Flood Hazard Assessment By Multi Criteria of Ghaghara River Basin, Using Geo-Spatial Technology

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Abstract- *Flood is the natural disaster worldwide, and predominant in any plain region, Flood hazard occur due to high discharge during rainfall. The present study aim to identify the flood risk zone based on Weighted Overlay Analysis method using CARTOSAT-1(IRS-P5) Shuttle Radar Topography Mission with the help of GIS 10 software. For the multi criteria Assessment there are Weights assigned of each class. Flood Risk assessment based on different criteria of limited factors such as Annually Rainfall distribution (100-140 cm), Slope of the basin (0-10^{0}), Drainage Density of the river channel (<0.3), Channel Gradient (47-216 m/km), Soil type (loam) of the basin prefer to susceptibility of flood prone areas in the basin.*

I. INTRODUCTION

Floods are persistent natural hazards and affecting many countries therefore it has been classed as natural disaster type in the world Ogah et al. (2013). Flooded leading to drainage by rivers of sediments that invade mainland congestion by rivers, high intensity rainfall, wrong land use planning and the mismanagement of water resources changes the pattern of land use, construction of roads, concrete construction, and unplanned settlements and urbanization and Deforestation, etc.Rachna and Joisy(2009).It has been reported that > 80 Thousand square kilometer of land in India under flood zone and nearly 32 million Indians associated with flood. Based on a central water committee assessment nearly 37 million hectares approximately 1/8th of India's fertile geographical region are susceptible to flooding during the monsoon (Valdiya 2004). Flood Risk assessment based on different criteria such as drainage density, Rainfall, slope, channel gradient, soil, land use and lithology-geomorphology which are Considered for the level of the hazard and it identify Using multi criteria Assessment to Weights assigned evaluate the Risk and assailability of flooding hazard in the basin (Surjit and Kaushik 2012). The intensity and length of the rain are the most influential considerations for flood risks (Ahmed M and Youssef et al 2011).

II. STUDYAREA

Geographically it is lies between 25^{o} 45' to 30^{o}36' N latitudes and 79^{o} 26' to 84^{o} 40' E longitudes (Figure.1). The altitudes vary 7030-216 m in the Himalaya to about 216-47 m in the Ganga plain. The surfaces consist of unconsolidated sediments. Slope of the study area towards North West–South Eastin direction. The climate is humid subtropical and ranges from 80 to 100 cm of annual precipitation. The local temperature varies from 5° to 25°C in winter and from 20°C to more than 40°C during summer (Sinha 2005).

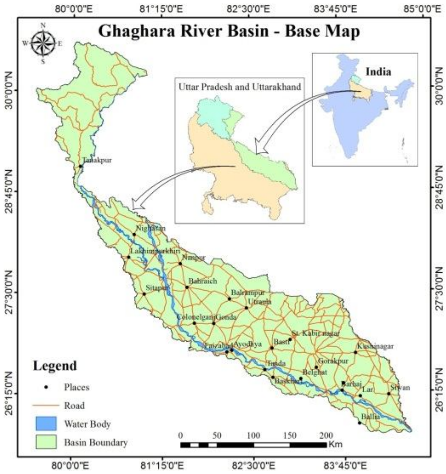

Figure1: Location map of the study area

III. MATERIALSANDMETHODS

The Geospatial technology and toposheets of Survey of India of the scale 1:50,000 have used with the help of GIS 10. The Drainage Density map, slope and Channel Gradient map were prepared by CARTOSAT-1(IRS-P5) Shuttle Radar Topography Mission. The soil map was prepared by digitizing the National Remote Sensing Centre. The Annual Rainfall Distribution map was prepared from Indian Meteorological Department. Flood affected Settlements data taken from the Remote sensing Application Centre, Uttar Pradesh to evaluate the study. After preparing thematic maps weight assignment for each class given rank by factor based on its estimated flooding importance. (Fig 2)

Results and Discussion

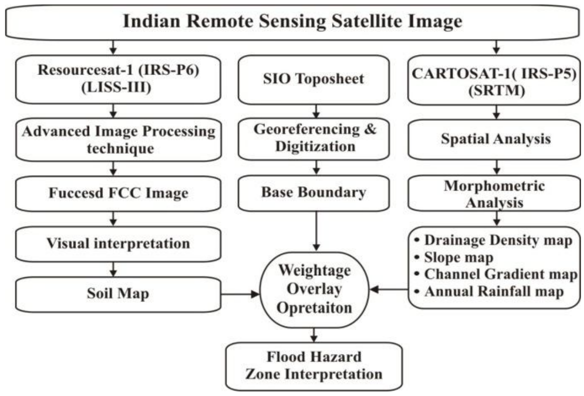

Figure 2: Flow chart of the methodology

A. Rainfall Distribution

Water levels in the river are increasing due to heavy precipitation. When the water level rises above the river banks then water starts overflowing; result ant causes the floods(Nicholls2001). The area receives annual rainfall. 80-200 cm, the average yearly rainfall of the basin isabout140cm and Weights are assigned and Classified into four categories, as shown in (table. 1) the higher weights are assigned to low rainfall trends and lower weights to high rain fall trends. The prepared Annual rainfall map is shown in (Figure.3).

Table 1: Average Annual Rainfall details (Source: IMD, India)

Class	Average Annual Rainfall (cm)	Weight
1	80- 100 cm	I
2	100- 120 cm	II
3	120-140 cm	III
4	140-160 cm	IV
5	160- 180 cm	V
6	180- 200 cm	VI
7	>200 cm	VII

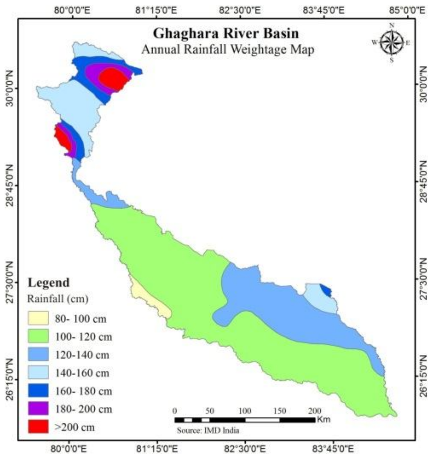

Figure3: Map showingthe Annual Rainfall weightage map

B. Slope

The slope affects the direction and quantity of surface run-off Dai et al. (2002). Slope angle of the basin plays a vital role in directing and distributing surface runoff Ajin et al. (2013), High angle slopes are more prone to surface runoff, while flat terrain is subject to water logging. Slope angle of watershed ranges from 0 to >70, weights are assigned (table. 2). Less value was assigned higher rank due to almost flat terrain while the maximum value was classified as lower rank due to relatively high run-off. The weight assigns to the slope map (Figure.4)

Table 2: The Slope weight details (Source: SRTM DEM, India)

Class	Slope^0	Weight	Intensity
1	0- 10	III	High
2	10- 30	II	Moderate
3	30- 70	I	Low

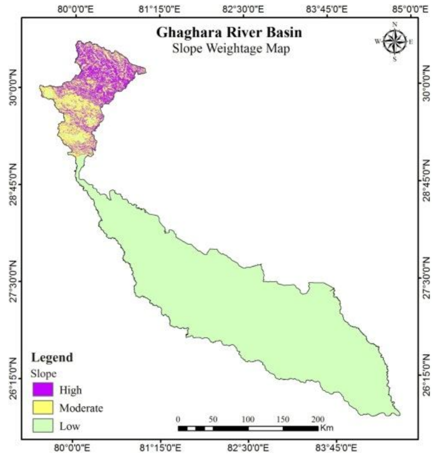

Figure4: Map showing the Slope Weight age Map

C. Drainage Density

Drainage density is the reverse function of infiltration, lesser infiltration of rainfall, which is lead to surface run-off Shiva Shankar et al. (2014). The values of high drainage density are suitable for runoff and therefore imply low flood chances. Higher weights are given to poor drainage density whereas lesser weights assign to higher drainage density (table 3). The weights assigned drainage density map with respect to flooding (Figure. 5)

Table 3: The Drainage Density weight details (Source: SRTM DEM, India)

Class	Drainage Density (m/km sq.)	Weight	Intensity
1	>1.9	I	Low
2	1.5-0.7	II	Moderate
3	<0.3	II	High

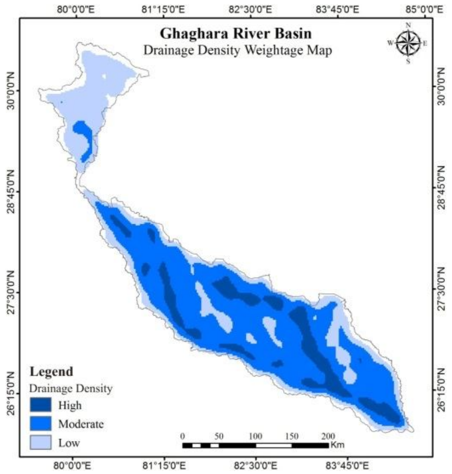

Figure5: Map showing the Drainage density weightage map

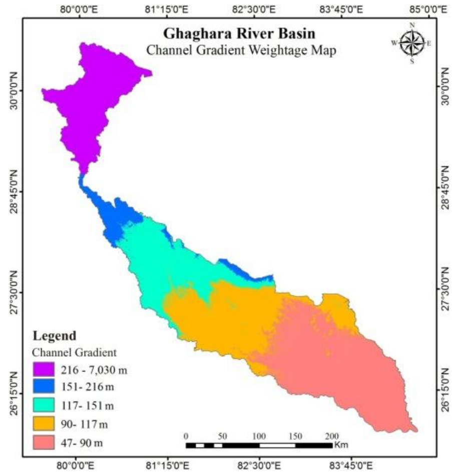

Figure6: Map showing the Channel Gradient weightage map

D. Channel Gradient

There life aspects of the waters he dare associated with three dimensional features involving an area, volume and altitude. It is observed that the mean channel slope decreases with increasing order number Govinda rajuetal. (2015). The Channel gradient value is varying from 47 to7030inthe study area, Higher Channel gradient values are favorable for runoff, and hence indicate low flood chance while lowest value cause to generate flooding in the study area. Higher weights are assigned to lower values of stream gradient and lower weights have been assigned to high values of stream gradient (table4). The weights assigned Stream gradient map with respect to flooding (Figure.6)

Table 4: The channel Gradient weight details (Source: SRTM DEM, India)

Class	Channel Gradient (m/km)	Weight	Intensity
1	47-90	V	High
2	90- 117	IV	High
3	117- 151	III	High
4	151-216	II	High
5	216- 7030	I	Low

E. Soil type

The probability of flood risk increases with reduced soil infiltration capability, resultant increase in surface runoff. When the Frequency of the surface water that exceeds the soil's infiltration capacity, It runs down on sloping ground and can lead to flooding Lowery et al. (1996). Soil was categorized based on infiltration capacity. The soil types Sand, Clay and Loam in the basin include; highly infiltrated, moderately infiltrated and less infiltrated respectively. The weights assign to each soil class (table. 5). The prepared soil map (Figure. 7).

Table 5: The Soil weight details (Source: NRSC, India)

Class	Flood Intensity	Weight	Intensity
1	Loam	III	High
2	Clay	II	Moderate
3	Sandy	I	Low

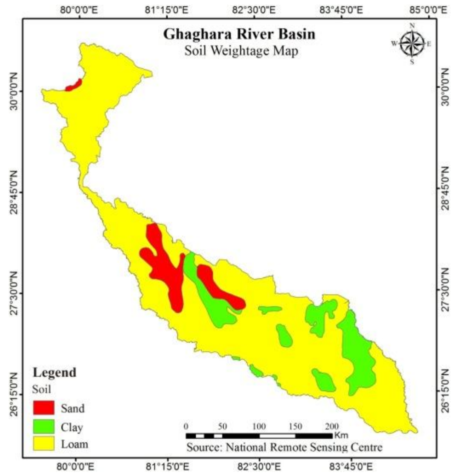

Figure7: Map showing the soil weighted map

F. FloodHazardRiskZone

The frequency of flood in each flood risk area is measured the weight for each contributing factor considered (table.6). The weights of the complete amount factor maps were overlaid. The total weight for calculating the chances of flooding in a specific flood risk area is the sum of each contributing factor pramojanee et al (1997) The selected contributing factors to find the accessibility of the flood and calculated of hazard areas using Raster Calculator in ArcGIS (table.7). The flood hazard map was prepared by giving weightage rank suitable to these contributing factors and helps to prepare the map (Figure. 8a and 8b)

Table 6: The Contributing factors to flood

Sl. No.	Contributing Factors	Weight
1	Rainfall Distribution	V
2	Slope	IV
3	Drainage Density	III
4	Channel Gradient	II
5	Soil type	1

G. Flood affected settlements

List of flood affected nearby settlements along Sharda, Ghaghra andRapti Riverin U.P. during August 2018 to September 2018 report by Remote Sensing Application Centre, Uttar Pradesh, India.Total 468 settlements affected by flood hazard during monsoon season. Include, 30 settlements affected along the Sharda, 108 settlements affected along Rapti River and 330 settlements affected along Ghaghara River.

Table 7: Total Flood Affected settlements details (Source: UPRSAC, India)

Sl. No.	River	Settlements
1	Sharda River	30
2	Rapti River	108
3	Ghaghara River	330
Total catchments		468

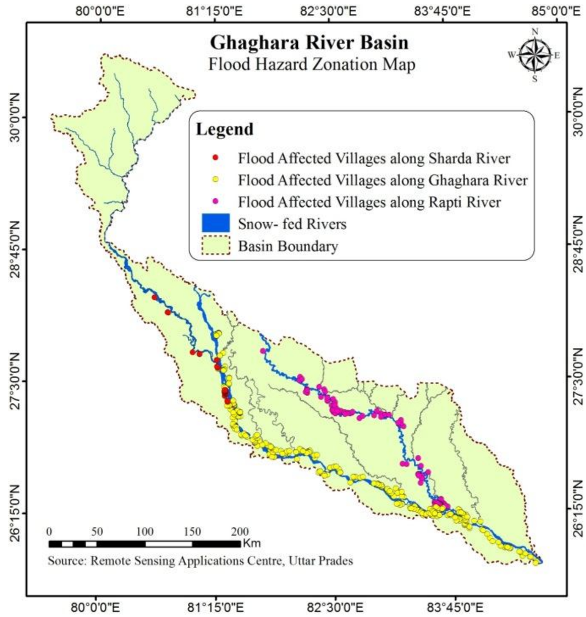

Figure8a: Map showingtheFlood Affected villages along the River

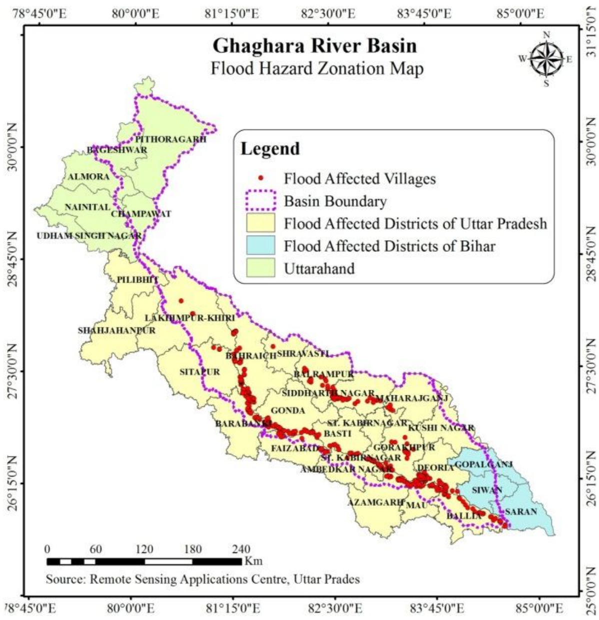

Figure8b: Map showingtheFlood Affected Districts

IV. CONCLUSION

This mapping, modeling and analysis of multiple applications in disaster management. Floods are the natural phenomenon that cannot be avoided, but it's minimizing the hazard. The scale and frequency of floods increase due to climate change, higher intensity of rainfall, mismanagement of the water resources and forests, construction in flood plains and wrong land use planning this decreases their ability to absorb water from floods. Using the flood hazard map, flood prone areas can be detected, which help to planning of development works.

V. ACKNOWLEDGMENT

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