- Remote Sensing can help in disaster identification, response prioritization, damage assessment, inundation monitoring, river course changes and identification of vulnerable zones required for flood disaster management.
- Flood areas inundation period will help in planning the impact of floods on soil and type of crops that could be grown there.

VIII. POLICY RECOMMENDATIONS /SUGGESTIONS

- A number of smaller flood retention reservoirs of suitable capacity should be constructed on or near each river to regulate the ferocity of flash floods down-stream of these reservoirs.
- Remedial measures of the protection of a chronically flood affected area should be to train the rivers on their way to the sea by constructing protective embankments and judicious dredging.
- There should be closer coordination amongst concerned agencies like the Railways, National Highways and State Irrigation/Flood Control Departments in order to ensure that structures like bridges, roads, railways etc. do not intensify flood problems.
- The State should undertake legislation and enforcement agencies should be strengthened to prevent unauthorized river bed cultivation and encroachments into drains etc.
- Flood relief channels should be constructed to drain excess of flood water to remote artificial lakes.
- Structural changes and land elevation should be encouraged.
- Conservation of Soil and afforestation measures in the upper catchment of flood prone rivers should be adopted.
- Maximum utilization of the water resources available in these areas and introduction of suitable cropping methods would help in development of these areas.
- House structure should be strengthened and providing ring bunds are important mitigation measures.
- Landsat Imagery should be used for flood management.

IX. CONCLUSION

Floods is considered as one of the most serious environmental hazards which is drawing planners and government attention towards mitigation measures effective for flood disaster management. The growth of Economy of areas prone to floods is seriously hampered and special measures are required to be taken for their economic development.

Therefore chronically flood prone areas should be treated as backward areas and special status and measures adopted for promoting economic development in those areas. Remote sensing through satellites provides help in correctly identifying flood affected areas, extent of damage caused by flood, monitoring of shift in river, sediment deposition and areas which require structural strengthening (embankments) or non-structural measures for flood control.

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