COPING STRATEGIES IN RIVERBANK EROSION AFFECTED AREAS: A CASE STUDY OF ANDHARMANIK VILLAGE IN MANIKGANJ DISTRICT

By

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Master in Disaster Management

Postgraduate Programs in Disaster Management (PPDM)

Department of Architecture

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A thesis submitted to the Department of Architecture in partial fulfillment of the requirements for the degree of Master in Disaster Management

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Department of Architecture
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Declaration

It is hereby declared that

1. The dissertation is my own individual and original writing and it was written when I was pursuing a Master's degree in Disaster Management at Brac University.
2. Except where properly cited through comprehensive and correct referencing, the dissertation does not include anything already published or written by third party.
3. The dissertation does not incorporate any material that has been approved or submitted for any other university or other institution's degree or diploma.
4. I have recognized, acknowledged and credited all major sources of assistance.

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Approval

The thesis titled "Coping Strategies in Riverbank Erosion Affected Areas: A Case Study of Andharmanik Village in Manikganj District." submitted by Md. Abdur Rahman (ID: 18168003) of summer, 2018 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master in Disaster Management on March 22, 2022.

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Ethics Statement

The whole study was conducted with an ethical competence and integrity in terms of conscious decision making and responsibly acting considering of legal standards as well as social, economic and ecological consequences.

While conducting field survey, at first and foremost, consent was surveyed respondent. All the actions such as taking photographs, talking with officials, respondents were conducted with permission. The field survey was conducted with Beneficence- Do not harm manner. Wherever any intellectual property is used for the purpose of this study, they are given proper credits with proper citation. The whole research is conducted with full objectivity starting from determining the research questions to research findings. The overall research design, data analysis and representation are carried out regardless any bias and inclination.

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First of all, I would like to express my deepest gratitude to Allah, the almighty for his merely extended blessing to me to this study, manages each and everything soundly. This study could not come out without the help and encouragement of a number of people. I am really thanked and gratefully remember them.

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Finally, I am indebted to my parents and my wife a permanent source of inspiration for all my works and achievements.

Abstract

Bangladesh is considered to be the biggest delta in the world. It is crisscrossed by the Ganges, Brahmaputra, and the Meghna river system and their branches and distributaries. It is also considered to be one of the most disaster-affected countries in the world. In Bangladesh, there are few disasters that visit every year. Among them, flood and river erosion is a very common disastrous event. Each year thousands of people lose their crops, houses, livelihood, homestead land, cultivable land, and become homeless. Road, embankments, schools, mosques hospitals, and other rural infrastructures are damaged and eroded away due to river erosion.

The erosion affected people migrate to cities or nearest town and they live in the urban slum areas. Some major effects due to the riverbank erosion are- displacement of people from one place to another, the effect on public health, educational structure, people's occupation and livelihood, unemployment rate increases, affect in agricultural production, transportation, etc. The major causes of riverbank erosion are flooding, deforestation, heavy rainfall, unplanned settlement, land use, the strong current of the river, over clearing of the catchment, gravel extraction, and poor river management.

This study tried to explore the local people coping strategies with riverbank erosion of Andhermanik village in Harirumpur Upazila of Manikganj district. Primary and secondary data were used in the study. The data were collected by questionnaire survey, key informant interview, focus group discussions, and field observation. The results of the study showed that people tried to adapt with the adverse situation by their own techniques. People have experienced erosion more than two three times. The practiced coping strategies were composed into physical, economic, and social strategies. Physical strategies include evacuation, relocation, and migration. They also adopted housing-related coping strategies like selling, dismantling, shifting to new areas.

Economic coping strategies include changing occupation, borough or loan money, opening business, etc. Household’s ability to adapt with river erosion depends on people’s socioeconomic and environmental conditions, such as education, income, and occupation. Though river erosion causes the loss of lives and properties, people’s indigenous coping techniques could significantly reduce their vulnerability without outside assistance. Effective early warning systems integrate local coping practices with modern technology and sustainably improve socioeconomic conditions are necessary to reduce the losses from riverbank erosion.

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List of Acronyms

BBS	Bangladesh Bureau of Statistics
BWDB	Bangladesh Water Development Board
CEGIS	Center for Environmental and Geographic Information Services
CVI	Climate Vulnerability Index
DRR	Disaster Risk Reduction
GBM	Ganges, Brahmaputra and Meghna
GDP	Gross Domestic Product
ICT	Information and Communication Technology
IDMC	Internal Displacement Monitoring Centre
IDP	Internally Displaced People
INGO	International Non-Governmental Organization
MoDMR	Ministry of Disaster Management and Relief
NGO	Non-Governmental Organization
NWMP	National Water Management Plan
UNHCR	United Nations High Commissioner for Refugees
VGD	Vulnerable Group Development
VGF	Vulnerable Group Feeding
WASH	Water Sanitation and Hygiene

Chapter 1

Statement of the Problem

1.1. Introduction

Bangladesh is a flat alluvial plain and also known as one of the largest floodplain and deltaic areas in the world. It is vulnerable to natural disasters which include riverbank erosion which, over the past century, has been a major threat for the settlements of Bangladesh. It is caused by the loss of floodplain households' land and natural resources (Krantz, 1999). Riverbank erosion is a significant geomorphological feature. It is a process in which bank lines are shifted and stream bars are migrated (Bhuiyan, Islam, & Azam, 2017). Bangladesh's natural intricate network of rivers and creeks drains a catchment area of about 1.5 million square kilometers, of which only about 7% is within its territorial borders (Krantz, 1999).

Riverbank erosion is one of the most unforeseeable natural phenomena and complex types of disaster that makes millions of people homeless. The displaced people, due to erosion, have no other alternative than to settle on accreting char land and create a typical social and economic char environment. Compared to other parts of Bangladesh, the severity of the damage, risk, and vulnerability from flood and riverbank erosion is much higher in riverine char-land settlements since population pressure forces many people to live in the floodplain areas.

River erosions can occur either naturally or through human impact. The Padma River and its tributaries are changing their physical characteristics as a result of riverbank oscillation, levee breaching, and the formation of mid-channel bars. The depths of the river are shallower at some places. For this reason, the river bank lines are very unstable now. This works as a threat to the infrastructure’s development, which is crucial for the growth of the entire southwestern region of the country.

1.2. Background

Every year, due to riverbank erosion, valuable land is lost including cultivable and village settlement land, markets, school, roads and towns are destroyed, which displacs tens of thousands of people. This research examines the the nature of human adaptation systems in the Andhermanik village in Manikganj district, by investigating the social, physical, and

cultural aspects of the displaced people. Some policy measures are suggested to improve floodplain residents' ability to deal with these hazards.

This paper discovered that riverbank erosion is one of Bangladesh's major impediments of development and that it is displacing a large number of people every year. Recurring displacements are frequent in Bangladesh's erosion-prone districts, and such uncertainty impedes the implementation of rehabilitation and long-term development programs.

The location of the study area is in the char of Padma River which is the border area Manikganj. This village is most vulnerable to erosion, already half of the village has eroded within the past few years. Most of the inhabitants of these areas are highly dependent on agricultural production, and a small percentage of people are in private service, own small businesses, and also work as day labor. Weak economic conditions and lack of government funds make them more vulnerable. Permanent or temporary migration is the coping option for the affected families because there is no other way. More than 50 percent of the family migrated due to river erosion and a lower percentage amount of people take shelter nearby roads or villages temporarily (Rabbi, Saifullah, Sheikh, Sarker, & Bhowmick, 2013).

Despite riverbank erosion having severe negative impacts on the economy of Bangladesh, no serious attempts have been in place either at the micro or macro levels, to reduce riverbank erosion and its adverse impacts. Moreover, the negative impacts are aggravated in the predominantly agriculture-based areas. The past decade has been critical in the study area regarding river bank erosion. Increased population, especially households below the poverty line living in the erosion-prone areas made the condition worse. This study tries to estimate the socioeconomic condition of the displaced population and also the proportion of land eroded due to river erosion and its impacts on a vulnerable population.

Andharmanik village has been experiencing erosion over the past 10 years and this is due to the increasing population over time. The riverbank erosion causes a massive amount of land loss both settlement and cultivable land, population displacement, and landlessness as it is a widespread and recurrent natural hazard affecting the lives of people severely. This study tries to estimate the socio-economic condition of the displaced population and also the proportion of land eroded due to river erosion and its impacts on it.

The major causes of riverbank erosion are flooding, deforestation, heavy rainfall, land use, over clearing of catchment area, stream management, a strong current of the river, and river bank vegetation, silt deposition, sand extraction, gravel extraction, and poorly managed embankments. Some major effects due to the riverbank erosion are- massive land loss, displacement and movement of people from one place to another, the educational structure is also negatively changed, affect in public health, affect in profession and income of the affected people, jobless & unemployment rate increases, affect in the transport system, agricultural production, and division of the joint family etc.

1.3. Objectives of the Study

The overarching goal of this research is to learn about the coping strategies used by Padma River erosion victims, as well as their economic and social circumstances. In addition, some objectives were set to help achieve the study's goals, which are as follows::

a. To investigate the impact of river erosion on the affected people
b. To identify the coping strategies of vulnerable people affected by river erosion

1.4. Rationale of the Study

Riverbank erosion is considered to be one of the most inhuman, unpredictable, and grave types of disasters. Erosion depends on a number of factors including the quantity of rainfall, river morphology, soil structure, flooding characteristics, and the topography of the river bed. Such catastrophic event took a less toll on lives but more on livelihoods, occupation, income as cropland and homesteads, as well as other livelihood opportunities, were devastated. It is a rural, local and repetitive natural hazard that has a significant impact on the lives and property of riverside residents (Ahmed 2016; Islam et al. 2016; Alam et al. 2017). Riverbank erosion is regarded as a gradual, silent disaster that ranks first in terms of property losses in Bangladesh (Shamsuddoha and Chowdhury 2007; Rahman et al. 2015). This study investigated the effect of river erosion on the life and livelihood of local people and their adopted coping mechanism to live with this disaster. The knowledge acquired from this case study-based research can guide future researchers and policymakers to get a better picture of the ground reality along the river banks of the Padma River.

Manikganj district is one of the most at risk or vulnerable for riverbank erosion. Sometimes it does not get sufficient attention from the government like other affected districts. The affected people are being ignored thus they were getting poorer day by day. The local people don't have many options for their livelihood. Over the past twenty years, this area's geographical land formation has changed extensively. Another reason to choose this area is it's close to Dhaka city so transportation is not a hassle for me.

1.5. Scope of the Study

This study mainly dealt with the direct impact of river erosion on the affected people. It covered people's immediate adapting techniques and long-term coping strategies to live with this disaster. This study included the immediate displacement, migration, physical, economic, and socio-psychological aspects. This study does not consider some technical aspects like river dynamics, spatial and hydro-morphological information related to bank erosion of rivers.

1.6. Limitations of the Study

One of the major limitations was the lack of previous studies or research in the selected study area. There were a number study describing the river erosion scenario but study particularly dealing with coping or adaptation strategy focused on the Manikganj region has not yet been done. The government of Bangladesh very recently announced river erosion as a disaster that emphasized the seriousness of the problem. Another challenge faced during primary data collection was to find the affected people as they have mostly relocated. Rich and upper-middle-class families mostly migrated after impacted by river erosion to the urban or safer places as per their ability. Households with lesser means migrated to nearer towns or adopted a combination of coping strategies to survive. Moreover, as an academic exercise, the research had limitations of funds and time which lead to limited sample sizes. A more elaborate study in this region will surely reveal more representative findings.

Chapter 2

Methodology

2.1. Introduction

The methodology is a systemic process in a research, theoretical examination of the methods used in a particular field of study. As a result, in order to complete this research, this study followed a well-defined procedure. The methodology used to carry out the study efficiently and in accordance with its objectives was as follows:

2.2. Problem Identification

Bangladesh is located in the Bengal delta, which is formed by three powerful rivers: the Ganges, the Brahmaputra, and the Meghna (GBM) (S. H. Rahman & Islam, 2016). Between 1973 and 2007, 88,780 hectares of land were eroded along the banks of Brahmaputra, 27,990 hectares of land along the banks of Padma, and 38,510 hectares of land along their distributaries, according to CEGIS (Mohammed Raju and Taznin Afroza, 2014). As consequence, a large number of people find themselves homeless and displace due to riverbank erosion and this population migrates to the nearest urban area, town or cities and lives in the slum areas (Bhuiyan et al., 2017). In terms of long-term impact on people and society, no other disaster is as devastating as riverbank erosion in Bangladesh (K M Elahi, 1991). So, it is important to identify the impacts of this catastrophe, sufferings, and coping strategies of the affected people. In-depth understanding of which can lead us to formulate a better risk reduction strategy. River erosion directly affects approximately 1 million people each year. and because of this erosion landlessness could be high as 70% (Mohammed Raju and Taznin Afroza, 2014).

2.3. Formulation of the Objectives

After conceptualization of the ground reality, the research question of the study was clearly defined. The study is to identify coping strategies adopted by the affected people in terms of physical, social, and economic perspectives.

2.4. Selection of the Study Area

Manikganj district is among the most vulnerable districts for riverbank erosion. It has several Upazilas that are frequently affected by river erosion. Harirampur is one of them, it is located about 86 km from Dhaka and located within one of the most erosion-prone areas of the mighty river the Padma. The Padma and Ichamoti rivers are major rivers in this area. Harirampur Upazila is comprised of 13 union parishads. that are seriously affected by

riverbank erosion. Andharmanik village has been experiencing erosion over the past few decades. From the early liberation war of Bangladesh in 1971 to 2019, the river Padma has caused extensive riverbank erosion in these areas. River erosion resulted in the massive land loss, forced displacement, and landlessness in this area.

2.5. Reconnaissance Survey

To get a view of the nature of the study area, a reconnaissance survey was conducted. It helped in preparing a perfect questionnaire for the study and to finalize the sample size.

2.6. Selection of Parameters and Data Collection Methods

Some parameters were selected to conduct the study. For this study, the following parameters were selected.

Table 1: Objective wise parameters

Objective	Parameters
■ To investigate the impact of river erosion on the affected people	Land
	Housing
	Income
	Changing Croping Pattern
	Infrastructures

Objective	Parameters
■ To identify the coping strategies of vulnerable people affected by river erosion	**Physical coping strategy** (evacuation, relocation, migration, house, water supply, and sanitation)
	Financial coping strategy (occupation, income, poverty, etc.)
	Social coping strategy (education, knowledge base, etc.)

2.7. Questionnaire Preparation

For collecting primary data, a semi-structured questionnaire was prepared for the study. For Focus Group Discussion (FGD) and Key Informant Interview (KII) separate check list were prepared.

2.8. Study Methods

For this study, both a questionnaire survey and focus group discussion was done. Information and data were also collected from secondary sources. Primary data has been collected from field surveys from the affected community people. Secondary data and information have been collected from published books, literature, BBS, national and international organizations, Government Offices like Upazila Administration, Boyra union Parishad, Land Office, Water Development Board. KII was done with Union chairman, AC land, PIO and PWD Project Engineer.

2.9. Sample Size Determination

Andharmanik village is consists of 924 households. The study considered the displaced river erosion affected households only; families having at least one time displaced were considered. Out of 924HH, 165 HH were found affected and displaced. A total of 116 households were taken as sample with 95% confidence level. Simple random sampling method was used for selecting the respondents.

Picture 1: Household survey with the community people

Picture 2: Household survey with the community people

Picture 3: FGD with union chairman and members.

Picture 4: KII with project director, cyclone shelter, DDM.

Picture 5: Key Informant Interview (KII) with Upazilla Statistics Officer. KII were also done with AC (Land), Upazila Project Implementation Officer (PIO).

Picture 6: Key informant interview & field visit project engineer of WDB at embankments of the study area.

2.10. Triangulation

The collected data and findings were gone through a triangulation process to enhance overall data quality, validity and credibility and also reduce biases.

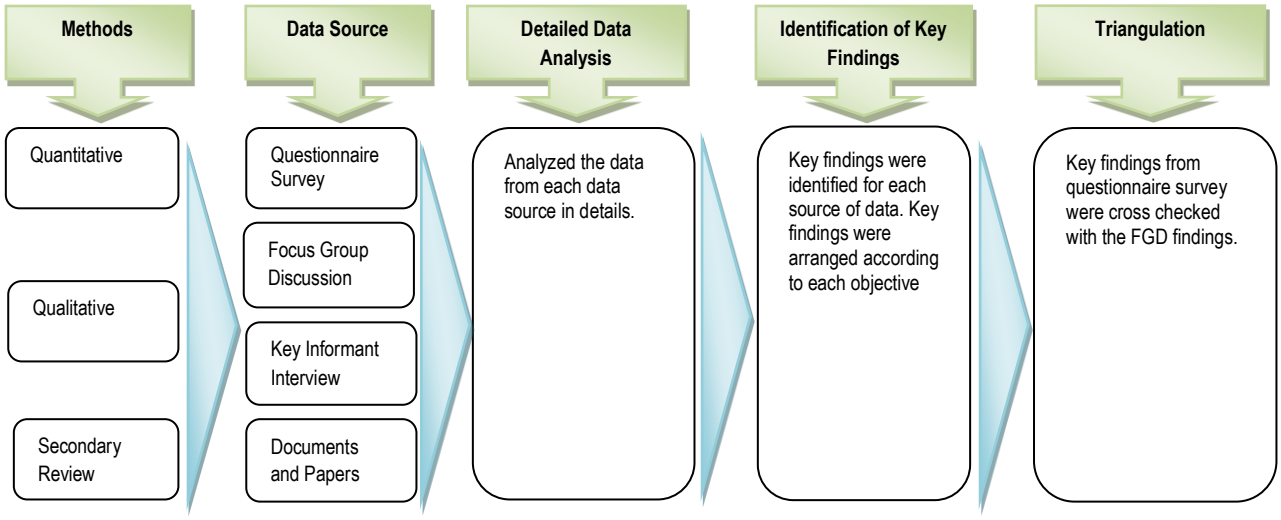


Figure 1: Data, Information and Finding Analysis and Triangulation process

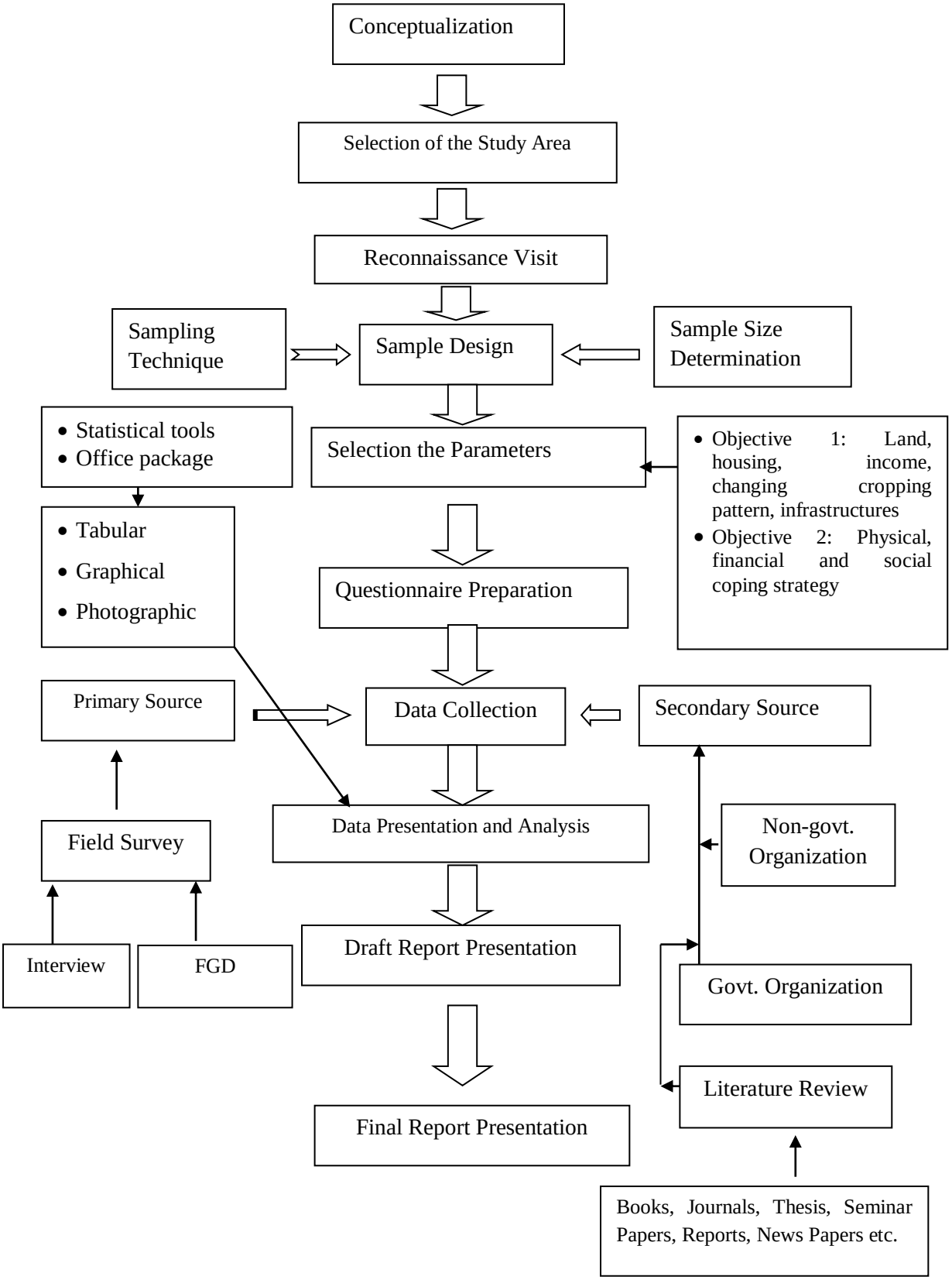
1.1. Data Interpretation and Analysis

In this stage of research, assembled and processed data have been analysed using SPSS, Microsoft Excel, etc. Different types of figures and tables are created based on analysed output using Microsoft Excel and Microsoft Word.

1.2. Preparation of Draft and Final Report

After the completion of the analysis of the study findings, a draft report has been prepared. After reviewing the draft report, the necessary correction has been made. Then the final report of the study has been formed under the guidelines of the supervisor and finally submitted to the supervisor.

Figure 2: Flow Chart of Methodology



Chapter 3

Literature review towards a conceptual framework

3.1. Introduction

Initially, it was necessary to develop a broad understanding of the thesis's various issues and jargon. This chapter explained the related terminologies, background and Bangladesh situation with some statistics.

3.2. Riverbank Erosion

Riverbank erosion is a significant geomorphological phenomenon. This progression is very common in many countries around the world's fluvial and coastal environments, though the occurrence and implications of erosion may vary. (Pati, Lal, Prakash, & Bhusan, 2008; Das, Dutta, & Saraf, 2007). It is a progression in which river shorelines are shifted and stream bars are migrated (Bhuiyan et al., 2017). Many factors affect riverbank erosion. They are, decrease or increase in shear strength, shifting of the river course, characteristics of erosion-prone shore and bed materials, poor vegetation cover, rapid drawdown, obstacles in the streams, pressure imbalance at the bank face, boat wakes, and wind wave (Tanvir Rahman, Islam, & Rahman, 2015). Riverbank erosion is regarded as a slow, unpredictable and considered as the topmost disaster in term of property losses in Bangladesh (Shamsuddoha, Chowdhury, & Trust, 2007). It is a regional and recurring natural hazard that has a profound impact on the life, livelihood, property, and development of the riverside residents (Ahmed, 2016; M. S. Islam, Huda, & Islam, 2016; Alam et al., 2017)

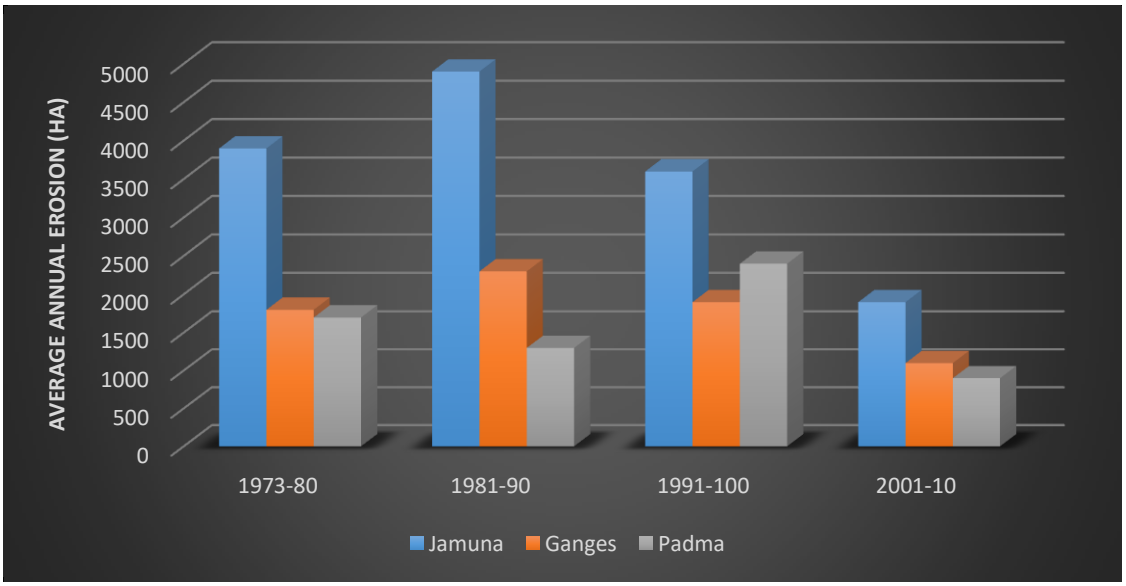
3.3. River Erosion in Bangladesh

Bangladesh is the largest deltaic plain in the world (M. S. Islam, Sultana, Saifunnahar, & Miah, 2014). It is crossed by the Ganges, Brahmaputra, and Meghna river systems, as well as their tributaries and distributaries. The country's total area is 147570 km2, with rivers and inland water bodies accounting for 6.7 percent of that total. The GBM region covers approximately 88 percent of the total land area of the country (Ahamed, 2001). Bangladesh is situated in the south of the Bengal delta which was developed by a basin area of three mighty rivers (S. H. Rahman & Islam, 2016). The amount of sediments deposited in the GBM basin is the highest in the world today (Kuehl, Hariu, & Moore, 1989). According to various studies, approximately 1050 million tons of sediments are discharged from the Bengal basin each year (Milliman, 1995), of which 600 million metric tons are deposited within the Bengal delta (Meade, 1996). As a result, riverbeds in GBM are silting up, losing

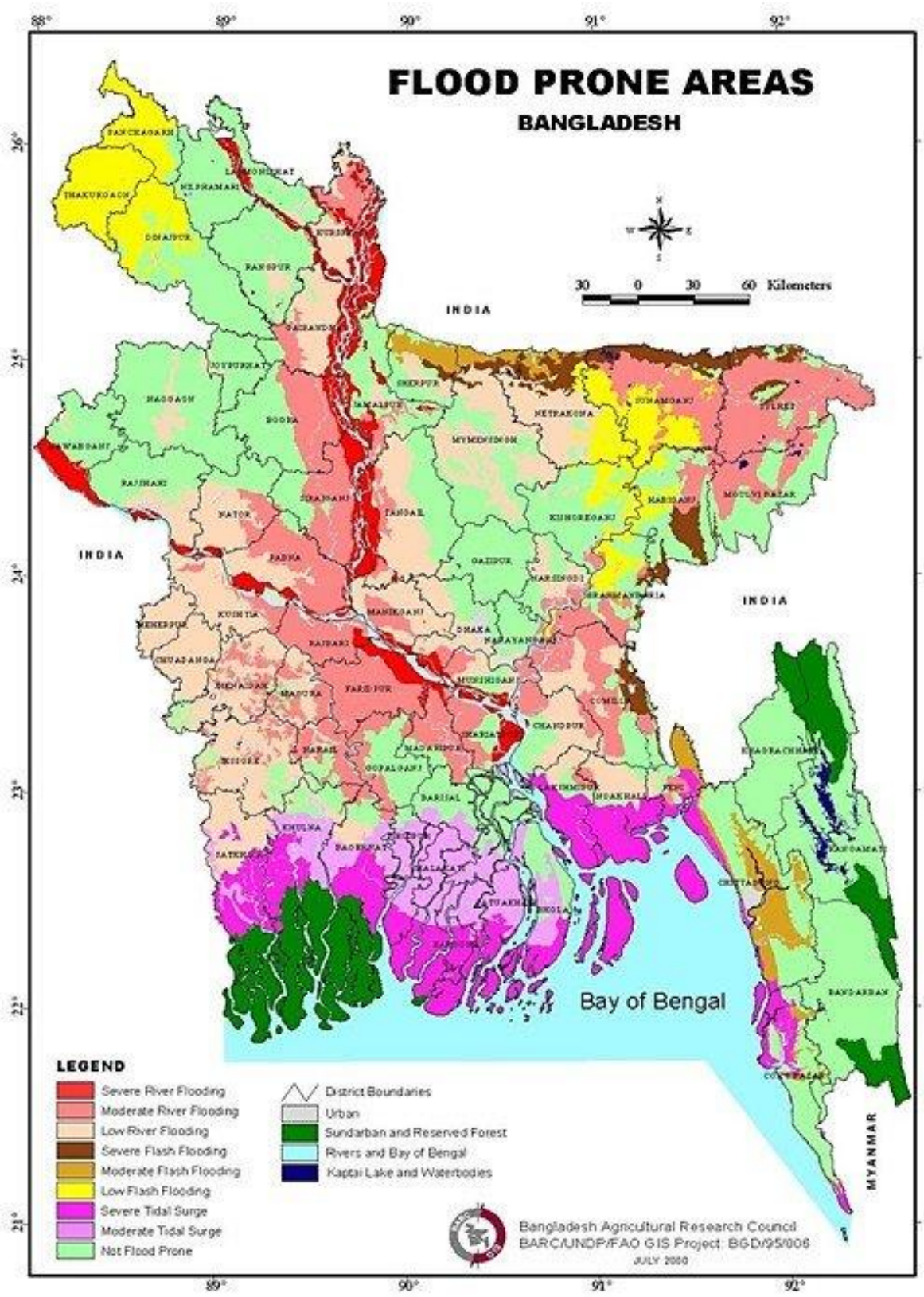
depth, and becoming shallower. Because of this over-siltation, the river formation is constantly being adjusted, and the river channels are constantly shifting. Fluvial floods and riverbank erosion are caused by these phenomena in this basin as well as in Bangladesh (K Maudood Elahi & Rogge, 1990).

A tributary and distributary of the Padma, Teesta Jamuna, Brahmaputra, Meghna, and Surma rivers and their tributaries encompassing the country with a length of about 24,140 km (BBS, 2011). All of these rivers cause erosion at different points, and annual rivers erode 10,000 ha of land in Bangladesh (MoWR, 2007).

Figure 3: Annual eroding along the Jamuna, Ganges, and Padma rivers (period-averaged)



(Source: CEGIS)

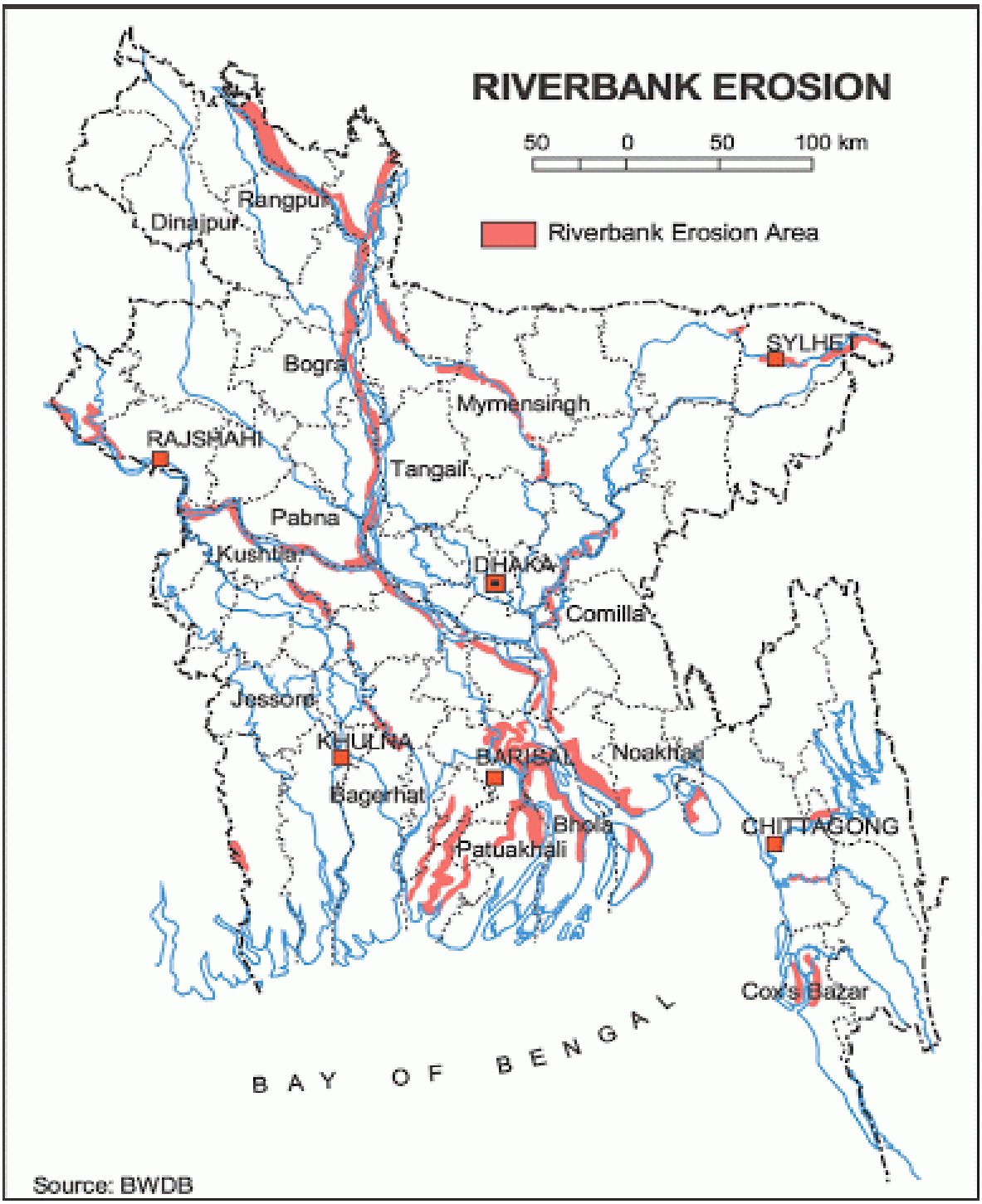


Between 1973 and 2004, approximately 877.90 km2 of land along the Jamuna (Lower Brahmaputra) and 293.90 km2 along the Padma (Lower Ganges) were eroded (Borḍa, Project, & (Bangladesh), (2009). There are 283 locations, 85 towns, as well as numerous growth centers situated along the bank line that are vulnerable to erosion (M. D. F. Islam & Rashid, 2011), and approximately 15–20 million people, are at risk from the

consequences of erosion (Hutton & Haque, 2003). As a result of river bank erosion, a large number of people become homeless, unemployed, and relocated to cities or neighboring towns to live in slum and squatter settlements (B. Das, 2011). In addition to floodplain and settlement, the country loses numerous structures including schools, markets, mosques, several kilometers of roadways, railroads, and flood control embankments each year. In terms of long-term consequences for individuals, people, communities, and society, no other disaster is as catastrophic as riverbank erosion (K M Elahi, 1991).

Millions of people are affected each year by river erosion, which destroys standing plants, vegetation, crops production, cultivable land, and homestead land. It is estimated that river erosion affects approximately 5% of Bangladesh's total floodplain. According to some researchers, river bank erosion is occurring in approximately 94 of the country's 489 Upazilas. Other researchers have identified 56 Upazilas with an erosion problem. Flood hazards and river erosion are now almost daily occurrences in nearly 100 Upazilas. 35 of them are severely affected.

According to the Bangladesh Water Development Board (BWDB), there are a number of districts that are more erosion-prone. The most prone districts to erosion are Bogra, Kurigram, Sirajganj, Lalmonirhat, Rangpur, and Gaibandha in the country's north, and Manikgonj, Chandpur, Rajbari, Faridpur and Shariatpur in Dhaka zone, Tangail, Sirajgonj and Jamalpur in Mymensingh zone, and Patuakhali's coastal areas. According to a CEGIS study conducted in 2009, the most erosion-prone area in Bangladesh is the Sirajganj district, which experienced total land erosion at a rate of 622.2 hectares (Lamiya Ahmed, 2019).



3.4. River Erosion of the Major River

3.4.1. Jamuna River

The Jamuna River's net erosion was approximately 37296 hectares between 1973 and 2017. The accretion along the Jamuna was 14246 hectares throughout this period. Manikganj and Faridpur experienced the most erosion among the districts on the Jamuna's banks, while Rajbari experienced the least 640 hectares. Because of the presence of highly erodible materials on the left bank of the Jamuna River, river erosion was much higher than on the right bank.

Table 2: Jamuna river erosion from 1973-2017

District	Eroded Area (ha)	Accreted Area ha)
Bogra	11456	5094
Gaibandha	10215	1589
Jamalpur	10864	4993
Kurigram	19584	312
Manikgonj	6568	34
Pabna	2738	14
Sirajgonj	23697	4540
Tangail	8180	25
Total	93302	16603

Source: CEGIS

3.4.2. Padma River

According to the data, both banks of the Padma are moving outward from the center, and the stream is widening. Between 1973 and 2017, the net erosion along the Padma River's 100km length was approximately 93,302 hectares.

The rate of erosion along the Padma River, according to the CEGIS report, changes over time. For example, in the 1980s, the Padma River was widening at a rate of 160 meters per year, which increased to 230 meters per year in the 1990s. The rate of widening has recently slowed to 140 meters per year. Shariatpur was the worst-affected district, losing 23697 hectares. In 2017, 1425 hectares area was eroded along the banks of the Padma River, with approximately 114 hectares containing settlements. The rural road was eroded for about 343 meters.

Table 3: Padma river erosion from 1973-2017

District	Eroded Area (ha)	Accreted Area (ha)
Dhaka	2564	15
Faridpur	8763	4525
Madaripur	2592	3107
Manikgonj	7139	36
Munshigonj	5971	29
Rajbari	640	55
Shariatpur	9627	6478
Total	37296	14246

Source: CEGIS, 2018

3.4.3. Ganges

According to CEGIS, an interpretation of satellite images from the last few decades demonstrates that the Ganges is nearly stable in width, despite the fact that it is constantly shifting.

Between 1973 and 2017, the river's erosion was 31,421 hectares, while accumulation and accretion was 27,026 hectares. During this time, Kushtia district is by far the most affected region by the Ganges (total erosion is 11,834 hectares). In 2017, erosion along the Ganges River's banks was estimated to be around 329 hectares, with settlements on 21 hectares. Along the river, approximately 169 meters of the Upazila road and 273 meters of the rural road were eroded. CEGIS anticipated 22 potentially vulnerable sites along the Jamuna, Ganges, and Padma rivers. There are fifteen of these sites on the banks of the Jamuna, four of the sites on the banks of Ganges, and three of the sites on the bank of Padma River.

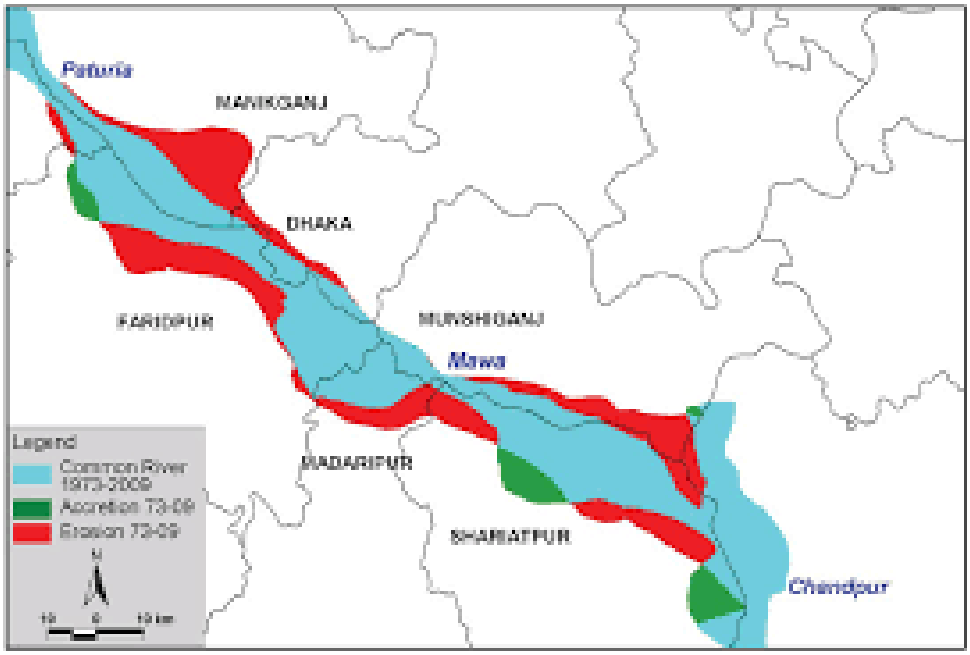
Table 4: Ganges river erosion from 1973-2017

District	Eroded Area (ha)	Accreted Area (ha)
Kushtia	11834	1617
Natore	2047	148
Nawabgonj	4997	10735
Pabna	8044	10001
Rajbari	7845	2698
Rajshahi	2160	1828
Total	31421	27026

Source: CEGIS, 2018

3.5. Geological Characteristics of the Padma River

The Padma river, which flows from Aricha to the junction with the Meghna river in Chandpur, is a combination of the Jamuna and Ganges rivers (M M Rahman & Islam, 2017). The Padma's current path dates from less than 200 years ago (Best, Ashworth, Sarker, Roden, & Gupta, 2007). Because the Padma's path is relatively recent, it is possible that its own silt has formed. Erosion occurred on both sides of the Padma River. The river's banks are migrating outwards, and the river is widening as a result. Over the last four decades, the Padma River's net erosion has totaled 32,189 hectares (M M Rahman & Islam, 2017). Over time, the pace of erosion along the River fluctuates. The Padma River was widening at a rate of 160 meters per year in the 1980s, which amplified to 230 meters per year in the 1990s, and 130 meters per year was recently somewhat reduced.



3.6. Coping Strategy

Coping strategies or adaptation mechanisms are the clear and specific psychological and behavioral efforts that people employ to tolerate, withstand, endure, accept, lessen, or minimize traumatic situations (Taylor, 1998). Two noteworthy common coping strategies are: Problem-solving and emotional focus. Problem solving coping strategies involve doing something active to relieve stressful situations, whereas emotion-focused coping mechanisms include attempting to control the emotional consequences of traumatic or potentially stressful situations. Studies have shown that individuals use both types of techniques to combat most stressful situations (Nia, Aliloo, & Ansarin, 2010; Folkman & Lazarus, 1980).

Another distinction that is frequently made in coping-related works is between avoidant and active coping strategies. Active coping strategies are either psychological or behavioral responses that aim to change the nature of the stress or how one thinks about it, whereas avoidant coping strategies lead individuals into actions (such as drinking or alcohol abuse) or psychological illnesses (such as withdrawal or surrender) that retain them from coping with stressful occurrences directly (Taylor, 1998) (Kammu & Krishna, 2020). Normally, Active coping strategies, regardless of whether emotional or behavioral, are generally thought to be better ways to deal with traumatic situations, whereas avoidant coping mechanisms appear to be a psychological or mental risk factor or symbol for negative responses to stressful traumatic life events (Holahan & Moos, 1987).

3.7. Types of Disaster-Related Coping Strategies

There are many coping strategies that have been identified and used in the field of coping-related literature. Some researchers (Folkman & Lazarus, 1980) classified coping responses into four groups, namely

- Problem-focused,
- Emotion-focused,
- Support-seeking, and
- Meaning-making coping

Weiten and Lloyd (Weiten, Lloyd, & Lashley, 1991) have documented another four types of coping strategies, namely;

- Appraisal-focused (adaptive cognitive),
- Problem-focused (adaptive behavioral),
- Emotion-focused, and
- Occupation-focused

Again some other researchers like Billings and Moos (Billings & Moos, 1981) added escaping coping as one of the emotion-focused coping responses.

But, in reality, affected people, individuals, the community adopted multiple coping strategies concurrently. These depend on geographic, economic, sociological, psychological, and other related conditions. All these strategies demonstrate the usefulness, but some researchers recognized that those affected people using problem-solving-focused coping strategies, help them better to adjust in life. Naturally, individuals use a mixture of several coping approaches, which change in course of time. When individuals perceived greater control over their problem then problem-focused coping mechanisms will be used.

Coping is peoples' natural survival technique and people's ability to manage with disasters adverse impacts. According to Paul, Bangladesh is a flood-prone country, in flood-vulnerable villages, individuals continuously fight against flood-related impacts in accordance with their exposure level and capabilities, with varied approaches applied at different geophysical settings (Paul & Routray, 2010).

It was evident that individuals living in low flooding locations or less vulnerable places and with the better socioeconomic condition are more likely to cope with the negative flood impacts compared to the people living in locations with high frequency and sudden flooding events. Likewise, families' capacity to cope with disaster impact depends on household's

socio-economic conditions, like income, livelihood, education, occupation, etc. Most of the affected people tried to cope with these hostile situations by their own methods and techniques (M. S. Islam, Hasan, Chowdhury, Rahaman, & Tusher, 2012). It is opined that people's ability to respond to environmental threats and disasters is influenced not only by the physical and tangible forces that affect them, but also by native cultural and social belief systems that shape how people perceive and organize their actions (Hutton & Haque, 2003).

3.8. Migration

The term migration is defined by IOM as "the movement of a person or a group of persons, either across an international border, or within a State. It is a population movement, encompassing any kind of movement of people, whatever its length, composition and causes; it includes migration of refugees, displaced persons, economic migrants, and persons moving for other purposes, including family reunification" (IOM, 2011). IOM uses the term "environmental migrant" to describe: "Persons or groups of persons who, for compelling reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their homes or choose to do so, either temporarily or permanently, and who move either within their country or abroad" IOM (2011).

3.9. Internally Displaced Person (IDP)

Many terms, theories and concepts have been used in literature, including environmental migrants or climate change migrants, or climate migrants, ecological or environmental refugee, environmentally induced or forced migration, or climate change refugee, and environmental displaces. However, there is no universally accepted definition of environmental displacement that can be used to pinpoint the problem (Warner, Ehrhart, Sherbinin, Adamo, & Chai-Onn, 2009).

Internal Displacement

Internally Displaced Persons are people who have been forced to leave their homes or living places but remain in their own country (IDPs). Internal displacement is distinguished by its coercive nature and characterized by the fact that affected populations do not cross an internationally recognized boundary (OHCHR, 2020).

Guiding Principles on Internal Displacement

Individuals or groups of people who have been forced or compelled to flee or leave their homes or places of usual residence, particularly as a result of the situation to avoid the effects of warfare or armed conflict, widespread violence, human rights violations, or natural or man-made disasters to catastrophic events, and who have not passed an internationally recognized National border (Deng, 1999).

UN Definition

The current UN definitions are explanatory rather than legal in nature. It does not grant IDPs any special rights under international law. IDPs should have the same rights as other citizens as citizens of their country. The definition presented in the Guiding Principles is widely accepted as the most recent UN definition (UNHCR, 2018).

"The distinctive feature of internal displacement is coerced or involuntary movement that takes place within national borders. The reasons for flight may vary and include armed conflict, situations of generalized violence, violations of human rights, and natural or human-made disasters."

In the case of Bangladesh, there are a variety of characteristics of displacement, including those who are displaced temporarily due to disasters, those who are displaced and unable to return to their place of habitual residence, which has been devastated by disasters, and those who migrated to different areas with little or no intention of returning. Displaces suffer significant socioeconomic impoverishment, stigmatization and marginalization as a result of involuntary migration (Mutton & Haque, 2004).

3.10. Population Displacement

In the perspective of an emergency, displaced people are people who have been forced to flee their homes due to a natural, technological, or intentional event (WHO, 2012). "A forced removal of a person from his or her home or country, often due to armed conflict or natural disasters" (IOM, 2011). In 2019, well almost 1,900 disasters caused 24.9 million new displacements across 140 territories and countries around the world (IDMC, 2020).

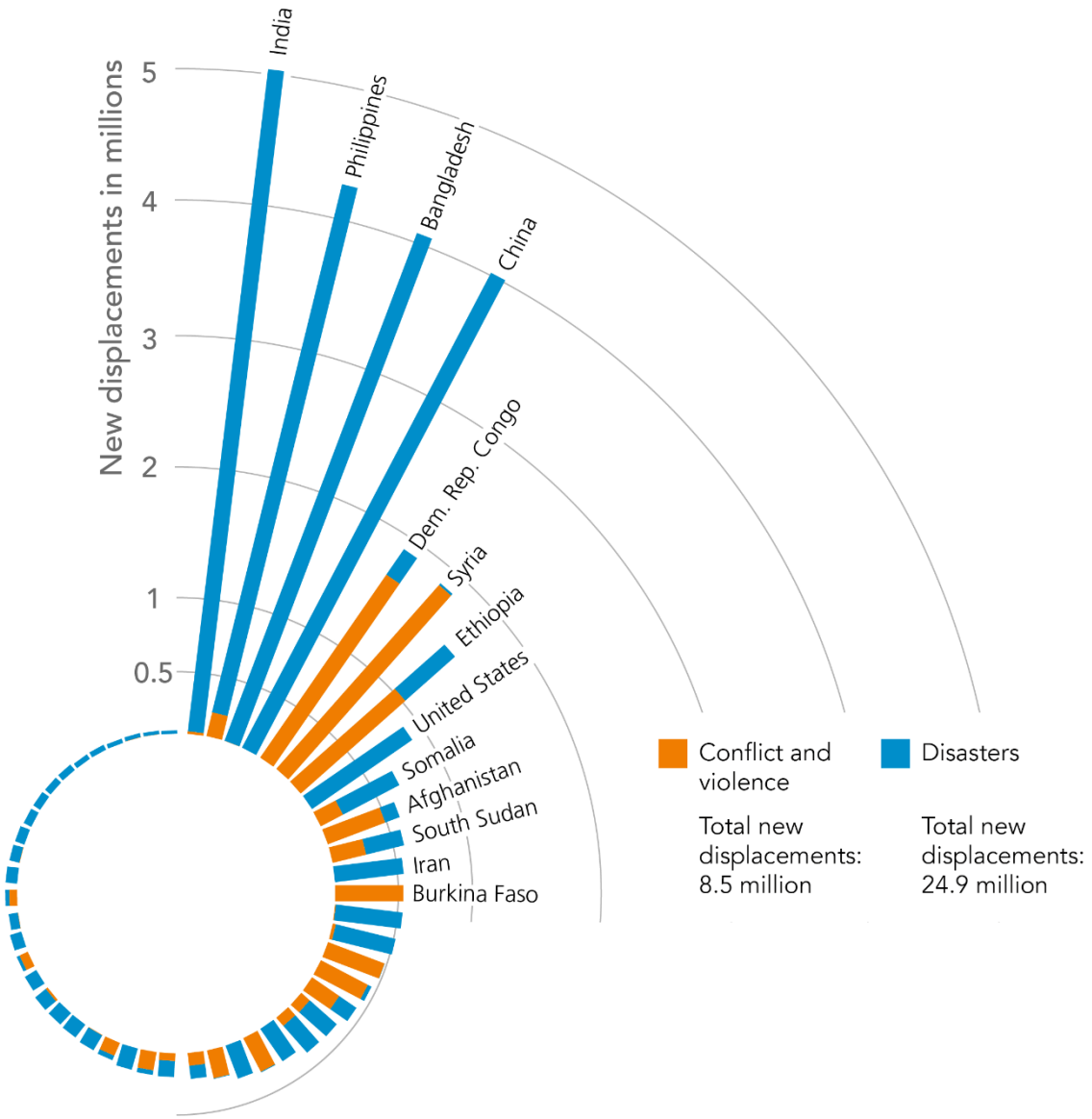


Figure 4: Bangladesh with world population displacement

This is the highest figure as of 2012, and it is three times the number of people displaced as a result of conflict, civil unrest and violence. Each of Bangladesh, China, India, and the Philippines recorded over 4 million disaster related displacements (IDMC, 2020).

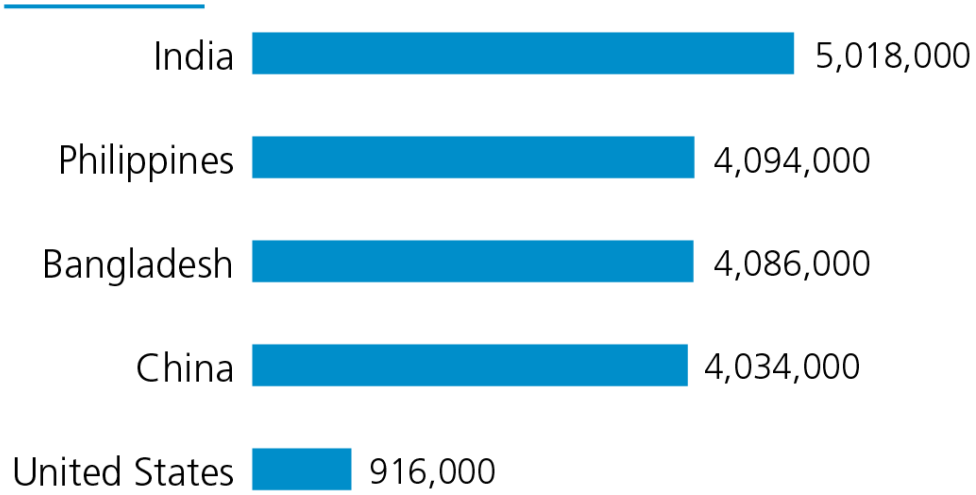


Figure 5: The five countries with the highest number of new displacements in 2019

3.11. Causes of River Bank Erosion in General

River bank erosion takes place both naturally and as a result of human activity. Streams and rivers are constantly changing dynamic systems. Natural riverbank erosion can result in beneficial outcomes such as the emergence of productive alluvial plains and deltaic terraces. Some steady rivers have a sufficient amount of erosion; but nevertheless, unsteady rivers and the erosion that is occurring on their banks are reason for concern.

River bank erosion has so many underlying causes, with additional factors that can expedite it. Flooding, flow management, land use over-clearing of drainage basin and stream bank vegetative cover, and improperly managed gravel and sand extraction are the primary causes.

There Are Some Factors Contributing to River Erosion:

- Intense Rainfall
- Too much sand and gravel extraction
- Strong wave and tide movement
- Inadequate soil drainage
- Reversal and acceleration of flow inside the stream
- Flooding of bank soils leading to rapid declines in flow
- Exposure of banks from off-stream source
- River channel lowering or infilling

3.12. The Causes of Riverbank Erosion in Bangladesh

Bangladesh is a riverine nation. Approximately 700 rivers, including tributaries, distributaries, flow through Bangladesh, forming a good shipping lane with a total length with about 24,140 kilometers. The majority of the country's land is formed by silt carried by rivers.

- Heavy Rainfall: Bangladesh has monsoon season. During the rainy season, it gets a lot of rain. This heavy rain is also a major cause of riverbank erosion. Places where there is no well-constructed river levee or retaining wall, the soil can be eroded as a result of heavy rainfall at that time.
- Floods: Every year in our country, people are affected by floods, particularly when it rains. This is the most important cause of riverbank erosion.
- Deforestation: Deforestation is the removal of trees from a forest, rendering it non-forested. Trees can cling to soil aggregates. However, when trees are cut down, the soil particles are becoming loose, and as a result, the soil of the river bank can gradually erode.
- • Silt Accumulation: Deforestation, vegetation loss, landslides, land clearing, and other unplanned embankments, earthwork and destruction of hills for road construction, etc. carried a massive amount of silt in the river system beneath by river tributaries. As a result, there is silt accumulates. These results in the rivers' water holding capacity reduce. The river's course is altered, and the river's bank is eroded as a result.
- Strong River Current: Another factor that contributes to erosion is the river's current. Our country's major rivers include the Padma, Meghna, and Jamuna. There are some areas of these rivers where the current of the river water is much stronger than in others. These areas are severely impacted by riverbank erosion.

3.13. The Effects of Riverbank Erosion

Riverbank erosion, one of Bangladesh's catastrophic events, causes unimaginable suffering to thousands of people who live along the banks of the country's rivers every year. Bank erosion alone has displaced millions of people and has become a major social hazard also. River erosion is a violent disaster that has been dubbed "the silent killer"(Nayem Hasan, 2019). The effects are indescribable in words.

Some of the impacts were identified below:

- Loss of cultivable land
- Loss of inhabitable land
- Displacement of people
- Impact on public health
- Impact on educational structure
- Impact on affected people's occupations
- Unemployment
- Poverty
- Agricultural production losses
- Depletion of cropland
- Agricultural demotion
- Increase in salinity of soil
- Loss of investment and Low investment
- Hinder of wealth creation

3.14. Operational Definitions

- **Coping strategies:** Coping or adaptation strategies are the particular psychological and behavioral initiatives that individuals use to defense, accept, tolerate, endure, reduce, or minimize traumatic situations. There are two common coping strategies that have been identified: Problem-solving coping strategies require active efforts to address stress situations, whereas emotion-focused coping mechanisms involve attempts to control the psychological consequences of traumatic or potentially stressful events. According to studies, individuals use both types of coping strategies to deal with the majority of traumatic situations
- **Bank readability:** The degradation of the riverbed and river banks by either narrowing or widening of the channel. Readability is the inherent yielding or nonresistance of soils and rocks to erosion.
- **Displaced populations:** A rapid, sudden and unexpected impact, such as a natural catastrophe, arms conflict, or violence, causes people to be displaced from their residences, places without assets, or livestock, etc.
- **Flood plains:** It is typically a flat area of land surrounding to a stream or river that extends from the banks of its channel to the bottom of the valley walls and floods during periods of flood or high outflow. The soils are typically made up of levees, silts, and

sands that were deposited throughout floods. A floodplain is an adjacent area over which the water stays when flooding occurs in the rivers.

- **Riverbank erosion:** It is the decline of a stream's or river's banks. This is distinct from scour, which refers to the erosion of the watercourse's bed. The roots of trees or vegetation growing near a stream are eroded as a result of this. As the vegetation roots firmly bind the soil, they work like anchors that hold soil in the face of the water.
- **Weathering:** Weathering refers to the breakdown or disintegration of minerals and rocks on the Earth's crust. It is caused by rainfall, extreme heat, temperature and microbial activity. It does not necessitate the removal of any rock material. Weathering can be classified into three types: physical, chemical, and biological.
- **Climate change:** The change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
- **Environmental change:** Large-scale changes in the physiological and bio geophysical (chemical, geological, and biological) surroundings caused by natural processes or influenced by human activities.
- **Flood:** An overflow or massive influx of water that inundates normally a dry land. One of the most widespread natural disasters in Bangladesh is flooding. It is characterized as temporary water coverage or inundation of an area not generally covered by water, caused primarily by rising water in natural water-courses, rivers, streams, reservoirs, and onshore canals.

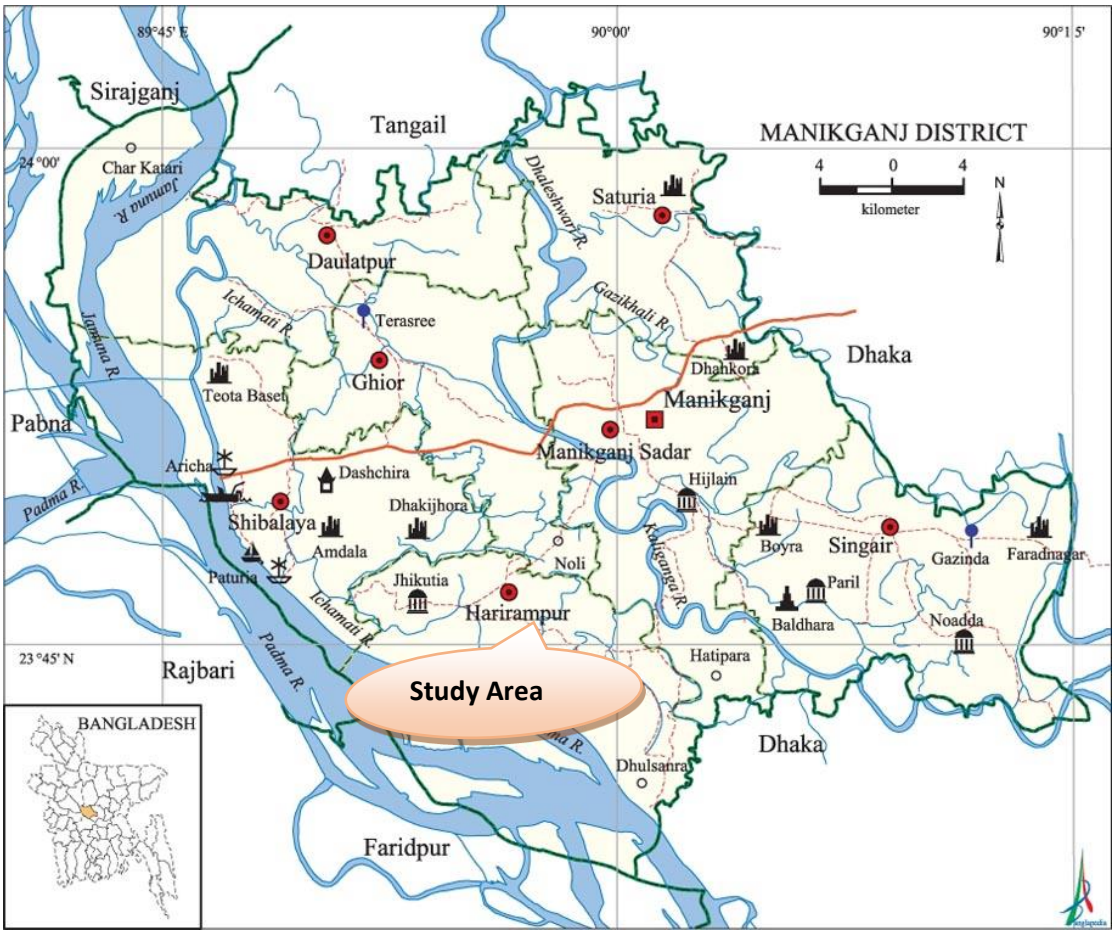
Chapter 4

The Study Area

4.1. Location

Manikganj district is situated at the central region of Bangladesh. It is a district of the Dhaka Division. Manikganj was formerly a subdivision of Dhaka. In 1984, it was designated as a district. Manikganj was the location of the world's deadliest tornado in terms of fatalities on April 26, 1989. Initially, 1,300 people were reported dead, with 12,000 injured (Jonathan Finch, 2008). It is bounded on the north by Tangail district, on the south by Faridpur and Dhaka districts, on the east by Dhaka district, and on the west by Pabna, Rajbari, and Sirajganj districts.

The Manikgonj district is extremely vulnerable to flooding and river erosion. River bank erosion is a main natural hazard in Mnaikgonj that occurs nearly every single year. All most all its upazila Daulatpur, Ghior, Harirampur, Saturia, Shibalaya and Singair experience river erosion.



Map 5.1: Manikgonj district map.

4.2. Demographic Condition of Manikganj District

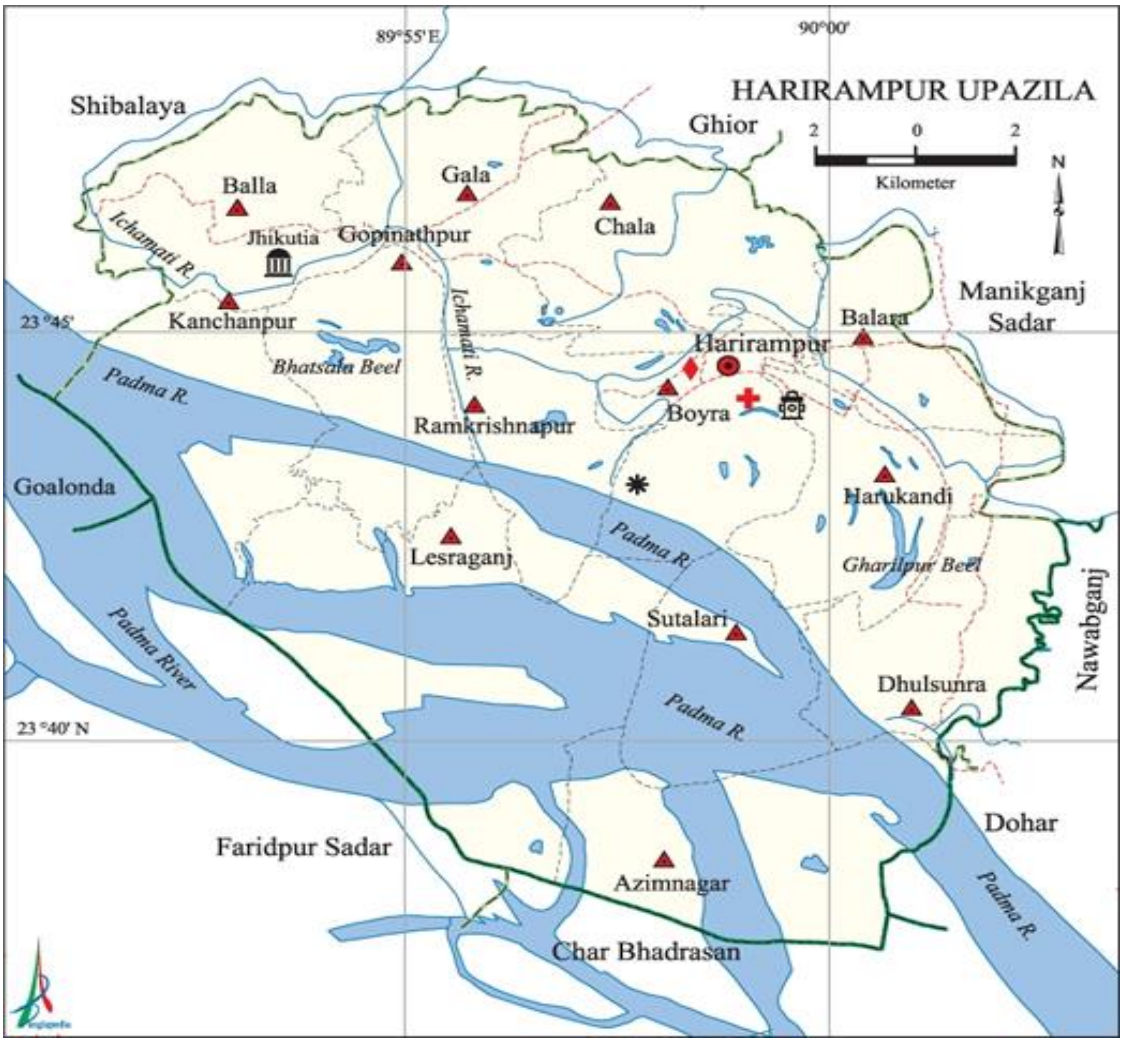
Table 5: Demographic view of Manikganj District.

Name	Population Census 1991-03-13	Population Census 2001-01-22	Population Census 2011-03-15
Manikganj District	1,175,909	1,285,080	1,392,867
Daulatpur	138,606	155,674	167,026
Ghior	127,521	138,479	146,292
Harirampur	156,326	171,274	139,318
ManikganjSadar	237,771	261,662	309,413
Saturia	140,215	155,137	171,494
Shibalaya	143,842	154,239	171,873
Singair	231,628	248,615	287,451

Source: BBS, 2011

4.3. Harirampur Upazila

Andharnmanik village is situated in Harirampur Upazila which has an area of 245.42 sq km. It is bounded by ghior, shivalaya, and manikganj sadar upazilas on the north, faridpur sadar upazilas and char bhadrasan on the south, Nawabganj, Manikganj Sadar and Dohar upazilas on the east, Goalanda, Shibalaya and Faridpur Sadar upazilas on the west. The total population of the Upazila is 1,71,274, among them male 184994, female 86280. Main water bodies and rivers include Padma and Ichamati River, but there is also Bhatsala Beel, Gharilpur Beel and Mollabari canal are prominent.



Map 5.2: Horirumpur upazila of Manikgonj district.

4.4. Demographic Condition of Horirumpur Upazila

Table 6: Demographic view of Horirumpur Upazila

Union	Area (acre)	Population	
		Male	Female
Azimnagar	4244	6749	6022
Kanchanpur	7725	3330	3190
Gala	4898	11043	10975
Gopinathpur	4406	7190	6905
Chala	4952	9494	10021
Dhulsunra	4169	3769	4172
Boyra	4037	5846	6540
Balara	2707	8013	9396
Balla	3497	11577	11057
Ramkrishnapur	3897	5354	6011
Lesraganj	8310	6933	6257
Sutalari	2866	3705	3536
Harukandi	3928	1991	2198

Source: BBS, 2011

4.5. River Erosion of Horirumpur Upazila

Harirampur upazila is also erosion prone upazila in Manikgonj district. The table shows the union-wise river erosion data of the Horirumpur Upazila.

Table: Union-wise river erosion of Horirumpur Upazila

Union	Eroded Area (acre)	Percentage of total union	Percentage of total upazila
Lesraganj	**8310**	**100**	**13.93**
Sutalari	2866	100	4.80
Azimnagar	4244	100	7.11
Harukandi	3535.20	90	5.92
Kanchanpur	6566.25	85	11.01
Dhulsunra	3335.20	80	5.59
Boyra	2422.20	60	4.06
Ramkrishnapur	2143.35	55	3.59
Gopinathpur	2203	50	3.69
Balara	n.a.	n.a.	n.a.
Balla	n.a.	n.a.	n.a.
Gala	n.a.	n.a.	n.a.
Chala	n.a.	n.a.	n.a.
Total			

Source: (Muhammad Muzibur Rahman, Islam, & Islam, 2016)

4.6. Andharmanik Village

This village was chosen because it is situated on the banks of the Padma River and almost every year some form of erosion occurs here. BWDB constructed an 1,800 meters long embankment in 2007 and 2008, and a 1,200 meters long Jute Mattressing Scheme, a river training project in 2019 at Andharmanik village to protect the village as well as the upazila town from riverbank erosion by Padma. However, the recent incidents of Padma riverbank erosion have threatened the Upazila complex, Upazila health complex, police station, rest house, and the 200-year-old Andharmanik bazar (Khan et al. b 2018). Andharmanik village has 4,161 people in 982 households. The literacy rate at is 68.6 percent (BBS, 2011).

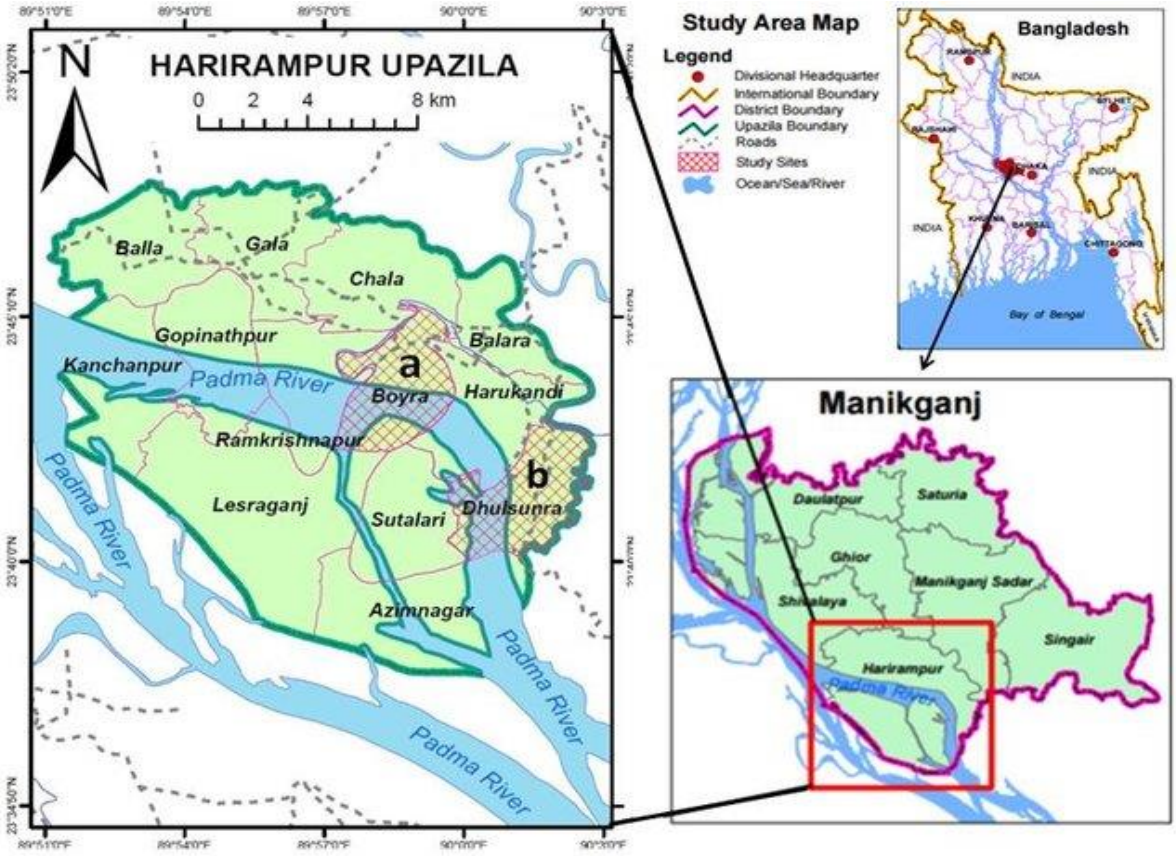
4.7. Demographic Condition of Andharmanik Village

According to the Bangladesh Population Census 2011, the population of Andharmanik village of Manikganj district is as follows:

Table 7: Demographic view of Andharmanik village.

Village Name	Year of Census	Male	Female	Total
Andharmanik	2011	1989	2172	4161

Source: BBS, 2011



Map 5.3: Boyra union map of Horirumpur upazila.

4.8. Occupation Pattern

Bangladesh is an agrarian country with farming and fishing as the most important sources for people's livelihood. Agricultural land is the vital resource for the people living in Bangladesh specially those who live in rural areas and bank line. Agriculture employs around 60 % of the civilian workforce, and around 80 % of the population is rural, mainly inhabiting the floodplain areas. The poor had less amount of land to support their family. But in the study area due to the river erosion incidents, the scenario is different. At present respondent's main livelihood is agriculture. But small business/ shops is next most popular livelihood. The villagers were involved in fishing, fish trading, livestock, poultry, rickshaw, van, driving vehicles, daily labor, etc. most of the families three were more than one income-generating person.

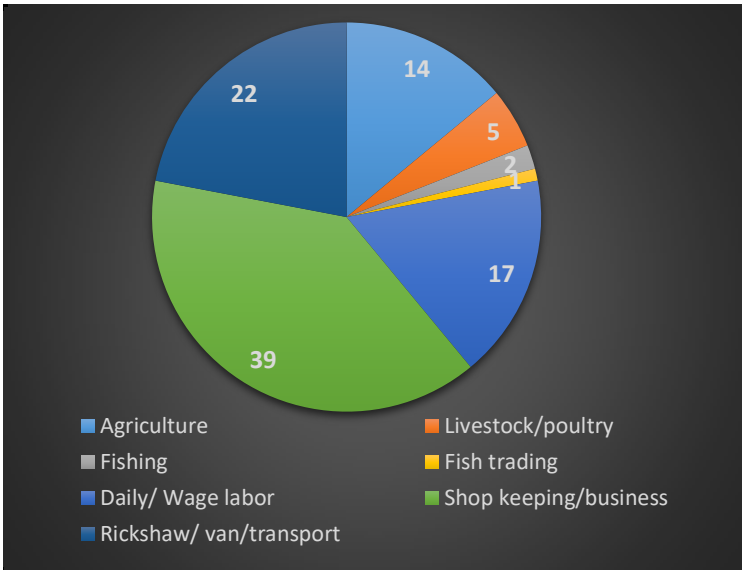


Figure 6: Occupation pattern

4.9. Income Structure

Currently respondent's main livelihood is agriculture. But small business/ shops is next most popular livelihood. The villagers were involved in fishing, fish trading, livestock, poultry, rickshaw, van, driving vehicles, daily labor, etc. most of the families three were more than one income-generating person.

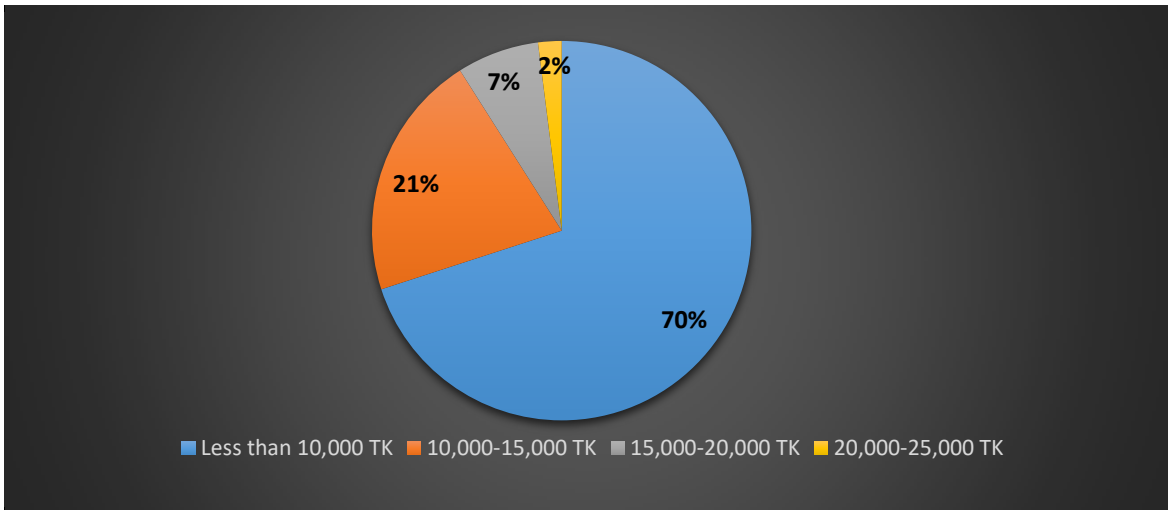


Figure 7: Household Monthly Average Income

4.10. Educational Sector

Education is an important tool that makes a man competent to serve the nation as well as lead a healthy and happy life with nothing to worry about whereas an illiterate man leads his life in miseries and is always occupied with how to modify his livelihood. When a disaster strikes, most of the people don't have sufficient knowledge on coping strategy which results to lose their source of livelihood. Thus poverty reduces the opportunity to invest in educational sector.

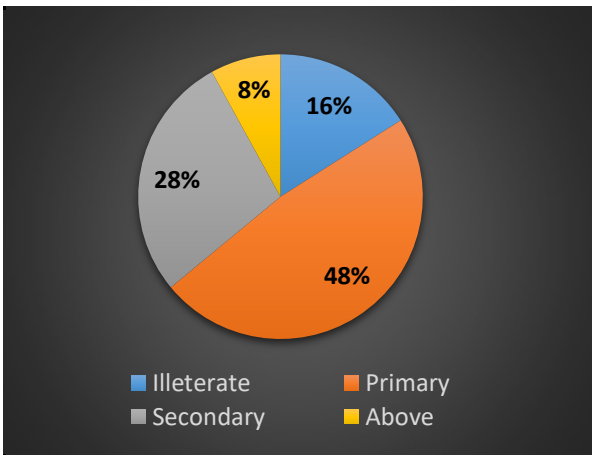


Figure 8: Educational status of the respondents

4.11. River Erosion of the Study Area

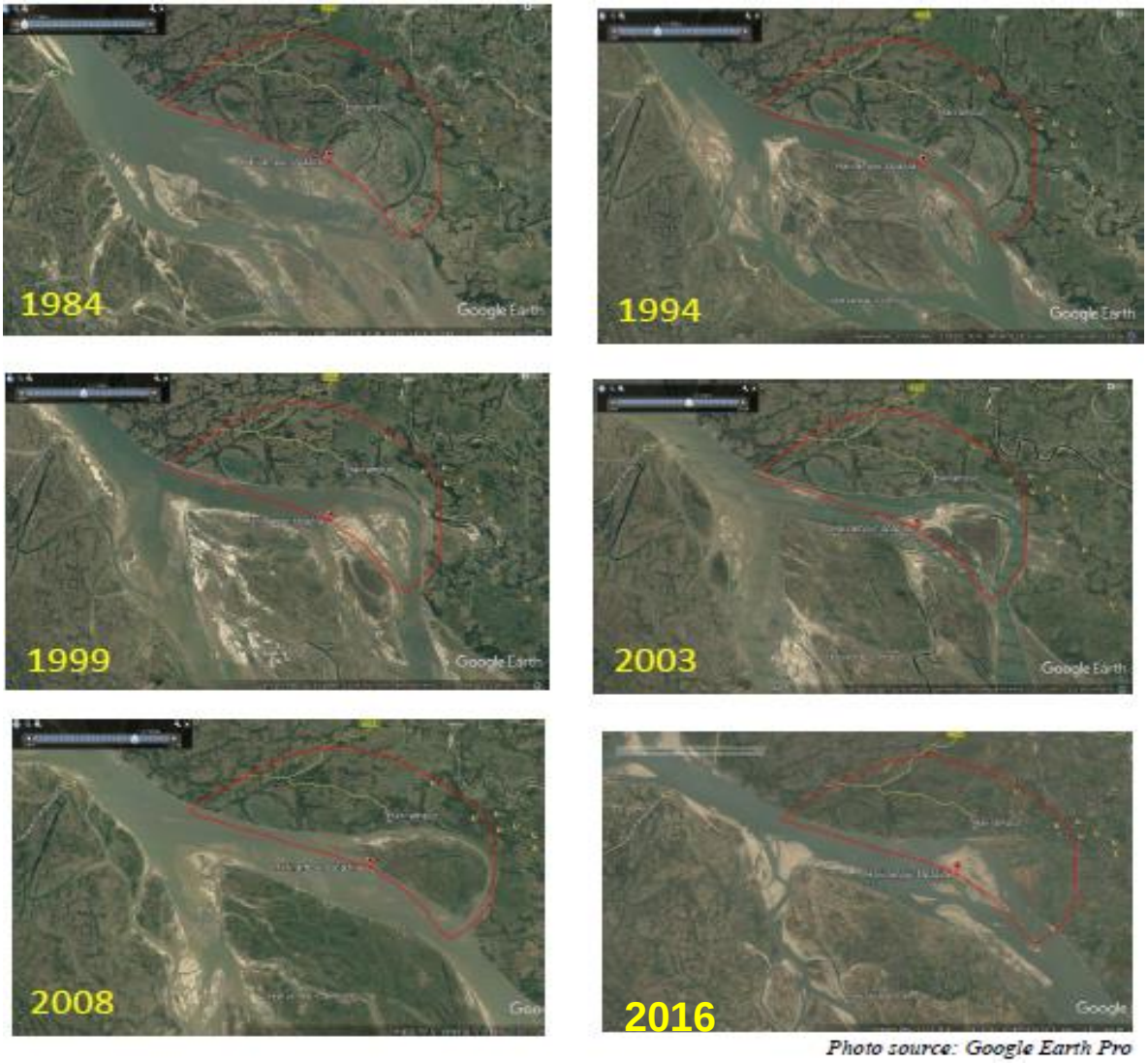


Photo source: Google Earth Pro

Map: 5.4: River erosion map of the study area

River Erosion of the Study Area

Primary school destroyed by river erosion at Harirumpur upazila, Manikgonj district (The Daily Star, 2019).

More than 300 families homeless in Harirampur in Manikganj due to erosion (The Financial Express, 2018).

Scenes of erosion by the Padma river at Bahadurpur Bazar in Harirampur upazila of Manikganj (The Daily Star, 2018c).

The Padma devoured over 600 houses, 25 shops and vast croplands in Harirampur upazila (The Daily Star, 2018b).

A section of the embankment in Harirampur upazila has collapsed, risking the upazila headquarters (The Daily Star, 2015).

Erosion has taken a serious turn in Harirampur upazila over 200 houses in five villages during the last one week (The Daily Star, 2018a).

Chapter 5

Findings

5.1. The Major Impacts of River Erosion

Riverbank erosion wreaks havoc on the riverine inhabitants' land. The losses were accounted through the loss of agricultural and cultivable land, its production, loss of homesteads areas, loss of cattle or animals, etc.

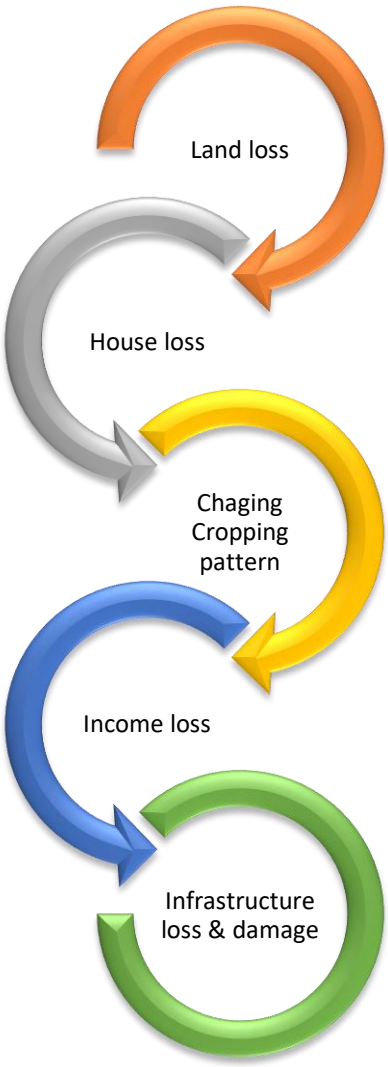


Figure 9: Major impacts of river erosion

5.1.1. Loss of Land

It was found that all of the respondents in the study area had lost their land either completely or partially. Almost 100 percent of people lost their agricultural land due to river erosion. Again 88% of people lost their homestead land due to river erosion. They were

evicted from their original homestead. The consequences of unwilling displacement are always negative, whether physically, socially, or economically.

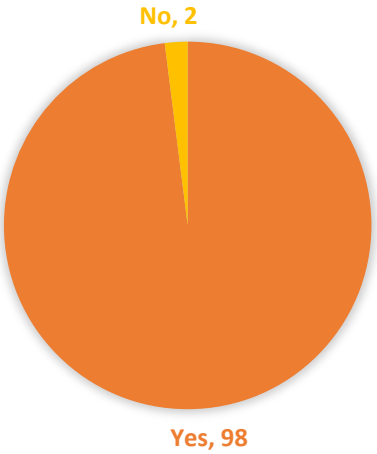


Figure 10: Lost agricultural land

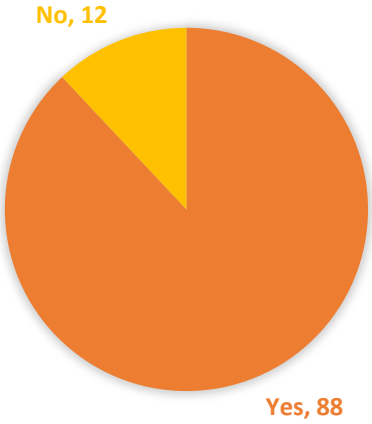


Figure 11: Lost homestead land

Data showed that 22.5% of respondents lost less than 0.5 acres of their cultivable land. About 34.8% of respondents lost 0.5-1.0 acres of their agricultural land. About 30% lost 1.1-2.0 acres of their agricultural land. About 12.7. lost more than 2.0 acres of their cultivable land. Economic losses rise due to the loss of agricultural production.

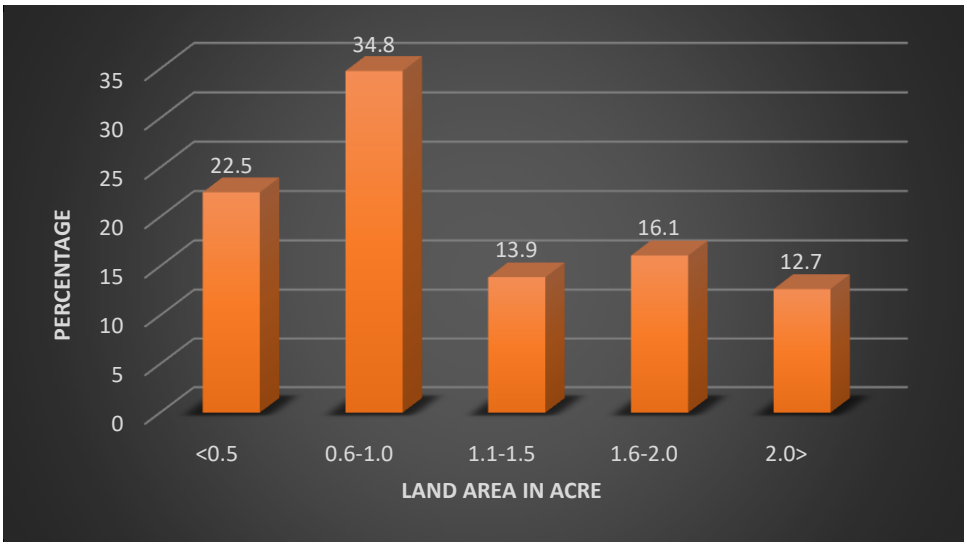


Figure 12: Agricultural land area lost due to erosion

Picture 7: Visiting erosion prone area of the village

Picture 8: Talking with community people

5.1.2. Loss of House and Structure

It was found that almost all the respondents had lost their houses due to riverbank erosion. Some of them managed to shift their movable house materials to other locations. When erosion took place and came towards their houses, they all together dismantled their houses themselves pursuing to shift household materials. But all of them did not get enough time to take house materials. Few of them sold their houses to vendors, who employed several laborers and took off the materials.

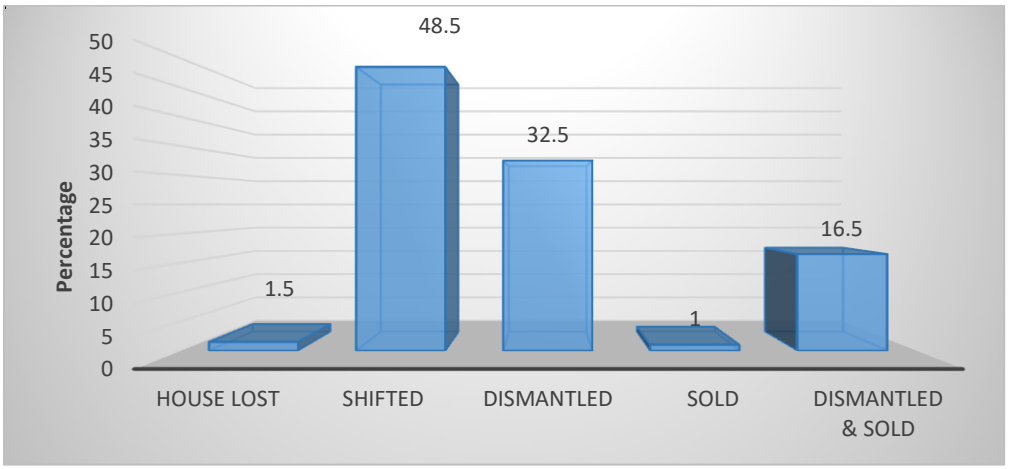


Figure 13: River erosion impact on house structure

5.1.3. Loss of Agricultural Production

As a result of bank erosion, a massive area of agricultural land goes under the river. It is observed that after the agricultural land destruction the crop production is fully destructed. The main agricultural production is Boro, Pulse, and Jute. Sometimes they also produce homestead vegetation to achieve their daily need or demand. Such type loss creates unlimited depression to the small earning families. Due to the loss of land, a large number of riparian residents also lost their standing crops. Crop losses were greater for wealthy landowners than for smaller landowners. Crop was their primary source of income, and if

they did not yield their crop on time, they suffered from a lack of money, which led to unavoidable suffering.

Table 8: Change in copping pattern in the study area

Before Erosion		After Erosion	
Crop	Percentage	Crop	Percentage
Paddy	70	Paddy	20
Jute	20	Nut	70
Pulse	10	Pulse	10
Others	10	Others	10

5.1.4. Changes in Economic Functions and Income Loss

Any type of displacement has a significant effect on the displace households' regular sources of earnings and income-generating activities. The effect was considered severe if it was caused by a sudden forceful event that resulted in unwilling and forced displacement. Loss of income forced them to live in substandard conditions, and they were unable to return to their previous way of life. Natural disaster displacement was distinct from other types of displacement. They struggled to find new employment and sources of income in their new settlement area. Riverbank erosion forced displaced people to seek refuge in remote areas or migrate to cities. Landless, asset less, jobless household heads are in grave financial distress often abandoned their families. Women in those households who were left alone had to work hard to support their children and families.

According to the data gathered, approximately 85% of respondents reported a loss of income as a result of riverbank erosion-induced displacement. The recurrence of displacement, on the other side, had a substantial effect on income. Number displacement was realized to have a significant negative impact on the total monthly income of the affected families. In terms of total monthly income, the households that were displaced the more times suffered the most.

5.1.5. Water and Sanitation Loss

Drinking water use and sanitation situation 100% affected lost their drinking water sources like tube-well as well as latrines from river erosion It is the inhuman condition that most of the displaces did not access to safe drinking water as the study villages had tube wells but washed away by the erosion. In the sheltered place displaces did not get sufficient safe drinking water in the neighbor’s land or kin’s land or in the embankment. It is tough to get tube wells in the area. It is accounted that 61% displaces had the safe drinking water availability after erosion attack. It was found that 58% displaces had no access to latrine.

5.1.6. Infrastructural Loss and Damage

With the field survey it is observed that besides the agricultural land, crop productions, homesteads land losses, other community assets were also washed away. It includes pond, vegetation, schools, mosques, roads, bazar etc. It is found that about 50% trees were destroyed or uprooted or gone underwater due to erosion in Narikeli.

Table 9: Infrastructural losses due to bank erosion

Category	Number
Pond	5
Bazar	2
Primary school	1
Vegetation	50%
Mosque	2
Roads	20 km

They stated that they used their own technique and system to address needs and problems. However, things were out of their reach due to displacement and settling in a new area. Searching for homestead land became a priority, and a few of them were successful in becoming landowners. A number of respondents were discovered who were adamant about not settling in their current residence. Because of the erosional hazard, many affluent farmers in the study area have become marginal farmers, if not landless. Due to massive sand siltation, agricultural land has become unproductive and barren, and cropping patterns have been significantly altered. Furthermore, the infrastructure, facility, building and property losses are massive (Bhuiyan et al., 2017).

5.2. Introduction

In the time of river erosion, there were very few options for coping, one has to leave that place and moved to safer areas. This chapter tries to describe the coping strategies that affected community people had applied in the time of erosion.

5.2.1. Coping Strategy

Coping means to invest one's own conscious effort, to solve personal and interpersonal problems, in order to try to master, minimize or tolerate stress and conflict (Lloyd & Weiten, 2008). The term coping generally refers to adaptive or constructive coping strategies which reduce stress. Coping strategies refer to the specific efforts, both behavioral and psychological, that people employ to master, tolerate, reduce, or minimize stressful events. In the study, practiced coping strategies can be composed into the following groups.

Figure 14: Coping strategies

5.2.2. Physical Coping Strategy (Locations and Structures)

In the time of river erosion, respondents mainly adopted few strategies. Researchers divided them into three main categories. They are evacuation, relocation, and migration. Evacuation is the immediate or short-term strategy and relocation and migration are long-term strategies.

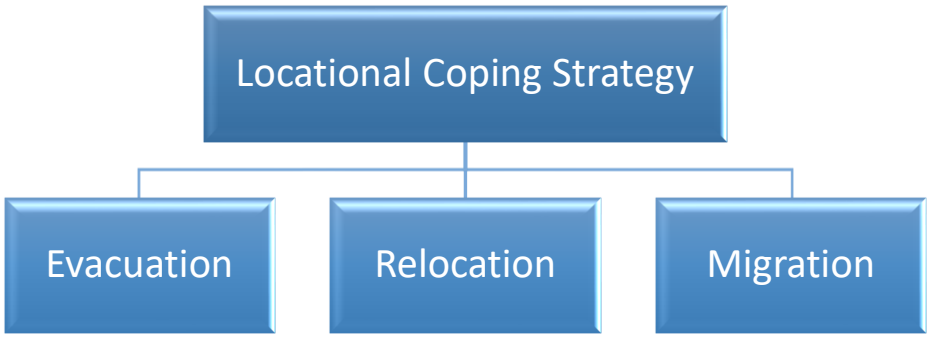


Figure 15: Locational Coping Strategy

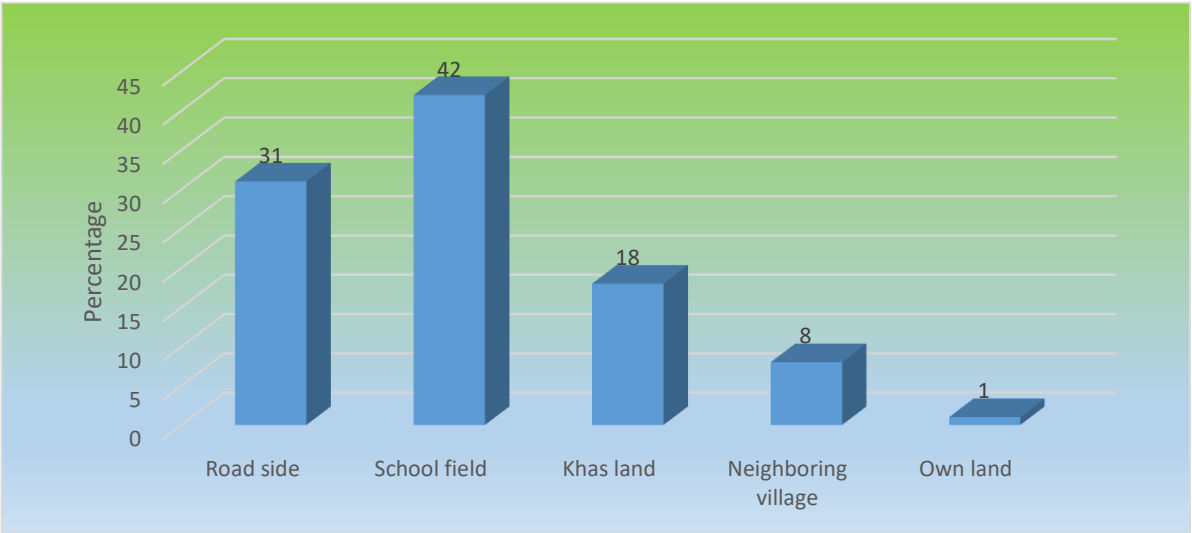
5.2.3. Locational Coping Strategy

5.2.3.1. Evacuation (Immediate Strategy)

Emergency evacuation is the urgent immediate escape of people away from an area that contains an imminent threat, an ongoing threat, or a hazard to lives or property (JIMDO, 2020). At the time of river erosion, respondents mainly adopted two strategies, short term, and long term. First, they evacuated the degraded area promptly to a temporary area like the

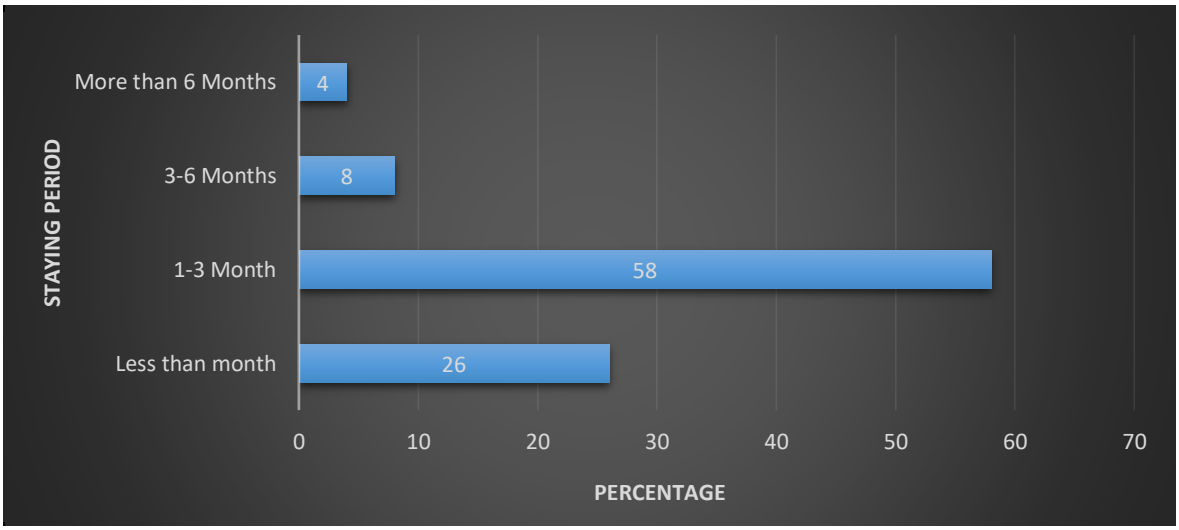
roadside area, side of the embankment, khas land, etc. It is also a form of displacement. Internal displacement refers to the forced movement of people within the country they live in (IDMC, 2018). When people are forced from their homes but remain within their own country, they are known as Internally Displaced Persons (IDPs). The key characteristics of internal displacement are its coercive nature and the fact that affected populations do not cross an internationally recognized border.

Figure 16: Locations of displaced people shelters



About 42% people took shelter at the nearby education institution adjacent fields. 31% people took shelter roadside higher places. Only 1% people shifted their own land that are mainly agricultural land.

Figure 17: Duration of living in their temporary shelter.



5.2.3.2. Relocation (Long Term Strategy)

Displaced people took shelter in those places only temporarily. After that respondents took 1 to 6 months to move a safer place. Some of them migrated and some of them relocated in their community. Respondents have relocated from their places as last resort. Relocation or planned relocation is understood as a solutions oriented measure, where an individual or household is physically moved to another location and resettled there (UNHCR, 2014). Sometimes well-planned relocation can be both a form of disaster risk reduction and a form of climate change adaptation.

Figure 18: Movement pattern

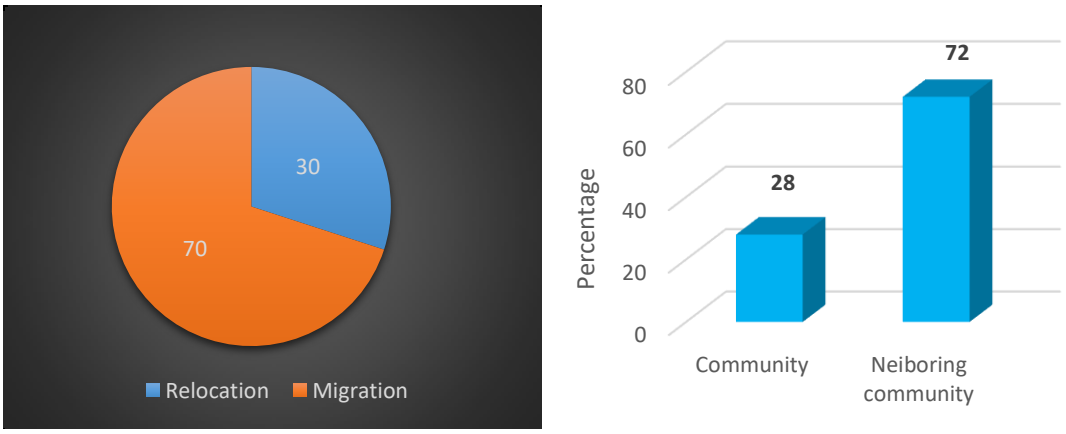
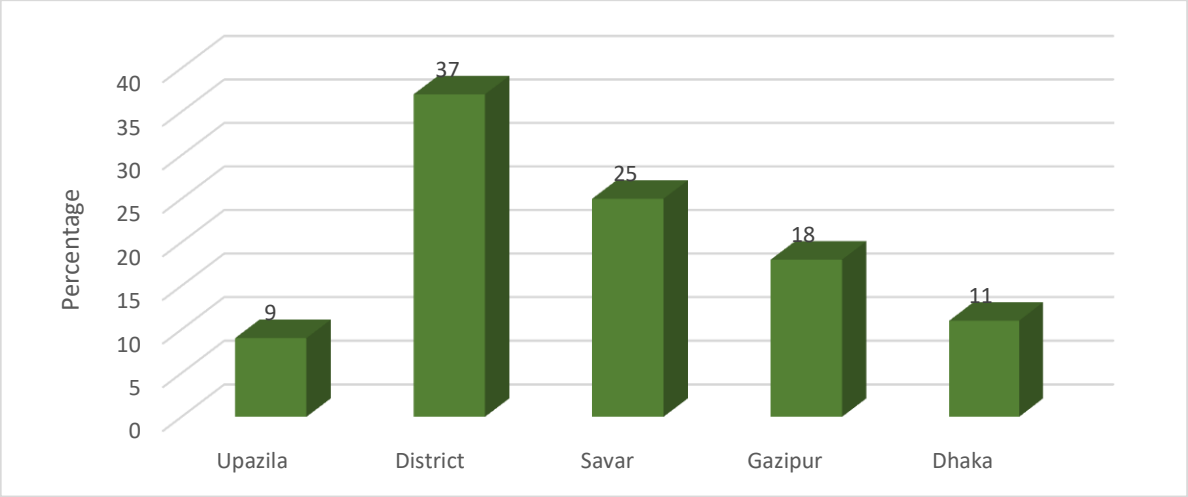


Figure 19: Duration of living in their temporary shelter.

5.2.3.3. Migration (Long Term Strategy)

From the FGD, it was found that about 70% of erosion affected families have migrated from the community due to river erosion alone. They primarily migrated to urban areas within and outside the district. They mainly migrated to the Manikgonj district town. The below figure shows the location-wise distribution.

Figure 20: Location-wise migration.



The figure indicated that 37% of the respondents migrated to the neighboring town or district town for better facilities and some respondents moved to other town for safer settlement and employment.

5.2.4. Housing Related Coping Strategy

Housing is a basic human need. House is a structure serving as an abode of human beings. It is a place where one can take rest, sleep and cook food. By housing it is meant not only a shelter but also includes those qualities of comfort and convenience. After land, river erosion severely affected the house structures and associated facilities like water supply, sanitation, kitchen or cooking space, livestock sheds etc.

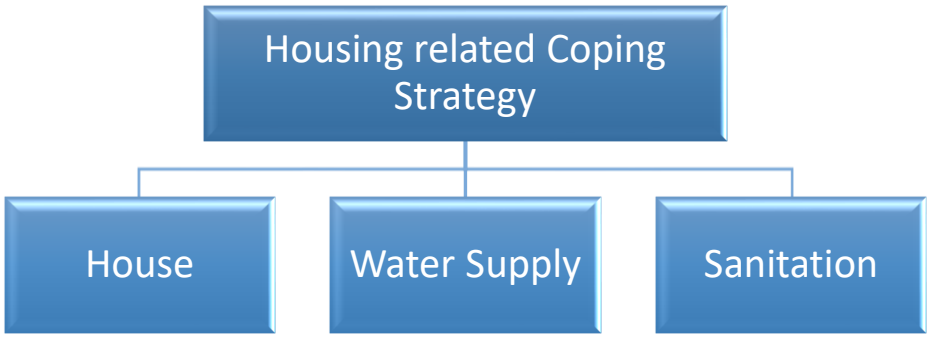


Figure 21: Housing related Coping Strategy

5.2.5. Coping Techniques Used For Saving Houses

After a land loss, the house is the second important asset that was threatened by river erosion. As people can see the approaching river, they mostly saved their house from complete wash way. But still, 3% responded said that they have lost their houses due to erosion. The remaining 97% of people saved their housing materials. As most of the houses

were Kacha, they dismantled their houses, carry them to other places. About 65% responded dismantled their houses, only 2% responded said that they sold their houses to other people and 33% responded said that they dismantled their houses and sold some of the housing materials.

Figure 22: House lost status due to erosion

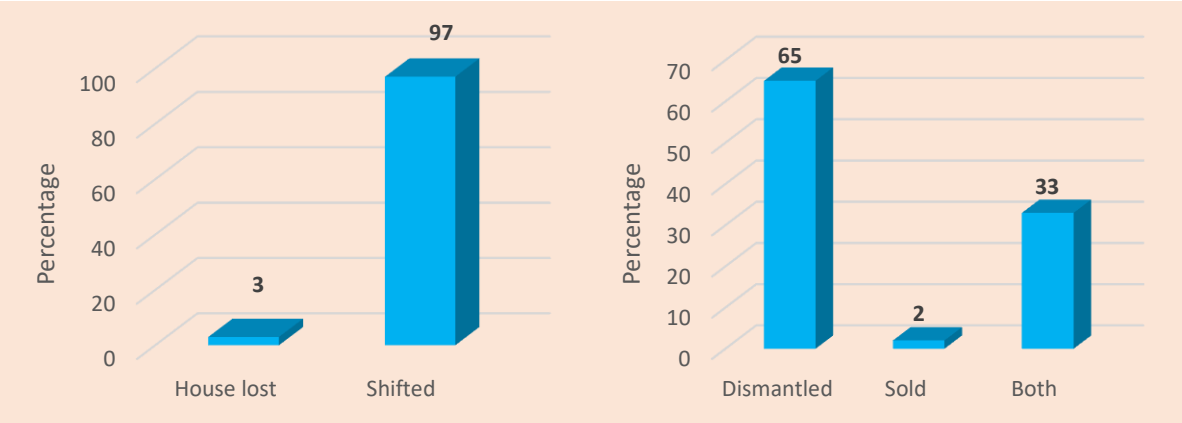
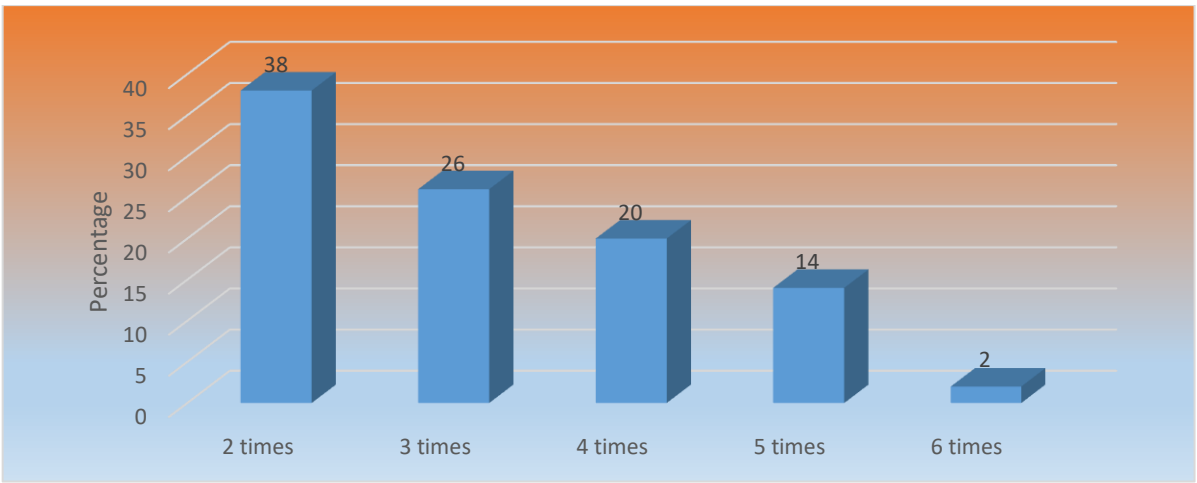


Figure 23: House saving strategy

5.2.6. Shifting Homestead

Most of the respondents resettled in the neighboring areas when they were further displaced by riverbank erosion. This is why people are displaced multiple times. The situation explains that they generally tend to stay in the areas closer to the original place of residence, with the hope of recovery of land in emerging char areas and desire to live with their own land.

Figure 24: Number of times homestead shifted due to erosion



The figure indicated that most of the respondents 38% shifted their homestead two times and 26% of the respondents shifted their homestead three times and 2% of respondents shifted their homestead 6 times in the study area due to riverbank erosion.

5.2.7. Loan for Housing

Respondents said that they took a loan for restoring their houses. About 78% responded said that they borough money either from their relatives or from a bank (microcredit) for house restoring. 22% of respondents didn't borough any money and used their own savings.

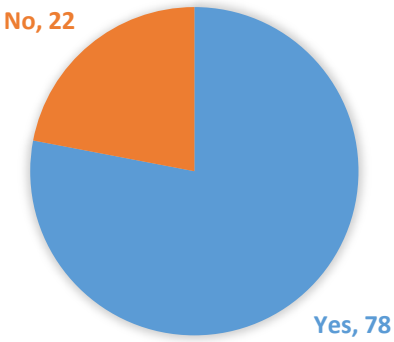


Figure 25: Borough money for house restoring

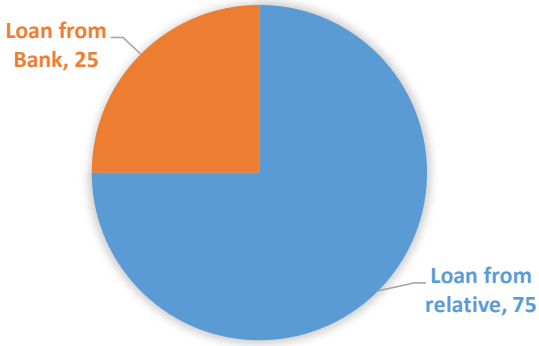


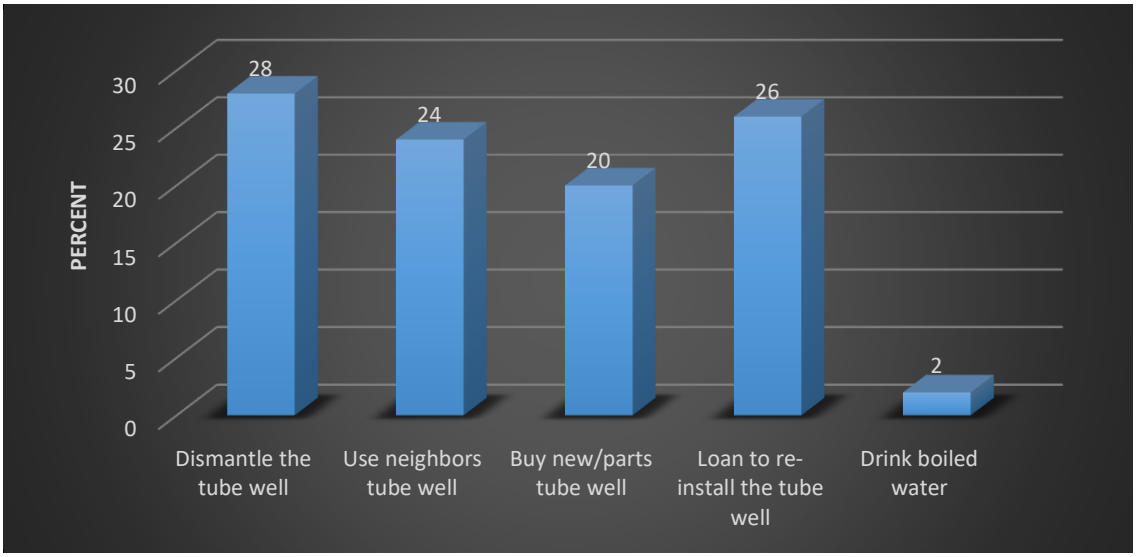
Figure 26: Source of fund for house restoring

Among the people who borough money for house restoration, 75% took that money from relatives. As microcredit providing NGOs didn't give loans to people who do not have land. But recently it has changed.

5.2.8. Water Supply Sources

Water facility is a good indicator of the socio-economic status of the village. Water supply is the most important facility that is related with the housing condition. It is difficult to imagine any clean and sanitary environment without water. 100% responded used tube well water for drinking as well as domestic purposes. Respondents adopted several strategies to ensure drinking water supply. They dismantle the tube well and transported to new relocated places, in that time they use nearby neighbors' tube well, they used to loan money to buy new pipe, parts and to install the tube well. Only 2% responded that they pond water but they boiled them before drinking.

Figure 27: Strategies adopted to access drinking water



5.2.9. Sanitation Facility

Sanitation facilities also an important element of housing conditions. It is an inhuman condition that most of the displaces did not access to safe latrine immediately after the erosion. Sanitation in the study area tends to be unhygienic with existing latrines poorly maintained. This study found that 68% of total respondents use the Kacha latrine, which is made of the ring and surrounded by sack or bamboo with bamboo or tin roof. About 24% with semi-pucka latrines and only 4% of respondents had access to proper latrines in the study area.

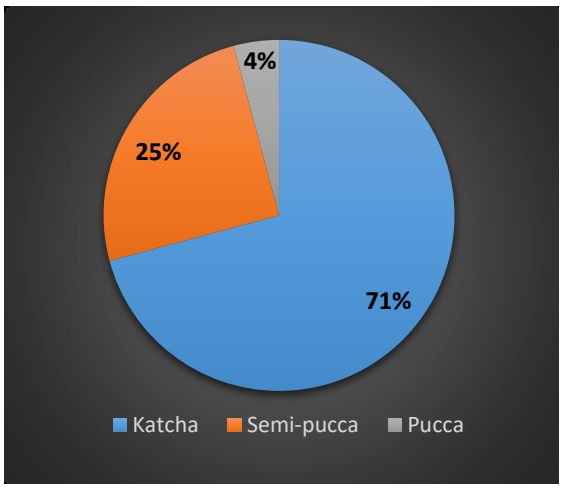
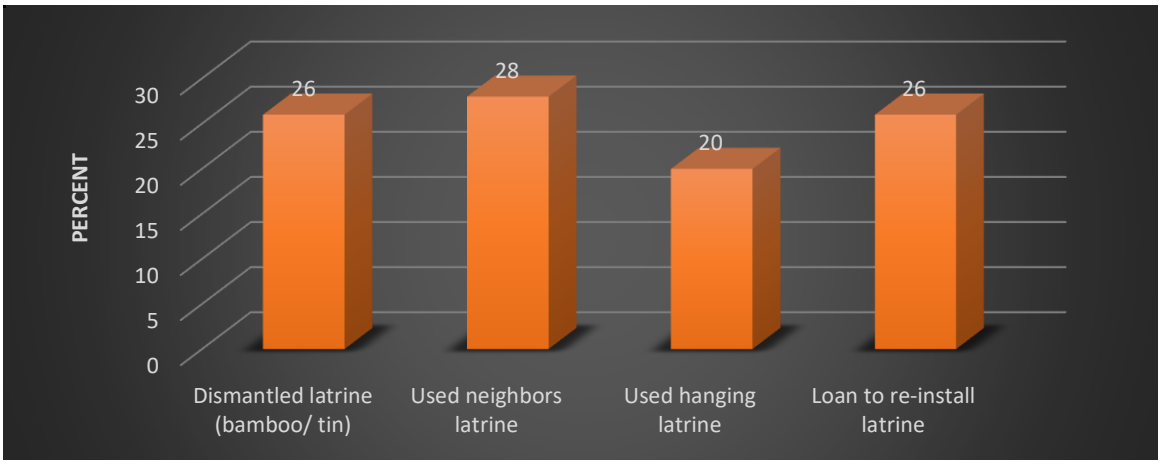


Figure 28: Latrine condition

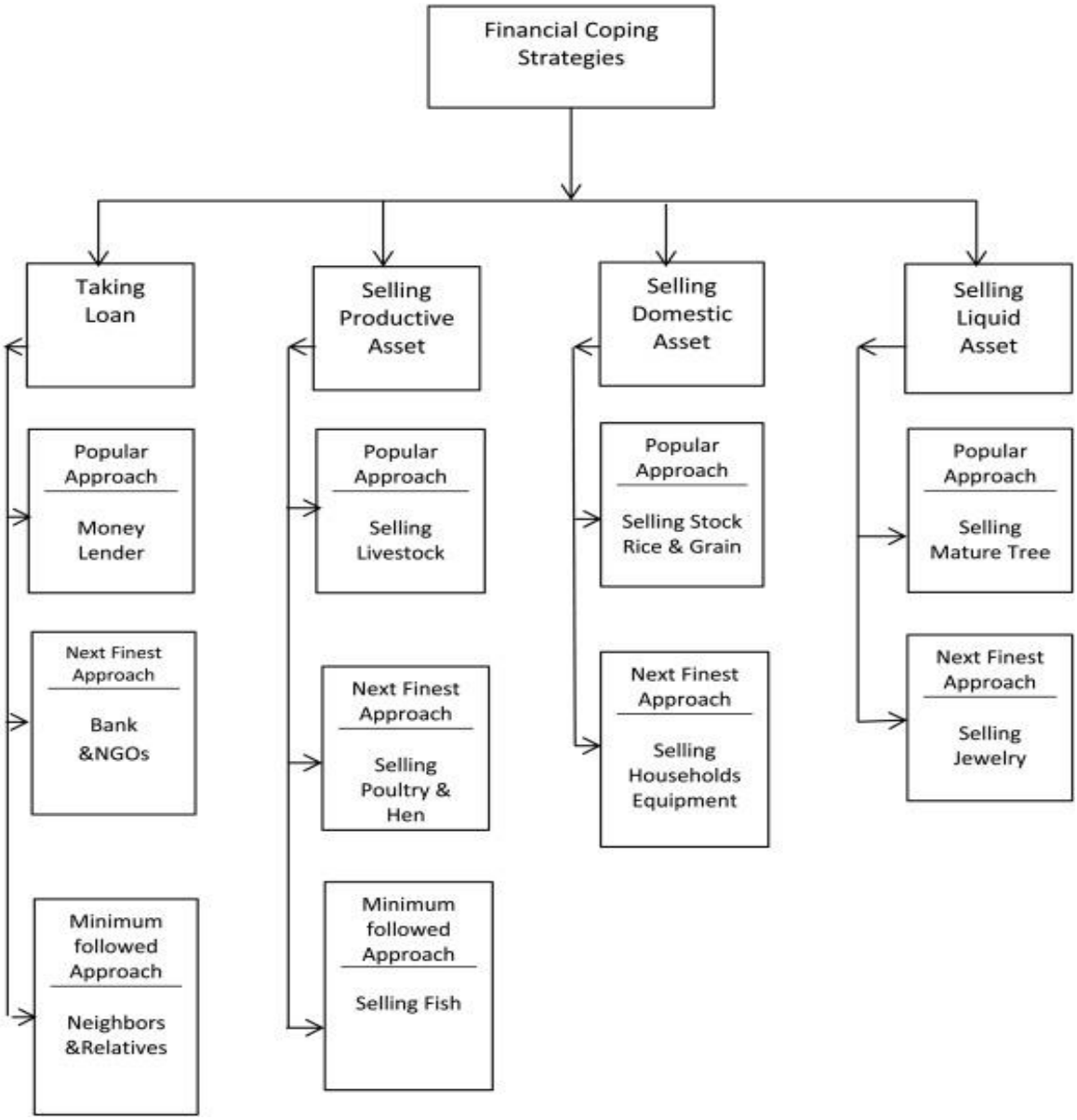
Figure 29: Strategies adopted to access drinking water



Respondents adopted few strategies at the same time to cope with the situation. They tried to save whatever possible, they dismantled the bamboo chati, tin roof and pan, used makeshift latrines, Katcha latrines, nearby neighbors' latrine. They used to loan money to re-install the latrines.

5.3. Financial Coping Strategy

River erosion affected people mostly took different initiatives including loans, saving; change of consumption pattern, and selling and mortgaging of valuable property to adapt in response to the decline the income. Most of the households try to cope with a flood by reducing their consumption of food and daily primary needs. The household income was not adequate to deal with the flood. Therefore, money is the most vital need in most the crisis period. People also borrow money from lenders, relatives, microfinance institutions, etc. People of this area have taken several financial initiatives to cope with this situation. In a study (Jahan, 2000; Parvin, Shimi, Shaw, & Biswas, 2016) following coping strategies were usually taken by erosion-affected people.



Source: (Jahan, 2000) (Parvin et al., 2016)

In the study area, respondents mainly adopted the following financial coping strategies. The researcher divided them into four main categories. They are occupation, income, poverty, and food security.

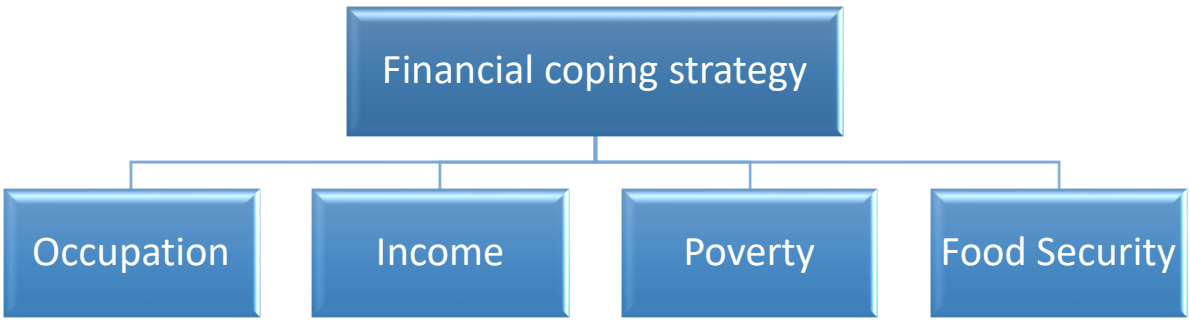


Figure 30: Financial coping strategy

5.3.1. Present Occupation

Currently, the respondent's main livelihood is agriculture. But small business/ shops is next most popular livelihood. The villagers were involved in fishing, fish trading, livestock, poultry, rickshaw, van, driving vehicles, daily labor, etc. most of the families three were more than one income-generating person.

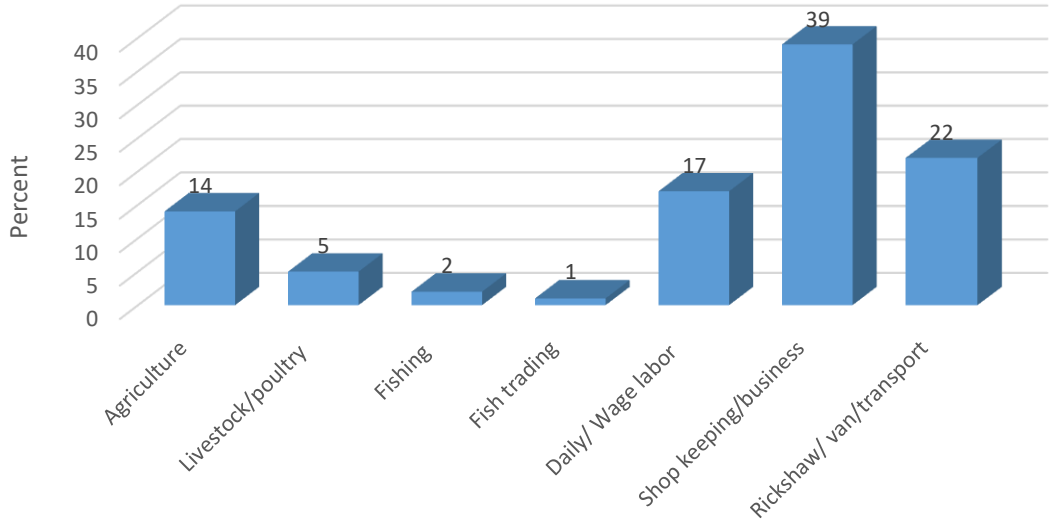


Figure 31: Present livelihood pattern

5.3.2. Change in Livelihood Pattern

To cope with river erosion, villagers have changed their occupation pattern. Previously most of the inhabitants engaged in agriculture-related livelihoods like crop production, livestock, fishing, etc. But due to the loss of land, villagers are now mostly involved in non-agricultural jobs like shop keeping, small business, day labor, rickshaw, van puller, or transport worker at the village or nearest town.

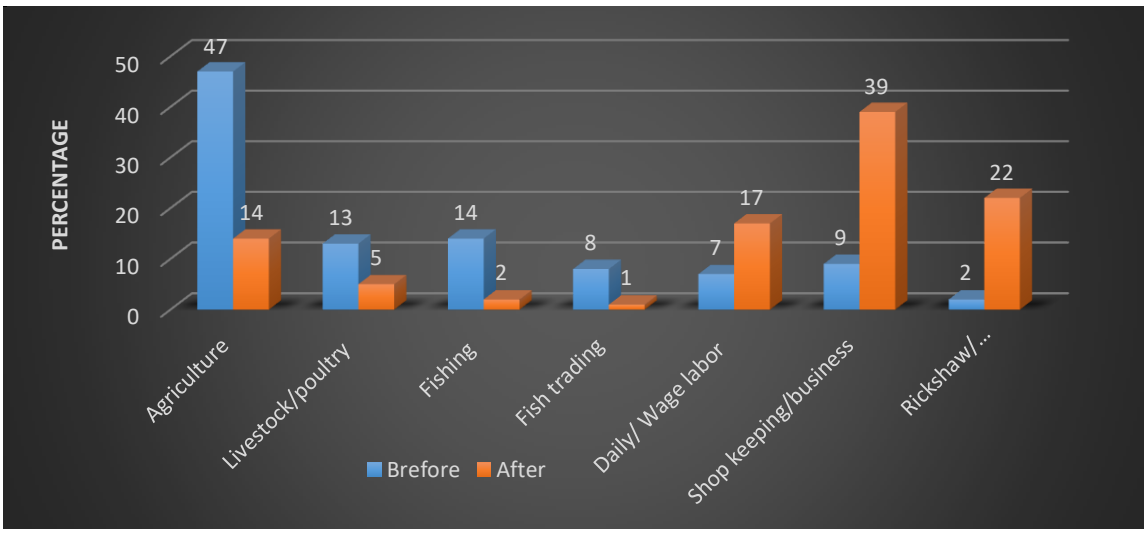
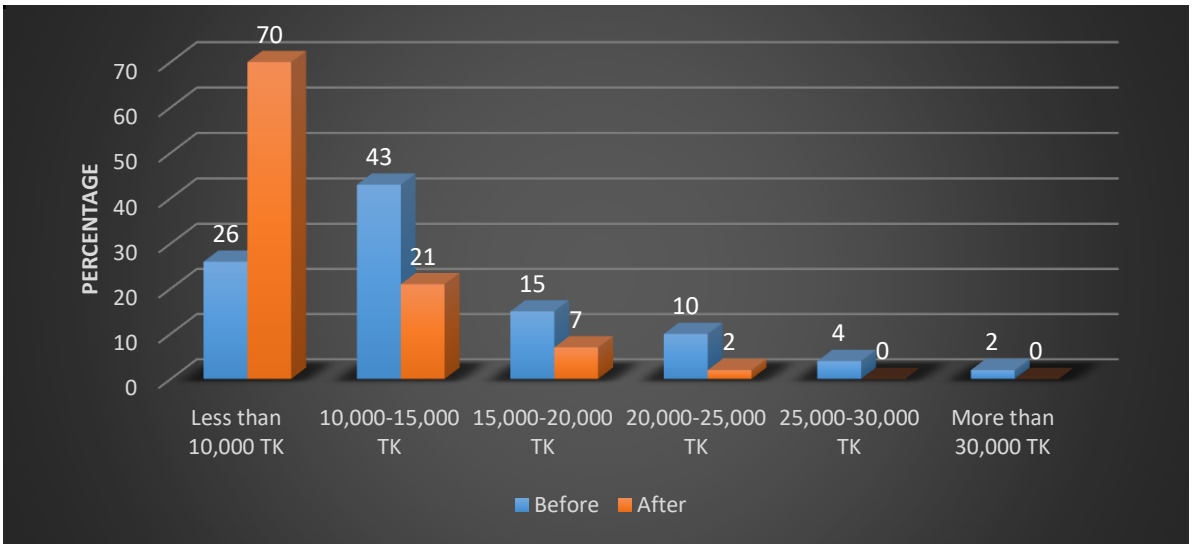


Figure 32: Change in livelihood pattern

5.3.3. Income Erosion

Erosion causes displacement and displacement has a direct impact on regular sources of income and income-generating activities. Loss of income compelled them to live a sub-standard life and they could not continue their way of living even parallel to the way before displacement. They face difficulties to find new sources of income in new settlement areas. Riverbank erosion displaces take shelter in distant places or migrates to urban areas. The landless and jobless heads of the households under financial duress often desert their families. Left alone, women of those households have to struggle hard to maintain their families.

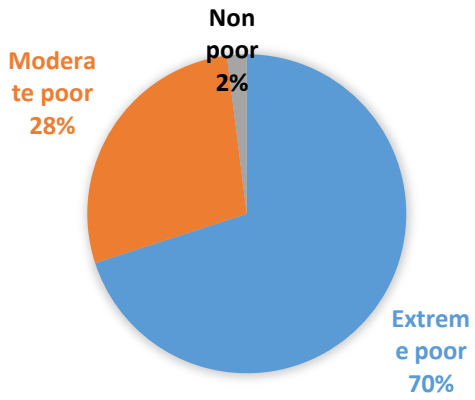
Figure 33: Change of income after erosion



5.3.4. Poverty Level

This result indicated that the poverty level is very high among the affected families. Families have lost occupation and income. Crop production was also lost due to land erosion. They struggle to meet their food needs. Among the respondents, it was found that 98% household is poor, among them 70% in extreme poverty level. Only 2% of people reported that they are doing well.

Figure 34: Poverty level

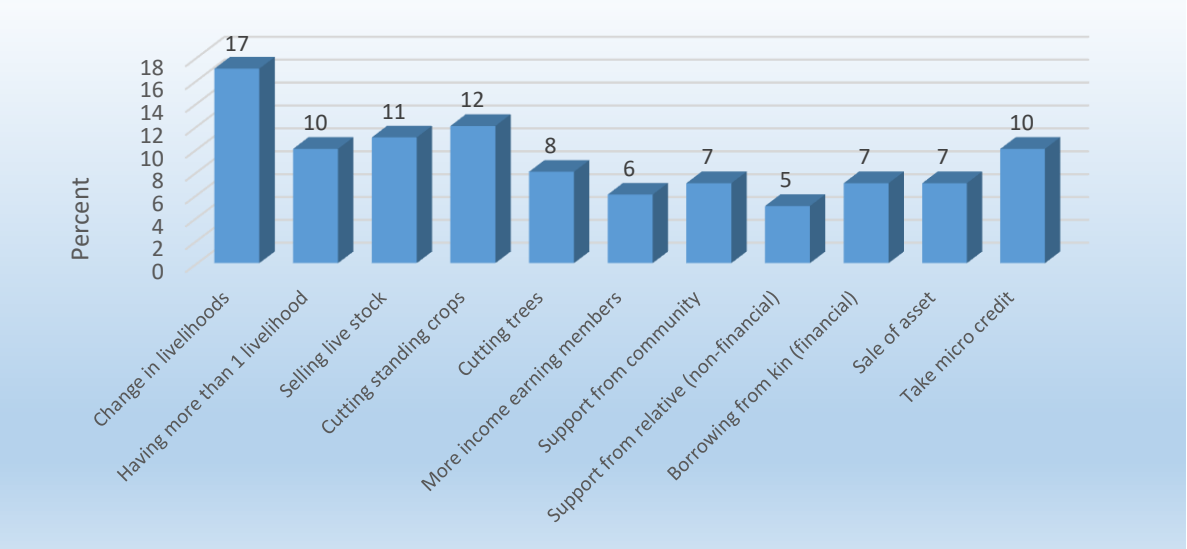


5.3.5. Livelihood Coping Strategy

Households adopted several strategies. Most of the time they adopted more than one strategy. The most prominent was the change of livelihood. Affected people took support from their relatives; they took financial support like a loan, soft credit at zero, or low-

interest rate. Sometimes they sold their assets, borrowing credit at a high interest rate. They also used their savings to cope with river erosion.

Figure 35: Livelihood coping strategy



The impact of coping strategy in short term and long term poverty of affected people also came out in the research.

5.4. Coping With Food Insecurity

Household expenditure on food ranged from BDT 3000 to 10,000, and the most regular monthly expenditure was BDT 3000 to 4000, whereas the national consumption expenditure per household per month is BDT 11,000. Households suffer food insecurity and occasional hunger. A few households suffer from severe hunger (1%), about 11% of the households suffered from moderate hunger, and the majority of households (88%) have occasional or no hunger at all in their households.

The majority of the households adopted different strategies to cope with a shortage of food, 71% of them borrowed food from their neighbors, 51% took loans, and 31% ate fewer items of food or poor quality food. However, only 1% of participating households reported to take extreme measures like stop schooling of the children or selling or keep mortgage of assets.

5.5. Social Coping Strategy

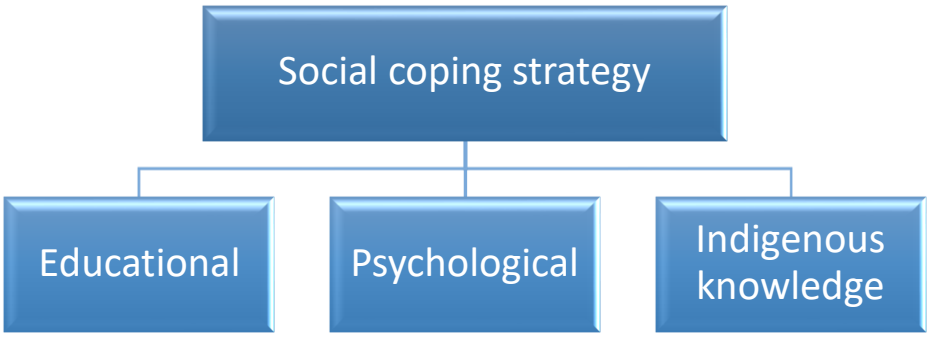


Figure 36: Social Coping Strategy

5.5.1. Educational

Disaster enhances the dropout rate by impeding the children from going to school. When the respondents were asked about their expenditure on the educational sector, most of them replied that due to their poor economic condition investing in the educational sector is hindered. The riverbank erosion destroys the school structures including buildings, wash block, playground etc. Due to having an insufficient amount of fund, they are unable to reconstruct the schools for their children to get a proper education. Such a situation promotes child labor to contribute to the family income. Some students drop out of school, high drop of the girls, some children continue their classes in temporary or open spaces, changed their schools, year loss, etc.

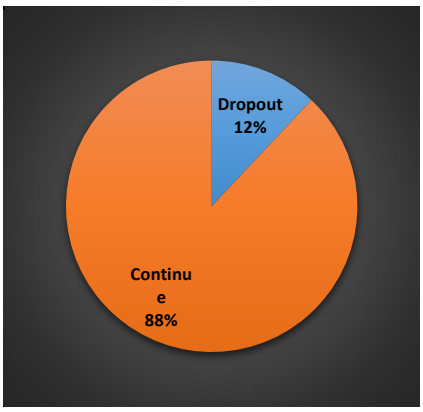


Figure 37: Dropout rate

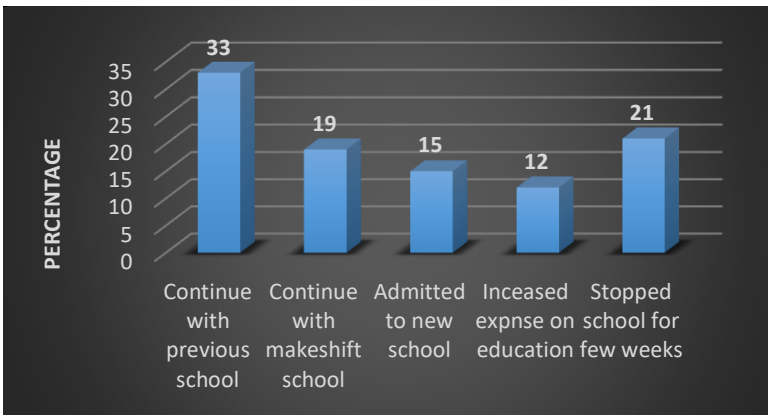


Figure 38: Educational coping mechanism

5.5.2. Psychological

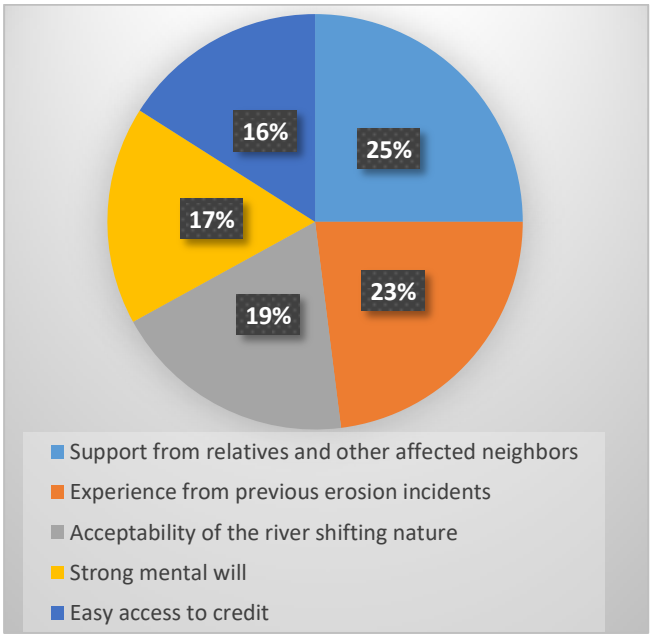
Natural disasters affect millions of people physically and psychologically all over the world (Norris & Elrod, 2006) and the consequences are widespread. About 30–50% of the disaster-affected people suffer from moderate to severe psychological distresses (WHO, 2016) due to high exposure to the trauma, experiencing injury or death of loved one, and reduced social support (Brooks, Amlôt, Rubin, & Greenberg, 2020). In the study area

respondents identify some psychological responses the faced on the occasion of river erosion. The consequences were, fear, flashbacks, feel helplessness, loneliness, disappointment, low self-esteem, sleep disturbance, crying, suicidal tendency, and relationship problems. People used few strategies to cope with this tress knowingly or unknowingly. They include maintaining social relations with relatives and other affected neighbors, experience from previous erosion situation, their positive perception of river shifting nature, strong mental will, etc.

Table 10: Psychological consequences

Psychological consequences	Responses
	Percent
Fear	16%
Flashbacks	21%
Feel helplessness	19%
Crying	17%
Low self-esteem	15%
Sleep disturbance	6%
Loneliness	3%
Disappointment	2%
Suicidal tendency	1%
Relationship problems	1%
Total	100%

Figure 39: Psychological Coping Strategy



5.5.3. Indigenous Knowledge on Erosion Prediction

Respondents also told that they can predict the erosion. They said that riverbank erosion mainly takes place both during the flood and after the flood when the water in the river decreases. About 65% claimed that their prediction was right. The prediction mainly based on river current velocity, flood water height, and their experience. It is evident that erosion takes place where the water current strikes most. Banks with concave slopes and vertically erected banks are more prone to erosion. Their prediction seems logical and impressive. But most of the time they wait for the last moment to be eroded.

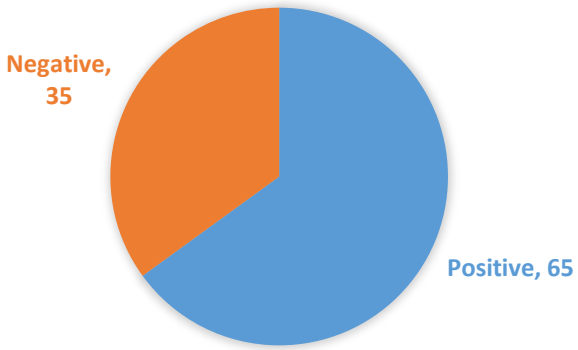


Figure 40: Indigenous knowledge on erosion

Chapter 6

Recommendations

Riverbank erosion is a common natural hazard in Bangladesh. When rivers reach maturity (as in the case of the three great rivers, the Ganges, the Brahmaputra, and the Meghna), they become sluggish, stagnant, and meander or braid. These oscillations cause enormous erosion on riverbanks. Millions of people are affected each year by erosion, which destroys standing crops, roads, farmland, school field, and homestead land. It is anticipated that erosion affects approximately 5% of Bangladesh's total floodplain. So apparently there is no way Bangladesh can avoid river erosion.

To manage river erosion risks, an equitable integration of both structural and non-structural measures is required, as well as the development of a solid knowledge base to understand the complex and dynamic geological and unique and changing morphological processes of the Padma River. In this chapter, the researcher provided some suggestions to deal with river erosion.

Loan without Interest Scheme

In Bangladesh, small loan are very common in rural areas. Disaster vulnerable areas specially flood; cyclone drought, erosion prone areas, bank or micro credit institutions can implement special financial schemes and loans with zero interest rate. In addition, banks should assess their environmental risks for financing in different areas by creating a Climate Risk Fund to be used in case of emergency. The banks and financial intuitions can ensure regular financing flows in selected vulnerable areas and sectors.

Individual Loan Instead of Group Loan

In Bangladesh, especially in rural area small loans are very common from micro credit institutions. In these institutions, there is system to form a group of seven to nine members to get a loan. All people together get the loan but the loan amount is not very big. The purpose is that if anyone fails to repay the installment, other group members will take the responsibility and they will pay the installment or loan amount. It is becoming very hard for affected individuals to form this group and get the loan. Today no one wants to be responsible for other person. If this system can be relaxed, they more people can get the loans.

Development of River Erosion Affected People Database

A comprehensive database can be developing of the affected population from river erosion. Then initiative can be taken to rehabilitate these people one by one. But the there is strong monitoring initiatives need to be taken as well as regular update of this database. Various safety net programs can be taken targeting these people to recover from this plight and getting a sustainable livelihood.

Potable House Technology at the Affected Areas

Floods and subsequent river erosion are an annual part of life in much of Bangladesh. These floods wash away lands, houses and their vital assets. Wealthier people use materials which are not damaged by flooding, such as corrugated iron sheets, cement pillars and walls, but people who are less well-off have to manage with thatch and bamboo. But we need to develop a least cost portable technology so that in time for land erosion people can dismantle their house and easily transport them and again install the house in safer land. In Bangladesh we already have these practices but it need to be improved and least cost.

Identification of Vulnerable Areas

At first, it is very important to identify the vulnerable places, locations, upazila and district to deal with river erosion. According to some researchers, bank erosion is happening in approximately 94 of the country's 489 upazilas. Several other researchers have identified 56 upazilas with erosion. Bank erosion and flood hazards have now become almost routine in nearly 100 upazilas. 35 of them are severely affected. The gradual migration or shifting of the major rivers' channels in Bangladesh ranges from 60m to 1,600m per year. In a typical year, approximately 2,400 km of the bank line is severely eroded.

Well Thought out Structural Interventions

In Bangladesh, the government has invested billions of dollars in embankment construction, river training, and flood protection-like projects. These engineering interventions are very important for river erosion protection. Government should initiate an efficient and comprehensive program to battle against river erosion at the identified vulnerable locations.

Construction of Required Flood Protection Infrastructures

It needs to be ensured that river or stream boundary conditions (flow velocities, river depth, water levels) for different structural design options (embankment, spurs, levee revetments) etc. should be based on specific characteristics of major rivers. Introduction of new technology like two and three-layer stream bank protection systems etc. Continuation of dredging operation to the needful river and transport network.

Establishment and Dissemination of Effective Early Warning System

The skills and knowledge are available for early warning of river erosion. However, this system must be established with the goal of creating a risk-informed early warning system for riverbank erosion at the community level. It should evaluate stream dynamics as well as the risks and vulnerabilities of communities living in erodible areas. The early warning messages should be simple to understand and easily disseminated throughout the community.

Initiation of Erosion Specific Rehabilitation Program

Respondents didn't receive any support from the government as erosion-affected victims. Government has many safety-net programs but there is lacking of erosion-specific rehabilitation programs. A rehabilitation program is critical for long-term survival. The study revealed that the study area lacked a proper rehabilitation program. Because the majority of the population lives below the poverty line, they are unable to repair or rebuild their homes that have been damaged or eroded by erosion.

Policy Reform

The government should adopt specific policy directives to address riverbank erosion. A comprehensive assessment should be done to examine the magnitude of river bank erosion, the number of affected people by it, their root causes, and mitigation measures. A national habitat policy should be developed to meet the needs of the thousands of people who are displaced each year. Local government agencies should take the lead in all of these phases, and they should have facts and figures on potential affected people who live on the risky side of the river. Local government agencies, in addition to these, should be delegated and have the capacity, as well as an accountability mechanism, with the goal of reducing river erosion related vulnerability and responding rapidly, efficiently, and thoroughly.

Save Natural Vegetation Cover

Greenery, foliage, trees, vegetation, plants has a significant impact against bank erosion. River, stream banks with vegetation cover erode at a slower rate than those river banks without vegetation. It is because the root systems of trees and shrubs generally strengthen the land all around the river bank, making the bank less prone to widespread collapse. Plants can also play a role as shock absorbers throughout heavy rainfall, slowing the rate of erosion.

Town and Village Settlement Planning

Physical Settlement planning is a useful tool to plan towns, villages, roads, shelters, etc. which are free from river erosion zone. This settlement can be based on the probability of erosion risk, exposure, probability of vulnerability, the population at risk, etc. The idea is to create a corridor in the alluvial plain that allows the river to flow freely, and within which decision-makers will not try to control erosion with engineered barriers and keep the settlement area safe from erosion.

Khas Land Management

The strategy should be made to identify free land/ khas land to nearby safer zones to improve the management capacity of authority. The strategy should also include the allocation of khasland and provision of housing in Adarshya Gram and Abashon/Disaster-Resistant House Projects

Planned Relocation

Planning for shifting, movement, resettlement and relocation is critical, and it necessitates the establishment of an enabling environment, which includes the establishment of a legal justification, the lawful basis for planned relocation, institutionalization, capacity-building, and a whole-of-government approach. Planned relocation should be included in national development strategies, policies, plans, laws, such as those governing land use, climate change adaptation, disaster risk management, and national action plans.

Government-NGO Coordination/ Joint Initiative

The coordination and collaboration within and between various government agencies, as well as between government and non-government initiatives, regarding river erosion, must be enhanced and strengthened. The government scheme are primarily focused on aid programs such as relief distribution, food distribution, vulnerable group feeding (VGF), food for work, vulnerable group development (VGD), cash for work, and so on; however, these state welfare schemes are frequently insufficient, unorganized, ad hoc, politicized, and ineffective. But there is much room for improvements to be made in government schemes. Close coordination, cooperation, collaboration among various local government institutions is required to alleviate the problem. But on the other side, a lot of international and national non-governmental organizations (NGOs) have specific and special programs aimed at those communities, and areas affected by river bank erosion.

Chapter 7
Conclusion

In a summary, riverbank erosion affects the people of our country every year. The effects are indescribable in words. The study identified that affected people adopted a variety of coping strategies to deal with this disastrous event. People evacuated, displaced, relocated from the area, later they migrated to nearby urban areas. People have to change their housing structures, livelihood patterns to survive the situation.

People took help from their relatives, community people, developed borrowed money from relatives, sometimes borrowed money from microcredit institutions with a high interest rate. People have to starve, change their food intake; people get poorer than in their previous condition. During the recovery of river erosion-affected populations, communities in erosion-prone areas, a resettlement strategy for livelihood, income-generating activities, the improvement of healthcare facilities & services, and schooling & education facilities should be implemented. NGOs can offer simple credit schemes to affected people, allowing them to immediately resume their income-generating activities.

NGOs can advocate for rights-based advocacy efforts and campaigns to encourage, motivate and inspire affected people to claim their access to food, education, water, sanitation, healthcare, and employment opportunities as part of their essential rights. It is also critical for the affected people to develop problem-solving skills.

As displaced people were suffering primarily from a lack of shelter, house-building materials such as CI sheet, tin, bamboo, wood, doors, windows, ropes, carpentry tools, and livestock are essential things for re-building lives of the affected population, and they can also be rehabilitated by establishing Adarsha Gram. Riverbank erosion is a contemporary catastrophic environmental concern for the government and related Nongovernmental organizations.

As a result, the time has come for comprehensive and exceptional attention needs to be given with exemplary activities to deal with this disaster. Initiatives can include loan without interest scheme, development of river erosion affected people database, potable house technology, pre identification of vulnerable areas, well thought out structural interventions, effective early warning system, erosion specific rehabilitation program, policy reform, save natural vegetation cover, town and village settlement planning, khas land management, planned relocation etc.

The Government of our country and non-governmental organizations should take immediate steps to reduce the volume of the effects of riverbank erosion. It also needs to conduct some scientific research projects to find out long-term sustainable solutions that can be helpful to improve the socio-economic status of the affected people.

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Appendix A: Questionnaire

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(All Information will be used for research purpose only)

Coping Strategies in River erosion affected areas: A case study of Andharmanik village in the District of Manikganj.

Questionnaire

Questionnaire No:……. Date:……
General Information:

1. Name of the respondent ……Age……
2. Household size……..
3. Type of Family……a. Nuclear b. Joint
4. Education of the HH head:
5. Do your family depends on agricultural land
   a. Fully dependent b. Mostly dependent c. Partially dependent d. Not dependent

Livelihood

6. Number of earning members in the HH…….
7. Profession (member 1) : ……
8. Profession (member 2) : ……
9. Profession (member 3) : …….
10. Average Monthly Income (member 1): ……..
11. Average Monthly Income (member 2):……..
12. Average Monthly Income (member 3):……..
13. Total monthly income (HH):……...
14. Total monthly expenditure (HH):……..
15. Profession before erosion (HH head):…….
16. Profession immediately after erosion (HH head):…….
17. Steps taken to keep earning (livelihood related adopted coping strategy)
18. ……
19. ……
20. ……
21. other
22. Cost for restoring livelihood?

23. Source of livelihood related fund? A) Own, B)Loan from relative, C) Loan from Bank D) Other
24. Loan amount BDT:…….....

Livelihood Patterns

Major livelihood strategy of household? (Rank 5 of them)

Before erosion	After erosion
1. Crop Production 2. Livestock/poultry 3. Fishing 4. Manufacturing 5. Wage labor 6. Shop keeping /business 7. Rickshaw/ van puller 8. Other; specify	1. Crop Production 2. Livestock/poultry 3. Fishing 4. Manufacturing 5. Wage labor 6. Shop keeping /business 7. Rickshaw/ van puller 8. Other; specify

Livestock/ poultry

1. Do you have livestock/ poultry? A) Yes, B) No
2. If yes, total value of it?.....
3. Do you face any difficulties related to livestock/ poultry? A) Yes, B) No
4. If yes, then describe?.....
5. Economic loss related to livestock/ poultry?
6. Steps taken to deal with the difficulties?.....
7. Cost for restoring livestock/ poultry?
8. Source of fund? A) Own, B)Loan from relative, C) Loan from Bank D)Other
9. Loan amount BDT:…….....

Erosion related (community level)

10. How far your home is situated from river (m/km)?
11. How much land is eroded in last 50 years?

Year	Bigha/acre/Hector/
1971-1980	
1981-1990	
1991-2000	
2001-2010	
2011-2019	

12. How many times erosion events have occurred in the last 50 years in your community?
13. How many times you lost your homestead in the last 50 years?
14. Quantity of eroded homestead land in your village (katha/bigha/acre)?
15. How many times you lost your homestead in the last 50 years?
16. Quantity of eroded agricultural land in your village (katha/bigha/acre)?
17. What types of infrastructure were lost due to erosion (with quantity)?
    a. Road b. Bazar c. Schools/colleges d. Mosque e. other
18. How long have you been living in this area?
19. Any community level initiative to mitigate erosion? a. Yes b. No
20. If yes, then describe…….

Erosion related (HH level)

21. How many times you lost your homestead in the last 50 years?
22. Quantity of eroded homestead land (katha/bigha/acre)?
23. Cost of the eroded homestead land?
24. How many times you lost your agricultural land in the last 50 years?
25. Quantity of eroded agricultural land (katha/bigha/acre)?
26. What crop you produced on that land (crop loss)?
27. A) Rice, Quantity……. B) Wheat, Quantity……C) Vegetable, quantity……
28. Cost of the crop production lost?
29. Cost of the eroded agricultural land?

House level

30. Did you loss house due to erosion? A) Yes, B) No
31. Type of house structure before erosion? A) Pucca, B) Semi-pucca, C) Katcha
32. Type of house structure after erosion? A) Pucca, B) Semi-pucca, C) Katcha
33. Type of house related loss?
    a. Houses totally damaged
    b. Houses were partly damaged
    c. Damage of the houses was insignificant
    d. Others
34. Did you move/transfer your house? A) Yes, B) No
35. House related economic loss BDT?
36. Steps taken to stop house loss (house related adopted coping strategy)
    a. Making temporary house
    b. Making movable house
    c. Sell house/ materials
    d. other
37. Establishing new house (house related adopted coping strategy)
    a. Moved to own empty land
    b. Moved to urban area, slum
    c. Rented new land
    d. Buy new land
    e. other
38. Type of house structure after erosion? A) Pucca, B) Semi-pucca, C) Katcha
39. Cost of the new house/ restoring house:
40. Source of house construction fund? A) Own, B)Loan from relative, C) Loan from Bank D)Other
41. Loan amount BDT:…….....
42. Based on your experience which type of house prefer?

Water supply

43. Source of drinking water supply before erosion?
44. Source of drinking water supply after erosion?
45. Economic loss related to water supply?
46. Do you faced any difficulties related to water supply? A) Yes, B) No
47. If yes, then describe?.....
48. Steps taken to deal with the difficulties?.....
49. Cost for restoring water supply facilities?
50. Source of fund? A) Own, B)Loan from relative, C) Loan from Bank D)Other
51. Loan amount BDT:…….....

Sanitation (toilet)

52. Condition of toilet before erosion? A) Sanitary B) Non-Sanitary
53. Condition of toilet after erosion? A) Sanitary B) Non-Sanitary
54. Economic loss related to toilet?
55. Do you faced any difficulties related to sanitation? A) Yes, B) No
56. If yes, then describe?.....
57. Steps taken to deal with the difficulties?.....
58. Cost for restoring toilet facilities?
59. Source of fund? A) Own, B)Loan from relative, C) Loan from Bank D)Other
60. Loan amount BDT:…….....

Education

61. Do your children faced any difficulties related to education due to erosion? A) Yes, B) No
62. If yes, then describe?.....
63. Economic loss related to toilet?
64. Steps taken to deal with the difficulties?.....
65. Cost for restoring education facilities?
66. Source of fund? A) Own, B)Loan from relative, C) Loan from Bank D)Other
67. Loan amount BDT:…….....

Health

68. Do your family member faced any difficulties related to health due to erosion? A) Yes, B) No
69. If yes, then describe?.....
70. Economic loss related to health?
71. Steps taken to deal with the difficulties?.....
72. Cost for restoring health treatment?

Physical, social and psychological aspects

73. Do you and your family member faced any physical stress? A) Yes, B) No
74. If yes, then what? A) Death, B) Injury, C) Stress, D) Disability, E) Sleep disturbance E) Other
75. Do you and your family member faced any mental stress? A) Yes, B) No
76. If yes, then what? A) Insecurity, B) Fear, C) Flack backs, D) Helpless, E)Crying, F)Other
77. Steps taken to deal with the difficulties?.....

Vulnerable people (women, girls, children and aged people) (FDG)

78. Problems faces by women and girls? A) Yes, B) No
79. If yes, then what? A) Hygiene related, B) Sexual violence, C) Domestic violence, D) Harassment E) Insecurity, E) Other
80. Problems faces by aged people? A) Yes, B) No
81. If yes, then what? A) Insecurity, B) Fear, C) ……, D) ……., E)Other
82. Steps taken to deal with the difficulties?.....

Future plan

83. Do you have any plans for relocation? a. No b. Yes
84. What will you do if your home eroded again?

a. I have a plan to shift b. I don't know yet c. I think, my family will not be affected d. Others……..

Economic cost status

Particulars	Livelihood	Livestock	House	Water	Sanitation	Education	Health
Economic loss (bdt)							
Taken loan	Yes/ No	Yes/ No	Yes/ No	Yes/ No	Yes/ No	Yes/ No	Yes/ No
Loan amount (bdt)							

Comments

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