

Exploring Hazard Risks and People's Adjustment: A Study in the Downstream of the Padma Multipurpose Bridge Project

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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

Postgraduate Programs in Disaster Management (PPDM)
Department of Architecture
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April 2022

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Declaration

It is hereby declared that

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3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
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Approval

The thesis titled “Exploring Hazard Risks and People’s Adjustment: A Study in the Downstream of the Padma Multipurpose Bridge Project ” submitted by Md Fahim Azraf Khan (ID: 20268015) of Fall, 2020 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master in Disaster Management on April 20, 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 taken from each authority to survey their facilities. All the actions such as taking photographs, talking with staff and volunteers were conducted with permission. The field survey was conducted with Beneficence- Do not harm manner. While surveying the child protection facilities, their privacy and dignity was fully respected without interrupting their regular activities like playing and learning.

One of the major ethical points followed in this study is to maintain the anonymity and confidentiality in data collection procedure and analysis to respect the law and policy of Child Protection Sector. All the respondents are kept anonymous as well as CFS samples studied in the research are presented with different identification numbers throughout the data analysis and findings. 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.

Acknowledgements

The author expresses his utmost gratitude to the Almighty ALLAH for allowing this work to be carried out as planned and accomplish the desired goals. The author would like to extend his profound gratitude to his thesis supervisor, Dr. Md. Humayun Kabir, Professor, Department of Geography, and University of Dhaka for his expertise, valuable guidance, unceasing encouragement and immeasurable assistance to transform this research into reality. The author is gratefully indebted to Muhammad Ferdous, Lecturer & Coordinator of Postgraduate Programs in Disaster Managements (PPDM) at BRAC University, without his guidance and mentorship in every step throughout the process, this research would have never been accomplished. Moreover, the author would also like to extend his gratefulness to the Brac University for their valuable support in carrying out the whole procedure. The author places on record sincere gratitude to their parents and friends for their incessant support through consistent encouragement and motivation.

Abstract

The development induced hazards (i.e. erosion) has become a matter of great concern in recent years. The Padma Multipurpose Bridge Project is going to be one of the biggest infrastructures in Bangladesh and is estimated to increase the annual growth by more than 1.0 per cent. But large development projects have some demerits too. Due to this massive construction process, the normal channel of the river has been altered and it has resulted significant erosion in the downstream of the Padma river. So a study has been undertaken to understand the hazard risk of the Uria Village which is situated at the downstream of the Padma river in Louhajang upazila. To investigate the changed social and economic status and the coping strategies of the people living in the area, a questionnaire survey has been done on 113 households. Moreover, change of land use pattern of the area has been determined using Landset. Finally, an overall comparison has been done on the present livelihood, economic status and condition of the houses of the households with the state before beginning of the construction of the Padma Multipurpose Bridge. It has been found that, water bodies have been decreased to a great extent but build up area has been increased almost 8 times between 2000 and 2020. The agricultural lands also decreased from 91134.8 acres to 15335.34 acres in the mentioned period. Due to erosions specially in the downstream, these lands have been engulfed by the Padma river. On the other hand, 74 out of 100 people lost their lands where they used to live or cultivate. Only 15% of them have been able to find new jobs and livelihood. To adopt with the condition, 66% respondents are planning to relocate themselves to nearby villages or cities like Holudia, Madaripur, Goalibanda, Srinagar etc. which are situated in comparatively highlands. It has been recommended to provide small interest-free loans to the affected people from the administration so that they can adopted with the shocks of disasters and build new temporary houses to live in. Along the shore of the Padma, plantation of this Vetiver grass can mitigate the rate of erosion as well. Finally, after the end of construction, the current location of the Shimula Ghat should be changed as it has accelerated the rate of the erosion in the downstream.

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List of Acronyms

UNICEF	United Nations International Children's Emergency Fund
BWDB	Bangladesh Water Development Board
SDG	Sustainable Development Goal
UNHCR	United Nations High Commissioner for Refugees
ISCG	Inter Sector Coordination Group
REIS	Riverbank Erosion Impact Study
IEB	Institute of Engineers Bangladesh
GoB	Government of Bangladesh
WARPO	Water Resources Planning Organization

Chapter 1

Introduction

1.1 General Background

A very unique geographical condition, tropical monsoon, flat topography and dense population have made Bangladesh susceptible forever to the natural disasters. From the ancient time people living in coastal belt are used to risk their lives in front of deadly cyclones, landslides or flash floods. According to the global index 2021, Bangladesh stands at 7th in most climate change affected countries.

River bank erosion has been one of the biggest disasters of this country. Specially during the monsoon, extensive current of the river hit the soil of the bank and river erosions become typical. Heavy rainfall, deforestation, increased waterflow specially in upstream braided nature of the rivers exaggerate the process of the erosion in every year. Due to climate changes, the weather pattern has been changed. Altered pattern of the rainfall, high intensity of precipitation etc. result the sudden collapse of the surrounding lands of the river and cause a huge damage.

As per Bangladesh Water Development Board (BWDB) the most erosion prone districts are Sirajgonj, Bogra, Kurigram, Gaibandha, Lalmonirhat, and Rangpur, in the country's north, and Manikgonj, Chandpur, Rajbari Shariatpur, and Faridpur in Dhaka region, with Tangail and Jamalpur in Mymensingh zone, and the coastal areas of Patuakhali. Among them, the most erosion prone area in Bangladesh is Sirajganj, which faced a total land erosion at a rate of 622.2 ha, according to a CEGIS study in 2009.

Due to extensive river erosion, every year millions of people have to lose their cattle, crops, housing structures, and farmland. In addition to that many public infrastructures like schools, colleges, government offices have to be engulfed in the water of the river. The rivers of Bangladesh have unpredictable channel to flow channels which change every year and affect the rural flood plain population. It also becomes difficult for the government as well as local administration as prediction the river erosion still is a mammoth task.

According to Banglapedia, still no pattern has been identified to forecast the river erosion perfectly as a large number of variables such as bank material, flow velocities, water level variations, platform of the river, sediment into the river etc. are involved in it.

In particular, bank lines of the Padma River are vulnerable, unstable and has a history of erosions. The river is wide with excessive erosion occurring along the left bank near Harirampur upazila of Manikganj district. In recent time, the right bank of the Padma has also come under threat of extreme erosion, particularly in Naria upazila of Shariatpur district.

From Banglapedia, it has been found that, the eroding of the Padma has been occurring along both banks. During 1993, it was recorded that, the width of the Padma river varied from 2.7 km to 10.7 km and in 1984 it varied between 3.7 km to 8.5 km. Between 1984 and 1993 the widening rate was 159 m/year, right and left bank erosions were 38 m and 121m respectively. So it is proven that, the widening rate of Padma is significant since long.

With all the other natural causes, the river Padma has been being effected by the infrastructural projects as well. The development induced hazards (i.e., erosion) has become prominent in the recent years. The recent construction of the Padma Multipurpose Bridge Projects have brought a light of hopes for the whole nation. The Padma Bridge is estimated to increase the GDP of the country by more than one percent. It will benefit about three crore people across 21 south-western districts of Bangladesh. But large development projects have some demerits too.

1.2. Problem Statement

Bridges normally effect the usual direction of flow of the river. As a result, the normal characteristics of the surrounding areas have been suffering huge erosions rate in last half a decade. Sometimes, the upstream of the river is noticed and analyzed carefully but still the downstream remains unnoticed.

The changed direction of the channel due to Padma Multipurpose Bridge and specially for newly located Shimulia Ghat for transportation of the heavy construction goods for the Padma bridge have made the downstream region of the river massively vulnerable. The people living there for more than three generations, were not used to the erosion of the river padma. But it has been found that within last 5(five) years the erosion has been significant enough.

The problem has been more intense here because people living in the downstream were not used to this type of problems before. During the monsoon, rate of erosion has been accelerated and has becoming typical in last five years. Riverbank erosion mainly occurs due to the braided nature of rivers in Bangladesh, and is further aggravated by heavy rainfall, particularly upstream, and increased water flow. The lives of the downstream side of the Padma river is at stake.

To survive during disaster, people eat fewer meals, borrow money or take a loan, or sell their labor cheaply in advance . If necessary, they also sell their land, livestock, housing materials and other personal belongings, including jewelry and household goods. The other impacts include reduced ability of the soil to store water and nutrients, exposure of subsoil, which often has poor physical and chemical properties, higher rates of runoff, shedding water and nutrients otherwise used for crop growth, loss of newly planted crops and deposits of silt in low-lying areas. Besides, Soil erosion removes valuable top soil which is the most productive part of the soil profile for agricultural purposes. The loss of this top soil results in lower yields and higher production costs. The risk of floods are also considerable in this location. Overall, the development induced hazard risk in the downstream of the padma river cannot be ignored at all. During the construction phase of the bridge, enormous river training activities have been done in the upstream of the river. But very few attractions have been given in the downstream of the river. That is why, this portion has become a victim of the recent development activities.

A very few government interventions have been occurred in the place and according to the people living there, not a significant number of studies have also been done. But the significance of the study on this area is notable. An assessment can bring out the altered social changes and newly induced vulnerability of this location. On the other hand, the sustainability and livability of these locations are crucial to achieve the SDG goals also. Specially, achieving the Goal 1 : No poverty, Goal 3 : Good Health and Poverty , SDG 11 : Sustainable Cities and Communities will not be possible without the timely interventions from the government in these areas . So, An assessment was badly needed to identify the critical economic and social conditions of the victims of the National Development. An analysis on the coping strategies with the development induced hazard can facilitate the people in that region to handle the situation.

1.3. Area of Study:

So an area just within 5 km of the bridge and with 2 km away from the Shimulia Ghat has been selected for the study. The place is situated in Kharia village (Word 1 and 2),Kumarbhog union, Louhojong Upazila , Munshiganj district. Along the coast of the river about 100 households live there in permanent basis and almost all of the households are the sufferers of the development induced hazards.

1.4 Objectives

The objective of the present study was to:

- To assess the changed erosion pattern of the area after the inception of the construction project
- To identify/explore the changed income, living condition and social structures of the people living in downstream of the Padma Multipurpose Bridge Project
- To understand and explore the coping strategies with the hazards of the people living there

1.5 Research Questions

- What are the changes in erosion pattern of the area after the inception of the construction project?
- How did income, living condition and social structures of the people living in downstream of the Padma Multipurpose Bridge Project experience alteration in last half decade?
- What are the coping strategies adopted by the people to mitigate the impacts of the development induced hazard?

Chapter 2

Literature Review

2.1. Introduction

Bangladesh is mainly a riverine and low-lying country located in South Asia with a coastline of 580 km (360 mi) on the northern littoral of the Bay of Bengal. The delta plain of the Ganges (Padma), Brahmaputra (Jamuna), and Meghna Rivers and their tributaries involve 79 percent of the country (Rashid and Haroun, 1991). Four uplifted blocks (including the Madhupur and Barind Tracts in the centre and northwest) occupy 9 percent and steep hill ranges up to approximately 1,000 metres (3,300ft) high involve 12 percent of the land area. Heavy seasonal rainfall, high temperature, and high humidity characterize a tropical monsoon climate in Bangladesh.

Natural disasters such as floods and cyclones hit the country in almost every year (Geography, 2020). According to Nehal (1995), Bangladesh is in portion of the humid tropics, with the Himalayas situated to the north and there is a funnel-shaped lowing coast touching the Bay of Bengal in the south. This has shaped the gate of the world's largest river delta draining consisting of Ganges, the Brahmaputra, the Meghna, their tributaries and distributaries.

This certain geography of Bangladesh produces not only the life-giving monsoons but also the catastrophic ravages of cyclones, floods, tornadoes, droughts, river-bank erosions and earthquakes (Brammer and Khan 1991). Ahmed and Mohiuddin (1989), said that with a large number offshore islands which are continuously in the process of forming the entire coastal area of the country, standing barely about 9 meters above the sea level and separated by tidal inlets, sea arms, extensive mud flats and creeks, Bangladesh is apparently one of the most disaster prone countries in the world.

2.2 Disasters in Bangladesh

Bangladesh is a country of southern Asia and is a home of 200 million people, is widely known as a land of natural disasters. Bangladesh has been affected by natural disasters such as floods, river bank erosion, earthquake, drought, cyclones, landslide etc. Huge number of people sacrificed their lives and many other become homeless. When these disasters break out, modes of communication is suspended creating untold troubles to people (Sajedul, 2014).

2.2.1 Cyclone and Storm Surges

The coastal belt of Bangladesh is vulnerable to cyclones almost every season. Generally these storms occur in early summer (April-May) or late rainy season (October-November). Mainly the low atmospheric pressure during this season is the reason behind their generation (Flierl and Robinson, 1972). A storm surge is occurred by the extensive pressure within a cyclone and by high winds acting on the water. At the end, a mass of water, a huge wave, moving at the same speed as the cyclone is originated. During the years from 1797 to 1991, the costal region has been hit by 60 cyclones in Bangladesh, among them 32 were accompanied by storm surges.

It has been investigated that, a tropical cyclone forming in the Bay of Bengal can have a lifetime of one week or longer. The height of the surges are about 12 m in some cases (Khalil, 1990). The most desctructive cyclone occured on 12 November 1970 with a wind speed 241 km/hr and killed over 500 000 people. A wave of up to 9 m high was produced by this cyclone. (Johnson, 1982). Cyclone Sidr was another devastating cyclone .The cyclone was a category 4 storm which claimed 3,406 deaths and over 55,000 people injuries (Paul 2009). On the other hand, The Joint Damage Loss and Needs Assessment mission, led by the World Bank, estimated losses caused by Cyclone Sidr at US \$1.7 billion, a figure which represents about 3% of the country's gross national product. Another devastating cyclone Aila s was responsible for at least 339 deaths across Bangladesh and India; more than 1 million people were left homeless.

2.2.2 Floods in Bangladesh

Hossain and Akhtar (2004) explained that floods are the overflow of large amount of water beyond its normal limits. It is the significant natural disaster causing pervasive devastation to human life and property in Bangladesh. From the perspective of Islam, S.R., and Dhar, S.C.(2007) , the remarkable floods that occurred in 1954, 1955, 1974, 1984, 1987, 1988, 1993, 1998, 1999, 2000 and 2007 have been so disastrous and caused heavy threat to lives and economy. Frequently, during the rainy season our country is affected by floods when there is redundant rainfall. The flood of 1988 created a new record for flooded area and 1998 flood was remarkable with its long duration. Due to the possible causes of climate change, the flood damage potential in Bangladesh is rising. In Bangladesh, the following types of floods are normally encountered (Amartya et al., 2005).

2.2.2.1 Types of Floods

A flash flood is a rapid flooding of low-lying areas: washes, rivers, dry lakes and depressions (Flash, 2017). Brammer H. (1996) said that in the hilly region of Bangladesh flash flood are one of the most common forms of natural disaster occurred almost every year. This sudden inundation of water also carried silt, rocks, sediments and other debris caused damage to agricultural products and casualties. Especially during the monsoon period mountain region of Bangladesh are suffered by the flashflood triggered by excessive torrential rainfall. Three major rivers flowing through the country originated from outside the country and received nearly 1,200 km³ water every year (BWDB, 2020).

Generally, the word flood is synonymous with river flood. River flood is a common affair in the country caused by bank overflow. WARPO (2004) said that around 80% occurs of the total flow in the 5 months of monsoon from June to October. A similar condition is seen in terms of rainfall also. As a result Bangladesh suffers from abundance of water in monsoon due to this skewed temporal distribution of river flow and rainfall, frequently resulting into floods and water scarcity in other times of the year, developing drought conditions (IEB, 1998). Climatologically, the discharge into Bangladesh from upper catchments occurs at different time of the monsoon. In early monsoon in June and July maximum discharge occurs in the Brahmaputra whereas in the Ganga maximum discharge occurs in August and September. The peaks synchronization of these rivers results in devastating floods. These types of incidents are common in Bangladesh.

The rivers of Bangladesh drain approximately 1.72 million square km area of which 93% are outside of its territory in India, Bhutan, Nepal and China. WARPO (2004) said that the annual average runoff of the cross boundary rivers is around 1200 cubic kilometers. According to Chowdhury (2003) flood normally happens in many parts of the country but is mainly prevalent in the south-western part of the country. Ground water flood occurs in the flood plains where natural drainage systems have been disturbed either due to human interferences e.g. encroachment of river courses and unplanned roads construction etc. or due to gradual decay of the natural drainage system (Amartya et al., 2005). The natural drainage system cannot carry the run-off generated by the storm when intense rainfall takes place in those areas, and in many localities causes temporary inundation. This rain-fed flood is increasing in the urban areas.

From the report of Rahman (2005), floods due to storm surges mostly takes place along the coastal areas of Bangladesh over a coastline of around 800 km along the southern part. Continental shelves in this part of the Bay of Bengal are shallow and extend to approximately 20-50 km. Moreover, the coastline is conical and funnel like in shape in the eastern portion. Storm surges generated because of these two factors due to any cyclonic storm is comparatively high compared to the same kind of storm in several other parts of the world (Chowdhury 2003). Maximum height of the surges were found to be 10-15 m in case of super-cyclones, which causes flooding in the entire coastal belt. As reported by FFWC (2005), the worst type of such flooding was on 12 November 1970 and 29 April 1991 which caused loss of 300,000 and 138,000 human lives respectively. During the months from June to September coastal areas are also subjected to tidal flooding when the sea is in spate due to the southwest monsoon wind.

2.3 River Bank Erosion

River bank erosion refers to the wearing off; of the top soil that encloses a river or a stream. This is an ongoing disaster and there is no specific indicator to measure the extent of damage. According to World Disaster Report (2001) published by IFRC, around 10,00,000 people are affected by river erosion and about 9000 hectre cultivable lands are vanished in river in each year. Only a few affected people among these are able to find new shelters while others become homeless for uncertain period (Sajedul 2014). River-bank erosion causes massive property loss, including land and physical infrastructures which render people destitute virtually overnight. The main threat to embankments is created by river-bank erosion; it also accounts for a major hazard for towns situated along the major rivers.

2.3.1 Riverbank Erosion in Bangladesh

Bangladesh is placed as sixth most erosion and flood prone country in the world (UNDP 2011) Along the major three river, river bank erosion will be increased by 13% within 2050 and 18% by 2100 (Aktar,2015) . The hazard erodes land and assets. As part of management practice the people alone usually build makeshift adoptive structure. In case of failure, they lose these infrastructures with other assets including land permanently (Khatun et al., 2019)

Generally, it occurs during the period from May to October every year. The most critical consequence of river activity is the physical destruction of land, homesteads, and other property

(Nehal,1995).River bank erosion is a local and recurrent natural hazard that impacts severely on the life and property of the people living in the riverside areas (Ahmed 2016; Islam et al. 2016; Alamet al. 2017). Riverbank erosion is recognized as a silent, slow, and topmost disaster focusing the losses of property in Bangladesh (Shamsuddoha and Chowdhury 2007; Rahman et al. 2015). Rahman and Islam (2016) said that Bangladesh is situated in the Bengal delta which was developed by three mighty rivers i.e., the Ganges, the Brahmaputra and the Meghna (GBM) .The deposit of sediments in the GBM basin is the highest in amount in the world (Kuehl et al. 1989).

It has been estimated that, approximately 1050 million tons of sediments annually discharge from the Bengal basin (Milliman et al. 1995), in the Bengal delta among 600 million tons are deposited (Meade 1996). As a result, the river beds in GBM are silted up and losing their depth. Frequently, due to over siltation the river configuration is being adjusted and the river channel is shifting repeatedly. For fluvial flood and riverbank erosion, these phenomena are common in the country (Elahi et al. 1990). It is said at BBS (2011) that, a network of rivers of the Jamuna, the padma, the Teesta, the Brahmaputra, the Meghna, the Surma and their tributaries covering the country with a length of about 24,140 km .

For causing erosion at different points and annual rivers eroded 10,000 hectares of land in Bangladesh more or less all the rivers of Bangladesh are responsible (NWMP 2001). Land had been eroded along the Jamuna (Lower Brahmaputra) Between 1973 and 2004, about 877.90 km² and 293.90 km² along the Padma (Lower Ganges) (CEGIS 2009). Islam and Rashid (2011) stated that there are 283 locations along the bank line, 85 towns and growth centers are vulnerable to erosion and about 15–20 million people are at risk from the effects of erosion (Hutton and Haque 2003; Rahman et al. 2015). As a result, numerous people migrate to cities or nearest town and live in the urban slum areas becoming homeless due to river bank erosion (CEGIS 2009; Das and Bela 2011). Several kilometers of roads, railways, and food control embankments annually damage along with foodplain and settlement.

No other disasters are as disastrous as riverbank erosion in terms of long term effect on people and society (Elahi 1991). In South Asia the Ganges named Padma in Bangladesh part is a crucial river system which supports the life and livelihoods of millions of people. The catchment area of the Ganges river system is around 1.09 million km², originates at the Gangotri glacier in the Himalayas and is one of the largest river systems in the world. It crosses China, Nepal, India and Bangladesh,

making it a quintessential international river along its 2526 km course to the confluence with the Meghna. About 79.1% of its entire catchment has shared with India while only 4.3% lies within Bangladesh which is equivalent to 32% of the country and receives average annual rainfall of 1200 mm (Mirza 2004; Sulser et al. 2010). Therefore, it is subjected to high seasonality and recurrent floods of large magnitude (Sharma 2005) with the annual total discharge volume of around 80% occurring during the monsoon season i.e., July–October (Kale 2003).

Erosion and deposition statistics of the Ganges indicated that along the right bank of 57 km² land was lost whereas around 59 km² was gained along the left bank during the period of 1973–2011 (Dewan et al. 2017). The Harirampur, Faridpur Sadar, Char Vadrason, Dohar, Mawa Ghat, Shiv Char, Tongibari areas are considered as the most erosion-prone areas among the other parts of Padma in Bangladesh. The people of these areas are the most vulnerable community in the lower Ganges food-plain and their fate is regulated by the dynamic river character. Every development sector of this area faces the adverse impact of the erosion.

Harirampur is situated about 86 km away from Dhaka, the capital of Bangladesh and located on the mostly erosion prone area of the mighty river Padma. It is located at 23.7333°N and 89.966°E with an area of 245.42 km² and is bounded by Shivalaya, Ghior and Manikgonj Sadar upazilas on the north, Char Vadrason and Faridpur Sadar on the south, Manikganj Sadar, Nawabgonj and Dhohar upazilas on the east, Shivalaya, Goalondo Ghat and Faridpur Sadar upazilas on the west. Main rivers of this area are the Padma and the Ichamoti; and main depressions are Bhatsala and Gharilpurbeels. Harirampur upazila consists of 13 union parishads (subdivision of upazila), which is seriously affected by riverbank erosion (BBS 2011).

2.3.1.1 River Bank Erosion in Padma River

Historical maps for banklines of the Ganges have been compiled by BWDB (Bangladesh Water Development Board) for the years 1780, 1855 and 1886 for the reach from Indo-Bangladesh border to the Jamuna confluence (BWDB, 1978). A study of Dad (1977) stated the shifting pattern of the Ganges based on the plan map of the bankline collected from the BWDB. Rahman (1978) studied the erosion of the Padma river from Goalundo to confluence of the Padma-Meghna.

The areas face extensive bank erosion by the river Padma from 1971 to 2000. Moreover, Munshiganj, Madaripur and Shariatpur are more vulnerable districts to river bank erosion in

Padma River. From 1988 to 2017 erosion was measured for 29 years period. To calculate the eroded land area, seven satellite images were used. It took six interval periods for the measurement 1988–1993, 1993–1998, 1998–2003, 2003–2008, 2008–2013, 2013–2017.

In the period of 1988–1993 highest erosion rate was found with 2089.693 ha/year, 10,448.47 ha land was eroded in this 5 years period. Erosion rate also higher in 1993–1998 years period with 1986.672 ha/year, 9935.179 ha land eroded in this 5 years period. In 1998–2003 time periods the average erosion rate decreased from 1986.672 to 1879.536 ha/year. Gradually in time period of 2003–2008 and 2008–2013 the erosion rate decreased to 1533.186 and 937.6009 ha/year. In 2013–2017 the erosion rate was slightly increased to 1106.426 from the past 5 year time period of 2008–2013. Average erosion rate in this 29 years period was measured as 1472.056 ha/year with total land of 42,689.59 ha land eroded in this time. This high erosion rate caused huge land loss in this area.

2.4 Development Induced Hazard

Development-induced involuntary resettlement is common in Bangladesh as in many other developing countries. According to Khatun (2009), Infrastructure development projects in the country have affected 50,000 individuals annually since independence in 1971, and these projects have resulted in the acquisition of a rough total 7000 ha between 1994 and 2004. However, involuntary resettlement and land acquisition are increasingly social and political issues in Bangladesh, as can be seen by the prominence of recent civic protests (Barisal Correspondent, 2013). Moreover, Because of high population density and land scarcity in the country these factors are enhanced.

In Bangladesh Major development-induced involuntary resettlement operations include Jamuna Multi-Purpose Bridge Project (JMBP) completed in 2000, needed the 2900 ha of land acquisition and affecting 105,000 individuals, and Bhairab Bridge Project (BBP) completed in 2004, which requiring 17 ha of land and affected 4000 individuals. During the JMBP the relocation was the largest land acquisition case in recent infrastructure development in Bangladesh and was primarily completed within rural settings and included community relocation with civic facilities as well as livelihood restoration programs (Khatun, 2009). The resettlement in the BBP was relatively small-scale compared to other recent development projects in the country; however, this process was

unique as it was implemented in semi-urban settings. The resettlement package for BBP incorporated the reconstruction of commercial plots and livelihood restoration, including employment in the development project. These cases can be counted as successful as after relocation they provided rehabilitation activities for affected people.

However, many other development-induced involuntary resettlement operations in Bangladesh centralized the focus on legally required cash compensation and guidelines from external funding agencies, and they lacked emphasis on relocation and rehabilitation programs such as community reconstruction and livelihood restoration (Khatun,2009, Zaman,1996). The Road Network Improvement and Maintenance Project II (RNIMP-II), loan provision for which was completed in 2014 funded by the Asian Development Bank (ADB), was one of several recent major infrastructure development projects in Bangladesh; its purpose was to improve transport efficiency and strengthen integrated road networks through the construction and maintenance of regional and district road connections. It affected a large number of residents 19,166 people in different parts of the country, covering both urban and rural areas (ADB, 2014, Ministry of Communications Roads and Highways Department, 2008).

Chapter 3 Research Methodology

3.1 Selection of the Study Area

Uria village of Kumarovog Union under Mushiganj district has been selected as the study area for the present study. While selecting the research area, the intension was to find a location which has been heavily affected by the recent erosion and lots of people have been displaced. It was already known that the upstream of the Padma Multi Purpose Bridge project experienced some river protections. So, the aim was to find out a suitable location where the altered channel of the river Padma has effected and people have become homeless and lost their livelihood in last half of decade.

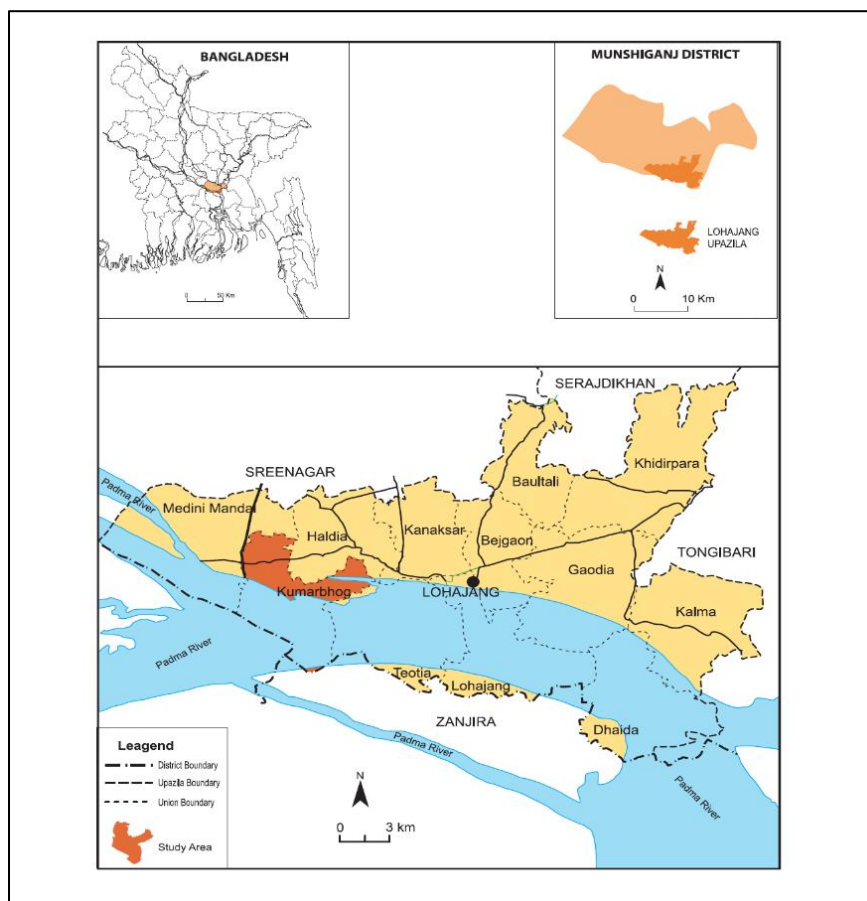


Figure 3.1: Location of the Study Area

Various locations including Shimulia Bazar, Kharia Village, Dokkhin Holudia, Chatar Masjid, Satgoria etc. were investigated for the research. Initial reconnaissance survey was done and finally

after multiple numbers meetings with the local people and government officials , finally Uria village was selected.



Figure 3.2: Uria Village (a, b, c, d)

3.2. Preparation of Questionnaire

As stated before, the goal of the research was to show the altered social and economic condition of the people living in the downstream of the Padma River, conducting a social analysis on the changed income, living condition and social structures of the people , understanding and analyzing the coping strategies with the hazards of the people living there and analyzing the changed erosion pattern of the area after the inception of the construction project.

In these circumstances, the goal of the questionnaire survey was to analyze the firsthand experience of the affected people. From the stories of these people, it was tried to understand the coping mechanism they have been following to combat the erosion disasters and what they perceive to

mitigate the impacts of these phenomenon. Another intention was to find the distress of the people who are the sufferer of the bridge construction. Normally their sufferings are overlooked so that the goal of the questionnaire was also the understand the real situations.

3.2.2 Defining Target Respondent

The selection of the proper respondent is a vital factor to ensure the robustness of the study. Purposive selection was already done on the study area and it was decided that at least one member from every household regardless of economic and financial status, religion, ethnicity or type of family would be interviewed regardless of economic status. Finally, interviews were taken from 100 households of Uria village . 6(six) interviewers were appointed for 2 days to complete all the interviews and then the collected data were analyzed through SPSS and Microsoft Excel. Considering the weather vulnerability, security issues and transportation problem to and from study area, it was decided not to go beyond three sessions to complete all the interviews.

3.2.3. Questionnaire Setup

To fulfill the aim of the survey, it was ensured to prevent any type of misunderstandings and ambiguities. The exact kind of information that is needed to gather were enlisted including the social and economic condition of the local people, the trend of erosion, the immigration nature, livelihood etc. The coping strategies of the people against the erosion were also decided to be enlisted.

The author also looked for the existing questionnaires that have been validated by published research but such kind of questionnaires were not found. Later , a similar type of questionnaire were found which was used in a previous research by the Department of Geography, University of Dhaka. But the content of the questionnaire was not enough so more questions were finally added. For the weak internet condition, it was decided to conduct the survey in paper and pen method. Finally, all the interviewers were briefed about the questions before the starting the session.

3.2.4 Choosing Question Type

There are different kinds of questions which are used in the questionnaire survey. As its is an explorative questionnaire different types of open ended questions were also provided. Some MCQ type questions were also enlisted where applicable. But there was no ranking type question.

3.2.5 Design Question Sequence and Overall Layout

After optimizing each question separately, it was tried to improve the overall flow of information and comfortability for both interviewer and interviewee during the session. Questions were printed in both sides of the paper to save the cost of printing and ensure the convenience for the interviewer. Some follow-up questions were also provided for better understanding. In some portions, answer tables were provided for the cleanliness of the paper.

3.2.6. Piloting

Before starting the official study, a piloting was done to make the whole process flawless. One of the interviewers took an interview and the other members observed the process. At beginning some confusions were found out. Then all the team members sat together and found the solution. After that all the members started to take interviews simultaneously.

3.2.7. Logic Behind Choosing Questionnaire Survey

The main purpose of the study was to investigate the changed social condition of the people from the first hand experience. Therefore, a questionnaire survey method was chosen. It provides a relatively cost efficient, quicker and reliable way of obtaining the information from a large or small sample of people.

It is understandable that a more qualitative analysis could have provide better insight of the research but due to time constraint and covid regulations FGDs and KIIs could not be organized.

3.3. Change of Landuse Pattern Analysis

Materials and methodology in remote sensing and GIS entail a number of interconnected tasks. The current study's approach has been divided into several sections. All of these requirements are being prepared using ArcGIS 10.5 software. The United States Geological Survey (USGS)

provided the Landsat 8 image for the land use study of the existing intervention area based on the surrounding 5 km and 10 km buffer region.

3.3.1 Data Acquisition

Satellite ID	Path/ Row	Acquisition Date	Spatial Resolution
Landsat 5	137/44	19-01-2000	30 m
Landsat 5	137/44	30-01-2010	30 m
Landsat 8	137/44	30-03-2020	30 m

Source: (earthexplorer.usgs.gov)

3.3.2. Image Processing

- After collecting the data, the images were processed in ArcMap 10.5, which included layer stacking and research area masking.

3.3.3. Development of Classification Scheme

The maximum likelihood classification mechanism was implemented for the image interpretation. In supervised classification, sample pixels from images that are characteristics of specific classes are picked, and then image processing software (ArcMap 10.5) is used to classify all other pixels in the image using these training sites as references. Five major types of classified zone were identified by the supervised classification:

- Water Body
- Built Up Area
- Agriculture
- Vegetation
- Open Space

3.3.4 Production of Initial Land Cover Map

After completing all the required steps, the acquired maps have been produced by ArcMap 10.5. For the statistical analysis and graphs of different land classes of the images have been prepared with the help of Microsoft Excel and SPSS.

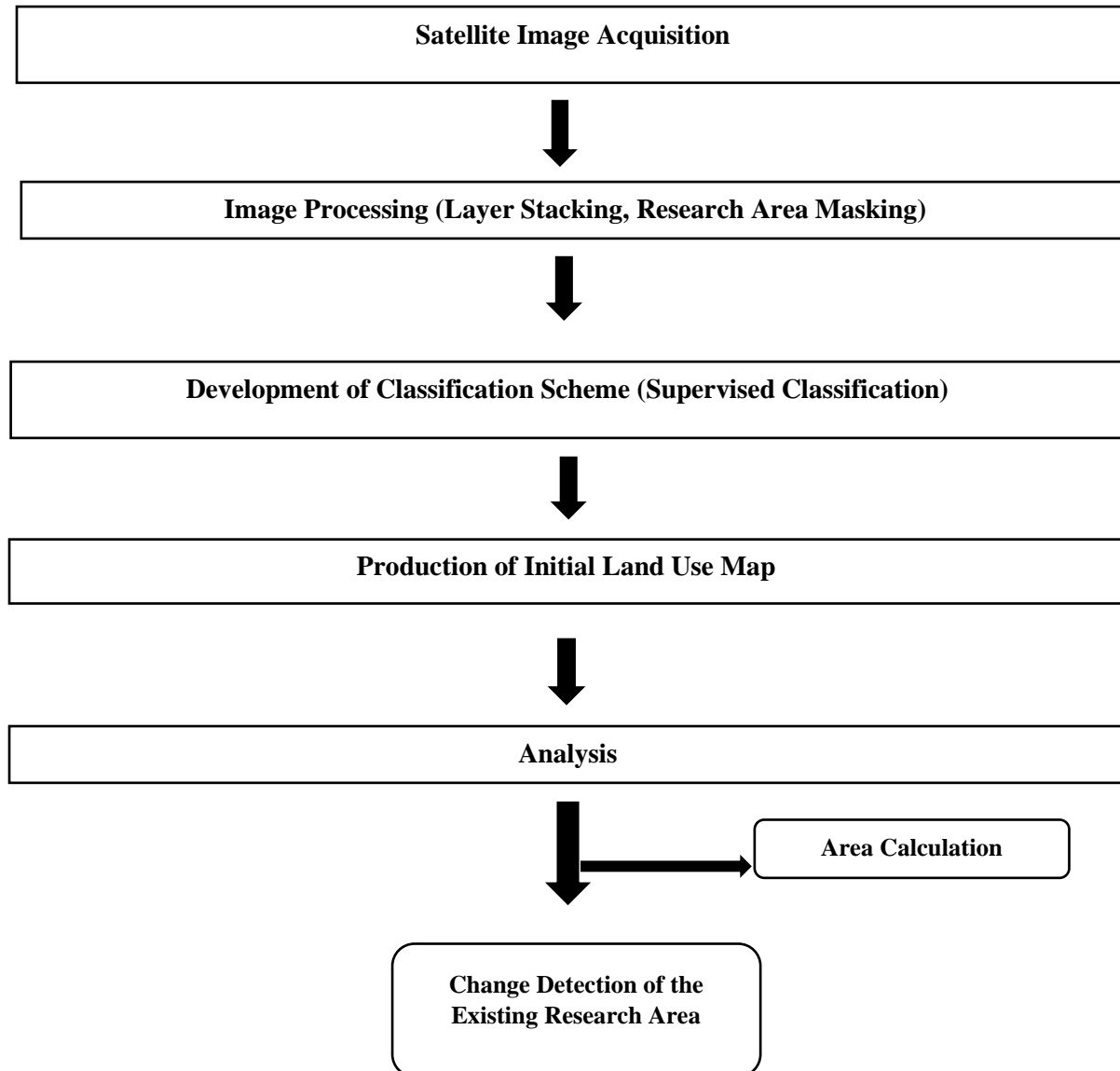


Figure 3.3: Flow chart of the methodology

In the flowchart, it has been described that at first Satellite Image Acquisition was done to collect the right images. After that using Layer Stacking, Research Area Masking images were processed. Then after developing classification scheme, initial landuse map was produced. At last it was ready for analysis.

Landuse and Landcover Change in the Study Area

4.1 Introduction

Land use and land cover (LULC) change is one of the most important, immense and perceptible transformations of the earth's surface (Alam et al. 2020). Assessing the change of landuse pattern at different spatial scales can be occurred in wide range of perspectives such as change in demography, resource management, environmental conservation, land use planning, and sustainable development. It is always difficult to predict the normal flow channel of the Padma River.

The Padma/Ganga is an important river in South Asian region which provides livelihoodfor millions of people both in India and Bangladesh.. Below its confluence with the Brahmaputra it has been known as the Padma, which align with the Meghna at Chandpur and below which the channel is known as the Lower Meghna. So a landsat image analysis has been done to understand the change in landuse pattern around the Uria village. After that a full phased analysis has also been done.

4.2 Landuse Landcover Change

Significant results of the Landsat image analysis are shown below in the form of land use distribution maps. The image has five four different land classes, and each color represents the distribution of the area of each classified subtype.

The results of the Landsat image analysis are shown below in the form of land use distribution maps. The image has five four different land classes, and each color represents the distribution of the area of each classified subtype.

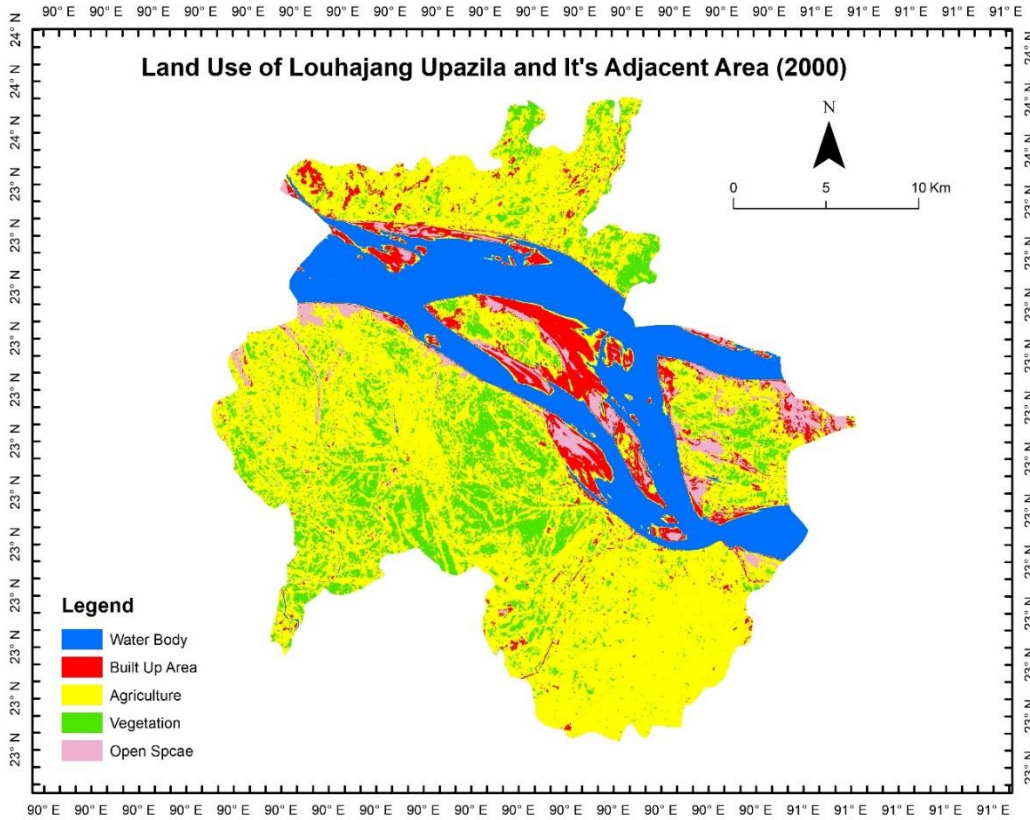


Figure 4.1: Land use of the proposed area in 2000

It has been found that in 2000 (Figure 4.1), most of the land in Louhajang were used for agricultural landuses . The channel of the Padma river flow was from North-West to South-East as usual. Some built up areas have been found in the river bank areas which were also severely vulnerable to erosions. There are some portions of vegetations in close wo the banks as well. But the rate of erosion is no significantly found in 2000. It is to be noted that, the bridge construction was not begun in this time.

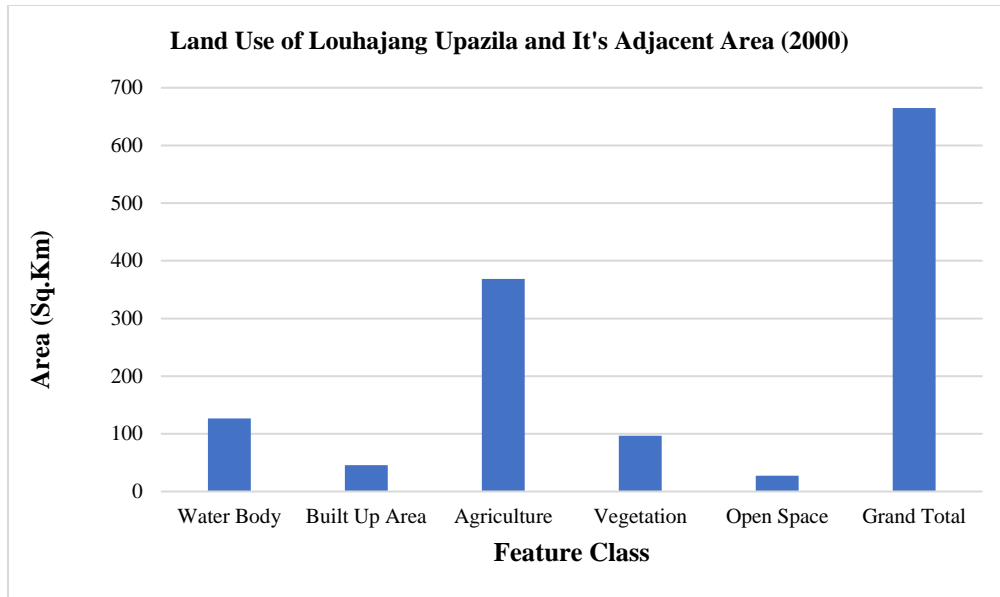


Figure 4.2: Land use change of the intervention area (2000)

Therefore, (Figure 4.2) , most of the lands (370 sq.Km) were being used for agricultural purposes at 2000. It has been evident that at that time the rate of erosion in the Uria village was less and that is why people could rely on agriculture for their livelihoods. 120 sq km of areas were water bodies at 2000. From the overall land use pattern, very few spaces were regarded as open spaces.

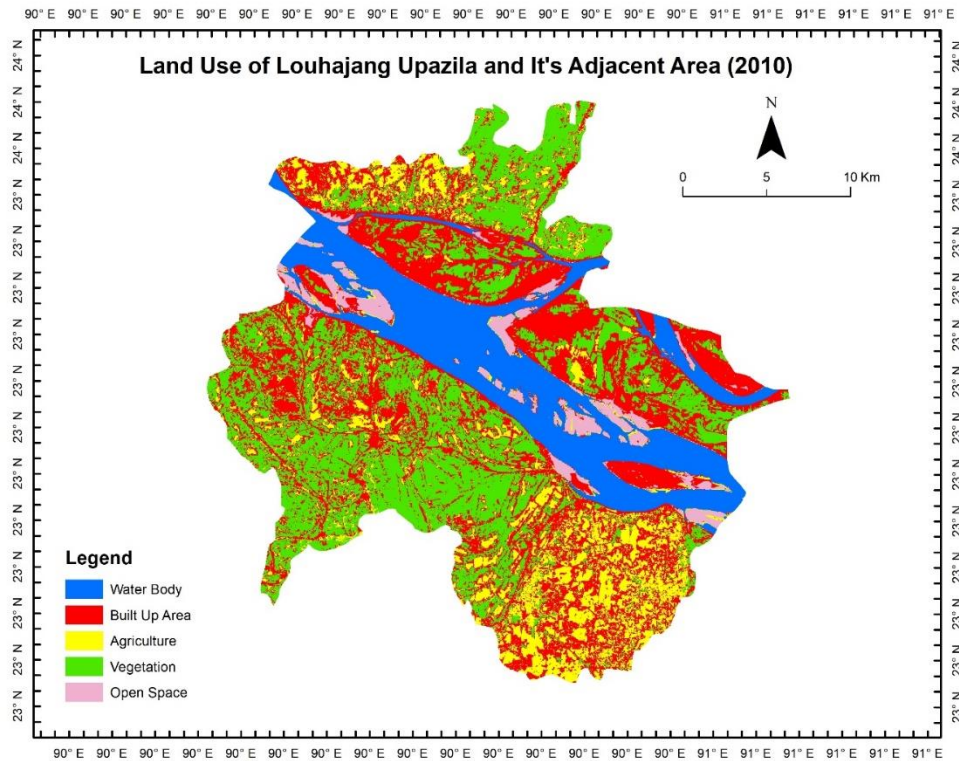


Figure 4.3: Land use of the proposed area in 2010

In 2010, (Figure 4.3) there had been significant changes in the land use pattern. Some signs of erosion have been found towards the north direction. On the other hand, the portion of built up areas have been significantly increased in this period of time. As the impact of the erosion lands used for agriculture had been decreased to a great extent. But like before, the open spaces did not increase and it remained more or less similar.

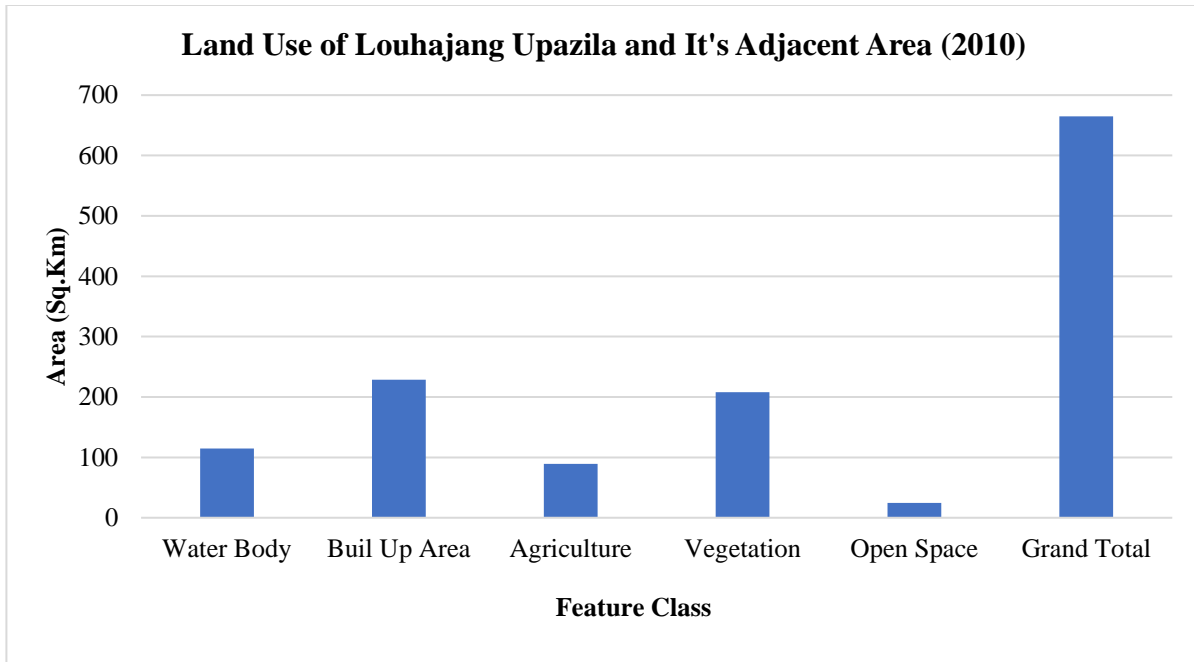


Figure 4.4: Land use change of the intervention area (2010)

From figure 4.4, it has been found that , in 2010 lands occupied for built up areas and vegetation are similar (213 sq. Km and 202 sq. Km respectively) . The portion for water bodies remained similar with the 2000 land use patterns. But the land use for the agriculture plummeted to 90 Sq.Km within 10 years of time frame.

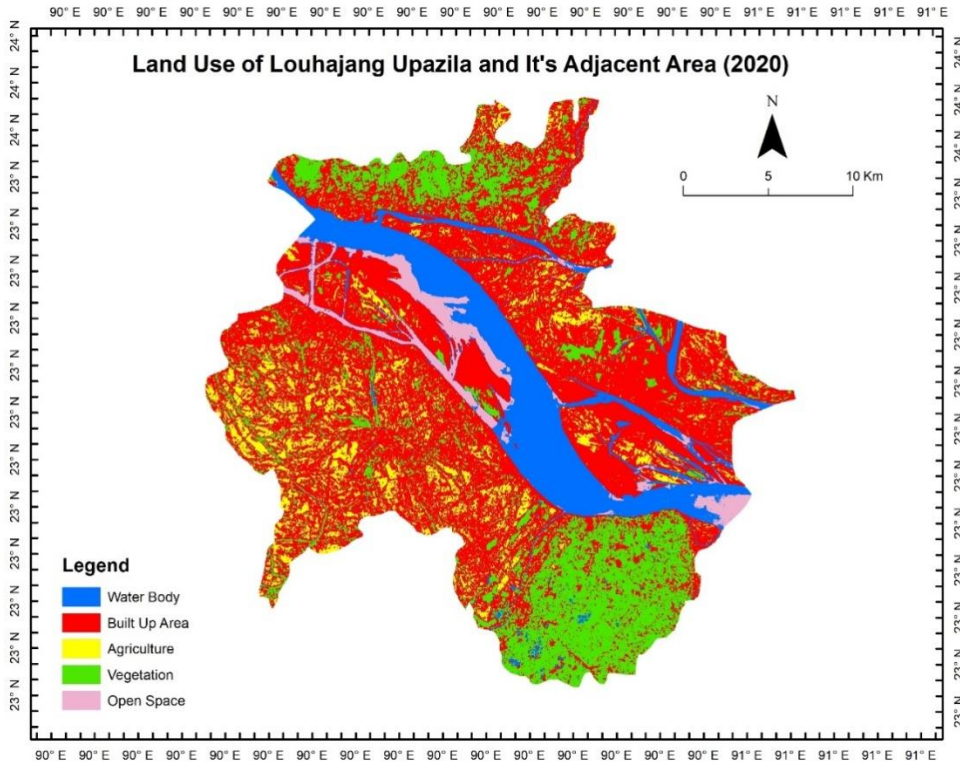


Figure 4.5: Land use of the proposed area in 2020

In figure 4.5, the portion of built up area has been greatly increased. It can be perceived that it has been occurred due to construction of the Padma Multipurpose bridge project. The area used for vegetation has been only available in the north and south side of the area. The lands used for agriculture were also relatively less. Some increased rate of erosion also has been found due to change of location of the Shimulia water port.

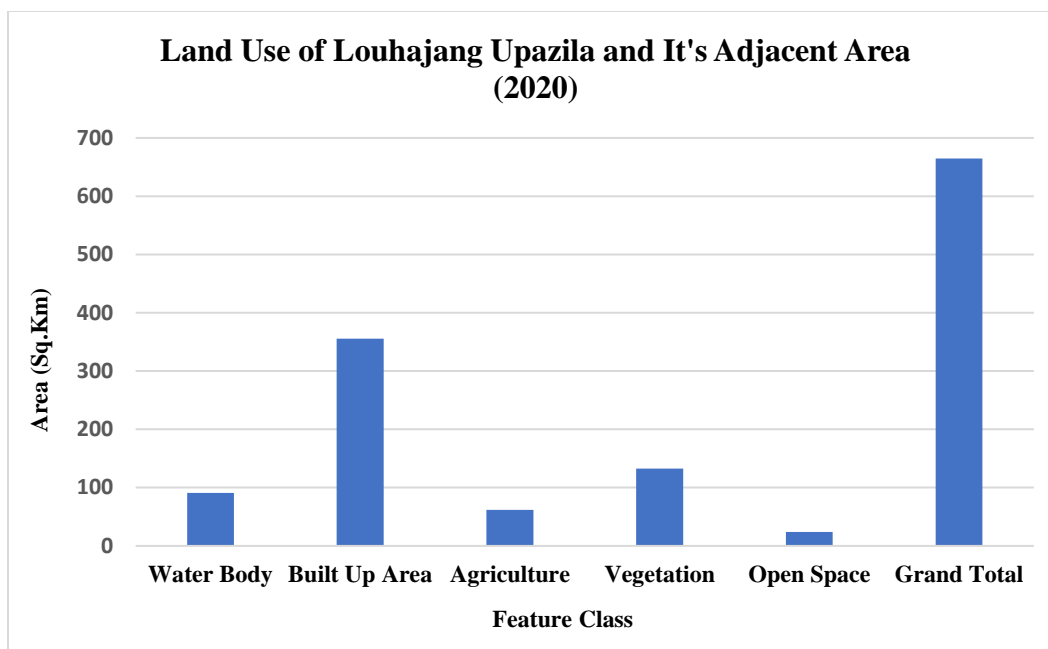


Figure 4.6: Land use change of the intervention area (2020)

In 2020, the built up area has been occupied 355 Sq Km of land which is significantly larger than any other type of landuse. Due to the construction of the Padma Multipurpose Bridge Project which began in 2004, the erosion rate had been increased in the downstream of the river and so many people have relocated and build up area has been increased in Louhajang.

Table 4.1: Landuse Change of Study Area (2000-2020)

Year	Water Body (Acre)	Built Up Area (Acre)	Agriculture (Acre)	Vegetation (Acre)	Open Space (Acre)	Grand Total (Acre)
2020	22456.9	87882.89	15335.34	32783.42	5851.446	164310
2010	28298.46	56500.56	22044.24	51449.73	6021.949	164314.9
2000	31293.38	11280.34	91134.8	23840.69	6763.264	164312.5

From table 4.1 it is clearly evident that, water bodies have been decreased in a great extent but build up area has been increased almost 8 times. The agricultural lands also decreased from 91134.8 acres to 15335.34 acres. Due to erosions specially in the downstream, many lands have been engulfed by the Padma river, so people got less interested in agriculture.

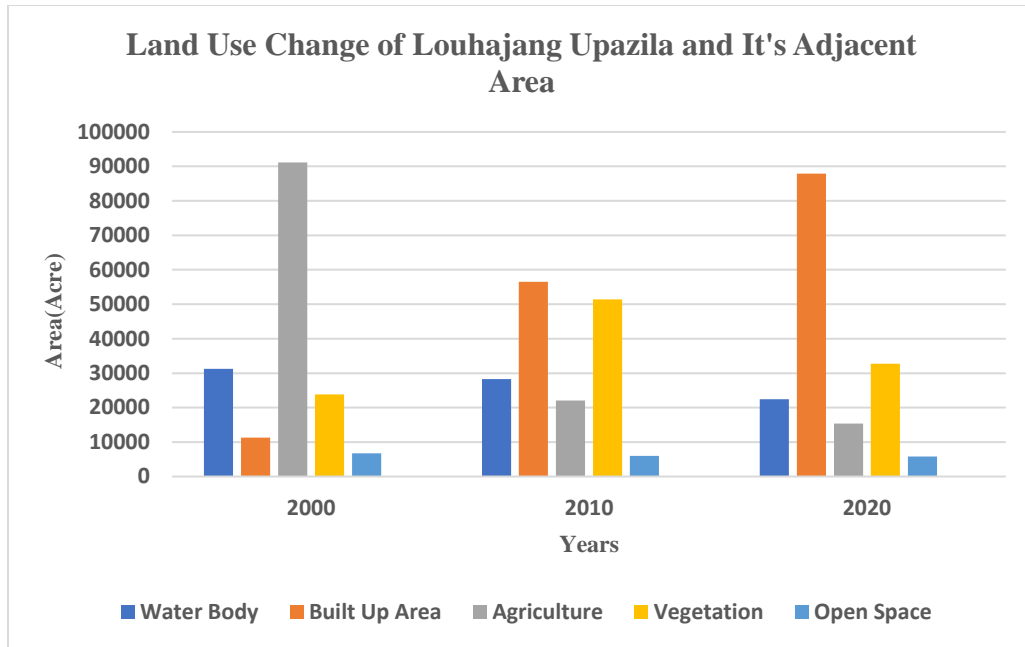


Figure 4.7: Existing land use comparison of the intervention area.

In 2000 agricultural lands were predominant whereas in 2010, both build up areas and vegetation areas were close to each other. In the current stage (2020), the portion of build up area has become largest.

4.3 Overall Discussion

We can identify the present condition of the land use of LouhajangUpazila and its adjacent area by relating the table of the resulted output of the existing research area with the bar diagram.

Water Body: In 2000, the entire amount of water body was 31293.38 acres, but by 2010 and 2020, it had reduced to 28298.46 acres and 22456.9 acres, respectively.

Built Up Area: When comparing the three years, the built-up area rose significantly (2000, 2010, and 2020). The overall built-up area was 11280.34 acres in 2000, and it has since risen to 56500.56 acres and 87882.89 acres.

Agriculture: In the agricultural zone, there was a progressive decline. The overall area was 91134.8 acres in 2000, but it reduced to 22044.24 acres in 2010 and 15335.34 acres in 2020.

Vegetation: The quantity of vegetation in 2000 was 23840.69 acres, which climbed to 51449.73 acres in 2010, but declined to 32783.42 acres in 2020.

Open Space: In the open space area, there was a modest rate of deterioration. It was 6763.264 acres in 2000, but by 2010 and 2020, it had reduced to 6021.949 acres and 5851.446 acres, respectively.

5.1 Introduction

The study has found significant impacts for the change in the flow of the Padma river. It has been found that the location of the 'Shimulia Ghat' which is currently situated 3.7 kilometers away from the Padma Multipurpose Bridge was relocated for the easy transportation of the heavy loaded construction materials of the Padma river. A significant number of the respondents claimed that due to the changed location of the 'Shimulia Ghat' the depth of the water at the port has increased significantly. On the other hand, a very few river protection schemes have been taken in the downstream of the river. So, according to the respondents it has costed around 4 kilometers of the land which have been engulfed in the Padma river.

On the other hand, the respondents from Uria village have experienced a very negligible positive impacts of the bridge construction and the recent development of the area. Many land development projects can be found around the projects namely Asian Shanti Nibash, Amin Mohammad City, Batayon City, Green City and so on. But they have not recruited the labors from the effected area. Moreover, many lucrative live cooking restaurants have been established. The responders have informed that, they were not recruited by the restaurant owners either. So Padma Multipurpose Bridge Project has contributed very little in the livelihood of the people living in Uria Village.

So due to the erosion most of the people either changed their occupation or just had to accept unemployment. But a significant fact is, a good number of households have send at least one member to the middle east countries as labour. These particular families are less effected in the recent flood or the erosion of the river. But still these families are in fear that if the rate of erosion remains same or increased in the upcoming years they will not be able to handle the huge loss and have to accept same fate. Most of the people do not have enough knowledge to recommend the procedure of adaptation . They just expect proper steps from the government so that they can survive in this disaster. On the other hand, other than using gunny bags less than necessary, no significant steps were found from the government. The respondents have claimed that three or four groups from government and non governmental agencies have already visited the place and collected their information though still no response have come from them.

5.2 Profile of the Respondents

To make the research inclusive, it was tried to collect data from equal number of men and women respondents. But the plan was not successful. Due to the superstitions, religious belief, shyness or busyness in household works, the number of women respondents was only 28% and number of men was 72%. The number of total respondents were 113. Though the primary goal to collect the first hand experience of erosion disaster data was fulfilled. All the respondents were enough helpful and welcoming. They showed a lack of belief that these initiative would no bring any welfare for them but later they were understood about the purpose of the research.

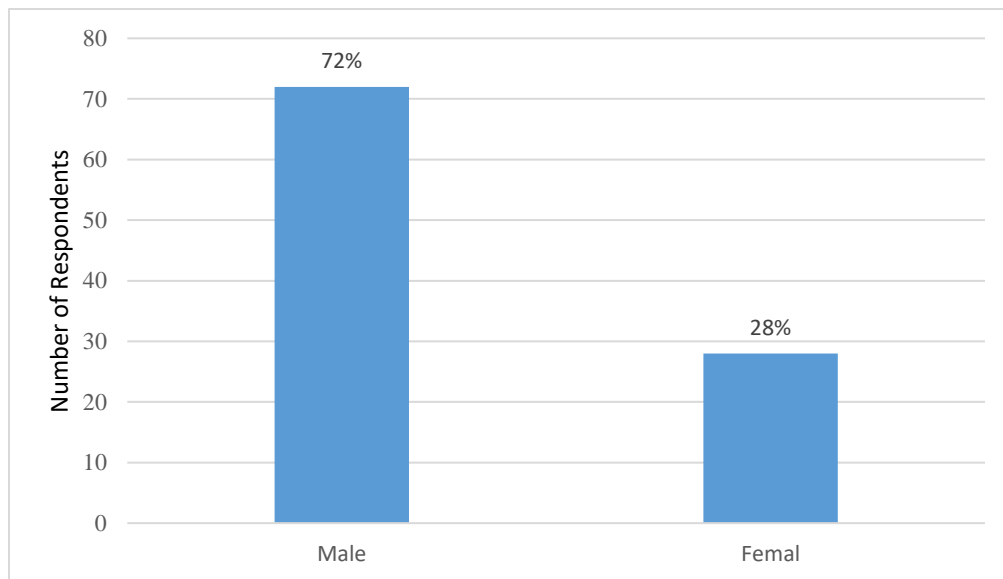


Figure 5.1: Number of male and female respondents

To have clearer idea about the respondents, so further informations like age, job profile, availability of their drinking water, type of the washrooms they use etc. information were also collected.

5.2.1 Age

Most of the respondents were middle aged and 60% overall were in between 25-55 years old. These particular age spans were prioritized because the children were not able to perceive the changes due to erosion and on the other hand the senior citizens were not responsive enough. Among the seven age groups, 25 to 35 years old groups were the most dominants. There were 25%

responders in this age group. On the contrary, there were only 3% persons from 76 to 85 age groups. 36 to 45 and 46 to 55 age groups were 18% and 17% respondents respectively.

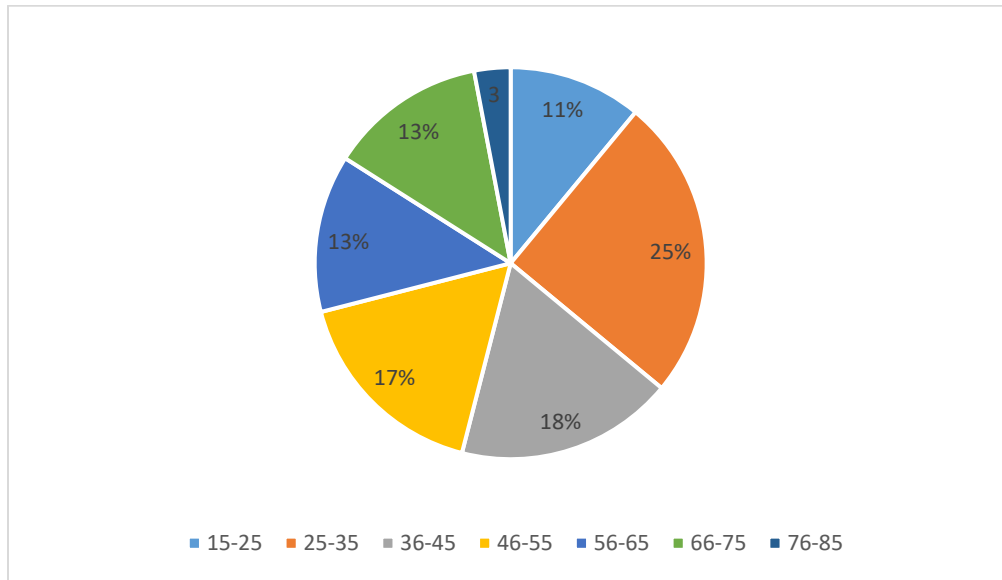


Figure 5.2: Age-wise distribution of the respondents

5.2.2 Employment Status

The respondents were found to be involved in different occupations including agriculture, day labour, small jobs, government jobs, immigrant, small business, snake charmers or unemployed. Among them, most of the respondents were found to be involved in small business like small confectionary type shop owner or tailors. In total 43 among the 88 available respondents were involved in small business. The second highest profession is small jobs like low wage labor in Dhaka or other big cities or under skilled garments workers. 10 among the 88 were completely unemployed. Some of the respondents did not disclose their employment status.

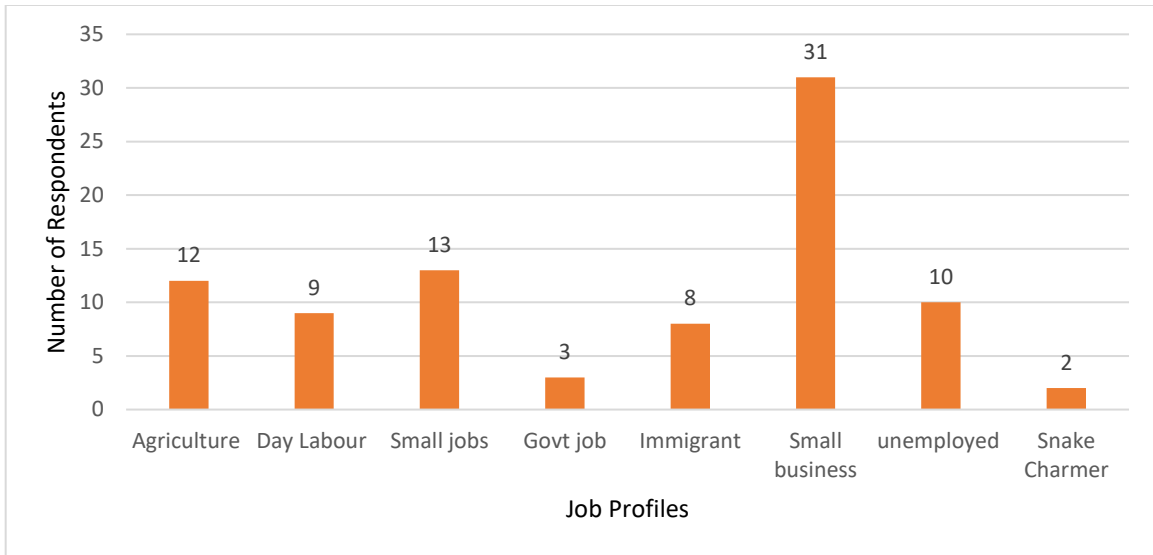


Figure 5.3: Employment status of the respondents

5.2.3 Supply of Water

Most of the villagers have tube well access however some of the tube well are arsenic affected. 72% out of 112 households get drinkable water from the tube well. On the other hand, only 4% of the respondents used to get water from the nearby ponds. Other get water from relatives or they have their own supply systems.

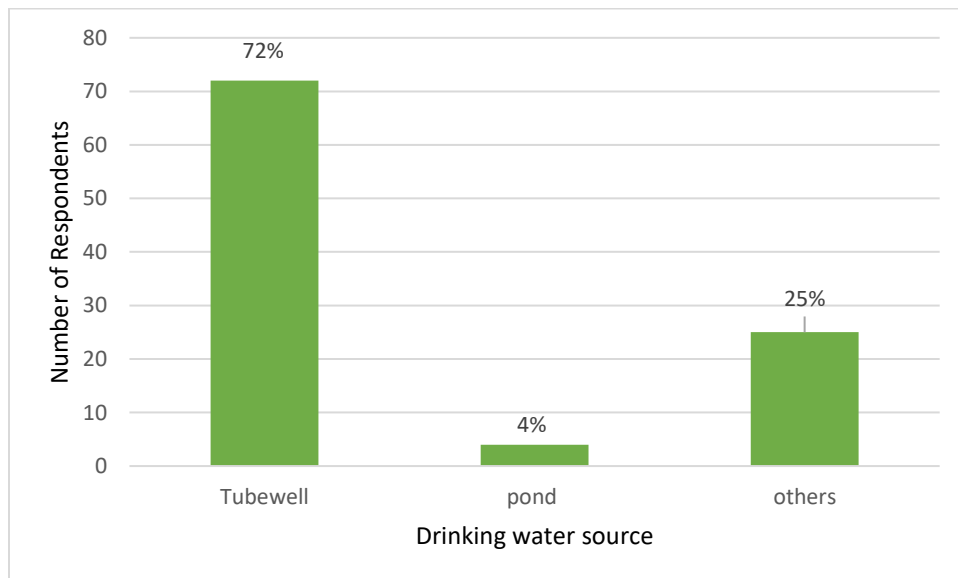


Figure 5.4: Drinking water source

5.2.4 Access to Toilets

It has been found that almost half of the respondents (46 out of 113) do not have access to the healthy toilets. The reason they have shown that they are not willing to invest their money in establishing healthy pit toilets because there is always some risks of erosion in the upcoming years and their lives are already at stake. 58 out of 113 respondents (51%) can have access to the healthy washrooms. 8% people had no washroom facilities and most of them are snake charmers or newly displaced households.

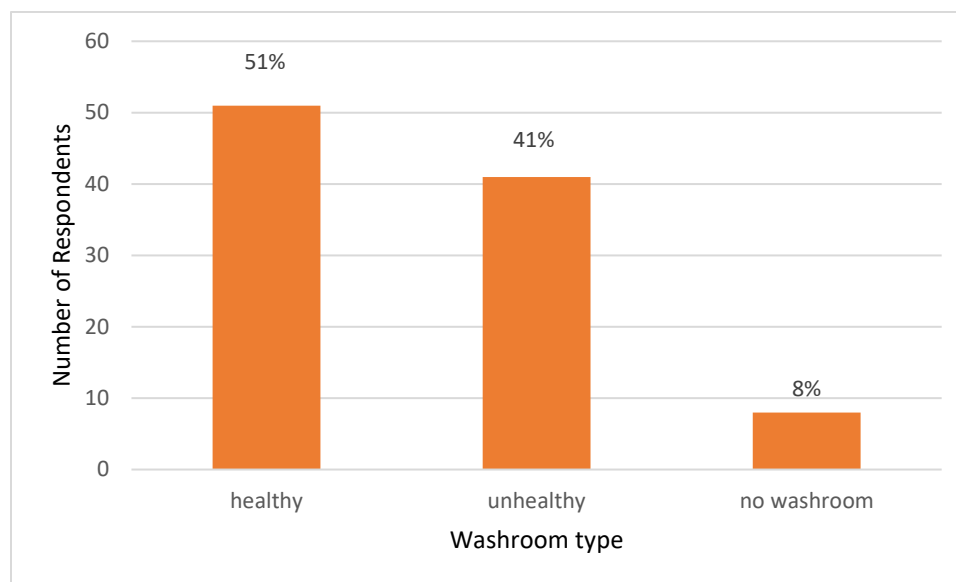


Figure 5.5: Washroom facilities among the respondents

5.3 Altered Financial Condition

It has been found that due to the recent increased rate of erosion and construction of the bridge project, the average income of the households have been decreased and their expense have increased due to recent price hikes and high demand of the rented small houses in the higher lands. Many respondents have lost their savings and their lives are in stake due to this disaster. The average earning people per house holds have also decreased to 1.3 from 1.9 in last five years. The current ill economic condition of the people have been more clearly understood by number of people in debts. 46 respondents among 100 claimed that they have fallen into debt trap after this disaster because they has no other way than borrowing money with high interest to feed their family. To pay back these debts they have to borrow again and this circle continues. On the other

hand, just five years ago, before the construction has started only 14 of them were in debt. Because at that time erosion or flood was not severe so that people had not to phase any unprecedented disasters and they could make their financial plans accordingly to avoid any type of disruptions. So in the following table a comparison of the economic condition between now and last five years have been drawn to understand the real impact of the recent river bank erosion.

Table 5.1: Economic Comparison of 2021 and 2016

Economic Criteria	Present (2021)	Past(2016)
Family Income	199648	20364.28571
Average Expense	19007	17440
Earning people	1.3	1.9
Present main Occupation	Small Business	Small Business
People claimed to have savings	15	25
People in debt	46	14

In the last five years, after the beginning of the full phase construction of the Padma river, it has been found that the loss of land has been the most severe consequences. According to the respondents almost, 74 out of 100 people lost their lands where they used to live or cultivate. 59 respondents claimed that they had lost their houses and now in big trouble. Maximum of these people said that they were not used to such disaster before the beginning of the construction of the Padma bridge. In their own language, some of them claimed that they even did not consider themselves as the people living in the shore of the rivers. But now they are experiencing the consequences of the huge river erosion. The rate of crop damages are relatively low because from the ancient time, living in this region are mainly accustomed to small business or fishing in the river. Agriculture or cultivation of land is not much popular livelihood here. Still 13 respondents claimed that they have lost their lands to cultivate due to the recent erosion of the river.

On the other hand, they said that the lost lands can be regained in dry season but they are not able to rebuild their houses anymore. The reason is that first of all they do not have that type of financial resources right now and secondly if any kind of barrage is not built they are not willing to take any risk anymore. According to their previous experience, the regained land can be engulfed by

the rivers again and they will loss all of their belongings. So, the lands which have lost have no use for them.

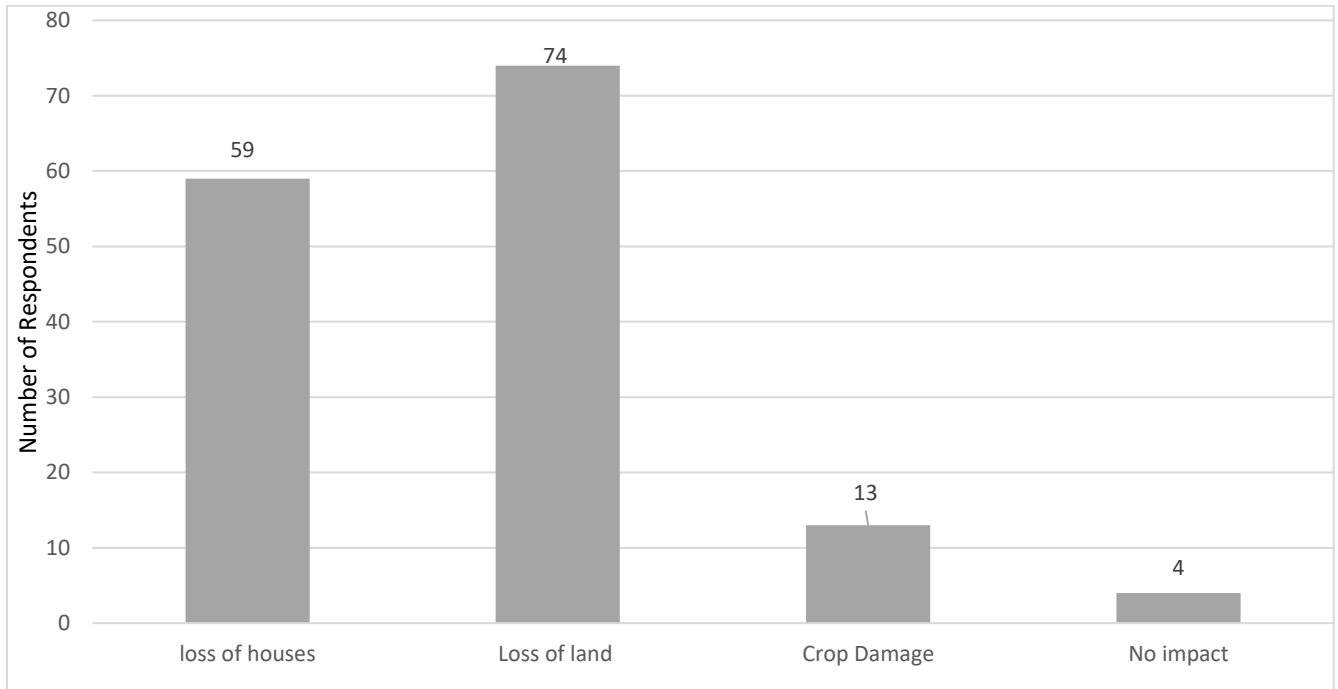


Figure 5.6: Respondents experiencing the recent consequences of different disasters

5.3.1 Change in Livelihood

To copup with the changed situation , the people had to change their livelihood. It has been found that number of people engaged in agriculture has been decreased due to the loss of lands. Nowadays people living in uria are mostly interested in small business like opening a confectionary shop, tailoring, conducting small bakeries etc. Among the 113 respondents, the highest 40 people are currently involved in small business where in 2016, it has been found that 32 of them were engaged in small business. At that time, 36 people were engaged in various types of agricultural professions like firming, cultivation, fishing etc. Due to the recent erosion, firming and cultivation have become almost impossible and some people are still involved in fishing in Padma River.

But the immigration to abroad as labour is becoming popular among the villegers.As government has taken a scheme to send smi-skilled labours to abroad from all over the country, the villegers have become interesed in it as a source of safe income. But the rate of unemployment has been

increased upto 100% in last half decades. The people involved in day labour has been increased as some of them got work in construction fields. In this region one of the dominant groups were snake charmer but nowadays their income has also decreased and the new generation is not that much interested in continuing the legacy. That is why the number of people among 113 respondents involved in snake charming has decreased to 6 from 8 in last half of decade.

Table 5.2: Change of jobs among the respondents

Type of Job	Current involvement (f) (2021)	Past Involvement (f) (2016)
Agriculture	11	36
Day Labour	18	11
Small jobs	13	6
Govt job	3	9
Immigrant	12	4
Small business	40	32
unemployed	10	5
Snake Charmer	6	8
Total	113	113

The less interest in agriculture was again proved by the number of households having agricultural tools. 89% households do not have agricultural tools like shovel, axe, hoe in their home. But they have informed that most of the tools have no use in nowadays.

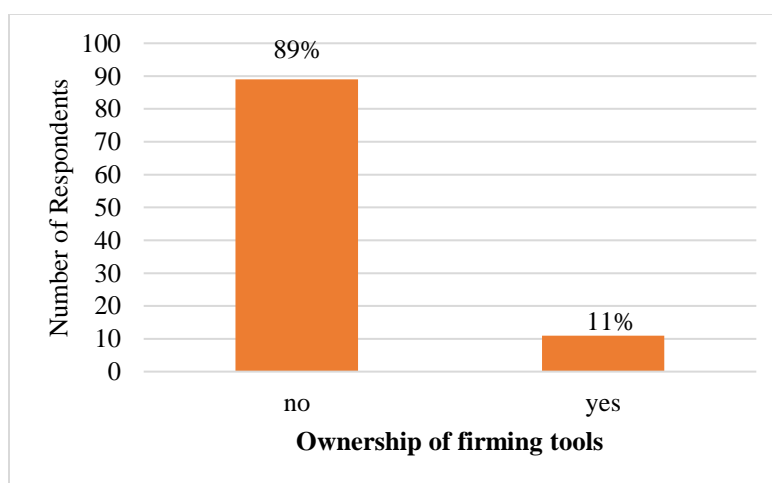


Figure 5.7: Ownership of farming tools

5.4. Coping Strategies to the Disasters

It has been found that , the people are more or less helpless in taking any type of coping strategies. They do not have that type of economic strength. But most of them had to rent new houses by spending their last belongings. They had to spend their savings or sell their cattle or land. But still the sufferings have not ended. The people who are in debt have to payback the loan with high interest.

Table 5.3 Adaptation Techniques of the Affected People

Adaptation techniques	Number of Respondents	%
new job / new business	17	15
built new house	26	23
Living in other's house	8	7
Rented new house	53	47
Temporary shelter on highland	9	8
Total	113	100%

Though 53 people among 113 who responded took the measure to rent new homes but none of them did this willingly. Almost all of them lost their houses in the river of Padma. 26 households claimed that they built new homes and most of them have diasporas abroad. But they are also afraid that they cannot afford another disaster. Only 8 households claimed that they are living in relative's house but soon or later they have to find their permanent place. A very few numbers of people found temporary shelters on nearby highlands.

Many people living in Uria Village are planning to relocate also. The preferable places are Holudia, Madaripur, Goalibanda, Srinagar etc. Whenever they will have enough financial strength they will go there for the safety of their future generations. In the questionnaire based survey, it has been found that , 66% respondents are planning to relocate themselves to nearby villages or cities which are situated in comparatively highlands. They have informed that already a huge number of people have relocated to adapt themselves with the increasing rate of river erosion.

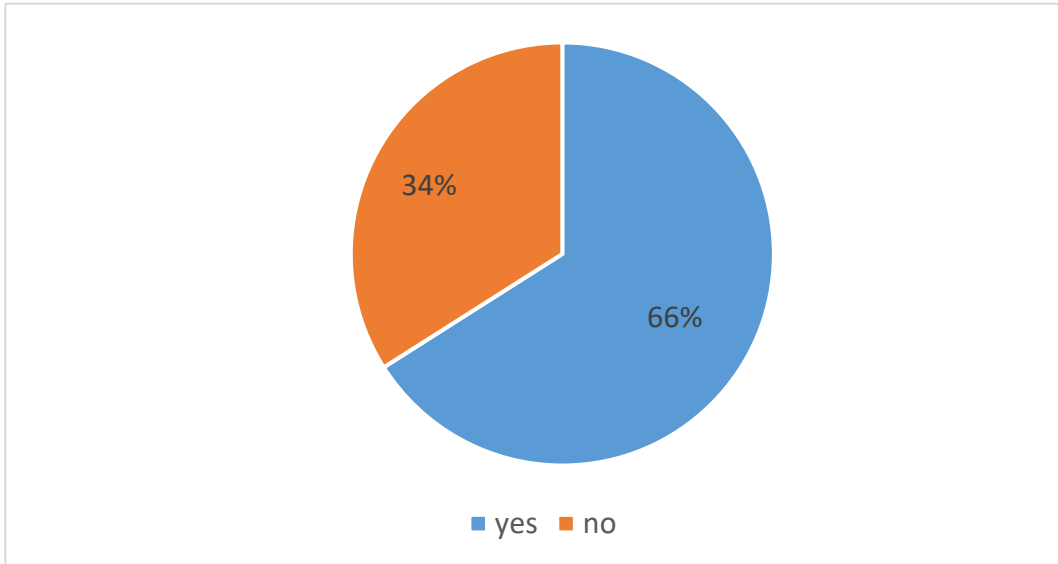


Figure 5. 8 Number of Respondents planning to relocate



Figure 5. 9 Temporary houses in Uria village

Not too much efforts have been found from the administration to protect the people from the erosion. Only geo bags have been used along the shore but their numbers are also not sufficient. Moreover, lack of regular monitoring has caused the loss of many bags.



Figure 5.10: Geo bags being used to protect Uria Village from erosion

However, the dwellers do not have much technical knowledge on adaptation with the erosion and flood. Most of the people believe that building barrage is the ultimate solution to protect the locality whereas very few people think that grants can be a solution. But most of them agreed that they do not have enough knowledge to comment in this part. The government should take the lead to solve this problem.

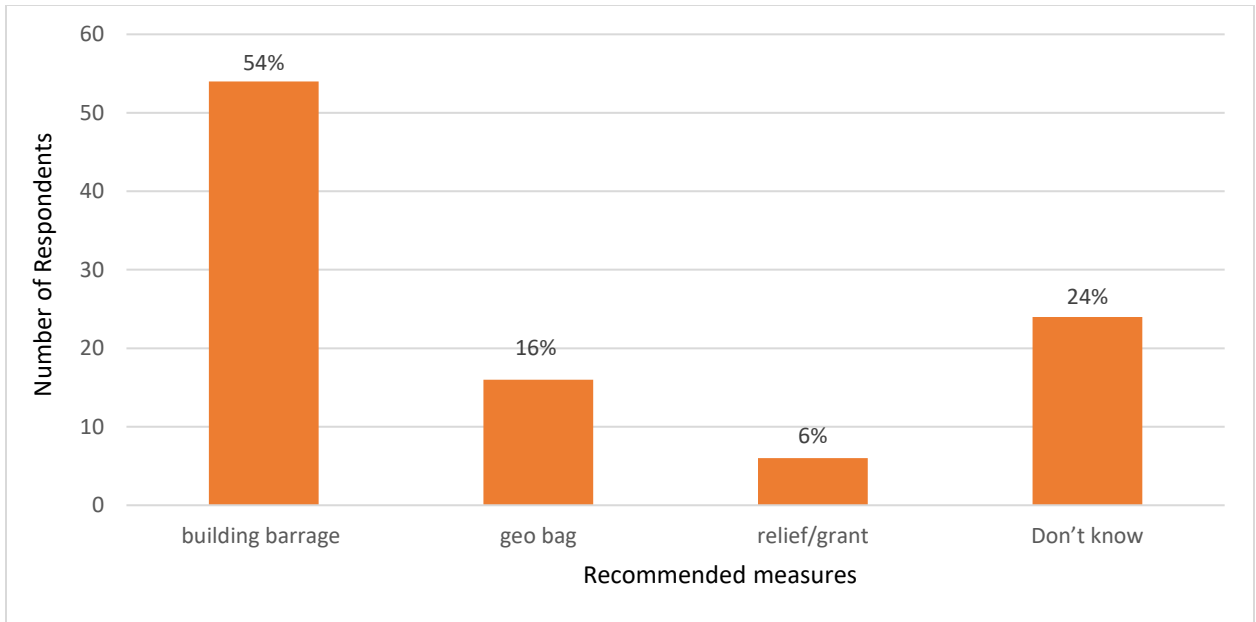


Figure 5.11: Peoples’ perception of techniques to mitigate river bank erosion

From figure 5.11 , it is clearly evident that 54% of the respondents recommended building barrage to protect their locality. On the other hand, 16% people put emphasize of putting geo bags along the shore. However, the only government investment there is putting geo bags. It is a significant finding that people are no more interested in receiving temporary grants or relief as very people think that is it is actually helpful(6%).

Chapter 6

Conclusions and Recommendations

6.1 Summary of the Findings

The sufferings of the people living in the downstream of the Padma river had been overlooked. This research gives an insight of the recent land use changes in this region as well as the endless agony of the people. The major findings of the study are :

- Water bodies have been decreased in a great extent between the time period of 2000 and 2020 but build up area has been increased almost 8 times. When comparing the three years, the built-up area rose significantly (2000, 2010, and 2020). The overall built-up area was 11280.34 acres in 2000, and it has since risen to 56500.56 acres and 87882.89 acres. Due to erosions specially in the downstream, many lands have been engulfed by the Padma river, so people got less interested in agriculture. The agricultural lands decreased from 91134.8 acres to 15335.34 acres.
- Most of the villagers have tube well access however some of the tube well are arsenic affected. 72% out of 112 households get drinkable water from the tube well. On the other hand, 52% respondents can have access to the healthy washrooms. 8% people had no washroom facilities and most of them are snake charmers or newly displaced households.
- The average earning people per house holds have also decreased to 1.3 from 1.9 in last five years. The current ill economic condition of the people have been more clearly understood by number of people in debts. 46 respondents among 100 claimed that they have fallen into debt trap after this disaster because they has no other way than borrowing money with high interest to feed their family.
- To cop up with the changed situation , the people had to change their livelihood. It has been found that number of people engaged in agriculture has been decreased due to the loss of lands. Nowadays people living in uria are mostly interested in small business like opening a confectionary shop, tailoring, conducting small bakeries etc. Among the 113 respondents, the highest 40 people are currently involved in small business where in 2016, it has been found that 32 of them were engaged in small business.

- The people are more or less helpless in taking any type of coping strategies. Though 53 people among 113 who responded took the measure to rent new homes but none of them did this willingly. Almost all of them lost their houses in the river of Padma. 23% households claimed that they built new homes using their last savings and most of them have diasporas in abroad.
- To protect the area from erosion, 54% of the respondents recommended building barrage to protect their locality. On the other hand, 16% people put emphasize of putting geo bags along the shore

6.2 Conclusion

The life of the people in Uria village in actually is at stake. Due to extensive river erosion, people of Uria have lost their cattle, crops, housing structures, and farmland. Furthermore, all the public infrastructures like schools, colleges, government offices are at risk to be engulfed in the water of the river. On the other hand, it also becomes difficult for the government as well as local administration as predicting the river erosion is still a mammoth task. To minimize the impacts of these disasters and building capacity of the common people to adopt with the erosion, various river protection programs and social safety net initiatives need to be taken. It has been found that still no social safety net programs taken by government (i.e., Employment Generation Programme for the Poorest (EGPP), KaBiKha etc) have not been introduced in Uria Village. But these marginalized people are the greatest sufferers of disasters. To survive during disaster, people eat fewer meals, borrow money or take a loan, or sell their labor cheaply in advance . If necessary, they also sell their land, livestock, housing materials and other personal belongings, including jewelry and household goods.

This study has been undertaken to give an insight of the recent land use changes in this region as well as the endless agony of the people. The research will also help the policy makers to understand the actual image of the people living in Uria village and take proper steps for the mitigation of the disasters. On the other hand, there are some sacrifices behind any type of development works. Padma Multi Purpose Bridge is going to be one of the largest successful infrastructural projects in Bangladesh and it will be a great contribution to our GDP. But this study has showed the other side of the coin. Being the citizens of Bangladesh, the people living in the downstream of the Padma river should also get their basic rights and safe livelihood options. Though government has

already taken some steps to save these people from the brutal natural disasters , still many more measures are needed to be taken. But before taking any steps, some preliminary data and analysis are needed to understand the fact. This research can be a great source of knowledge in this regard. Moreover, other researchers will be able will also get some new research problem or potential research field from this study. These issues are needed to be discussed and be placed at the nation's interest.

6.3 Recommendations

Some recommendations have been given to improve the adaptation processes with the existing disasters and mitigate the impacts of future disasters:

- I. The financial condition of the people suffered from erosion becomes really vulnerable. Government can introduce EGPP (Employment Generation Project for the Poorest) can help them to to survive the initial shock. The government can include these citizens in KabiKha (Kajer Binimoye Khaddo) programs where people get the opportunity to get involve in the infrastructural works of their own region. These people are paid in daily basis wich which they can meet their daily needs
- II. Using sand filled geobags is very common in Bangladesh. These have been used under in protective works since 1999 for its durability, cost effectiveness and sustainability(sadiket al. , 2011). But number of using geobags were not enough. In some places the bags are lost due to lack of proper maintenance and monitoring. So Bangladesh Water Development Board should look after this issue with great care
- III. Vetiver grassis utilised as an efficient option for slope protection in many countries, for its longer life, strong and long finely structured root system and high tolerance of extreme climatic condition (Islam,2013). In Bangladesh use of vetiver grasses are also increasing for its high performance in protecting the soil from river bank erosion. So along the shore of the Padma, plantation of this grass can bring greater success
- IV. Using concrete blocks are also a good option to protect the river from erosion. Erosion control by concrete blocks system secures the slopes by forming a solid defense against erosion, scouring by absorbing the energy of incoming water waves.
- V. Small interest free loans can be granted from the administration so that people can be adopted with the shocks of disasters and build new temporary houses to live in.

VI. After the construction end, the current location of the Shimula Ghat should be changed. According to the survey, after the establishment of the river port the erosion in this location has increased in a great scale. So this port should be relocated

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Annex 1 :
Questionnaire Used for the Survey:



পোস্ট গ্রেজুয়েট ডিজাস্টার ম্যানেজমেন্ট প্রোগ্রাম
ব্রাক বিশ্ববিদ্যালয়
গবেষণা এলাকা : লৌহজং উপজেলা, মুন্সিগঞ্জ

নমুনা নম্বর

Exploring Hazards Risk and People's Adjustment: A Study at the Downstream of the Padma Multipurpose Bridge Project

মাঠ পর্যায়ের তথ্যভিত্তিক এই গবেষণাটি ব্রাক বিশ্ববিদ্যালয়ের পোস্ট গ্রেজুয়েট ডিজাস্টার ম্যানেজমেন্ট প্রোগ্রামের অংশবিশেষ এবং এ গবেষণার স্থান হিসেবে মুন্সিগঞ্জ জেলার লৌহজং উপজেলা নির্বাচন করা হয়েছে। মাঠ পর্যায়ের সংগৃহীত তথ্যাদি শুধুমাত্র গবেষণা কাজে ব্যবহৃত হবে। এ বিষয়ে সম্মানিত উত্তরদাতাদের মূল্যবান সময় ও তথ্য দেয়ার জন্য ভূগোল ও পরিবেশ বিভাগ বিশেষভাবে কৃতজ্ঞ থাকবে।

খানা পরিবার জরিপ প্রশ্নমালা

সমীক্ষা এলাকাঃ গ্রাম ইউনিয়ন..... উপজেলা

স্বাক্ষাৎ গ্রহীতার নাম স্বাক্ষাৎ গ্রহণের তারিখ

স্বাক্ষাৎদাতার বয়স (বছর), পরিবার প্রধানের সাথে সম্পর্ক

১। পরিবারের ধরনঃ ক) একক পরিবার খ) যৌথ পরিবার গ) বর্ধিত পরিবার ঘ) অন্যান্য

২। পরিবার সদস্যদের সম্পর্কে কিছু তথ্য :

সদস্যদের নাম	পরিবার প্রধান কি হন?	বয়স	লিঙ্গ	শিক্ষাগত- যোগ্যতা	বৈবাহিক অবস্থা	কি কাজ করেন	কোথায় কাজ করেন
০১	০২	০৩	০৪	০৫*	০৬*	০৭*	০৮*

*০৫ঃ ছয় বছরের নিচে প্রযোজ্য নয়

*০৬ঃ ক) অবিবাহিত

*০৭ঃ ১) প্রযোজ্য নয়

*০৮ঃ ১) গবেষণা এলাকায়

- ১) অশিক্ষিত
- ২) প্রাথমিক শিক্ষা
- ৩) ৮ম শ্রেণী পাশ
- ৪) এসএসসি পাশ
- ৫) এইচএসসি পাশ
- ৬) স্নাতক/সম্মান
- ৭) মাস্টার্স
- ৮) অন্যান্য

- ১) বিবাহিত
- ২) বিপত্নীক
- ৩) তালাক প্রাপ্ত
- ৪) পৃথক

- ২) গৃহস্থালীর কাজ
- ৩) ছাত্র
- ৪) বেকার
- ৫) কৃষিকাজ
- ৬) ছোট ব্যাবসা
- ৭) চাকুরী (নির্দিষ্ট করে লিখুন)
- ৮) অন্যান্য (লিখুন).....

- ২) গবেষণা উপজেলায়
- ৩) গবেষণা জেলায়
- ৪) অন্য জেলায় (নির্দিষ্ট করে লিখুন)

৩। বসতবাড়ির বর্তমান অবস্থা সম্পর্কে কিছু তথ্য দিন :

ক্রমিক নং	তথ্যের ধরন	বর্তমান অবস্থা	মন্তব্য
০১	প্রধান ঘরের ধরন*		
০২	প্রধান ঘরের সংখ্যা		
০৩	প্রধান ঘরের আয়তন (বর্গফুট)		
০৪	বসত বাড়ির জমির পরিমাণ		
০৫	বাড়ি তৈরি কাল		
০৬	বসতবাড়ির সুবিধাসমূহ*		

*০১ঃ ক) পাকা

- খ) আধা-পাকা
গ) কাঁচা (টিন+কাঠ)
ঘ) কাঁচা (টিন+বাস)
ঙ) কাঁচা (সন+বাস)
চ) ঝুপড়ি
ছ) অন্যান্য

*০৬ঃ ক) বড় পাকা রাস্তার সাথে

- খ) স্থানীয় রাস্তার পাশে
গ) নদীর ধারে
ঘ) বাড়ির চারপাশে ফলজ অন্যান্য গাছপালা আছে
ঙ) বসতবাড়ি বন্যমুক্ত এলাকায়
চ) অন্যান্য

৪। পরিবার প্রধানের চাকুরী ও আয়ের উৎস (গৃহস্থালী সংক্রান্ত)

ক্রমিক নং	তথ্যের ধরন	বর্তমান অবস্থা	পদ্মাসেতু প্রকল্পের পূর্বর্তী সময়ে	মন্তব্য
০১	পরিবারে উপার্জনক্ষম লোকের সংখ্যা			
০২	পরিবারের প্রধান আয়ের উৎস			
০৩	পরিবারের দ্বিতীয় আয়ের উৎস			
০৪	পরিবারের মাসিক আয়			
০৫	পরিবারের মাসিক ব্যয়			
০৬	আয়ের উৎসের সংখ্যা			
০৭	আয়ের উৎসের ধরন*			
০৮	কোন সঞ্চয় আছে কি না			
০৯	কোন ঋণ আছে কি না			

*০৭। ক) কৃষি খ) দিনমজুর গ) জেলে ঘ) বেতনভূক্ত চাকুরীজীবী ঙ) ব্যবসা চ) কারিগর ছ) ভাড়া জ) পারাপার সংক্রান্ত কাজ বা) প্রেরিত অর্থ ঞ) দান ট) হাস-মুরগী পালন
ঠ) পশুসম্পদ ড) গাছপালা ও ফল চ) অন্যান্য

৫। নীচের জমিজমা সংক্রান্ত প্রশ্নগুলো সম্পর্কে তথ্য দিন

ক্রমিক নং	তথ্যের ধরন	বর্তমান অবস্থা	দশবছর পূর্বে	মন্তব্য
০১	কৃষি জমির পরিমাণ (স্থানীয় এককে*)			
০২	কৃষি জমির ধরন*			
০৩	চাষকৃত প্রধান ফসলের নাম			
০৪	একই জমি থেকে বছরে কয়টি ফসল পান			
০৫	চাষ পদ্ধতি (লাঙ্গল/পাওয়ার টিলার)			

*০২। ক) ভিটা জমি খ) নীচু জমি গ) অন্যান্য (নির্দিষ্ট করে বলুন) *০১। সাক্ষাতকার গ্রহণকারী স্থানীয় একককে দেশীয় আদর্শ এককে লিখবে

৬। আপনি কত বছরপ্রজন্ম অত্র এলাকায় বসবাস করছেন?

৭। আপনি/আপনার পূর্ব পুরুষ অত্র এলাকায় অভিগমন করে স্থায়ী বসতি যাপন করে থাকলে এ সম্পর্কে তথ্য দিন।

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৮। উত্তরদাতা পদ্মা বহুমুখী সেতু প্রকল্প শুরুর পূর্বে এলাকায় অভিগমন করে থাকলে কোন দুর্যোগ মোকাবেলা করত কি না?

ক) হ্যাঁ খ) না

উত্তর হ্যাঁ হলে অত্র এলাকায় কি কি দুর্যোগ সংঘটিত হত?

দুর্যোগের নাম	সংঘটন কাল	প্রভাব	মন্তব্য
ক) বন্যা			
খ) নদী ভাঙ্গন			
গ) খরা			
ঘ) অন্যান্য (নির্দিষ্ট করুন			

৯। পদ্মা সেতু নির্মাণ কাজ শুরু হওয়ার পর অত্র এলাকায় দুর্যোগ সংঘটন মাত্রা ও প্রভাব সম্পর্কে তথ্য দিন।

দুর্যোগ	মাত্রা/প্রভাব	মন্তব্য
অন্যান্য (নির্দিষ্ট করে বলুন)		

১০। আপনি ও আপনার পরিবার পদ্মাসেতু নির্মাণ পরবর্তী সময়ে কোন দুর্যোগ ঝুঁকিতে প্রভাবিত হয়েছেন কি? ক) হ্যাঁ খ) না
 উত্তর হ্যাঁ হলে কিভাবে বিস্তারিত বলুন?

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১১। পদ্মা সেতু নির্মাণের পলে অত এলাকার লোকজন কিভাবে উপকৃত হয়েছে? এ বিষয়ে বিস্তারিত বলুন?

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১২। সেতু নির্মাণজনিত কারণে নদীভাঙ্গন বৃদ্ধি পাওয়ায় আপনি কিভাবে ক্ষতিগ্রস্ত হয়েছেন?

- ক) বসতবাড়ি (কিভাবে বিস্তারিত বলুন ?.....)
- খ) কৃষি জমি (কিভাবে বিস্তারিত বলুন ?.....)
- গ) ব্যবসা/বাণিজ্য (কিভাবে বিস্তারিত বলুন ?.....)
- ঘ) জীবন-জীবিকা (কিভাবে বিস্তারিত বলুন ?.....)
- ঙ) ছেলে মেয়ের লেখাপড়া (কিভাবে বিস্তারিত বলুন ?.....)
- চ) যাতায়াত/যোগাযোগ ব্যবস্থা (কিভাবে বিস্তারিত বলুন ?.....)
- ছ) অন্যান্য (নির্দিষ্ট করুন)

১৩। পদ্মা সেতু নির্মাণের ফলে আপনি আপনার পরিবার ক্ষতিগ্রস্ত হয়ে থাকলে কোন ক্ষতিপূরণ পেয়েছেন কি? ক) হ্যাঁ খ) না উত্তর হ্যাঁ হলে কোন ধরনের ক্ষতিপূরণ পেয়েছেন?

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১৪। অত্র এলাকার ক্ষতিগ্রস্ত লোকজন পদ্মা সেতু কর্তৃপক্ষ থেকে কোন ক্ষতিপূরণ পেয়েছে কি? ক) হ্যাঁ খ) না গ) জানি না উত্তর হ্যাঁ হলে কোন ধরনের ক্ষতিপূরণ তা উল্লেখ করুন।

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১৫। বর্তমানে পদ্মা সেতু নির্মাণের ফলে আপনার জীবন-জীবিকা ক্ষতিগ্রস্ত হয়ে থাকলে কিভাবে মোকাবেলা করেছেন।

- ক) বসতবাড়ি স্বল্পমেয়াদী/দীর্ঘমেয়াদী.....
- খ) কৃষি জমি.....
- গ) জীবন-জীবিকা
- ঘ) লেখাপড়া কিভাবে
- ঙ) যাতায়াত/যোগাযোগ ব্যবস্থা
- চ) অন্যান্য (নির্দিষ্ট করুন)

১৬। বর্তমানে দুর্যোগঝুঁকি বিশেষত নদীভাঙ্গন ব্যাপকভাবে বৃদ্ধি পাওয়ায় অত্র এলাকা থেকে স্থানীয় লোকজন অভিগমন করে কি না!

ক) হ্যাঁ খ) না

উত্তর হ্যাঁ হলে অভিগমন জনিত তথ্য দিন।

অভিগমনকারী	কোথায় অভিগমন করেছেন	কেন অভিগমন করেছেন	অন্যান্য
ক) কৃষক			
খ) মৎস্যজীবী			
গ) দিনমজুর			
ঘ) ছাত্র/ছাত্রী			
ঙ) ছোট ব্যবসায়ী			
চ) বড় ব্যবসায়ী			
ছ) অন্যান্য (নির্দিষ্ট করুন			

১৭। নদীভাঙ্গন ব্যাপকভাবে বৃদ্ধি পাওয়ায় আপনার বসতবাড়ী ভেঙ্গে গেলে অত্র এলাকা থেকে অভিগমনের কোন পরিকল্পনা আছে কি?

ক) হ্যাঁ খ) না

উত্তর হ্যাঁ হলে কোথায় অভিগমন করবেন।

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১৮। অত্র এলাকার নদীভাঙ্গনসহ অন্যান্য দুর্যোগে ঝুঁকি হ্রাসে নীচের প্রতিষ্ঠানগুলো কোন ভূমিকা পালন করেছে কি না?

প্রতিষ্ঠানের নাম	ভূমিকা	মন্তব্য
ক) দুর্যোগ ও ত্রাণ মন্ত্রণালয়		
খ) জেলা/ উপজেলা প্রশাসন		
গ) জেলা দুর্যোগ ও পুনর্বাসন অফিস		
ঘ) বাংলাদেশ পানি উন্নয়ন বোর্ড		
ঙ) স্থানীয় কৃষি বিভাগ		
চ) স্থানীয়/দেশীয় এনজিও (নির্দিষ্ট করুন)		
ছ) কমিউনিটিভিত্তিক প্রতিষ্ঠান (নির্দিষ্ট করুন)		
জ) অন্যান্য (নির্দিষ্ট করে বলুন) ...		

১৯। অত্র এলাকার নদীভাঙ্গনসহ অন্যান্য দুর্যোগে ঝুঁকি প্রশমনে নীচের প্রতিষ্ঠানসমূহ কি কি ভূমিকা পালন করতে পারে?

প্রতিষ্ঠানের নাম	ভূমিকা	মন্তব্য
ক) দুর্যোগ ও ত্রাণ মন্ত্রণালয়		
খ) জেলা/ উপজেলা প্রশাসন		
গ) জেলা দুর্যোগ ও পুনর্বাসন অফিস		
ঘ) বাংলাদেশ পানি উন্নয়ন বোর্ড		
ঙ) স্থানীয় কৃষি বিভাগ		
চ) স্থানীয়/দেশীয় এনজিও (নির্দিষ্ট করুন)		
ছ) কমিউনিটিভিত্তিক প্রতিষ্ঠান (নির্দিষ্ট করুন)		
জ) অন্যান্য (নির্দিষ্ট করে বলুন) ...		

২০। নিচের বিষয়গুলো সম্বন্ধে দয়া করে তথ্য দিন।

- ক) পানীয় জলের উৎস : ১। নল কুপ ২। পুকুর ৩। অন্যান্য
- খ) পানি কিভাবে বিশুদ্ধ করেন? ১। গরম করে ২। ছেঁকে ৩। কোনটাই নয় ৪। অন্যান্য
- গ) সৌচাগারের ধরনঃ ১। স্বাস্থ্যকর ২। অস্বাস্থ্যকর ৩। সৌচাগারবিহীন
- ঘ) মোবাইল ফোন ব্যবহার করেন কি না? ১। হ্যাঁ ২। না
- ঙ) পরিবার প্রধানের জাতীয় পরিচয়পত্র আছে কি না? ১। হ্যাঁ ২। না
- চ) গবাদি পশু আছে কি না? ১। হ্যাঁ ২। না। হ্যাঁ হলে গরু টি, মহিষ.....টি
- জ) চাষের যন্ত্রপাতি: ট্র্যাক্টর/লাঙ্গল/অগভীর নলকূপ
- ঞ) বাড়িতে কোন প্রতিবন্ধী ব্যক্তি আছে কি না? ১। হ্যাঁ ২। না
- ট) স্কুলগামী ছেলেমেয়েরা নিয়মিত স্কুলে যায় কি না? ১। হ্যাঁ ২। না ৩। প্রযোজ্য নয়
- ঠ) আপনার বসতবাড়িতে বিদ্যুৎ সংযোগ আছে কি না? ১। হ্যাঁ ২। না হ্যাঁ হলে কোনটি- পল্লি বিদ্যুৎ/সৌরবিদ্যুৎ
- ড) আপনার বসতবাড়িতে টেলিভিশন আছে কি না? ১। হ্যাঁ ২। না হ্যাঁ হলে কোনটি- সাদাকাল/রঙিন

(আমাদেরকে সময় ও মূল্যবান তথ্য দেয়ার জন্য আপনাকে ও আপনার পরিবারের সকলকে অশেষ ধন্যবাদ)