

Regional Flood Hazard Mapping in Murshidabad, West Bengal



Science Science

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ABSTRACT

The creation of a very high spatial resolution GIS database is costly and time-consuming. Several factors need to be considered in accurately mapping of flood hazards under the condition of scarcity of data and other materials and tools that typify the situation in the most countries of the southern hemisphere. Due to scarcity of adequate data only two indicators i.e. flood frequency and flood prone area have been chosen for mapping. The study demonstrates a moderate resolution regional study that would be enough to identify flood hazard prone zones. Administrative units are selected as the most appropriate unit of investigation for the simple reason that these are the very units demarcating policy and planning authorities and resource allocation crucial to any practical intervention. The paper reveals the regional pattern of severity of the flood hazard in Murshidabad. It will help demarcate the policy and planning authorities and resource allocation during flood management.

INTRODUCTION

GIS has widely been used to map and model surface water and flood hazard (Aziz et al. 2003; Werner, 2001; Boyle et al. 1998). Remotely sensed data provides the instantaneous and synoptic view necessary for the estimation of flood and are therefore widely used in flood mapping and hazard assessment. Remote sensing data, however, is predominantly invaluable for developing countries in development planning (Imhoff et al. 1987). Its application is considered vital for third world countries because it is difficult for government to update their database due to the lack of resources with the traditional ground observation method which is both costly and time consuming (Dong et al. 1997). In this study, Murshidabad district of West Bengal is chosen as the study area and mapped at regional scale. Administrative units i.e. blocks are selected as the most appropriate unit of regional mapping as demarcating policy and planning authorities and resource allocation is based on these units in any practical intervention.

OBJECTIVES AND DATABASE

The main objectives of the study are-

1. To quantify the hazard indices
2. To map the regional pattern of flood hazard severity in the study area.

The study is based on secondary sources of data. The main sources are- Report of Irrigation and Waterways Department,

Govt. of West Bengal, Flood Preparedness and Management Plan, Murshidabad District and other articles from different open access journal.

STUDY AREA

Murshidabad district is the northernmost segment of the Presidency Division of West Bengal and is located at its north-eastern boundary. It is lying centrally in the lower Ganga valley. The geographical extension of the district is 24°50'20"-23°43'30"N and 88°46'00"-87°49'17"E with an area of 5324 sq.km. The district is separated from Malda by the Ganga River on its north. This pear-shaped district looks like an isosceles triangle with Farakka block on the north-west forming its apex. It is bounded in the north by the Malda district, on the west by the district of Birbhum, on the south by the districts of Burdwan and Nadia and on the east by Bangladesh. The Ganga river forms the northern and eastern boundary of the district for some distance and on the southern boundary there is the Jalangi river for a long stretch forming a part of the southern boundary between this district and Nadia. The total population as per 2001 census is 5866569 and density of population is 1120. About 90 per cent population live in rural areas

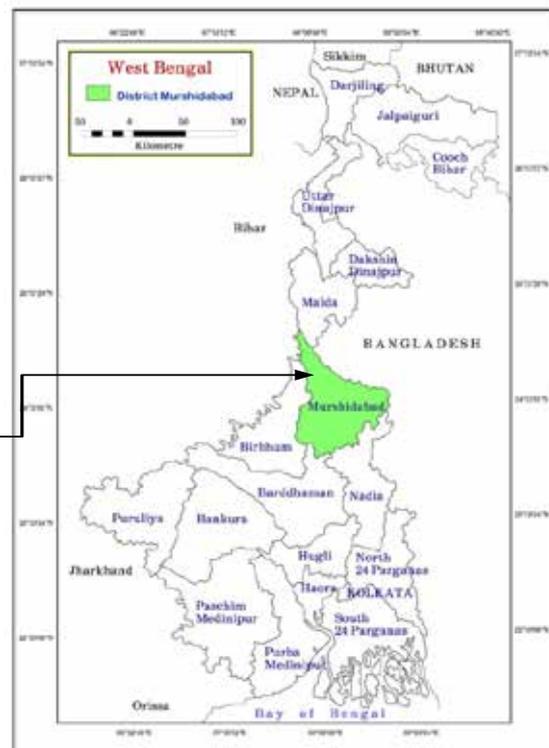


Figure 1: location of the study area

DISCUSSIONS

Methodology

Boundary of the development blocks namely has been delineated from a 1:500,000 maps prepared by Geological Circle, State Water Investigation Directorate, Water Investigation and Development Department of Government of West Bengal. The map has been transformed into soft copy. It has been geo-referenced using GPS control points collected during a field survey in the area. Since GPS satellites use WGS 84 as their reference ellipsoid the rectified map has been defined in that particular reference system using ArcCatalogue component of ArcGIS. Using onscreen digitization method all development blocks have been digitized in a single polygon shape file from this rectified image. Each polygon has been assigned a unique ID in the attribute table so that composite hazard index can be joined to the GIS data base using the common unique ID. To produce the indicator scores, both the variables are standardized by dividing the indicator by its standard deviation (Kundu, 1980). Aggregating indicators into a single composite index is adopted in the study.

On the basis of calculated Composite Hazard Scores for each block the final Flood Hazard map is prepared. Here also the Composite Hazard Scores are divided into quartiles to classify Low (Below 7), Moderate (7.01- 13), High (13.01- 25) and Very High (Above 25).

Table 1: Data used in deriving flood hazard maps at regional scale

Type of Map	Hazard Indicator	Hazard Factors	Variable Name	Source
Flood Hazard Map	Flood Frequency	Risk of flooding	Flood-freq	FPMP, 2005
	Flood Prone Area	Area under threat	Flood-prone	FPMP, 2005

Source: Adopted from Sanyal, 2000

Flood Hazard Indices

Two indicators i.e. flood frequency and flood prone area has been chosen for regional flood hazard mapping. The most important factor determining flood hazard is flood frequency. Both the indicators are standardized first. The weighting scheme for the hazard index is implemented in this case. A knowledge-based weighting scheme is applied to each of the two variables: indicators that represent a high level of dispersion across development blocks were given more weight; a variable depicting a uniform situation across the study area is not likely to distinguish between hazardous and non-hazard zones. The variable 'flood-prone' is attached to high importance because where the risk of inundation is very low the other variables cannot indicate or contribute to flood hazard.

Table 2: Differential Weighting Schemes for Flood Frequency

Flood Frequency	Weight
1-2	0.25
3	1.5
4	2.5
5	4.0
6	5.5
7	6.5
8	7.0
9	7.5

Adopted from Sanyal, 2000

Table 3: Differential Weighting Scheme for Flood Proneness

Flood Prone Area in %	Weight
Above 60	5
60- 50	4
50- 40	3
40- 30	2
Below 30	1

Subjective Weighting Scheme given by the author

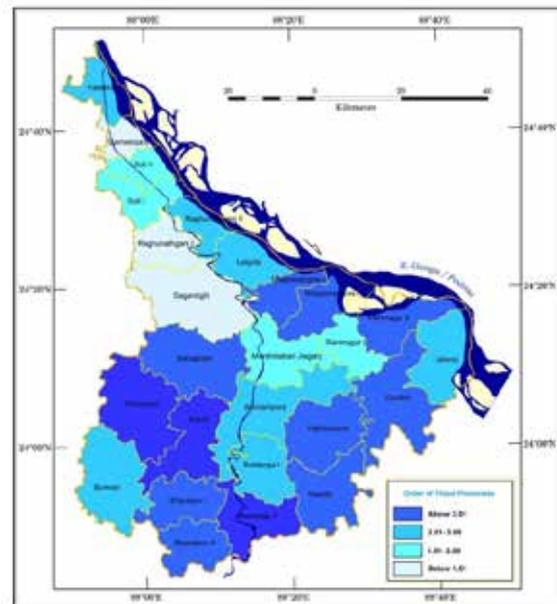
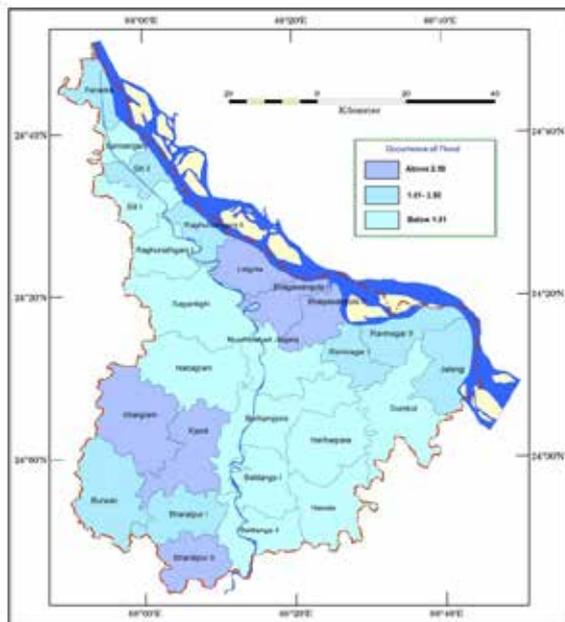


Figure 2a- 2b: (From left) 1a: Occurrence of flood; 1b: Order of flood-proneness

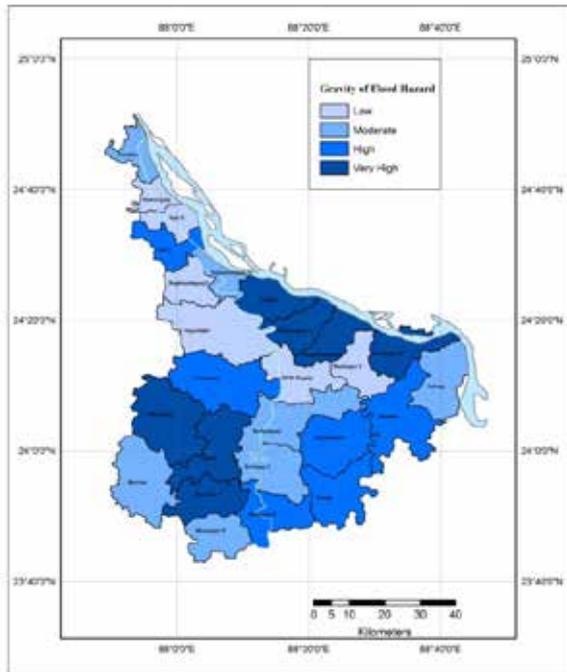


Figure 3: Block-wise severity of flood hazard

Figure 2a and 2b reveal block-wise occurrence of flood and amount flood prone areas in Murshidabad district. In terms of flood frequency the blocks Lalgola, Bhagwangola I and II in the eastern part of the study area and Khargram, Kandi and Bharatpur I in the western part are characterised by very high frequency zones. On the other hand Khargram, Kandi, Bharatpur I & II, Beldanga II, Nawda, Hariharpara, Domkal, Bhagwangola I & II have high order of flood proneness

CONCLUSION

From Figure 3 it is clear that three blocks in the western part of the study area and four blocks in the eastern part of the study area are very high probability of flood. These areas need special attention to the planners for flood management. This study will not only help formulating a flood management strategy for Murshidabad but also to show how a flood hazard map can be produced by using available information from local government agencies.

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