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ASSESSING THE FLOOD AND RIVERBANK EROSION IMPACTS AND COPING STRATEGIES IN HATIA UNION OF ULIPUR, KURIGRAM, BANGLADESH

MD. ABRAR TAZWAR RIJON[1] AND MD. FARUK HOSSAIN[2]*
[1]*Department of Geography and Environment, Pabna University of Science and Technology, Pabna, Bangladesh*
[2]*Departments of Geography and Environment, University of Dhaka, Dhaka, Bangladesh*

Abstract

The present paper aims to focus on the flood and riverbank erosion impacts and coping strategies in Hatia Union of Ulipur, Kurigram of Bangladesh. Due to the prevailing geographical location and topographical features, Bangladesh is considered as one of the most disaster-prone countries in the world. Kurigram district, located in the northern part of Bangladesh, is particularly flood and riverbank erosion prone because of its extensive river networks and its location within the Teesta-Brahmaputra River basin. Hatia Union of Ulipur Upazila was chosen as the study area due to its susceptibility to these disasters. In order to identify the flood and riverbank erosion impacts and coping strategies, field level data and information were collected through field survey and interviewing the respondents. Using ArcGIS Pro software, Sentinel-1 (SAR) and LANDSAT images with a resolution of 30 meters, the flood and riverbank erosion maps were produced. Floods and riverbank erosion both have significant impacts on local communication, food, shelter, health, employment, security, and people's movement. Local people suffer a lot and their lives and livelihoods are affected severely by these disaster events. The affected communities undertake various coping strategies with the support of governmental and non-governmental organizations to overcome the incumbent impacts of flood and riverbank erosion. Policy level development and effective implementation of various projects and programs prioritizing the most vulnerable areas, focusing on socio-economic advancement, and resolving relevant issues can limit the sufferings of local people.

Keywords: Flood, Riverbank erosion, Impacts, Coping strategies, Ulipur upazila, Kurigram district, Bangladesh

Introduction

Bangladesh is one of the most disaster-prone countries in the world and situated at the lower part of the Ganges-Brahmaputra-Meghna River basin (Islam *et al.,* 2013; Roy *et al*., 2017; Shahriar, 2020). Natural disasters occur on a regular basis and disrupt people's

*Corresponding author: faruk.geoenv@du.ac.bd

livelihoods in various parts of the country (Hossain and Fahad, 2023). Bangladesh is vulnerable to both disasters and climate change, ranking seventh in the world for extreme disaster risk, according to the Global Climate Risk Index 2021 assessment. This country is ranked 9th most disaster-risk-prone country among 193 countries (Atwii *et al.,* 2022), 27th among the 191 multi-hazard-prone countries in 2022 (IASC and EC, 2022), and 7th among the 180 long-term disaster-affected countries of the world in between 2000 and 2019 (Eckstein *et al*., 2021). From 1980 to 2008, Bangladesh was affected by 219 natural disasters and caused damages of approximately US$16 billion (Uddin *et al.,* 2019). Bangladesh's geographical location close to the Bay of Bengal, near the foothills of the Himalayan Mountains, landscape characteristics, the abundance of rivers, and the monsoon climate- all contribute to frequent extreme weather events such as cyclones, droughts, floods, storm surge, river erosion, and salinity intrusion (Faisal *et al*., 2021).

In recent decades, there has been an exponential growth in the frequency and huge socioeconomic impacts of natural disasters (Harrison and Williams, 2016). Various natural disasters have become more common nowadays (Thomas *et al.,* 2014). Among these disasters, floods have shown an increasing trend in both frequency and intensity. Floods can happen slowly or suddenly, and are usually caused by a river overflowing its natural bed (Tîncu *et al.,* 2018). Every year, floods affect approximately 215 million people worldwide, with Asia accounting for 95% of all victims (Saulnier *et al.,* 2018). Riverbank erosion is another notable geomorphological issue primarily observed in alluvial river floodplains (Bordoloi *et al.,* 2020), but the impacts of riverbank erosion stretch across all continents, varying in intensity (Das *et al*., 2014). This erosion problem is widespread, affecting many countries in both the North and South (Bhuiyan *et al*., 2017), and has far-reaching consequences, affecting millions of people worldwide every year (Naher and Soron, 2019). Being a riverine country at the confluence of the Ganges-Brahmaputra-Meghna (GBM) river system, Bangladesh experiences substantial annual challenges with flooding and riverbank erosion.

Flood and riverbank erosion are the major natural events in Bangladesh, and these are responsible for making thousands of people homeless and landless every year (Hossain and Fahad, 2023). Flooding and riverbank erosion affect people's way of life and change their livelihood patterns (Islam and Uddin, 2020). Floods frequently disrupt people's lives and livelihoods, as they account for almost 50 percent of all natural disasters (Ali *et al.,* 2019). Every year, flooding affects approximately 20% of Bangladesh's geographical area (Islam *et al*., 2018) and causes severe property damages and significant loss of lives. In Bangladesh, six major floods occurred in the nineteenth century, with years of occurrence in 1842, 1858, 1871, 1875, 1885, and 1892 (FFWC, 2020). The 20th century witnessed 18

significant floods, including disastrous ones in 1951, 1987, 1988, and 1998. Between 1990 and 2021, Bangladesh experienced 90 floods and floods of 1998, 2007, 2017, 2019, and 2020 are mentionable (FFWC, 2020). The 1998 flood inundated 68 percent of the country (FFWC, 2020). Floods have many adverse consequences since the water stays on the land for a long time, making all forms of communication obsolete. Infrastructure, development activities, domesticated animals, homesteads, crops, food storage and human life are all seriously affected (Roy *et al.,* 2015).

Riverbank erosion poses a serious and direct threat to Bangladesh's riverine districts. Around 20 out of the 64 districts in Bangladesh are vulnerable to riverbank erosion, with a staggering amount of approximately 8700 hectares of land being lost each year, affecting approximately 200,000 people by eroding their homes and agricultural lands (Alam *et al.,* 2017). Every year, riverbank erosion directly affects one million people and an estimated four million become homeless or are forced to live in constant uncertainty (Islam and Rashid, 2011). In Bangladesh, both frequency and intensity of riverbank erosion has significant consequences (Billah *et al*., 2023). It affects socio-economic structure and quality of life of the people also (Bhuiyan *et al.,* 2017). It is a local and recurring natural event that has a huge impact on riverbank residents' livelihoods (Islam *et al.,* 2016; Ahmed, 2016; Alam *et al.,* 2017).

Kurigram district, located in the Northern part of Bangladesh, is particularly flood and riverbank erosion prone because of its extensive river networks and strategic location within the Teesta-Brahmaputra River basin. At least 16 large and small rivers flow through Kurigram district. This region faces recurring challenges in its livelihood sector due to floods and riverbank erosion. Of particular concern is the occurrence of a massive flood every 5-6 years in this area (Nahar *et al.,* 2014). Almost all of the major rivers among the 16 have flood and riverbank erosion problems. At least 30 points along the Brahmaputra, Dharla, Teesta, Dudhkumar, and Gangadhar rivers are currently vulnerable to riverbank erosion and flooding (BWDB, 2022). Flooding is a significant factor in riverbank erosion in this area. The Brahmaputra River enters Bangladesh from the north in Kurigram district. Riverbank erosion took place in this region due to a number of natural and human - induced factors such as changes in the river's course, variations in the shear strength, geomorphology, features of the bed and bank materials, sudden drawdown and pressure imbalance at the bank face, low vegetation cover, obstructions in the channel flow, presence of structures, wakes from boats and exposure to wind and waves (Islam and Rashid, 2011; Rahman *et al.,* 2015).

The study site is in Hatia Union, Ulipur Upazila (sub-district) of Kurigram District, on the bank of the Brahmaputra River. Local people are facing difficulties in adjusting with unexpected flooding. Heavy rainfall in this region as well as in the upper stream countries causes high magnitude flooding. Any major fluctuation in river water level causes substantial riverbank erosion (Chowdhury, 2012). During the monsoon season, this area receives considerable rainfall, which enhances the probability of flood and riverbank erosion (Uddin and Basak, 2012). In recent times, severe floods have been observed in the present study area in 2020 due to heavy rainfall and huge water discharge of the Brahmaputra River (FFWC, 2020; Islam and Uddin, 2020). Brahmaputra River tends to lose its depths and bank erosion is escalating (Islam and Uddin, 2020). The shifting course of the river within this area results in the loss of houses, agricultural lands and urban centers (Pahlowan and Hossain, 2015). Moreover, the situation became worse due to the climate change induced problems (Shiferaw *et al.,* 2023). The livelihoods of local communities are severely affected by flood and riverbank erosion. Local people have little choice but to cope with disasters because they have a long history of experiencing them. Coping refers to the immediate response to the disaster which includes strategies, measures, and actions taken to address the specific hazard impacts during or after a disaster, and relies on existing institutional frameworks (Birkmann, 2011). Following a disaster, locals use their available resources to restore their livelihood so that they can deal with the catastrophe (Tanvir *et al*., 2015). They traditionally developed some strategies to survive during and after disasters.

Several studies have looked at different aspects of floods and erosion in different parts of Ulipur Upazila, but their cumulative impact on the local population of Hatia Union has not been studied. This research addresses this gap by examining the diverse challenges faced by locals and exploring coping strategies in the selected study area. The objectives of this research are to present flood and riverbank erosion scenarios in the study area by assessing the impacts of floods and riverbank erosion on local communities. In addition to this, this study explores how local people are coping with flood and riverbank erosion.

Materials and Methods

Selection of the study area: Ulipur Upazila is situated in Kurigram district and its geographical coordinates ranging between approximately 25°33' to 25°49' north latitudes and 89°29' to 89°51' east longitudes. The upazila shares borders with Kurigram Sadar and Rajarhat to the north, Pirgachha to the south, Assam (India) to the east, and Raumari and Chilmari to the south. Three major rivers: the Tista, Brahmaputra and Dharla, are flowing

through this upazila. Hatia and Burabari Unions of Ulipur Upazila under Kurigram district situated along the Brahmaputra River, are particularly vulnerable to natural disasters like flood and riverbank erosion (BWDB, 2022). Moreover, according to the surveyed Key Informants, Hatia union was more affected by flood and riverbank erosion in the previous period. That is why this area was suitable for the present study.

Hatia Union is located to the east of Ulipur Upazila headquarters and has an area of approximately 7571 acres (30.64 square kilometers) (Fig. 1). The population is approximately 27,552, with 12,937 females and 14,615 males, and there are 4,610 total households (BBS, 2022). The average literacy rate of Hatia Union is 37.7 percent. Hatia Union contains 38 villages, each of which contributes to the region's vibrant rural landscape.

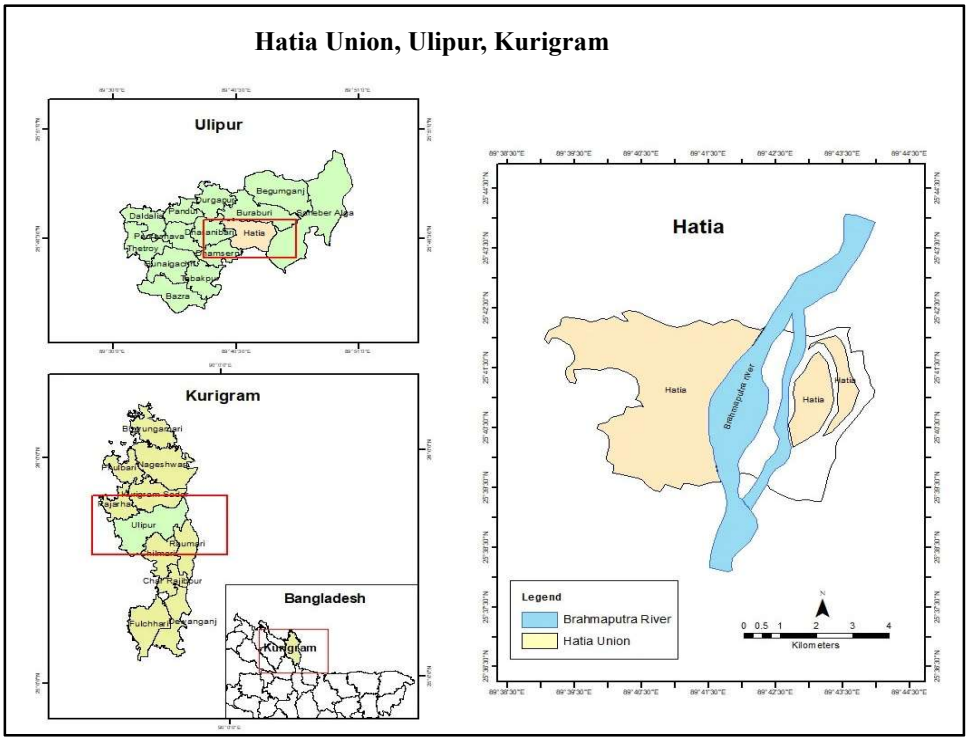


Fig. 1. Location of the study area.

Sample size selection

The sample size for this study was calculated by using Yamane's formula (Yamane, 1967), considering the number of households in the study villages. The formula is given as:

$$n = N / (1 + N \times e^2)$$

Here, n represents the sample size (number of households chosen for interviews),

N stands for the total households in the study areas, and e indicates the level of error.

To ensure a reliable sample size determination, a confidence level of 95 percent and a precision level of 7 percent were used. Rounding to the nearest whole number, the sample size (n) would be approximately 160.

Sampling method: The surveyed households were selected based on the ratio of total households in the respective villages. Field data relating to household survey was collected using a simple random sampling method (Table 1).

Table 1. Number of respondents from different villages in the study area.

Village name	Total number of households	Surveyed households
Bagua Anantapur (Paler Hat)	160	34
Majhi Para	65	14
Hatiar Gram	120	26
Nilkontho	35	9
Kamar Tari	220	43
Noya Dara	90	21
Jelengar Kuthi	60	13
Total	750	160

Source: Field Survey, 2023

Data collection techniques: The field survey for the current study was carried out in two phases: the pre-field survey on May 5, 2023, and the main phase from June 11 to June 18, 2023. The study incorporated both qualitative and quantitative approaches to meet the objectives of the research. Secondary data was collected through various sources such as journal articles, books, book chapters, documents of various organizations and data and

information from various online sources. A semi-structured questionnaire was designed for this study to collect data from the surveyed households. To get in depth information from the respondents, six Key Informant Interviews (KIIs) were conducted in different parts of the study area.

Data analysis techniques: The collected primary and secondary data were analyzed by using ArcGIS, Google Earth Pro software, SPSS and Microsoft Excel. The ArcGIS Pro software was used to create the map of the study area (Fig. 1). The flood and riverbank erosion maps (Fig. 2 and Fig. 4) were created using Sentinel-1(SAR) and LANDSAT images with a resolution of 30 meters and ArcGIS Pro software. NDWI processed data were obtained from LANDSAT 5, 8, and 9 to detect the water bodies for creating the erosion map (Fig. 6) and ArcGIS was used to calculate the total area (sq.km) for flood inundation and bank erosion of the study area.

For further analysis and interpretation of data, Weighted Average Index (WAI), Perception Index and Satisfaction Index were used. WAI was calculated for each indicator using the Ha & Thang (2017) formula:

$$WAI = \Sigma (Si \times Fi) / N$$

In order to evaluate the households' perceptions and comprehension of the various indicators pertaining to the impacts and coping strategies of flooding and riverbank erosion in the study area, a perception index was employed (Table 2).

Table 2. Perception Index Levels.

Categories	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Scale	0.01-0.2	0.21-0.4	0.41-0.6	0.61-0.8	0.81-1

The satisfaction index (WAI) is calculated using the following formula:

$$WAI = (0.2 \times f1 + 0.4 \times f2 + 0.6 \times f3 + 0.8 \times f4 + 1 \times f5) / N$$

Results and Discussion

The surveyed respondents were selected from the study area to know their views regarding the flood and riverbank erosion induced impacts and coping strategies (Table 3).

Table 3. Demographic Characteristics of the Surveyed Respondents.

Factors	Classes	Percentage
Gender	Male	77
	Female	23
Age range	21-30	11
	31-40	25
	41-50	31
	51-60	18
	>60	15
Level of education	Illiterate	76
	Class 1-3	7
	Class 4-5	8
	Class 6-8	3
	Class 9-10	3
	HSC	2
	Bachelor	1
Occupation	Unemployed	3
	Farming	35
	Animal husbandry	3
	Day labour	23
	Fishing	9
	Service	4
	Business	12
	Others	11
House type	Huts	33
	Kutcha/ Tin shed	62
	Semi-pucca	3
	Pucca	2

Source: Field Survey, 2023

Flood vulnerability level of the study area: During the monsoon season of 2020, the Brahmaputra basin experienced significant and prolonged flooding; with floods having a serious impact on both people and property in the Hatia Union. Most of the areas of this

Union were submerged several times at regular intervals. The Brahmaputra River began to rise in June 2020, causing massive flooding in the area by the first week of July (Fig. 2).

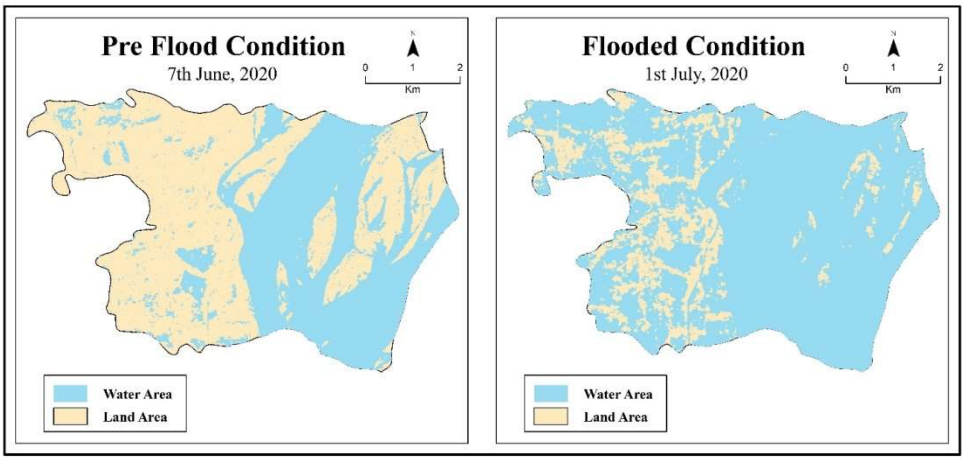


Fig. 2. Flooding in the Study Area.

Table 4. Before and After Flood Damage in Hatia Union, 2020.

Key Term	Area (Sq. km)	Percentage
Total area	30.81	100
Pre-flood waterbodies	13.59	44
Waterbodies during flood	25.63	83
Only land area flooded	12.04 out of 17.22	70

Source: Remote Sensing (RS) Data, 2020.

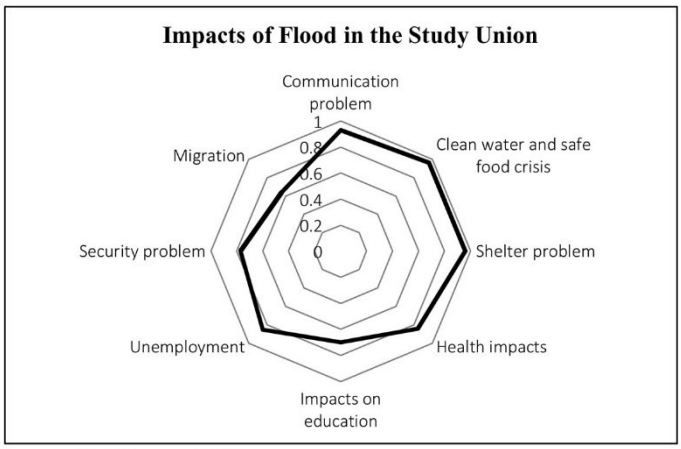
Prior to the flood, when the Brahmaputra River water began to increase from the normal level, and it covered an area of 13.59 square kilometers (44 percent) of the total area. During the flood, water covered 25.63 square kilometers of land, accounting for 83 percent of the entire area. The total flooded area was 12.04 square kilometers, accounting for 70 percent of the total land area (Table 4). This flood caused huge impacts on the people and the neighborhoods.

Perceived response on impacts of flood: The overall Weighted Average Index was calculated in order to fully comprehend the impacts of floods in the study area. The respondents' perceptions are represented on a scale of 0 to 1, with 0 denoting strongly disagree, indicating no impact on any given sector, and 1 denoting strongly agree, indicating a very high impact on anything. These values were used to calculate the overall severity of flood effects.

Table 5. Relative Grading of Impacts of Flood by Respondents as Reflected in Survey.

Impacts	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	WAI	OA
Communication problem	0	0	5	44	111	0.93	VH
Shortage of safe water and food	0	0	0	36	124	0.96	VH
Shelter problem	0	0	1	34	125	0.96	VH
Health problem	0	1	12	106	41	0.84	H
Impacts on education	0	4	89	53	14	0.70	H
Unemployment problem	0	2	30	53	75	0.85	H
Security problem	0	6	51	62	41	0.77	H
Migration	3	43	43	60	11	0.64	M

Note: Strongly disagree (SD): 0.01-0.2; Disagree (D): 0.21-0.4; Neutral (N): 0.41-0.6; Agree (A): 0.61-0.8; Strongly agree (SA):0.81-1. WAI: weighted average index, OA: overall assessment.



Source: Field Survey, 2023

Fig. 3. Impacts of flood in the study area Hatia union (WAI).

Flooding impacts, according to respondents, are more severe in some cases and occur more frequently than others. For example, shortage of safe water and food, and shelter problem both have the highest WAI of 0.96 and occur frequently, contributing to their greater impact (Fig. 5). Another serious issue with the WAI value of 0.93 is communication problem (Table 5). Inundation of roads and walkways causes serious mobility and communication challenges. The Brahmaputra River inundates a large area during high floods, and its width is around 12-15 kilometers, covering a large portion of the land. As a result, residents need to use small fishing boats or construct rafts out of banana or bamboo trees to travel from one location to another. Those who do not have these options must walk in the water at their own risk. Floodwater damages the structures of houses and roads because it remains in the ground for several days and takes time to retreat.

Floodwater damages the structures of houses and roads because it remains in the ground for several days and takes time to retreat. Another significant issue in this area is security, which has a WAI value of 0.77. Robberies are common during floods, and a gang of robber raid villages with large boats to seize cattle, goats, and other livestock. So, social violence becomes common problem during the flood period.

Security issues for women and girls become prevalent issue during flood. Girls sometimes find themselves at risk of eve-teasing or sexual harassment in the flood shelter or other locations where numerous people seek shelter during floods. Flood-induced migration has the lowest WAI of 0.64, resulting in less impact. However, during a flood, the majority of the affected families leave their homes and seek shelter in high ground nearby.

Riverbank erosion in the study area: From 2003 to 2023, the study area experienced both erosion and accretion events, occurring frequently throughout this period (Table 6). The timeline has been divided into four periods, each comprising five years of data on erosion and accretion occurrences. Typically, accretion events were observed to happen following severe erosion incidents in the recent past (Roy and Sarker, 2016). The provided table presents the erosion and accretion scenarios in the study area between 2003 and 2023.

The map presented below encompasses data from 2003 to 2023, providing an overview of the erosion pattern of the study area (Fig. 6). The terrain of this area was formed by processes of accretion and erosion during this time. The map enables a comprehensive understanding of the spatial patterns and temporal changes of Brahmaputra riverbank erosion in the study area's land area over the two decades. The map's susceptible areas highlighted the dynamic nature of the riverbank erosion.

Table 6. Erosion and accretion scenarios between 2003 and 2023.

Period	Net erosion (sq. km)	Net accretion (sq. km)
2003-2008	2.25	2.72
2008-2013	7.73	1.47
2013-2018	2.26	6.13
2018-2023	3.53	2.92

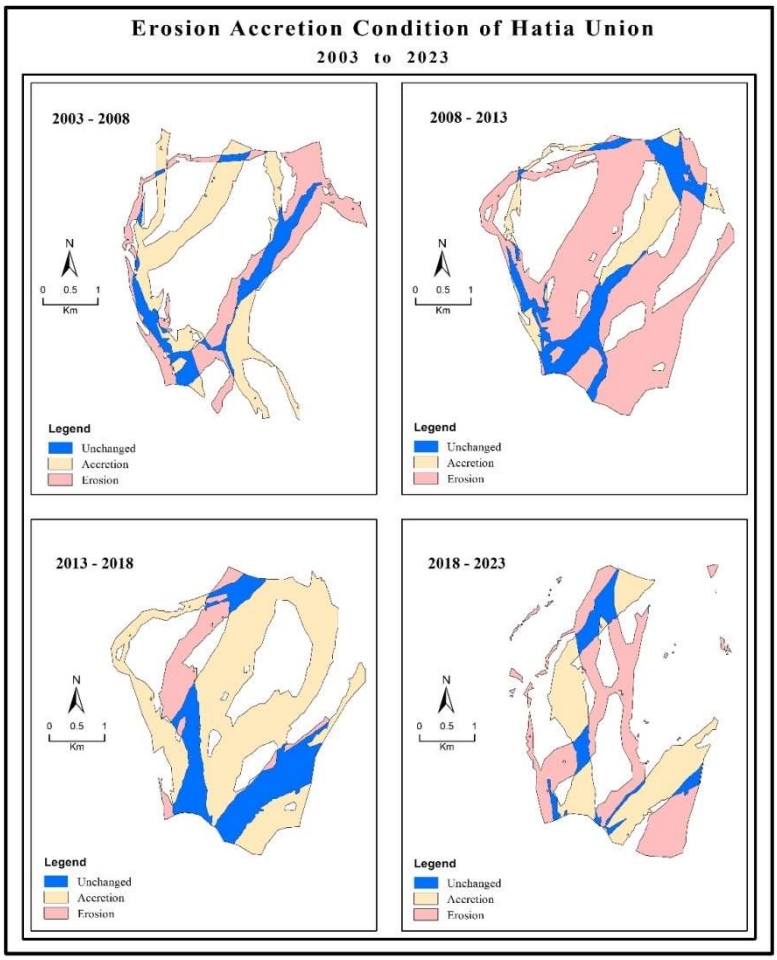


Fig. 4. Spatial Variations in Erosion Accretion Extent at Hatia Union in Ulipur Upazila, between 2003 and 2023.

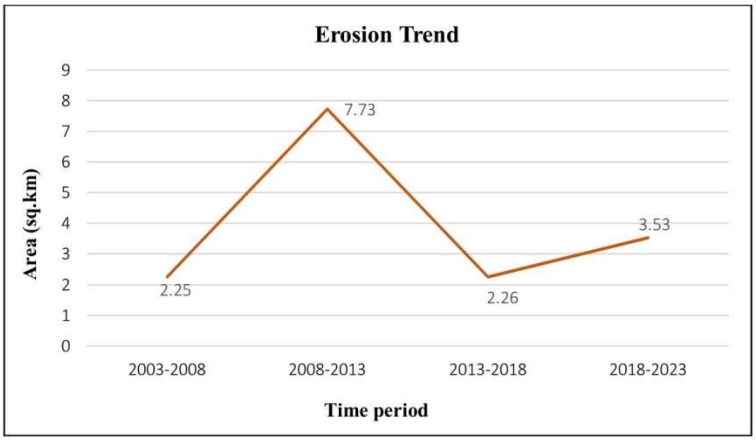


Fig. 5. Erosion trend in last two decades.

The erosion trend over the last two decades reveals as an oscillation pattern. There was less erosion at the beginning, then a significant increase, later a minor slowdown, and followed by a slow increase of erosion rates (Fig. 7).

Perceived response on impacts of riverbank erosion: Population displacement from erosion-prone areas is a common phenomenon (Bhuiyan et al., 2017). Since 1988, people have been facing riverbank erosion and the resulted impacts are huge land loss and displacement of several communities in this Union. Erosion has caused a substantial change in the land area of the Union in last two decades. The study suggests that, about 93% of the surveyed respondents have lost their land or property as a result of river erosion. Most of the affected land is agricultural, with residential property accounting for approximately 49%. Among those who have lost residential property, around 75% reported losing their homes more than three times. In terms of agricultural property, 45% of the respondents have lost more than 5 bighas of agricultural and business land. The impacts of the erosion have been severe, leading to many villages being completely eroded and lost to the river. It resulted in displacement; and those who were affected, endured increasing poverty and severe economic loss.

According to the locals, the Brahmaputra River used to run roughly half a kilometer away from the place from where it was few years back. However, due to riverbank erosion, river came to closer and made the area more vulnerable. For example, a village named Noya Dara eroded and was completely lost in the river only three to four years ago. At this point, Paler Hat Bazar and the surrounding areas are highly vulnerable due to the erosion. Moreover, flood induced impacts increased the area's vulnerability to more

erosion, perhaps leading to more losses and displacements for the local communities living nearby.

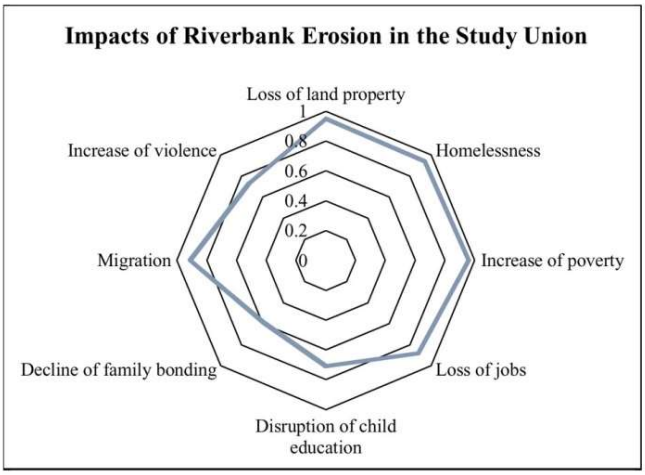
Table 7. Relative Grading of Impacts of Riverbank Erosion as Perceived by Respondents Reflected in Survey.

Impacts	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	WAI	OA
Loss of land property	0	0	0	39	121	0.95	VH
Homelessness	0	0	0	46	114	0.94	VH
Increase of poverty	0	0	5	25	130	0.96	VH
Loss of jobs	0	6	19	39	96	0.88	VH
Disruption of child education	2	14	63	59	22	0.71	H
Decline of family bonding	18	37	64	17	24	0.59	M
Migration	0	2	8	49	101	0.91	VH
Increase of social violence	4	13	56	51	36	0.73	H

Note: Strongly disagree (SD): 0.01-0.2; Disagree (D): 0.21-0.4; Neutral (N): 0.41-0.6; Agree (A): 0.61-0.8; Strongly agree (SA):0.81-1. WAI: weighted average index, OA: overall assessment.

Based on the data and information, there are serious consequences of Brahmaputra riverbank erosion on a number of aspects of the lives of the respondents, including land property loss, homelessness, poverty, loss of employment, disruption of education, social violence, and migration (Fig. 8). The WAI suggested a very high overall impact (VH-Very High) on most aspects, while some factors showed a high (H-High) and even a moderate (M-Moderate) impact.

With the WAI of 0.96 increase of poverty is the dominant effect here following by loss of land property and become homelessness accounting for WAI 0.95 and 0.94 respectively. Migration due to erosion contained WAI 0.91 which is also very high (Table 7). Affected people have no choice but relocate to other areas. Poverty causes various consequences, such as disruption in child education or a decline in family bonding over time. Even social violence, such as theft or conflicts were observed in the study. Another important finding was that poverty leads to child marriage of the females in the neighborhood. Early marriage occurs when the head of the family becomes landless or homeless, or when he/she faces the possibility of becoming impoverished. Another crucial fact is that dowry is a fairly common practice in every case of early marriage or marriage, and this dowry system is practiced in this area for decades.

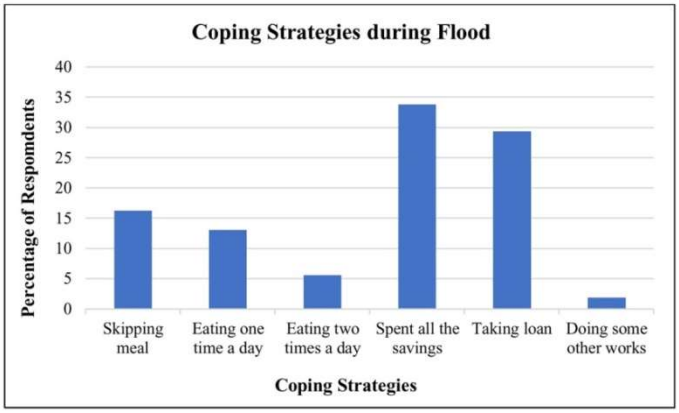


Source: Field Survey, 2023

Fig. 6. Impacts of riverbank erosion in the study union.

Coping strategies with flood and riverbank erosion: Despite receiving minimal assistances from different sources, the surveyed respondents have undertaken few coping strategies with the disasters they faced. It includes skipping meal, eating less meal or less nutritious foods, not spending all the money or taking out loans, and so on. Around one-third of the respondents (33.8 percent) choose to spend all of their savings or to take out loans by 29.4 percent (Fig. 9). The respondents save for months each year, and during a flood, they are compelled to spend all of their savings. The affected people had to spend all of their savings and also take loans from various sources to rebuild or relocate their houses due to floods and riverbank erosion.

According to the respondents, the majority of them took loans from local NGOs. However, some of them reported that the NGOs or banks sometimes refused to provide loans because they might be failed to return the money in the schedule time. As a result, they were forced to seek personal loans. Some people lend money at a high interest rate. One must pay at least 100 taka or sometimes even more interest on a loan of 1000 taka per month. The loan receivers must pay the interest every month on time. As a consequence, loan receivers pay double or even more than that amount of money with the interest they took.

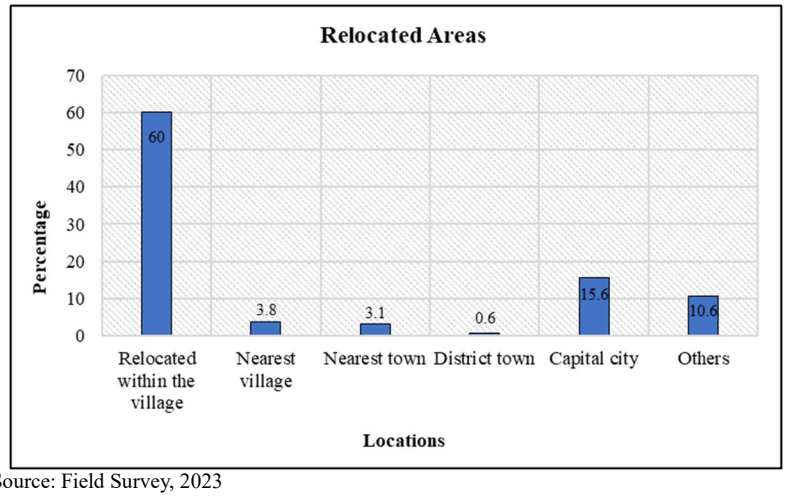


Source: Field Survey, 2023

Fig. 7. Variation of coping strategies adopted by the respondents during flood in Hatia union.

From the field survey it has been observed that more than half (60 percent) of the respondents relocated inside the same village (Fig. 10). This presumably reflecting an attempt to maintain ties to their origin and properties. Furthermore, the locals had several land properties in their villages, after losing one land, they moved into another. Interestingly, 15.6 percent of the respondents mentioned that their family members moved to the capital city for better jobs and living conditions. It also revealed that if a family lost all of their lands, they had to relocate to other people's land or take lease a nearby land. Usually, the day laborers moved from the study area to district level towns.

Some of the respondents fall into the category of migrating to nearest villages and others. Due to severe erosion problem in some villages such as Noyadara, Dagarkuti, Hatiargram etc., the residents of these villages were forced to relocate to nearby villages like Kamartari, Majhipara, Nilkontho and others. The displaced people usually live in a dense settlement. For instance, four or five families purchase a land jointly. Each family usually build one or two rooms and they live together. They have to stay in this way since they share nearly identical mental and financial conditions as a result of their displacement. Those who cannot afford to buy own land, they need to stay in rented house. Many well-off people who reside away from the river and setup Tin shed kutcha houses close to the river. For example, respondents need to pay taka 20,000 per decimal of land over the course of four or five years. Thus, a dense village area was built by the locals in the Hatiar gram under Kamartai where almost every house is used for rent purposes. Since 1988, the displaced people have been residing in these areas.



Source: Field Survey, 2023

Fig. 8. Variations in resettlement options explored by the respondents during riverbank erosion in hatia union.

Conclusion

Hatia Union, located in Ulipur Upazila, Kurigram District, is one of the most disaster-prone areas of Kurigram. Flooding and bank erosion have severe adverse effects on individual and the community. The objectives of the study were to assess the cumulative impacts of flooding and riverbank erosion on the local people of Hatia Union. Moreover, it aimed to explore how they cope with these disaster events and the strategies they adopt during and after disasters like flooding and riverbank erosion. The study reveals that people in this area endure constant hardship due to these disasters. Floods have a considerable detrimental impact, causing extensive damage to the houses of the respondents, crops, livestock, economic activities, educational institutions, and healthcare facilities. All modes of communication are seriously disrupted. Residents have to leave their houses and seek shelter during flood events. They rely on relief as flooding damages all forms of food security. Furthermore, floods create a major unemployment problem, leading to severe economic hardship in this area. The situation worsens when riverbank erosion occurs alongside floods. Riverbank erosion leads to severe land loss to the inhabitants. Over time, acres of valuable land including residents and prominent villages have been eroded and lost completely to the Brahmaputra River. Many affected people had no choice but to migrate to other places, where they often live miserable lives. They were forced to relocate their houses, and many previously well-off landowners have been reduced to extreme poverty due to erosion.

Various measures were undertaken to combat floods and riverbank erosion in this area are inadequate, and the necessary facilities have not reached to the underprivileged people. There is a lack of co-ordination too. In response to these disasters, more active policies must be implemented as soon as possible. If this area is neglected, the whole Kurigram District, and by extension the country, will face significant setbacks due to the negative impacts. Policies and plans should not only focus on minimizing the immediate impacts of floods and riverbank erosion but also prioritize building long-term resilience. Ensuring the safety, prosperity, well-being, and cultural heritage of the local population is crucial. Co-ordination is essential to focus on improving the livelihoods of local people. Engaging local communities in disaster risk reduction planning and decision-making processes can result in more sustainable and community-centered initiatives.

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