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Flood Hazard Zone Mapping of Ghaggar River in Ambala district 2001-2011

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Abstract: Flood is devastating natural hazards which lead to the loss of lives, properties and resources. Remote sensing technology along with geographic information system has become the key tool for flood monitoring, mapping in recent years. The 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. This paper presents a review of application of remote sensing and GIS in flood mapping. The central focus in this field revolves around delineation of flood zones and preparation of flood hazard maps for the vulnerable areas of Ghaggar river in Ambala district through remote sensing and GIS techniques. Create buffer utility of ARC MAP was used to create buffer zones around the river. Flood risk zone were delineated by grouping the polygons of the integrated layer in to different risk zone. The criterion analysis was applied to classify the flood zone map in to three sensitive risk zone classes. Corridors of 500m, 1000m, 2000m, were create around river and cover all land use categories and digitized as polygon data. The study demonstrated the potentials of GIS applications in flood hazard mapping.

Key Words: Flood, Hazard Map, Buffer Zone, GIS,

I. INTRODUCTION

Ambala district of Haryana lies between 30°10': 31°35' north latitude and 76° 30': 77° 10' east longitude. Total geographical area of the district is 1574 sq. km. Administratively this district is controlled by Ambala division. It is divide into three tehsils namely Ambala, Barara, and Naraingarh, and sub divided into six development blocks namely Ambala 1, Ambala 2, Barara, Shahzadpur, Naraingarh,. It is bounded by the district Yamuna Nagar in south-east. To its southern lies Kurukshetra district, while in its west are situated Patiala and Roper districts of Punjab and the union territory of Chandigarh. The Shivalik Range of Solan and Sirmaur districts of Himachal Pradesh bounded the Ambala district in the north and north east. The average altitude from the sea level is 900 feet approximately. Ambala district is comprised in 1574 sq. km. As per 2011 Census Ambala tehsil cover 46.63 percentage, Barara 19.31 percentage, and Nraingarh 28.56 percentage.

A. Objectives

The main objectives of the study are to demarcate the flood affected area and Mapping of flood hazard buffer zone in Ghaggar river through remote sensing and GIS techniques.

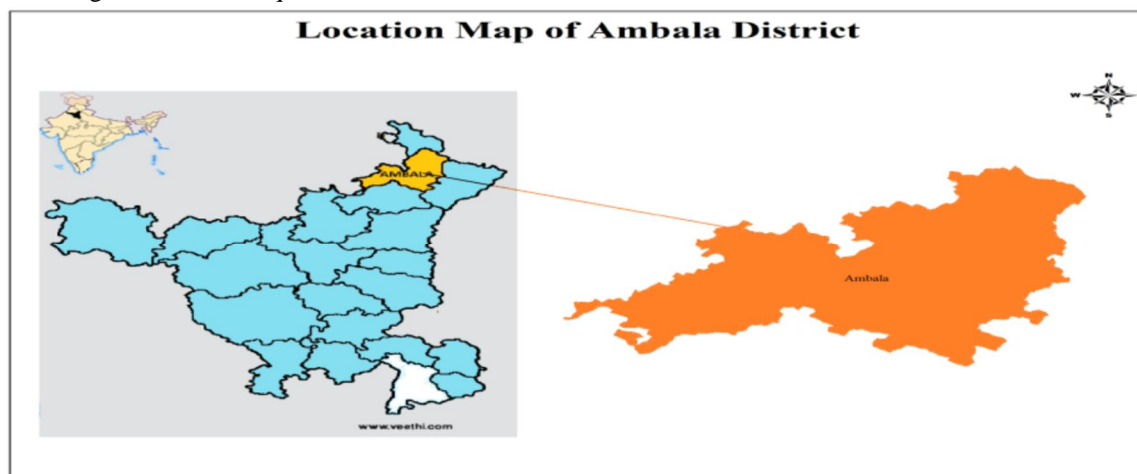


Fig.1.1

B. Data Base And Research Methodology

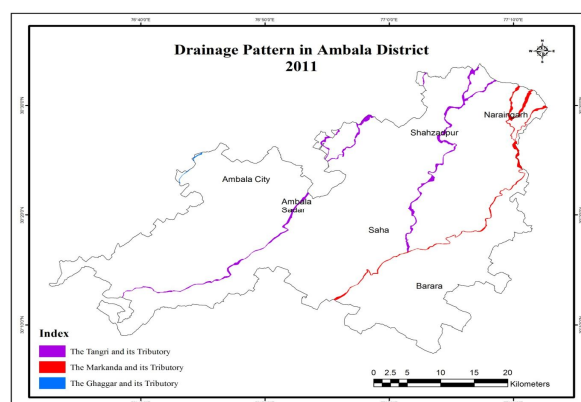
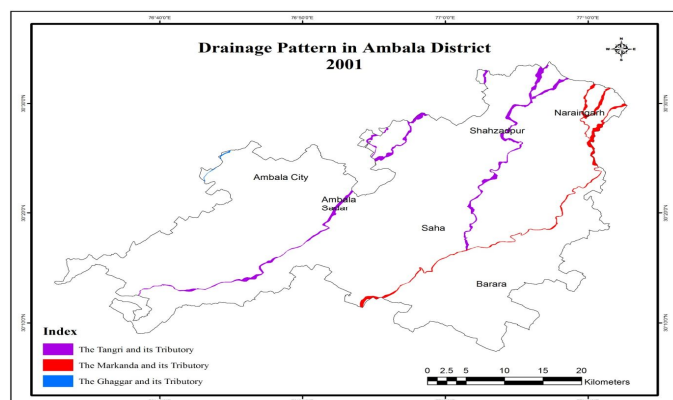
The present study has been carried out utilizing both primary as well as secondary data sets. Primary data includes Survey of India toposheets on 1:50000 scale. For the study, satellite images of Ambala district were acquired for the time period; 2001-2011, LANDSAT TM Satellite Image, 2001, and IRS-P6 LISS-III, for the year 2011 was obtained from (BHUVAN).

C. Drainage Network and Flood Zone of Ghaggar River

The district is mainly drained by non-perennial streams and drainage system of the district comprises the The Markanda, The Tangri, The Ghaggar and its tributaries. The Markanda and the Tangri streams ultimately drain in to the Ghaggar river beyond the territory of the district (Fig 1.1). The Ghaggar along with its tributaries however constitutes an inland drainage basin.

D. Drainage Pattern in Ambala District 2001-2011

This category comprises areas with surface water reservoirs or flowing as streams and rivers. The major part of the alluvial plain to the west of Ghaggar suffers from lack of surface drainage except in the east where the river Ghaggar and its seasonal tributaries drain the area. However there is a plain of the tributaries of the Ghaggar river. All the seasonal rivers like Tangri, Markanda etc, submerge while flowing down in the non-perennial river Ghaggar. River Ghaggar and its tributaries cover the area of 3956.6 ha which was 2.51 percent of the study area in 2001.



Source: Generated from LANDSAT TM Satellite Image, 2001 and IRS LISS III 2011 . Fig. 1.2, & Fig. 1.3

A total area of 3467.59 ha occupied by rivers which is 2.20 percent of the total area in 2011. A net decrease of 501.80 ha has occurred in the rivers located in the study area. Rivers have decreased from 5523.08 ha in 2001 to 5022 ha in 2011. River occupied 3.51 percent of the study area in 2001 which has decrease a total of 3.19 percent in 2011 showing a net decrease of -0.32 percent with an annual rate of decrease of 50.18 ha area.

E. The Analysis of Parameter of Ghaggar Flood Zone

1) **Flood Buffer Zone** : Create buffer utility of ARC/INFO was used to create buffer zones around the river. Flood risk zone were delineated by grouping the polygons of the integrated layer in to different risk zone. The criterion analysis was applied to classify the flood zone map in to three sensitive risk zone classes. Corridors of 500m, 1000m, 2000m, were create around river and cover all land use categories and digitized as polygon data.

- a) 500m Flood Buffer Zone (High Sensitive Zone)
- b) 1000m Flood Buffer Zone (Medium Sensitive Zone)
- c) 2000m Flood Buffer Zone (Low Sensitive Zone)

2) **Flood Buffer Zone 2001-2011**: The land use class of 2001-2011 of Ambala district comes under different buffer zone is given in the table 1.1.

a) **500m Buffer Zone (High Sensitive Zone)**: This zone comes under high risk sensitivity zone. River Ghaggar cover the area of 3021.11 ha area under 500m high sensitive zone of the study area in 2001. Total area 25181.28 ha affected by floods under 500 m buffer zone in 2001. The Ghaggar river occupy 4232.01 ha. and total area comes under high sensitivity zone has 28176.74 ha in 2011.

b) 1000m Buffer Zone (Moderate Sensitive Zone): River Ghaggar cover the area of sensitive zone of the study area. The area comes under 1000m buffer zone is moderate sensitive zone area, 36755.74 ha in 2001 and 44518 ha. comes under 1000m moderate sensitive zone.

Flood Buffer Zone	2001 (Area in ha)	2011 (Area in ha)	Change in 2001- 2011 (Area in ha)
500m (High Sensitive Zone)	25181.22	28176.73	2995.51
1000m(Moderate Sensitive Zone)	36755.74	44518.8	7763.06
2000m(Low Sensitive Zone)	44463.15	52704.5	8241.35
Total	106400.1	125400.03	18999.93

Table.1.1 Generated from LANDSAT PM, 2001, & IRS-P6 LISS III Satellite Image, 2011.

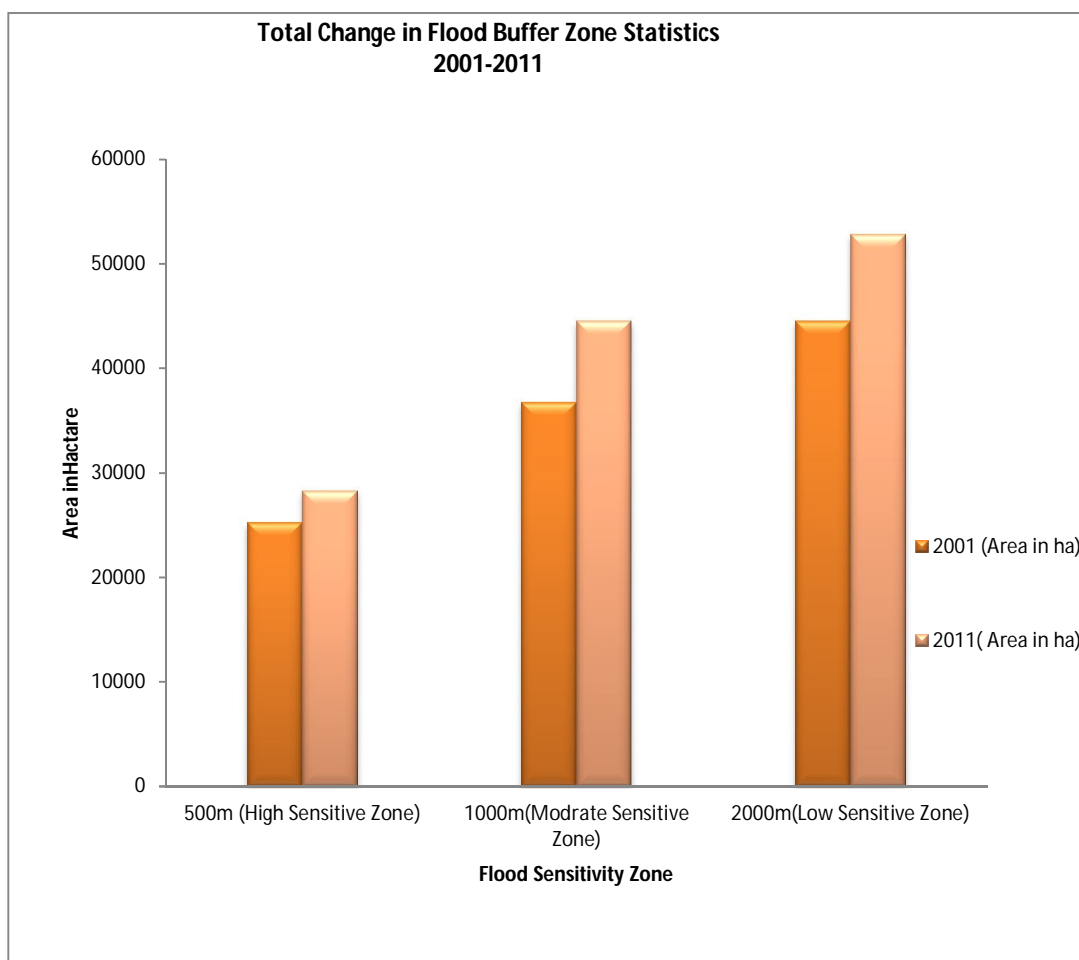


Fig. 1.4 Computed from LANDSAT PM, 2001, & IRS-P6 LISS III Satellite Image, 2011.

3) 2000m Flood Zone (Low Sensitive Zone): This zone comes under low risk zone. River the Ghaggar cover the area of 2986.11 ha area under 2000m low sensitive zone of the study area. Total area 44463.15 ha affected by floods under 2000 m low risk buffer zone. In 2011 this river which has 3495.98 ha area comes under low sensitivity zone. Total area comes under in this zone is 52704.5 ha. in 2011.

F. Total Change in Flood Buffer Zone 2001-2011

The flood buffer zone change that has occurred in the study area from 2001 to 2011 is shown in the table 5.5. The figures given in the table reveal that the highest change has occurred in 2000m low sensitivity zone. Low sensitivity zone of the study area in 2001

which has 44463.15 ha and 52704.5 ha in 2011 showing net increase of 8241.35 ha area. Moderate sensitivity zone has increased from 36755.74 ha in 2001 to 44518.8 ha and net increase 7763.06 ha of the flood buffer zone.

Fig.1.3

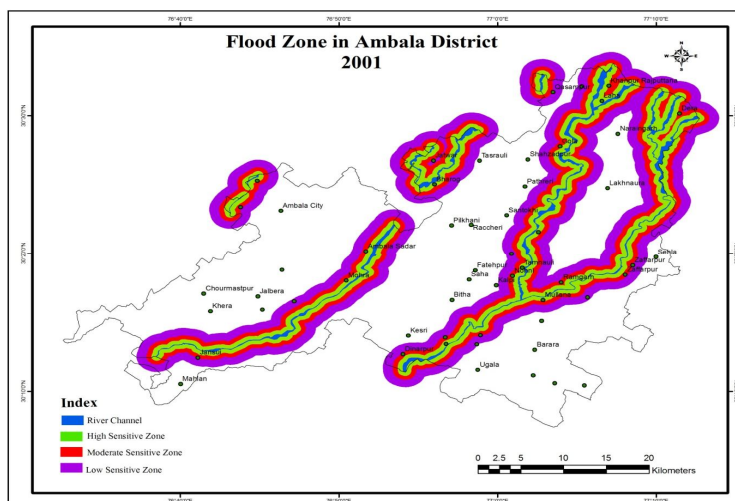
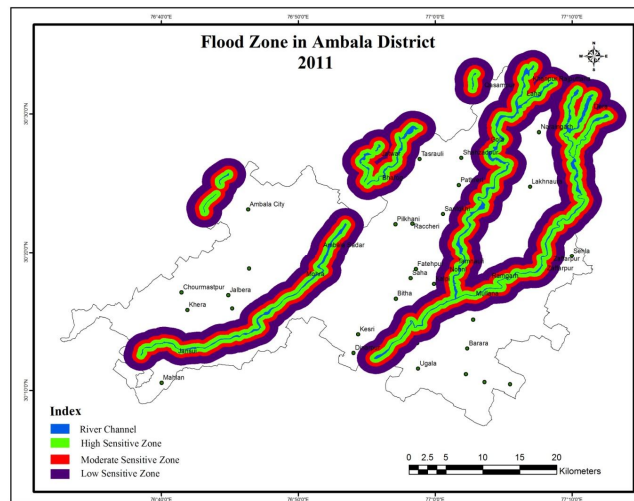


Fig. 1.4



Generated from LANDSAT TM Satellite Image, 2001 and IRS LISS III 2011, Fig. 1.3 & Fig. 1.4

A total area 500m flood buffer zone in the study is witnessing an increasing trend as the total area under it in 2001 was 25181.22 ha and by 2011 it has increase 28176.73 ha area. A total area 2995.51 ha has been increased. Total flood zone of the study area in 2001 which has 106400.1 ha and 125400.03 ha in 2011 showing net change in buffer zone has an 18999.93 ha. A total area 500m flood buffer zone in the study is witnessing an increasing trend as the total area under it in 2001 was 25181.22 ha and by 2011 it has increase 28176.73 ha area. A total area 2995.51 ha has been increased. Total flood zone of the study area in 2001 which has 106400.1 ha and 125400.03 ha in 2011 showing net change in buffer zone has an 18999.93 ha.

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