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Flood Vulnerability Assessment and Recommendations for Mitigation for Diphu Municipal Area using GIS Technology

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ABSTRACT: Flood is the abnormal high stages of river flow that overtops the banks of river in any of its reach that inundates the banks and causes tremendous losses and damages to humans and wild life. Flood is the major problem of North-east Indian states causing damages to crops and human lives and livelihood. In this study Diphu, the headquarter of Karbi Anglong district, in the state of Assam in India has been taken as the site of study. Geoinformatics data has been collected by surveying the entire area and maps are prepared using GIS software. The flood risks are assessed and recommendations are made for better preparedness to mitigate the losses due to floods in the area.

KEYWORDS: GIS, Flood Vulnerability, Flood Hazards, QGIS, Diphu, Assam.

I. INTRODUCTION

Flood is the abnormal high stages of flow that overtops the banks of river in any reach and causes tremendous damage to lives and livelihood. It is a natural event that results from excess rainfall due to severe combination of critical hydrometeorological conditions over the catchment [2]. Over the past few decades the nuisance of flood has captivated the lives of many in the state of North East. This study is an attempt to assess the current situation of Diphu, Assam and suggest certain guidelines and recommendations through studying the map prepared using GIS technology.

For the study Diphu Municipality area has been selected which is the Headquarter of Karbi Anglong District in the state of Assam, India. Diphu is surrounded by Jhum controlled forest, reserved forest and settlements. Three major rivers, namely, Baghmara river, Sorsori River and Diphu River passes through Diphu.

GIS based software, QGIS, which is a free and open-source cross-platform desktop geographic information system application that supports viewing, editing, and analysis of geospatial data has been used for analysis of data collected by field survey and recommendations are made based on analysis.

II. THE STUDY AREA

Assam lies in the north-eastern region (NER) of India, covering an area of approximately 78,438 km², extending from 24° 8' N to 28° 2' N latitude and 89° 42' E to 96° E longitude. The elevation of the Assam region ranges from 5-1964 m. The neighbouring states of Assam are West Bengal, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, and Meghalaya. Assam shares its boundary with neighbouring countries, Bhutan in the north and Bangladesh in the south. For the study Diphu Municipality area has been selected which is the Headquarter of Karbi Anglong District in the state of Assam, India. The Diphu city is divided into 10 wards for which elections are held every 5 years. The Diphu Town Committee has population of 61,797 of which 31,898 are males while 29,899 are females as per report released by Census India 2011. Population of Children with age of 0-6 is 6796 which is 11.00 % of total population of Diphu (TC). In Diphu Town Committee, Female Sex Ratio is of 937 against state average of 958. Moreover, Child Sex Ratio in Diphu is around 925 compared to Assam state average of 962. Literacy rate of Diphu city is 89.12 % higher than state average of 72.19 %. In Diphu, Male literacy is around 92.78 % while female literacy rate is 85.23 %. Diphu Town Committee has total administration over 13,388 houses to which it supplies basic amenities like water and sewerage. It is also authorized to build roads within Town Committee limits and impose taxes on properties coming under its jurisdiction [1]. Diphu is surrounded by Jhum controlled forest, reserved forest and settlements. Three major rivers, namely, Baghmara river, Sorsori River and Diphu River passes through Diphu.

Assam experiences flood every year, causing inundation of villages, damages to croplands, loss of livelihood, lakhs of families becoming homeless and affecting the entire NER due to



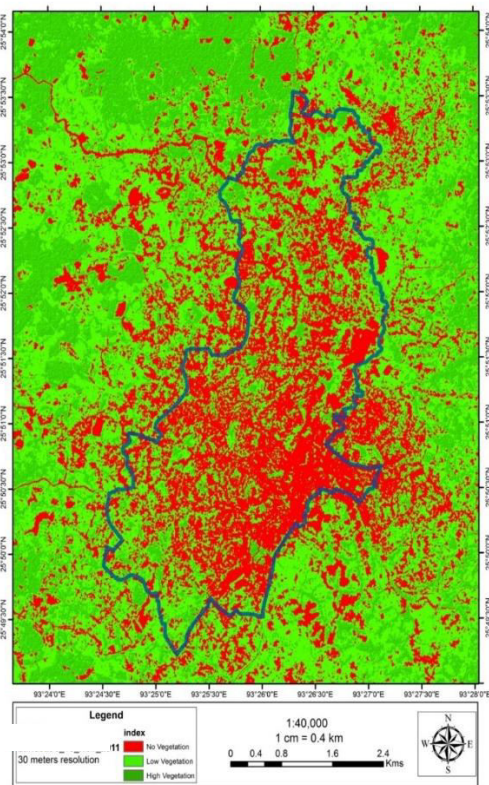
connectivity disruption . According to Rashtriya Barh Ayog (RBA), the total flood-prone area of Assam is 31.05 Lakh Hectares which constitute about 40% of the total area of Assam and 9.40% of the total flood-prone area of India [1]. Hence, flood risk mapping is essential for Assam to facilitate effective flood management practice and planning.

III. METHODOLOGY

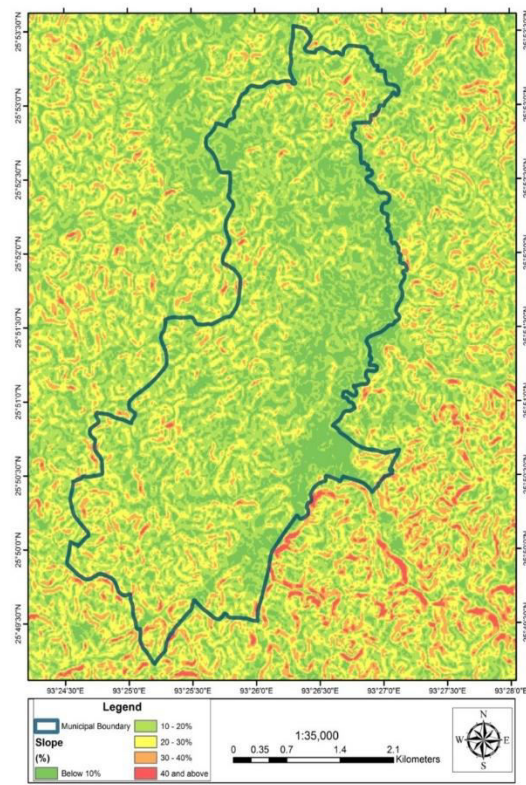
Geo Spatial data and Flood hazard data has been collected by field survey. Ward wise distribution of Infrastructure, population and slope-elevation maps are prepared for the entire Diphu municipality area. Flood level data has been obtained from local Authorities. Data are then combined in QGIS and assessments are made on the problem of flood hazard.

IV. EXPERIMENTAL RESULTS

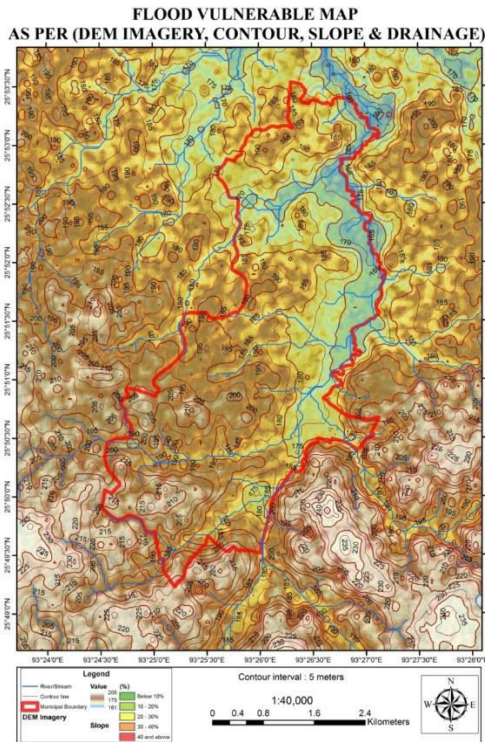
Figures shows the results of GIS based analysis. Figs. 1 (a) shows the NDVI map of Diphu Municipal Town. (b) is the slope and elevation map of Diphu Municipal Town. (c) shows the Flood Vulnerability map based on the slope – elevation and Drainage data of Diphu Municipal Town. (d) shows the flood plain zoning map of the slope and elevation map of Diphu Municipal Town.



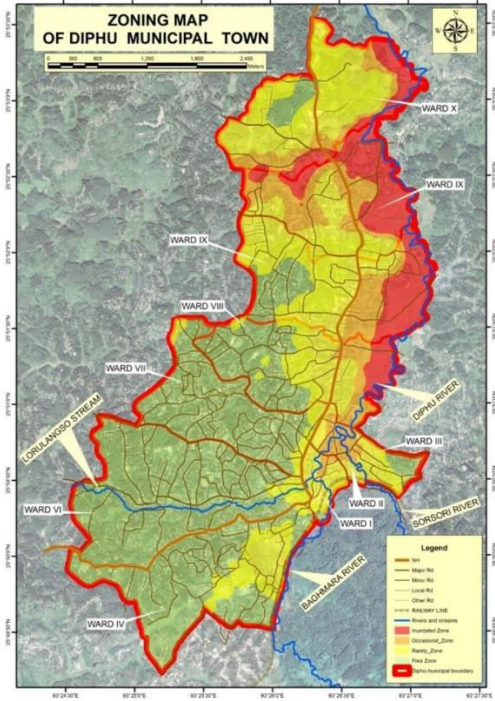
(a)



(b)



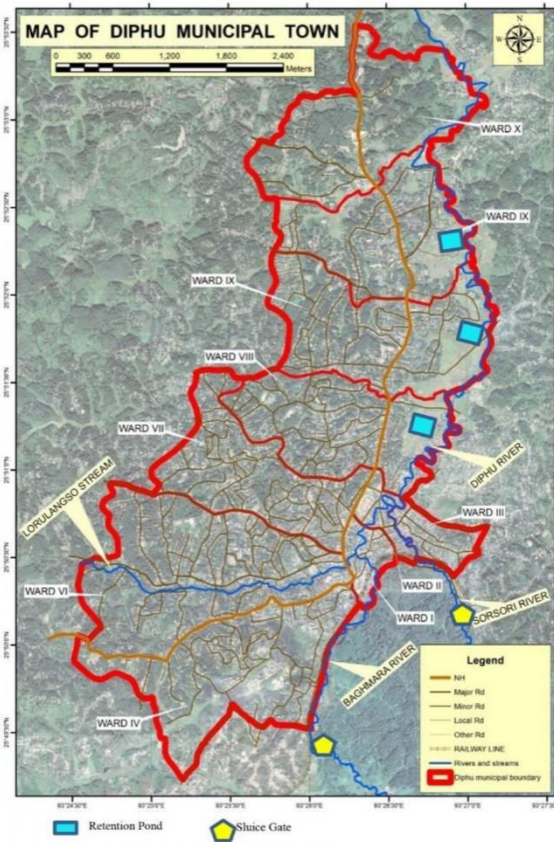
(c)



(d)

Fig.1.(a) NDVI map (b) Slope and Elevation map (c) Flood Vulnerability map (d) Flood plain zoning map

The criteria of elevation and surface slope delineates the regions having different levels of flood hazard. The downstream areas at lower elevation and flat slopes are more prone to flooding than those with high elevation and steep slopes [3]. Fig. 1(b) clearly depicts the slope and elevation scenario of the terrain. The northern side is clearly plain and more prone to flood hazards. Drainage density can be defined as the length of river channels per unit area of the basin, and it represents flow accumulation pathways [2]. The drainage network map of the study area is generated from DEM data using the hydrology tools, and drainage density is calculated by the line density tool in GIS. Proximity to the river channels plays a critical role in flood hazard modelling. During the river's overflow, the river's volume will exceed its drainage capacity, and the water depth in the areas located near the riverbed will increase significantly. The flood inundation will not impact only the nearest river location, but the waterlogging and risk of flood will expand to the surroundings which can be seen in Fig. 1(c). A raster layer is created using the Euclidean distance tool in GIS. Population density data are obtained from the Census 2011 [1]. It directly relates to vulnerability because more people will be exposed to hazardous events in an area with a high population density. The normalized difference vegetation index (NDVI) which is a standardized index allows us to generate an image displaying greenness, also known as relative biomass, also depicts the rich biodiversity that may be affected by the flood-prone area. Based on all the data collected, a Flood Zone Map has been prepared showing the most flood-vulnerable areas in Diphu Municipal Area, Fig. 1(d).



(a)

Fig. 2(a) Flood Mitigation Recommendations

In order to mitigate the flood hazards a few recommendations are made. Since the downstream side of the Diphu River Valley is more prone to floods, Retention ponds are recommended in the appropriate locations as highlighted in the Fig. 2(a). Sluice Gates are also recommended at appropriate locations on the Sorsori River and Baghimara River as highlighted in the Fig. 2(a). In order to prevent loss of life a buffer zone of atleast 200 m should be provided at the banks of the river where no settlement should be allowed by the authorities concerned. River widening and dredging may also be resorted to after proper cost-benefit analysis. Plantation along the buffer aforementioned zone is also suggested.

VI. CONCLUSION

Flood Hazard has been a common problem for North East India for a long time causing harm to life, livelihood and biodiversity. Earlier, Planning and execution was difficulty due to clustered data and lack of reach. But, today with the help of GIS technology, assessment and planning has become fruitful and effective. This study has been an effort to map and assess the flood vulnerable areas of Diphu Municipal Area and recommend certain viable solutions for flood mitigation.

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