

Risk Assessment of Storm Surge of Kutubdia Island Using GIS

Musfique Ahmed¹ and Rifat Anwar²⁺

¹ Post-Graduate Student of Environmental Engineering, University of Melbourne, Victoria-3010, Australia

² Student of Water Resource Engineering, Bangladesh University of Engineering and Technology (BUET), Dhaka-1000, Bangladesh

Abstract. Bangladesh is one of the most cyclone prone areas on earth. Southwestern part (Chittagong-Cox's Bazar) coastal zone is the most affected and important cyclone prone zone of Bangladesh. Kutubdia is an upazilla of Cox's Bazar, which is adversely affected by cyclone and storm surge almost every year. There are six unions in Kutubdia upazilla. Different unions are affected in case of different inundation height. All the unions are risky for cyclone and storm surge. But the amount of vulnerable features and number of shelters are different for different unions. So risk assessment is necessary to determine the most risky unions in order to reduce loss. For each union, the amount of vulnerable features has been determined from maps. These maps have been prepared by overlaying vulnerable features on the inundation map. The shelters are cyclone shelters and unexposed infrastructure where vulnerable people can be accommodated in times of disaster. Maps of different shelters have been overlaid on the inundation map to determine the number of shelters.

Keywords: storm surge, risk assessment, inundation map, vulnerable features, shelters.

1. Introduction

Bangladesh lies in the north-eastern part of South Asia between 20°34' and 26°38', north latitude and 88°01' and 92°41' east longitudes. It has one of the most complex river systems in the world. A network of rivers and their tributaries, numbering about 230, with a total length of about 24140 km covering the country, flow down to the Bay of Bengal (BBS, 1989). The coastal regions are subject to disastrous cyclones almost every year. The Bay of Bengal is the area of the world having the highest potential for massive loss of life from a storm surge associated with a tropical cyclone. Cyclones and storm surges, although not preventable, can at least be made less harmful, or the suffering they inflict can be considerably diminished by timely action. Cyclone and storm surges is the most common and frequent disaster of Kutubdia upazilla which causes a lot of sufferings to the life of the people of this island.

1.1. Cyclone and storm surges

Typhoons are tropical revolving storms. They are called 'Cyclones' in English, when they occur in the Indian Ocean area. They generally occur in early summer (April-May) or late rainy season (October-November). Cyclones originate from low atmospheric pressures over the Bay of Bengal. The Storm surges are oscillations of the water level in a coastal or inland water body in periods ranging from a few minutes to a few days, resulting from atmospheric forces in the weather system. A storm surge is partly caused by pressure differences within a cyclonic storm and partly by high winds acting directly on the water.

1.2. Objectives of the study

⁺ Corresponding author. Tel.: +8801760606741
E-mail address: rifat1525@yahoo.com

1. To determine the amount of vulnerable features to storm surge for each union.
2. To determine the number of different shelters for vulnerable population in each union.
3. To determine the risk level for each union.

2. Methodology

2.1. Identification of vulnerable features

The vulnerable features are those which will be easily damaged due to storm surge. The vulnerable features are: 1.Katcha Road.2.Agricultural Land.3.Food Godown.4.Factory/ Industry.5.Power Station.6.Cold Storage.7.Katcha Houses.8.Hat/ Bazar.9.Sluice Gate/ Culvert.10.Tube well11.Irrigation Pump.

2.2. Determining percentage of exposure

The steps are given below:

1. GIS maps for vulnerable features have been collected from CEGIS and LGED.
2. The inundation map has been collected from IWM.
3. Two types of inundation maps (for 3-4 m and 4-5 m inundation) have been prepared separately.
4. The GIS maps have been overlaid on the inundation maps
5. From the resulting maps, the percentage of exposure of the vulnerable features to the inundation have been determined (for both 3-4 m and 4-5 m inundation)

2.3. Determining risk level of the unions

1. The percentage of vulnerable features and the number of different shelters have been used to determine the risk level.
2. The greater amount of vulnerable features increases the risk level of a union.
3. The greater amount of shelters reduces the risk level of a union. Because more shelters will provide more accommodation places for the vulnerable population.

3. Results

Kutubdia island consists of six unions named- Ali Akbar Deil, North Dhurung, South Dhurung, Lemshikhali, Kaiarbil, Boroghob. The maps of vulnerable features and different types of shelters have been used to determine the risk level of each union. These maps have been prepared for 3-4 m inundation and 4-5 m inundation.

3.1. Determination of vulnerable features for 3-4 m inundation

Several maps have been prepared. They are

1. Maps of area inundated
2. Maps of katcha road
3. Maps of agricultural land
4. Maps of hat/bazaar
5. Maps of tube well
6. Maps of food godown
7. Maps of settlement

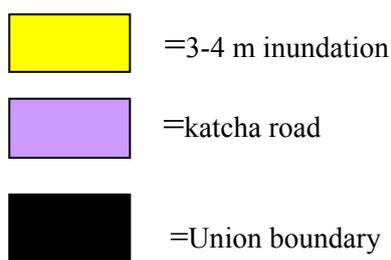
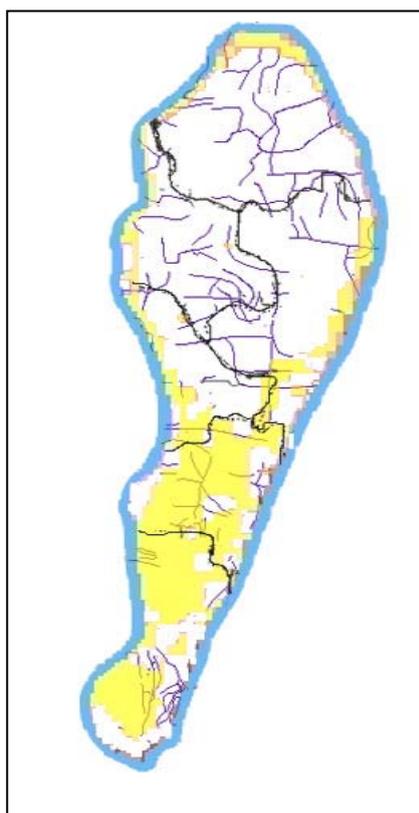


Fig. 1: Map of Katcha road exposed to 3-4 m inundation

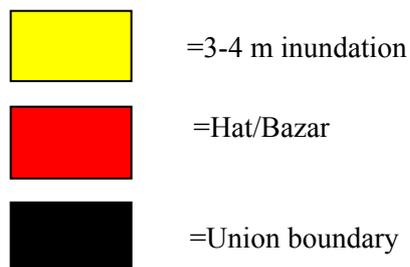
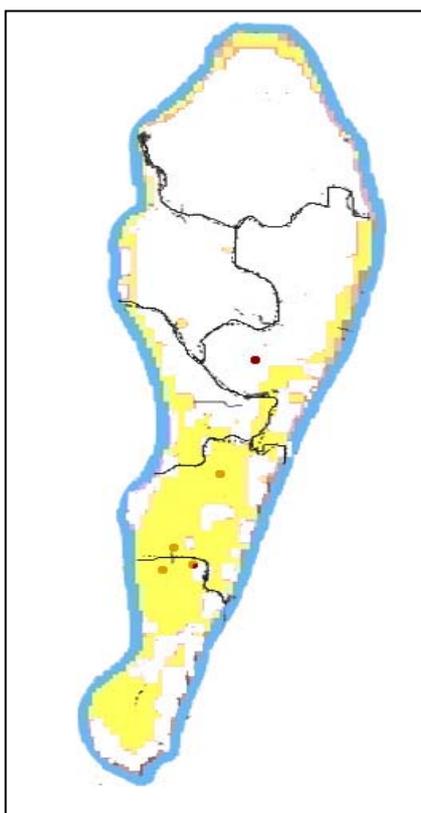


Fig. 2: Map of bazaars exposed to 3-4 m inundation

Such maps have been prepared for all the vulnerable features. The percentage of exposure of vulnerable features has been assumed using the maps. Using these percentages the amount of vulnerable features exposed to 3-4 m inundation have been determined for each union. Same procedure has been followed for 4-5 m inundation.

3.2. Determination of number of shelters for 3-4 m inundation

Different types of shelters are:

1. Cyclone shelter
2. Unexposed school
3. Unexposed college
4. Unexposed madrasa
5. Unexposed mosque
6. Unexposed growth centre
7. Unexposed hospital
8. Unexposed post office

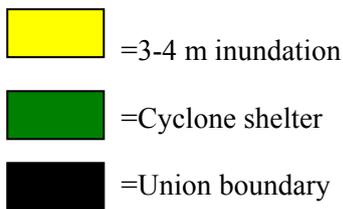
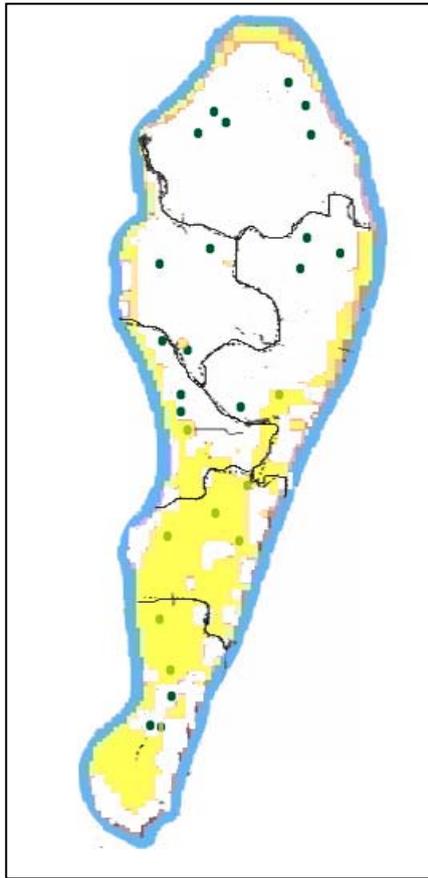


Fig. 3: Map of cyclone shelters exposed to 3-4 m inundation

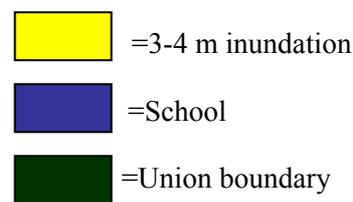
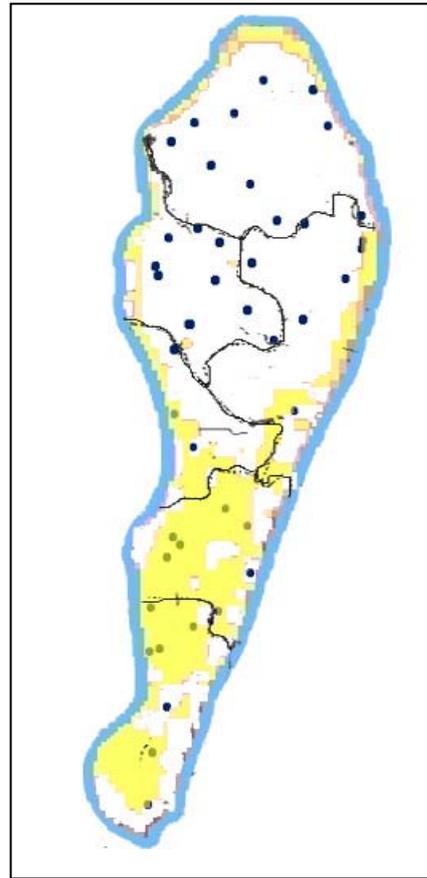


Fig. 4: Map of school exposed to 3-4 m inundation

Such maps have been prepared for all type of shelters. They have been used to determine the number of cyclone shelters and other unexposed shelters where people can be accommodated during storm surges.

3.3. Determination of risk zone

- Risk level of the unions has been determined by considering amount of vulnerable features and number of different shelters.
- Large amount of vulnerable features and inadequate number of shelters makes the union more risky.
- In case of 3-4 m inundation, almost all the katcha roads of Ali Akbar deil and Boroghop are inundated (from fig. 2). All the bazaars of Ali Akbar deil and Boroghop are also inundated (from fig. 3).
- For Ali Akbar deil, the number of unexposed cyclone shelter and school is four. For Boroghop, the number of unexposed cyclone shelter and school is one.
- Considering amount of vulnerable features and number of unexposed shelters, the most risky unions for 3-4 m inundation are Ali Akbar deil and Boroghop.

4. References

- [1] A. Baquee, Dr. AQM Mahbub and M. K. Zakir , ‘Community Risk Assessment and Risk Reduction Action Plan’, 2007, a report prepared by DRTMC with help and active participation of the Upazilla Disaster Management Committee (UDMC) of Kutubdia upazilla, pp.13-25 and 61-70.
- [2] CZPo, ‘Coastal Zone Policy’, Ministry of Water Resources, Government of the People’s Republic of Bangladesh, Dhaka, 2005, pp. 31-42.
- [3] G.M. Khalil. Cyclones and Storm Surges in Bangladesh: Some Mitigative Measures, *Natural Hazards*, vol.6, 1992.
- [4] Multi-purpose Cyclone Shelter Project (MCSP), ‘Summary Report’, Bangladesh University of Engineering and Technology and Bangladesh Institute of Development Studies, Dhaka, 1993.
- [5] S. R. Khan and M. Damen, ‘Cyclone Hazard in Bangladesh’, a report prepared by and revised by ITC, 2004, pp.1-9 and 13-14.