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ZONING OF FLOOD PRONE AREAS IN THE ERSTWHILE BARPETA DISTRICT OF ASSAM, INDIA

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ABSTRACT

Delineation and classification of flood prone areas in the erstwhile Barpeta district of Assam, Northeast India was made on the basis of the occurrence of flood events in the district during the period 1982-2004. The flood prone areas were delineated on the basis of village level data on inundation. A village was considered as a flood affected village when at least 80% of the total area of the village was inundated. The flood prone areas were classified into low, medium, high and very high flood intensity zones on the basis of the frequency of inundation. The percentage of flood affected villages in the district was 59% covering an area of 1137 sq km (35% of the total area). Out of the eight circles of the district, the worst sufferer was the Baghbar Circle, while the least affected circle was Jalah. The areas of the district belonging to low, medium, high and very high flood intensity zones are 170 sq km, 216 sq km, 409 sq km and 341 sq km respectively. The geographical distribution of the flood intensity zones reveals that it maintains the general relief and slope of the region.

Key words: Flood prone areas, Barpeta district, Frequency of inundation

INTRODUCTION

Delineation of flood prone areas and thereby, identification of the areas vulnerable to flood hazard is very important for better planning and implementation of flood hazard management programmes as well as for the implementation of other developmental projects (Scottish Executive Environment Group, 2004). Only after proper identification of the hazard zones, meticulous planning and precautionary measures can be taken in the high-risk zones to sustain environmental stability of the area.

The basic concept of delineation of flood prone areas is to regulate the land use in the flood prone areas to restrict damage potential. The flood prone areas are required to be developed in a regulated way to ensure that existing hazard and flood damage potential would not increase and new developmental works would not subjected to serious damages. In view of this, the identification and demarcation of flood prone areas belonging to different frequencies of inundation on a large-scale map seems to have great importance. A lot of works has already been done in this line in India and abroad (Rango and Salomonson, 1974; Dhanju, 1976, 1980; Burkham, 1978; Chaturvedi and Mohan, 1983; Jha, 1993; Choubey, 1997; Jain et al., 2005; Lastra et al., 2008).

In the beginning of the nineteenth century attempts were made to draw inundation maps in different parts of the world. Such inundation maps were found in the United States Geological Survey Reports. However, flood hazard mapping and zoning techniques in United States owe to origin and development to the pioneering works of several individuals including Ellis (1969) and Wolman (1971). India being one of the most flood prone countries of the world, the need for flood inundation mapping as well as flood plain zoning is most essential for disaster preparedness and mitigation of floods. It is, however to be noted that the pace of research in this area of vital human concern is rather slow in the country. In this regard, the works of Kayasth and Yadav (1977), Chakraborty (1979, 1991) and Kale (1998) may be mentioned. In Assam, no significant attempts were made to delineate the flood prone areas up to mid-part of nineteenth century. Kar and Goswami (1993) significantly contributed a lot in the field of flood hazard mapping of Assam. Though erstwhile Barpeta district is one of the most flood prone districts of Assam (Agarwal et al., 1998; Rastriya Barh Ayog, 1980), yet no attempt has so far been made to study or to map the flood intensity zones of the district. Here, an attempt has been made to identify different flood prone areas of the district with the help of the flood inundation data for the period 1982 to 2004.

Study area

The erstwhile Barpeta district of Assam, Northeast India has a fascinating diversified landscape, roughly rectangular in shape and lies between 90^{O}40? to 91^{O}20? E longitude and 26^{O}15? to 27^{O}05? N latitude (Fig. 1). The total geographical area of the district is 3245 sq km (DES Assam, 2003) including the small part letter on bifurcated to newly constituted Chirang district of the BTAD in 2004. The northern part of the district along the foothills of Bhutan is higher in elevation and slopes down gradually

towards south as presented in the slope map of the district prepared by the National Atlas and Thematic Mapping Organisation (NATMO). In a small strip along the northern border, the land slope vary from 80-300 m/km followed by another small strip with slope 10-20 m/km and then a vast plain area having slope below 10 m/km. Several north bank perennial tributaries of the river Brahmaputra traverse the district among which Manas, Beki, Pahumara and Kaldia are prominent. All these rivers cause floods in the district especially during the monsoon months (June to September) almost every year. Besides heavy monsoon rainfall, human induced factors, like construction of embankments, roads and rails, deforestation, encroachment of flood plain areas, etc. also aggravate the flood situation.

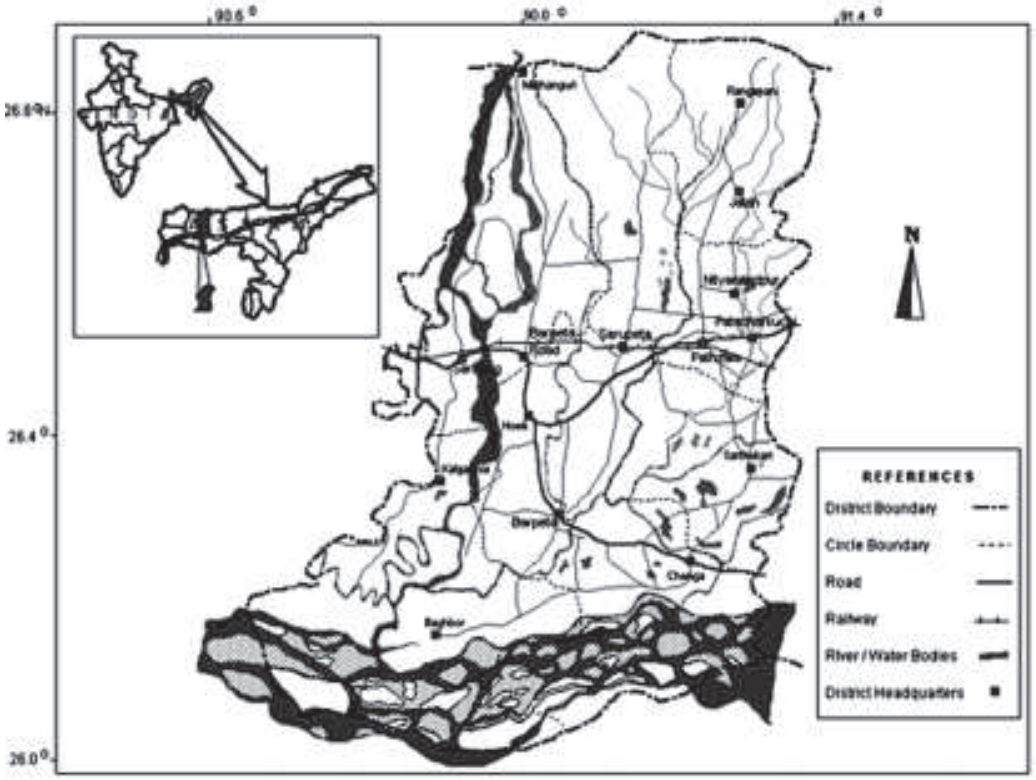

Fig. 1: Location map of the erstwhile Barpeta District (as on 2003)

The district is characterized by almost plain topography having four distinct physiographic zones - Bhabar, Terai, Middle plain and Active flood plains. Human settlement is very sparse in the northern part of the district comprising Bhabar and Terai zones and forests including the world famous 'ManasWildlife Sanctuary' cover most of the area. The middle plain having gentle slope, highly fertile land and good climatic condition has immense human significance with high population density. This region experiences occasional floods during rainy season. Active flood plains and Char lands are seen from the southern part of the middle plain areas and extend up to the northern bank of the river Brahmaputra. The region is dominated by southwest monsoon rainfall having maximum in the month of June (Kalita and Sarmah, 1983, 1986). Several spells of rainfall occur during the monsoon months and more than 80% of annual rainfall (237 - 308 cm/year) occurs during this period (June to September).

MATERIALS AND METHODS

Relevant flood inundation data at village level were collected for the period 1982-2004 from all the Circle Offices of the district. At the time of collection of data from these offices, information was also taken regarding the date and duration of inundation, approximate depth of water of the submerged areas and relief given to the affected villagers of each village as mentioned in FLOODsite (2008). A village was considered as a flood affected village when at least 80% of the total area of the village was inundated by floodwater. It was noticed that in some specific years, some villages were inundated more than once in a year for which frequency of inundation was more than one in that year. For instance, in the year 1988, three waves of floods inundated some villages of two circles situated in high flood prone areas. Therefore, frequency of inundation was recorded as three for those villages.

Based on the collected database, the flood prone areas of the district were delineated out at village level. At first, the flood affected villages in each year were identified and demarcated in each circle of the district. Then, a flood frequency table having different inundation frequencies was prepared considering the entire flood affected villages in the district. The flood prone areas of the district were further classified into four flood intensity zones as low, medium, high and very high according to the frequency of inundation during the study period in the range of 1-4, 5-7, 8-10 and 11-15 times respectively and the areas under different classes of flood intensity zones were delineated.

RESULTS AND DISCUSSION

The frequencies of occurrence of floods in different villages of the district were found out on the basis of the definition of the flood-affected villages as mentioned in the previous section. The results are presented in Table 1. It reveals that the frequency of occurrence varies from one to fifteen times during a span of twenty three years period (1982 – 2004). Out of 636 flood-affected villages of the district, 23 villages witnessed flood at least once and 14 villages faced floods for 15 times during the span of 23 years of study. Again 117 villages experienced ten times flood during this

Table 1: Frequency of Flood Affected Villages in the erstwhile Barpeta District (1982-2004)

Frequency of Occurrence	Name of circle								
	Jalah	Bajali	Bar-nagar	Saru-peta	Bar-peta	Kal-gachia	Sarthe-bari	Bagh-bar	Total
1 times	2	4	13	3	1	0	0	0	23
2 Times	11	7	13	5	1	0	0	0	37
3 times	3	2	7	1	1	1	0	0	15
4 times	1	2	5	2	4	3	0	0	17
5 times	3	3	10	5	13	2	1	0	37
6 times	2	8	11	4	14	7	4	3	53
7 times	0	3	4	2	9	9	5	5	37
8 times	0	0	4	6	7	3	10	9	39
9 times	0	0	4	6	25	3	10	25	73
10 times	0	0	4	8	33	8	18	46	117
11 times	0	0	0	0	8	7	3	10	28
12 times	0	0	0	4	7	11	3	13	58
13 times	0	0	0	2	5	16	1	21	45
14 times	0	0	0	9	5	11	1	17	43
15 times	0	0	0	2	2	4	0	6	14
Total No. of affected villages	22	29	75	59	135	85	56	175	636
Total No. of villages	**94**	**72**	**198**	**135**	**176**	**100**	**129**	**175**	**1079**

study period. The number of villages having frequency of 10 times was the maximum (117 villages) followed by frequency of 9 times (73 villages) and 12 times (58 villages). The numbers of villages having frequency 15, 3 and 4 times were found to be 14, 15 and 17 respectively. The study indicates that most of the villages which have high and very high frequency of occurrence of flood fall under Baghbar, Barpeta and Kalgachia circles of the district.

The numbers of flood affected villages in Jalah, Bajali, Barnagar, Sarupeta, Barpeta, Kalgachia, Sarthebari and Baghbar were found to be 22, 29, 75, 59, 135, 85, 56, 175 and 636 respectively. The highest number of flood affected villages were in Baghbar circle, where all the villages experienced by floods followed by Barpeta and Kalgachia circles.

Circle wise distribution of the number of flood affected villages in terms of percentage of the total number of villages in the respective circles is presented in Figure 2. It reveals that the percentage of flood affected villages was the highest in Baghbar Circle (100%) followed by Kalgachia Circle (85%) and Barpeta Circle (77%) respectively. In the other circles, the percentage of flood affected villages remained under 50%. The minimum was observed in Jalah Circle (23%).

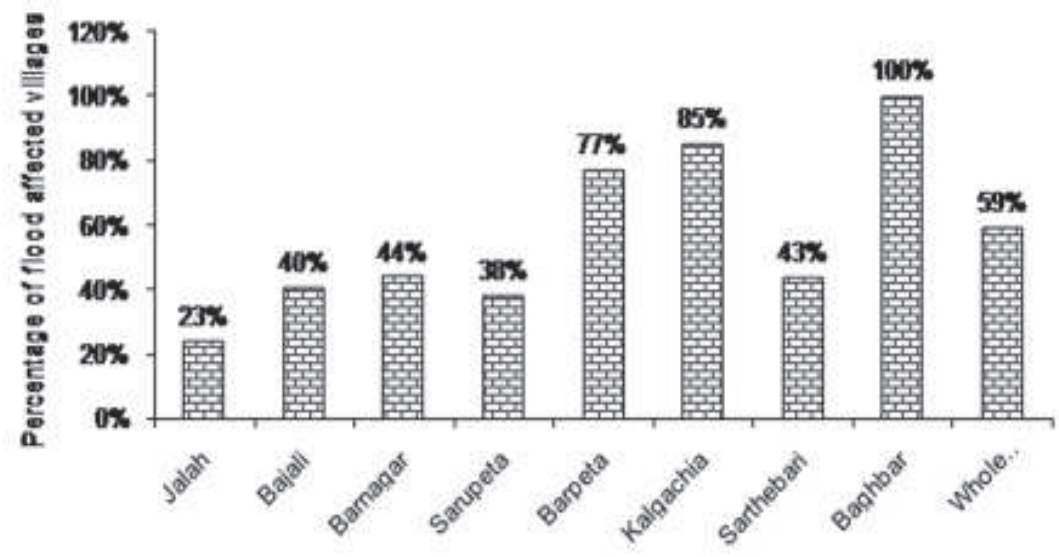

Fig. 2: Percentage of flood affected villages in different circles of the erstwhile Barpeta district

Circle wise distribution of flood affected areas as presented in Table 2, reveals that the areas under high and very high flood intensity zones were the highest in Baghbar circle compared to those of the other circles. Significantly, the area under low flood intensity zone in the circle was nil. In case of Sarthebari circle also, this figure was nil. However, area under very high flood intensity zone in this circle was 11.7 sq km unlike Baghbar circle, where it is found as 207.5 sq km. No area under Bajali and Jalah circle belonged to high and very high flood intensity zones. In case of Barpeta circle, the areas under different flood intensity zones from low to very high were 10.9 sq km, 52.5 sq km, 115.4 sq km and 24.6 sq km respectively. In the district as a whole these figures came out as 170 sq km, 217 sq km, 409 sq km and 341 sq km respectively.

The percentage of flood affected areas in each revenue circles under different flood intensity zones in the district are presented in Figure 3. Under low and medium flood intensity zones, it was found to be the highest in the Bajali circle, while the highest percentages of area under high and very high flood intensity zones were observed in Baghbar circle. Further, the figure reveals that the percentages of areas under these four flood intensity zones to the total area of the district were 5.2%, 6.7%, 12.6% and 10.5% respectively. Thus, the total flood affected area in the district was observed to be 35%. Observation on circle wise distribution of the flood affected areas reveals that Baghbar revenue circle was the worst sufferer, where 99% area was affected by floods, while Jalah was the least affected circle by floods (13% of the total area) followed by Barnagar and Barpeta circles (25% area). Next to Baghbar circle, flood affected areas were more in Kalgachia (40%) and Bajali (33%) circles respectively.

Different classes of flood intensity zones were delineated and presented in a village boundary map collected from the Revenue Department, Government of Assam as shown in Figure 4. It has been observed that most of the flood prone areas of the district belong to its southern part. Most of the areas on the northern side of the National Highway passing through almost middle of the district horizontally experienced no flood. Very high and high flood intensity zones were located mainly in the flood plains of the river Brahmaputra constituting the southernmost part of the district. Thus, it has been observed that the flood prone areas of the district were distributed following the general relief and the slope of the region. However, field observation revealed that some of the villages located near the riverbanks were not inundated due to flood protection works like embankment. For example, in Barnagar circle, the villages on the western bank of the river Beki near the railway crossing

Table 2: Number of villages and area covered under different Flood Intensity Zones (1982-2004)

Circles	Flood Intensity Zones								Total flood affected area in sq km
	Low		Moderate		High		Very High		
	No. of Villages	Area in sq km	No. of Villages	Area in sq km	No. of Villages	Area in sq km	No. of Villages	Area in sq km	
Jalah	17	31.90	5	8.47	0	0.00	0	0.00	40.37
Bajali	15	39.71	14	26.44	0	0.00	0	0.00	66.15
Barnagar	38	58.10	25	54.08	12	20.07	0	0.00	132.25
Sarupeta	11	20.41	11	21.52	20	44.61	17	27.77	114.31
Barpeta	7	10.93	36	52.53	65	115.40	27	24.64	203.05
Kalgachia	4	9.14	18	36.13	14	28.78	49	69.47	143.52
Sarthebari	0	0.00	10	5.91	38	61.44	8	11.71	79.06
Baghbar	0	0.00	8	11.82	80	138.27	87	207.53	357.62
Total	**92**	**170.19**	**127**	**216.90**	**229**	**408.57**	**188**	**341.12**	**1136.08**

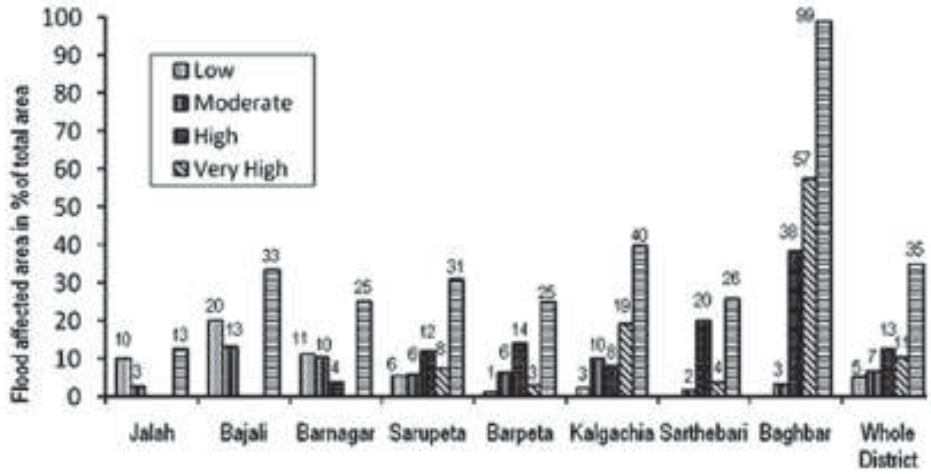

Fig. 3: Area under different flood intensity zones in the erstwhile Barpeta District

were not inundated at all, where as its south bank villages were inundated 5-7 times during the study period. Moreover, NF Railway line and National High Way No.31 were also protecting a number of villages on the down slope from inundation.

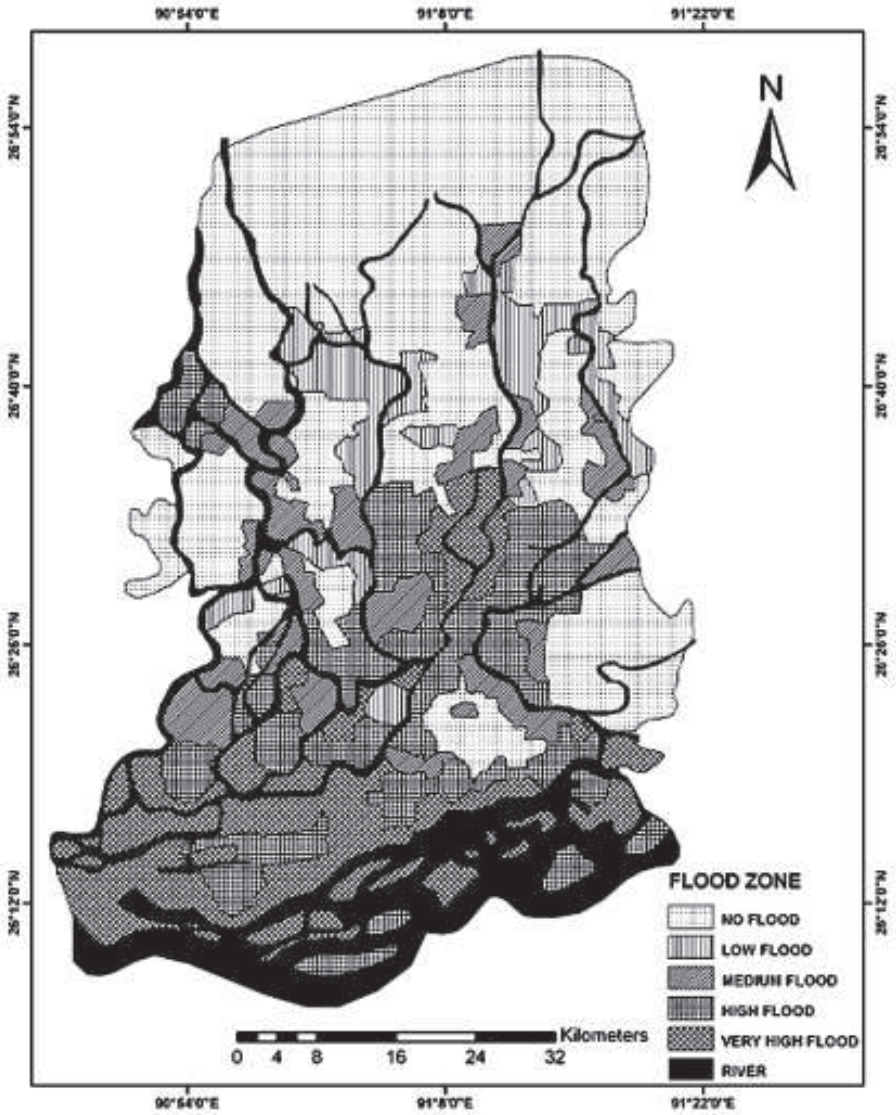

Fig. 4: Map showing the flood prone areas in the erstwhile Barpeta district of Assam

CONCLUSION

The overall study on delineation and classification of flood prone areas of the district reveals that out of the total of 1079 villages of the district, 636 villages (59%) are affected by floods. In terms of area, 1136.78 sq km comprising 35% of the total area of the district is affected by floods. Revenue circle wise distribution of flood affected villages in terms of the total number of villages in each circle reveals that Baghbar Circle (100%) is the worst sufferer followed by Kalgachia Circle (85%) and Barpeta Circle (77%) respectively. In the other circles, the percentage of flood-affected villages remains under 50%, the minimum being in Jalah Circle (23%). Classification of flood affected villages into four categories reveals that the numbers of flood affected villages under different classes starting from low to very high are 92, 127, 229 and 188 respectively. In terms of percentage of total flood affected villages these figures would be 14%, 20%, 36% and 30% respectively.

The flood affected areas and their percentage of total area of the respective revenue circle under Jalah, Bajali, Barnagar, Sarupeta, Barpeta, Kalgachia, Sarthebari and Baghbar revenue circles were found to be 40 sq km (13%), 66 sq km (33%), 132 sq km (25%), 114 sq km (31%), 204 sq km (25%), 144 sq km (40%), 79 sq km (26%), and 358 sq km (99%) respectively. These figures indicate that Baghbar circle is the worst sufferer compared to the other circles of the district. Kalgachia and Barpeta circles also suffer badly from flood hazard. Jalah and Bajali circles are the least sufferer in this regard. The flood affected areas under low, medium, high and very high flood intensity zones in the district as a whole were found to be 170 sq km, 217 sq km, 409 sq km and 341 sq km respectively.

The geographical distribution of the flood intensity zones reveals that it mainly follows the general relief and slope of the district. However, field observation reveals that some of the villages located near the riverbanks are not inundated due to flood protection works like embankment. Moreover, NF Railway line and National High Way No.31 are also protecting a number of villages on the down slope from inundation.

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