Causes and Consequences of Perennial Water Logging in the Life and Livelihood at Rajnagar Bankabarsi in Jashore District, Bangladesh

A thesis submitted to the
Department of Geography and Environment
in partial fulfillment of the requirements for the degree of
Master of Philosophy

University of Dhaka
Dhaka, Bangladesh

Submitted by
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October 2020

Dedicated

to

My Respected Parents

DECLARATION

I hereby declare that dissertation entitled "**Causes and Consequences of Perennial Water Logging in the Life and Livelihood at Rajnagar Bankabarsi in Jashore District, Bangladesh**" is the result of my own research, under the supervision of Professor Dr. Kazi Md. Fazlul Haq, Department of Geography and Environment, University of Dhaka, Bangladesh.

I further declare that previously this paper has not been submitted in partially or fully for any degree or other purpose to this university or any other university or institute.

The Author

CERTIFICATE OF APPROVAL

I have the pleasure to approve and certify the research work entitled "**Causes and Consequences of Perennial Water Logging in the Life and Livelihood at Rajnagar Bankabarsi in Jashore District, Bangladesh**" conducted by Maharun Nesa, Registration no. 194/ 2014-2015 to be presented to the Department of Geography and Environment, University of Dhaka in the partial fulfillment of the requirements for the Degree of Master of Philosophy.

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ACKNOWLEDGEMENTS

All praises belong to Almighty Allah, the most gracious, the most merciful who gave the knowledge and strength to complete this research work in the process of obtaining Masters in Philosophy Degree from the Department of Geography and Environment, University of Dhaka.

I express the gratitude to my supervisor professor Dr. Kazi Md. Fazlul Haq, Department of Geography and Environment, University of Dhaka under whose guidance the work has been accomplished. At this moment, I would like to thank Professor Dr. A.H.M. Abdul Baqee Department of Geography and Environment, University of Dhaka under whom I started the research work at the initial stages.

Here I would like to pay my gratitude to Department of Geography and Environment, University of Dhaka and also to the Library and GIS & RS Laboratory of the Department. My special appreciation to all the respondents of the study area for their unconditional cooperation during the survey time. I also thank the local administration i.e. Upazila Nirbahi Officer (UNO), Upazila Krishi Officer of Keshabpur Upazila for their extended help. In addition, I do also express my gratitude to some Non-Government Organizations like SHAMADHAN, for providing necessary data and important information for the research. My sincere gratitude to Mrs Hosne Ara who gave lot of support in arranging the Focus Group Discussions (FGD) and interviews with related stakeholders. I would like to thank one of my junior brothers Md. Shahriar for his remarkable support which I will remember in rest of my life.

I am also grateful to my well-wishers who always supported me by giving their courageous words and appreciations which were really encouraging for me to go forward.

Finally, I want to express my heartfelt gratitude to my beloved family members who gave me a significant and endless support without which it would have been an impossible mission for me to complete the work. I am also obliged to my husband and sons for taking all the pains and rendering all required supports in accomplishing the assignment.

ABSTRACT

Water logging has turned out to be one of the major environmental global issues, and Bangladesh seems to be one of the worst sufferers. Especially, the south western part of the country experiencing the problems of water logging since 1980s. The situation really compounded with the construction of polders under the Coastal Embankment Project (CEP). The present study has been conducted to investigate the causes and impacts of water logging on people's life and livelihood in village Rajnagar Bankabarsi of Jashore district. The study is heavily based on primary sources of data. Such endeavor has been carried out through all the standard data collection procedures (questionnaire survey, FGD and KII methods). The data are than analyzed in both quantitative and qualitative approaches. However, the secondary data have been collected from Local Upazila Agricultural Office, Union Land Office and different literatures. Quantitative data processing and analysis are carried out by the Statistical Package for Social Sciences SPSS 20.0. Study area map has been prepared through ESRI ArcGIS (Arc Info 10.3) using the satellite image from Google Earth Pro. The study attempted to analyze the spatial spread of water logging over time. Temporal variation of water logging in the study area has been presented through GIS and Remote Sensing techniques. In order to illustrate the socio-economic sphere, the study conducted questionnaire survey. Two hundred and seventy-five sample sizes have been determined for this study. Households have been surveyed for data through questionnaire survey. Comparative assessment of different variables depending on different period of time is the most significant part of this research. Study findings indicated that the study area experienced severe prolonged water logging; about 65 percent respondent opined that water logging continued almost 4 months in a year for many years making the life more vulnerable. More than half (51%) of the respondents indicated the rising river bed as the main cause of water logging. Few FGD participants blamed '*Gher*' as the major cause for the water logging in the study area. So, it can be said that Water logging is a combined effect of different issues in the study area. From the comparative assessment it has been found, there is an increase of *pacca* and *semi-pacca* type of houses in the study area. Field data also found changes in the livelihood pattern. Income group analysis through Gini-coefficient found that the disparity of income increases with time indicating poor people are the main victim of the

disaster as they cannot adjust with the changed environment after water logging. The local people adopted themselves with different types of homesteads level and in agricultural sector to adjust with the changed physical condition. In agricultural sector the impact was found only in the minimization of the duration of agricultural activities but crop production increased with time after water logging for applying effective adaptation mechanism. The present study has amply portrayed the prolonged sufferings of the poor families in the study area. The sufferings are so impending that an immediate measures from the government and NGOs are called upon. The neighboring areas of the study area has a record of bumper crops and this reality aspired the people who has been suffering. In a large scale, the water logging calamities brought curse for the majority of the people, but some people were able to achieve a better quality of life through different means. In light of these some measures are pointed for he distressed people as way forward.

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ABBREVIATIONS

ASTER	Advanced Space borne Thermal Emission and Reflection
BBF	Broad Bed and Furrow
BBS	Bangladesh Bureau of Statistics
BC	Before Christ
BDT	Bangladeshi Taka
BWDB	Bangladesh Water Development Board
CDMP	Comprehensive Disaster Management Program
CEP	Coastal Embankment Project
DND	Dhaka-Narayanganj-Demra
EIP	Early Implementation Project
EPWAPDA	East Pakistan Water and Power Development Board
ESRI	Environmental Systems Research Institute
FAO	Food and Agriculture Organization
FGD	Focused Group Discussion
GIS	Global Information System
GLOVIS	Global Visualization Viewer
GOB	Government of Bangladesh
HH	House Hold
IFI	International Financial Institutions
IK	Indigenous Knowledge
IWM	Institute of Water Modeling
IBIS	International Benchmarking of the Information Society
KCC	Khulna City Corporation
KCERP	Khulna Coastal Embankment Rehabilitation Project
KII	Key Informant Interview
KJDRP	Khulna Jashore Drainage Rehabilitation Project
LGED	Local Government Engineering Department
MSS	Mobile Satellite Services
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
NGO	Non-Governmental Organization
OEM	Operations Evaluation Department

PVA	Participatory Vulnerability Assessment
RS	Remote Sensing
SPSS	Statistical Package for Social Sciences
TM	Thermal Mapper
TRM	Tidal River Management
TRMM	Tropical Rainfall Measuring Mission
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNICEF	United Nations Children's Fund
USGS	United States Geological Survey
WAPDA	Water and Power Development Authority
WARPO	Water Resources Planning Organization
WFP	World Food Program
WMA	Water Management Association

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Chapter 1

INTRODUCTION

1.1 Background of the Study

Natural calamities and environmental events mostly depend on the geographical location and physical settings. In our present world environmental problems are very acute in most countries and these are increasing day by day in many parts of the world. Water logging is one of the problems. We, the human being suffer directly or indirectly from water logging. Water logging may be natural or man-made and also causes severe harm to people. Even it is not over-estimated that, water logging is a problem which might be hazardous than flooding. It is a problem related to poor drainage of water. Shamsuddoha and Chowdhury (2007) argued that already in many coastal places, water logging problem accrued due to lack of sustainable drainage network system and with time the problem is appearing more destructive with additional sufferings. Sahu (2014) perceived that water logging as an event of environmental issues with the notation of hydro morphological occurrence which leads to widespread water logging, thus appearance to be the great problem in Bangladesh**.**

Different factors have been identified for creating water logged situation in south western region of Bangladesh. Geographical location, physiography and climate play a vital role in formation of water logging. Awal (2014) made responsible the special geographical location i.e. southwest coastal region of Bangladesh for water logging and it is one of the most serious threats now-a-days. Holden et al. (2009) described water logged condition as the result of blockage of water in a low-lying area. They also identified some factors which control the formation of water logging, these are: local geology, topography, drainage, and the amount of water supplied to the site. But Rahman and Debnath (2015) described it as a depraved consequence of technological and economic development in the present age. Shamsuddoha and Chowdhury (2007) explained that due to distinct geographical setting Bangladesh has to receive and drain-out huge volume of upstream waters. They also discussed about how the water logging formulates in the country. According to them, in the summer, (May to August) the rivers in Bangladesh become very live as the volume of up streams water increases in the rivers by the melting of glaciers in the Himalayans. Again in the rainy season, huge precipitation occurs which is strongly influenced by monsoon wind from the south west also sets on at the same period. Thus the joint effect of upstream flows, precipitation and terrestrial run-off resulted to over flooding, causing water logging and prolong flood almost every year.

In recent years for a variety of reasons it has become an increasing problem: natural changes in river flow; increased sediment in riverbeds due to reduced sediment deposition on floodplains protected by embankments; and a lack of proper operation and maintenance of sluice gates of the polders i.e. circular embankments (Sarker, 2012; IFI WATCH, 2006). Actually, it is a combined effect of some natural and manmade factors.

According to physiography the south-west coastal area of Bangladesh is a part of the greater Ganges floodplain, an exceptionally complex and delicate hydraulic system, is flat and low-lying, hardly one meter above mean sea level and below high tide level (UNDP, 2011; Adhikary et al., 2012). A large number of tidal rivers flow in the South Western areas, such rivers are very complex in nature. The situation seems to be more complicated when upstream water flows interact with local level water flow. These rivers are characterized by erosion and sedimentation and discharge in the Bay of Bengal. This hydraulic system depends on a sensitive balance between flow of water from two directions: first downward flows from the Ganges (Padma) river, and secondly its distributaries, as well as sediment-laden tides from the Bay of Bengal. This natural system has been brutally disrupted by various human actions from several years and the complete consequences of which are now being sensed.

Large portion of southwestern Bangladesh suffers from water logging every year and water often take six months to drain out. UNDP (2011) informed that in 2011, more than 200,000 households has been destroyed by the massive waterlogging occurred due to the excessive monsoon rainfall in three districts of the region. Currently around 5% of total land of Bangladesh is affected by water logging (Rahman et al., 2009 cited in Khan, 2017). According to Department of Forestry of Bangladesh, it will increase to 14% by 2100 (Bangladesh Department of Forest, 2016 cited in Khan, 2017). (Mirza et al., 2005 cited in Rahman et al., 2010) said that, “water logging has been affecting about millions of people in Bangladesh during the past two decades leading to a large-scale damage of crop, employment, livelihoods and national economy.”

The elongated water-logging has caused significant displacement of people, changing the traditional occupation pattern of the region, creating unemployment problem, creating humanitarian challenges in safe water supply, sanitation, settlement, food security, health and hampered the overall socio-economic condition. So, it causes immense sufferings to the inhabitants of the area. In this context, it is a necessity to investigate the impact of water

logging in life and livelihood of the region to have quick improvement of the dire situation as it has now become a loud demand from all concerned.

1.2 Statement of the Problem: Water Logging in the Study Area

Water logging is a severe problem for the south-western region of Bangladesh which affects the people's life and livelihood of the region in many ways. *Rajnagar Bankabarsi* is a village of Jashore district under Keshabpur upazila also a part of the region and suffers from acute waterlogging for several years and causes significant damage to the life, natural resources, agricultural production and infrastructure in the study area.

The *Kabodak* River (*Kopotaksho* River) is now silt up and is not capable of containing river water into its bed which flows towards the west side of Keshabpur thana of Jashore District. As a result, the water inundates the riverside unions of Keshabpur (*Trimohini, Sagardari and Bidyanandakathi*) and many other areas have become waterlogged in the last few years due to this riverbed siltation.

Structural interventions by constructing roads and settlements in an unplanned and illegal way and regular encroachment of natural drainage system at the upstream and downstream of the *Kopotaksho* River due to over population are responsible for this unwanted and unexpected water-logging (Rahman et al., 2009 cited in Rahman et al., 2010). At the same time the adjacent river (*Harihar* River) also lost its navigability due to siltation and encroachment. Moreover, the construction of polders have caused a rapid siltation in the channel beds which, in further time especially in the rainy season has led to in serious water logging. It is to be noted that the study area falls under Polder-24 of Jashore District.

Available evidences show that water logging in the south-western region affects income, expenditure and occupation pattern and creates livelihood displacement for the local poor through reducing access to the common property resources. Their income earning opportunity has been changed from agricultural to non-agricultural activities because of this situation (Masud et al., 2014). So, the study area is situated on a highly vulnerable position from the water logging perspective. Recently, some researches gave indication to the changing livelihood patterns of inhabitants in water logged areas of south west region in Bangladesh. The present study is being carried out to validate the assumption that waterlogging is a major cause of disaster for the people's life and livelihood of ***Rajnagar Bankabarsi*** village.

1.3 Research Questions

The present study looks for the settlement dynamics that causes perennial water logging. With this view the primary research question looks for:

a) How people maintain their life in a waterlogged situation and what are the impacts on livelihood of that situation?

The secondary questions are:

a) How the people survive in a poor and fragile settlement?
b) How people survive in such a vulnerable socio-economic condition against poor agriculture?
c) What are the social impacts of waterlogging?

1.4 Objectives of the Study

The present study tries to focus on the water logging scenario of *Rajnagar Bankabarsi* Village with its impact on people's life and livelihood. The study in general attempt to gather information from three different perspectives; the investigation started with the selected family, secondly addressed the homestead issues as against water logging. Finally, exemplifying the agricultural miseries. The main thrusts or the objectives of the research are as follows;

- to portray the water logging situation in the study area;
- to exemplify the life and livelihood patterns and adaptation mechanism; and
- to illustrate the expectations of the local people of the study area

1.5 Operational Definitions of Water logging

There are many definitions of water logging have been formulated by different experts and researchers and the definitions were given from different point of views. However, most of them categorized water logging mainly from two different perspectives. The first one is:

a) **Agricultural perspective**:

In agriculture, various crops need air specifically, oxygen to a greater or lesser depth in the soil. When this happens, crop and pasture production will drop because plant roots cannot take up oxygen and so cannot grow; and the second one is:

b) **Human settlement perspective**:

Water logging can take place in any surface. When it spreads over a human settlement area, brings huge sufferings to people's life and livelihood. In this section some more specific definitions will be discussed to clarify the term water logging. According to FAO, 2015, "Technically this refers to a situation when the level of ground water meets plants' root zone. In some localities, this may last for at least three months, and may prolong up to 8-9 months or even become perennial".

Chatterjee et al. (2005) also defined water logging from agricultural perspective. They said "The term waterlogging usually refers to a condition of high subsurface water table affecting the growth and yield of crops. On the other hand, accumulation of surface runoff and thereby stagnation of water over depressed lands due to the restriction of natural passages of water which may arise because of inadequate surface drainage or due to the higher water level elevation at the outfalls also cause waterlogging which is termed as surface waterlogging."

"An area is said to be waterlogged when the water table rises to an extent that the soil pores in the root zone of a crop become saturated, resulting in restriction of the normal circulation of air, decline in the level of oxygen and increase in the level of CO_2" (Anonymous, 1976 cited in Pandey et al., 2010).

"Waterlogging refers to a situation when the water table fluctuates within the root zone depth of crops (cereals, cotton, and sugarcane) fruits, and vegetables for a period long enough to affect plant germination, establishment and growth adversely" (DMC, 2002 cited in Zaman and Ahmad, 2009).

The Working Group of Indian Ministry of Water Resources on Water logging, Soil Salinity and Alkalinity (1991) prescribed the norms for defining waterlogged, saline and alkaline areas. According to these norms, an area is said to be water logged (due to rise in water table) if the water table lies within 2 meters of land surface. An area is said to be potentially water logged if water table is between 2 and 3 meters of land surface (Planning Commission of India, 2013). But it is clear from the previous literatures that, the definition has another dimension too. Water logging is very much space oriented. Spatial characteristics also dominate the nature of it. And it is also spread over the human settlement area. From this point of view some definitions are discussed below:

Rehan and Raju (2017) said, “Water logging is the state when the normal working status hamper due to the presence of water in unexpected place, in an unexpected form”.

“Water logging may be defined as flooding within the embankments caused by hydro-geophysical factors where water remains stagnant for long time due to increased sedimentation of riverbeds and reduced height differential, between embankment and peak water level” (Islam et al., 2004 cited in Adri and Islam, 2012).

After being discussed all the definitions, it is clearly understood that, the term drainage congestion is used to refer to a situation when a river has been totally blocked by the buildup of sediment such that any water above the blockage has no way of draining out. When the annual monsoonal rains fall, averaging around 1.7 meters per year, water builds up with nowhere to go, resulting in static flooding. Flood heights can be measured in meters, not centimeters, and remain in place for as long as 8 months in some places (permanently in a few areas). This is commonly referred to in Bangladesh as “water logging” (Langford, 2014).

So, ‘water logging’ is a phenomenon of poor drainage problem of water with duration and huge land coverage which creates an unwanted situation by effecting plant growth, reduce crop production, destroy the natural environment, change livelihood pattern and down the quality of life. As seasonal water-logging disturbs all parts related to human life, it can be considered as a hazard to the local inhabitants.

1.6 Research Gaps

A number of research works have been conducted before on water logging in Bangladesh. Researcher investigated the problem from different point of view like impact of water logging on agriculture, biodiversity, economy etc. It is seen that, in regional perspective most of the researcher put their emphasis on south western part in considering Bangladesh as this part is most vulnerable to water logging. In some researches the main focused point was the reason behind water logging and about its solution but there is no research have been made to analyze the adaptability of people’s life and livelihood of a water logged area in a community level. And it is required to address the impacts in a community level, because every community has its own unique characteristics and social, economic and cultural structure.

1.7 Justification of the Study

Waterlogging in Bangladesh is a common phenomenon which affects the life and property of the people to a great extent. This included the standard of life and major sources of livelihood in the rural areas such as agriculture, livestock, irrigation water, agriculture machinery, and grain storage. Most of the livelihood sources are dependent on irrigation water which is also a cause of waterlogging both in the study area and all areas locating in south western part of Bangladesh. It is a disastrous natural phenomenon that damaged almost the entire area and because of this, it can be marked as the most damaging disasters after the independence of Bangladesh. This study probing the effects of water logging is imperative in many ways; it will provide the inside information for the policymakers about the causes of water logging, its impacts on life as a whole and sources of livelihood. It will be particularly helpful for disaster management cells, agriculture scientists, extension people, water management experts and NGOs working on the disaster management in Bangladesh and the world.

1.8 Scope of the Research

Large area in the southwestern part of Bangladesh has been waterlogged since 1980s. Peoples have realized that the construction of coastal embankment during the 1960s is mainly responsible for this water logging. Peoples demanded a sustainable solution of water-logging problems and raised their voice through a number of movements and they projeted their complaints in different ways since long. So an environment-friendly, economically and technically sustainable at the same time socially acceptable solution of the problem is an immediate requirement. This research focuses on the waterlogged situation, its impact on life and livelihood, and finally the mitigation and managerial procedures to address this adverse situation in *Rajnagar Bankabarsi* village, *Jashore*. In this study, it has been tried to investigate the reason behind the problem and find out the way to solve it with local people's opinion, demand and satisfaction.

1.9 Problems Encountered in the Field

In the process of data collection (both primary and secondary), some problems appeared during the literature review and in the field. Very limited literatures were found matching the objectives of the present study. This is identified as a limitation for this. During data collection, in the field, many respondents were not interested to answer many questions, especially about loan and savings; some of them hesitated a lot to give the answer.

Unavailability of agricultural and some other required data was another critical aspect faced during the data collection.

1.10 Research Methodology

Methodology is an important tool for any research. Without a planned and systematic methodology, one can't do any effective research work. The methodology section mainly deals with two main issues: the data collection methods and data analysis procedure. It mainly aims to organize the information, logical expression, observations, experiences to examine and analysis of data in a systematic process. For the current research all these systems are done to achieve the goals and objectives of the research. Primarily the study site was visited to understand the overall condition of the area as well as to identify the major problems and issues related to water logging in the selected area. During the visit, Focused Group Discussions (FGDs), transect walks, social mapping, consultations and interviews were carried out with the local community, key informants and community leaders to determine the specific problems and issues of water related stress and impacts. The present study has been undertaken and completed according to the following order of methodology.

1.10.1 Research Design

A research design is an important step for conducting a research systematically. It is a conceptual structure within which the research is conducted. According to the types of problem, objectives of the study, the research designed through observational study, household survey, Focus Group Discussion (FGD) and Key Informant Interview (KII). Figure-1.1 shows the design of the research step by step:

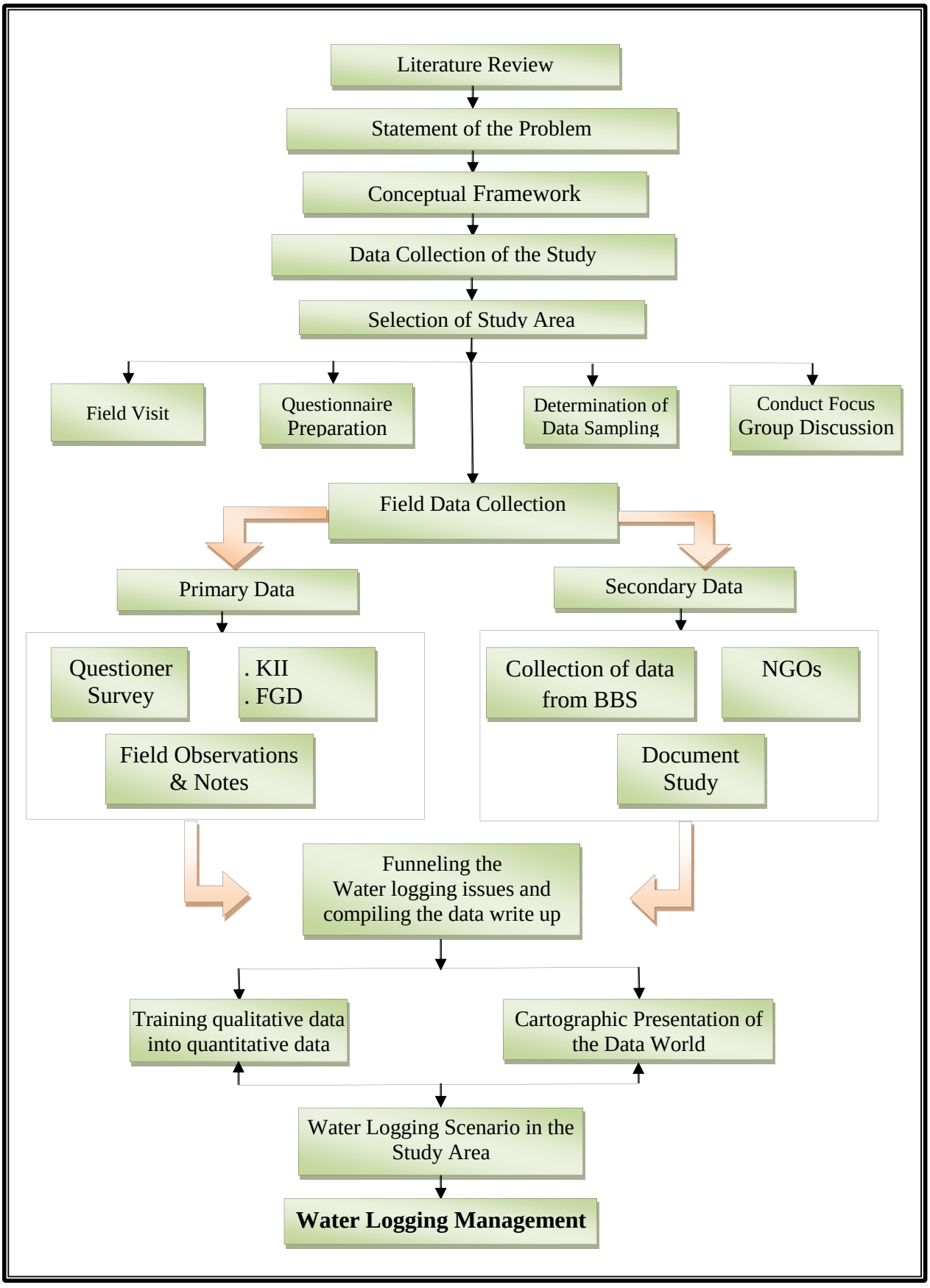


Figure-1.1: Design of the Research

1.10.2 Study Area Selection

Selection of study area is an important part of a research. The area should be selected very carefully so that it can meet up the purpose of the research. In order to collect the required data, *Rajnagar Bankabarsi* has been selected purposively from *Keshabpur* upazila of Jashore district as the study area. Reasons behind the selection of this area are:

- The village is mostly vulnerable due to water logging;
- People are suffering a lot due to water logging.

Detail description of the study area is given in Chapter IV.

1.10.3 Sample Size Determination

For any social survey sample size has a significant role in justifying results. Primary unit of sampling were the households of the project areas. To determine the sample size of the research, first the observation method has been followed to see the density of house hold in the area. According to the census 2011, the total number of house hold was 556 and total population was 2068 in the village.

In order to conduct questionnaire survey households has been taken at 95% confidence level (having 5% error of sampling) and sample size is determined based on the following formula (Yamane, 1967 cited in Israel, 1992)

$$n = \frac{N}{1+Ne^2}$$

Where, n = Sample size; N= Population (Total Households).

For the study area, village *Rajnagar Bankabarsi* sample size:

$$n = \frac{N}{1+Ne^2} = \frac{556}{1+556\,(.05)^2} = \frac{556}{1+1.39} = \frac{556}{2.39} = 232$$

During my field observation it was found that, one side of the village facing the water logging problem which is more than three quarter of the total area. The main objective of the study is to delineate the water logging situation and to see the impact of water logging in life and livelihood. In this context, strategically the affected part has been chosen for data collection. It was also found that, the number of population and house hold have increased after the last government house hold census 2011. That's why to make the sample size, it was considered to survey 1 in every 2 households (that means 1:2). It can be said that, the survey covers

almost 50% households of the area through this method. After covering the whole affected part of the area, total 275 households were surveyed. During the survey it was ensured the whole area is being covered. Data was collected from each part to make the sample size more participatory. So finally, the sample size was determined 275 for the research.

1.11 Data Collection Procedures and Analysis Techniques

The collected data need to have the accountability and validity to achieve the objectives of a research. However, both qualitative and quantitative methods have followed in this research to achieve the certain objective. A semi structured questioner containing relevant questions was used to conduct the field survey. It is important to mention, for comparative study, field data were collected from the respondents on the basis of different period of time. Considering the type of variables respondents were asked to give their answers from different time.

For this study, qualitative data would be analyzed thematically and quantitative data processing and analysis will be carried out by the Statistical Package for Social Sciences SPSS 20.0. The questionnaire included closed and open-ended questions. Answers of close-ended question quantified easily because it was coded before and easily input in SPSS. On the other hand, open-ended questions were not so easy for quantifying. For these open-ended responses, first the answers have arranged and categorized and then coded it. After that, the responses were analyzed by simple descriptive statistical analysis. Study area map has been prepared through ESRI ArcGIS (Arc Info 10.3) using the satellite image from google earth pro. Beside these, to show the temporal variation of water logging in the study area some GIS and Remote sensing techniques also used in this research.

1.11.1 Collection of Primary Data

For the current study questioner survey was the major part of primary data collection, but there were some other important parts also which have conducted before the questioner survey. These are as follows:

a) **Reconnaissance Survey:** It is the first visit of the study area. Basically, the survey was conducted before starting the standardized questioner survey. It was conducted to conceptualize the overall practical situation and procurement of the required background information of the study area.

b) **Informal Interviews:** Some informal interviews also taken before and during the field survey. It was a conversation with an individual using a series of questions related to the field survey which makes the field work easier and effective.

1.11.2 Collection of Secondary Data

As per Wikipedia, Secondary data refers to data which is collected by someone who is someone other than the user. The secondary data are readily available from the other sources and as such, there are no specific collection methods. Required secondary data like geographic location of study area, demographic information of the study area, prime economic activities, infrastructures etc. has been collected from published articles, materials, official records of various involved agencies for the current study. Literature review was also a part of getting secondary information.

Secondary data can be found in both qualitative and quantitative forms. The qualitative data can be acquired through newspapers, different literatures, interviews etc. while the quantitative data can be acquired through previously collected data such as climate data, census report, statistical information, financial statement etc. One of the advantages of secondary data is that it is easily available and hence less time is required to gather all the relevant information. Also, it is less expensive than the primary data.

1.11.2.1 Questionnaire Survey

For this study the field survey was conducted at the house hold level through face to face interviews by using standardized questioner. The survey was conducted through a simple self-developed questioner by researcher. The questioner is adapted in Bangla language and also translated into English to check the possibility of changing the meaning of the questioner. Both open ended and close ended question were included in the questioner to collect qualitative and quantitative data from the respondent. The questioner was pretested in the field and made necessary modification before conducting final interview. There were different types of questions (Annex B) to collect required data from the respondent. Dependent variables of this study life and livelihood and the independent variables are water logging and its impacts itself. Individual household interview and observation are used for collecting data from the participants. The questionnaire was mainly focused on the water logging impacts on the factors of life and livelihood assets of the affected population in the study areas.

1.11.2.2 Focus Group Discussion (FGD)

It is another research tool for qualitative data collection. Krueger and Casey (2000) described FGD as a fast, economical, and efficient method for gathering data which can give reliable and valid qualitative data from several participants. The study follows the FGD approach to collect primary data (Annex C). It (FGD) is a good way to gather information from a group of people from similar backgrounds or experiences to discuss a specific topic of interest. Hay (2010) described it as a highly effective vehicle which helps to find out the gradations and difficulties associated with people-place relationships. According to Toolkits, (2009) this method is applied to a group of participants guided by a moderator (or group facilitator) who introduces the topics for discussion and helps the participants to join in in a lively and natural conversation amongst them. For this study 4 different FGD were conducted with 4 different groups, these are: farmers, day labors, van drivers and women and the discussions were held with these groups consist of 8 participants. This discussion helped to review data already collected from the field level and to wider idea, fill up gaps of information given by the respondents and to understand the relative issues of the study. (FGD Participants at Annex D)

1.11.2.3 Key Informant Interviews (KII)

Key informant interviews are qualitative in-depth interviews with people who have precise knowledge about the community. The purpose of key informant interviews is to collect information from people who have firsthand knowledge about the community, including community leaders, important professionals or residents. For this study, interviews (Annex E) were taken of few important personalities and experts like UNO Keshabpur, Principal of Bankabarsi Primary School and Chairman of Local Keshabpur Water Management Committee etc.

1.12 Organization of the Study

The study comprises of eight chapters. These are as follows:

Chapter I is the introductory chapter comprising the background of the study, problem statement, objective of the study and other required features like research question, research gaps, justification of the study and scope & limitations. At the same time, it encompasses the methodology of the research work. In this chapter the structure of conceptual frame work and research design also given. In addition, the methods of data collection are explained.

Chapter II has two folds, the first one will describe about the research trend and in the second one, an attempt has been made to explore and highlight what researches, studies and literatures have been done so far related to water logging and its impacts on life and livelihood in Bangladesh and in other countries.

Chapter III is an attempt to explain the general and specific viewpoints of water logging for conceptualization. Additionally, global and local water logging issues are discussed to make a better assimilation. This chapter encompasses the history of water logging in Bangladesh, the reason of perennial water logging, spatial spread and temporal variation of it, polder development and GOB & NGOs participation also discussed elaborately as specific viewpoints.

Chapter IV describes the study area and also present the basic demographic information about the respondents of the study area is shown in this chapter.

Chapter V describes the impacted scenario of the study area.

Chapter VI is an attempt to focus the hardship in people's life of the study area on the basis of field data.

Chapter VII deals with the adaptation mechanism of local people of the study area to reduce the vulnerability.

Chapter VIII has the concluding remarks on the whole paper. It contains the summary of major findings and contains the recommendations based on the findings of the research.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Water logging is a kind of phenomenon with multidimensional scope and perspectives. Researchers has been investigated the issue from different points of view. As a result there are a number of research works available as literature resources. Water logging is one of the most common phenomena all over the world, of which, Bangladesh is no exception. Usually the low-lying countries are the worst sufferers. From those distressed countries Bangladesh is one of the worst sufferers in this aspect.

In this chapter an attempt has been made to explain the research trend and then illustrate other research works that has already been conducted relating to water logging. It is to be noted that in this chapter similar papers may come first and the other related literature being discussed chronologically.

2.2 Research Trend

After a thorough search through different search engines, it was found that there are number of research work done before on water logging and researcher investigate this issue from different point of view. In general, it can be seen that available articles, research papers and literatures focused on the impacts of water logging on different factors related to natural and human environment. Initially some researcher put their emphasis on the impact of water logging on environment. Impact on biodiversity, agriculture also got priority to the researcher. At the same time impact on human's life and livelihood also been investigated in some research work. Urban water logging also found as an important issue to many researchers. Some studies only discussed with the causes of water logging.

In recent time, after the advancement of technology researcher have shown high interest on the analysis of water logging by using GIS techniques. It is seen that both in Bangladesh and outside countries, number of researches conducted to delineate the water logged areas through GIS methods and techniques. These studies not only discussed on the spatial spread and temporal variation of it but also demonstrate a comparative analysis of different time.

Considering Bangladesh, the main focused region is south western part of the country but at present urban water logging also a big issue for conducting research. At present researchers try to investigate the impact of water logging on different sectors. Besides, life and livelihood, biodiversity, agriculture researcher also investigates impacts on natural environment, socio-economic life, migration, impacts on settlement pattern etc. Most of the research mainly considered the whole south western part of the country. But it is also required to do research on village level, because every village has its own unique characteristics and social, economic and cultural structure.

2.3 Review of Literatures

Underpinning this significance, the researcher consulted the following literatures:

2.3.1 Water Logging in the context of Bangladesh (South Western Region)

There are number of research work done before on water logging in Bangladesh. As south western part of the country is suffering from water logging for long time, most of the researcher has been selected this area to conduct their study. This section will emphasize on the discussion of those papers which will give a clear idea of water logging situation in south western region of Bangladesh.

Awal (2014) conducted a research, titled "Water Logging in south-western Coastal Region of Bangladesh: Local Adaptation and Policy Option". The study was conducted in various waterlogged areas like Jashore (presently spelled, Jashore), Satkhira and Khulna districts have been used in this study. Main objective of the study was to overcome the water logging problem in south-west coastal region of Bangladesh through formulating some policy which are appropriate. In this paper author try to find out how Precipitation, Topography, Sea-level rise, Urbanization are responsible for water logging. Moreover, the author marked rising of river bed due to siltation as one of the main reasons of the problem and also explain how CEP and polders create water logging. According to the researcher the slope of land of this region is north-south oriented but most of the embankments are constructed in the direction of east-west and thus rivers and channels lost their natural flow and create water logging. The researcher also made responsible the Wrong operations and poor management of polders/embankments and their sluice gates and thus within few years the negative impacts of the project began to appear. These includes: the siltation of riverbeds, increased saline

intrusion, the narrowing of river estuaries and changes in the normal morphological processes of rive. The author claimed that in Jashore, Satkhira and Khulna districts about 128 thousand hectares crop land were damaged that directly affects the life and livelihood of about one million people.

FAO (2015) prepared a report which presents the results of a study conducted in 2014 into the factors leading to water logging in the South West region of Bangladesh. It was carried out as co-chair of the Bangladesh Food Security Cluster, and is also a contribution towards the Government's Master Plan for the Agricultural development of the Southern Region of the country. Most of the issues related to water logging of the region were investigated in this study. Objective of the study was to identify the extent of water logging areas, damage, coping mechanisms, institutional response to water logging, recording opinions of all main stakeholder groups to reach to a long-term solution of the problem. The report also developed a possible road map for long term solutions to the water logging issues of the region, which could be both technically feasible and acceptable to the local community as well as to the local and national authorities. Objective of this study resembles to my research objective. So, this is considered as an important tool for my research. Primary data was collected by using FGD and KII tools and the study was conducted in four upazilas namely Sadar and Tala upazila (FGD in Tentulia Union) of Satkhira district, Abhaynagar (FGD in Payra Union) and Keshabpur upazila (FGD in Bidyanandakati union) of Jashore district of south west part. This paper aimed to find out the reason behind water logging in this area and finally some advice came out from it to solve the problem.

2.3.2 Impact of Water logging in Life and Livelihood

It is to be noted that very few research works have been conducted on the impact of water logging on life and livelihood in the context of Bangladesh.

Rejve (2006) projected how livelihood pattern changes in south western region of Bangladesh for water logging in different sectors like land use pattern, occupation, land price, Food security, Migration and many more. Government Projects like: a) Khulna Coastal Embankment Rehabilitation Project (KCERP) and b) Coastal Embankment Rehabilitation Project (CERP) has also been discussed in the paper. The article concluded with two important advices to solve the problem. The author argued that the development processes must ensure the involvement of the people.

After a deliberate search, it is seen that some areas of Jashore district like *Keshabpur, Manirampur* also getting importance to researcher as water logged area. Study area of this research is a village named *Rajnagar Bankabarsi* under Keshabpur Upazila of Jashore District, which also suffers from water logging for several years. An article has been considered similar to this research as the study area was Keshabpur Thana of Jashore District.

Adri and Islam (2012) conducted a research titled "Vulnerability and Coping Strategies in Waterlogged Area: A Case Study from Keshabpur, Bangladesh"**.** In this research article the south west part of Bangladesh is considered as susceptible to water logging due to the vulnerable geographical settings, mismanagement and climate change. Authors identify the most dreadful hydro-geophysical vulnerability of this area. This research tried to identify people's social vulnerability and one-off coping strategies under such adverse environmental condition to support the policy making process. In this research required data were collected through questionnaire survey and Participatory Vulnerability Assessment (PVA) which includes FGD, KII and case studies. About 270 households of the study area were surveyed. To assess the social vulnerability and to investigate the coping practice of vulnerable groups in the study area was main objectives of the research.

Rahman and Debnath (2015) examined the losses in ecosystem of DND embankment area due to water logging. Moreover, it's another purpose is to find out the root causes of water logging in the habitats. In this research basically they observed the influences of DND embankment on the environment and lives concerned. According to them, economic and business activities are being damaged along with the deteriorations of human health and educational services. They opined that climate change, land feather, poor drainage system in urban area, unplanned urbanization and infrastructural development are mainly responsible for water logging in Bangladesh. From several findings of the research some important findings is necessary to mention: according to their result, about 71 percent of households have been damaged partially or fully in the area, 66 percent of roads and paths go under water, about 74 percent of informal workers (rickshaw puller, vendors, hawker, and grocery shoppers) face hardship heavily and their income decreases and about 77 percent of the citizens are suffering from water borne diseases in the area. They gave importance on policy implementation to solve the problem.

IFI WATCH (2006) is a paper papered by *Unnayan Onneshan* (The Innovators) explained the water logging situation in the South-Western region of Bangladesh as a development disaster. The paper gives a clear picture of the region after the extensive rainfall of September and November in 2005. According to the description around 10,825 hectares of cultivable land of 184 villages of *Abhaynagar, Manirampur* and *Keshabpur* Upazila under Jashore district went under water during that time. This paper described the area by giving lots of data and information which helps us to understand the actual situation. The paper also discussed about the reason behind the problem and explained some projects like Khulna Jashore Drainage Rehabilitation Project (KJDRP) and CEP as main reason of water logging as all these projects were undertaken ignoring the local scientific knowledge and traditional wisdom. According to the explanation we come to know that even the nature of region also been ignored and prepared 'everywhere fit' design. Thus water logging has become permanent in the Southwest Coastal Zones and suffering continues due to these wrongly designed structures as well. The paper also illustrated some other factors responsible for water logging and also put emphasis on the desire of local people to solve the problem and concluded with mentioning the demands of local people to solve the problem.

Islam and Kibria (2006) examined the projects under taken to solve water logging in a paper named, ADB Financed Project of Mass Destruction in Southwest Coastal Region of Bangladesh, which is a report article supported by *Uttaran*. Main objective of the paper is to document, understand and analyze the projects like KJDRP, CEP etc., which were established to solve the problem. But authors revealed that local people of the region rejected those projects. According to the report, local communities denied KJDRP and declared that KJDRP authorities will not be allowed to do any further work in the area.

2.3.3 Impact of Water logging from Different Perspectives

Some researchers examined the impact of water logging from different perspectives and it is also important to identify the impacts as it plays a vital role in changing the pattern of human's life and livelihood. Masud et al. (2014) investigated impacts of water logging on biodiversity in their research. The study area was selected in *Dumuria* and *Keshabpur* upazila of Khulna and Jashore district in South- western region of Bangladesh. Main objective of the study is to examine the impact of water logging on biodiversity in the study area. Authors opined that, water logging reduces the availability of birds and fishes, restricts the opportunity to rear livestock. It restrains all sorts of plant growth, fruit trees and timber trees. Field survey

of the research shows that water logging has changed the scenario of whole physical environment. Major findings of the research are, water logging reduces the scope for traditional fishing, kitchen gardening, livestock rearing and other household economies. Authors found from the field survey that stock of native fish species has reduced due to water logging. Livestock rearing has reduced significantly. Growth of all sorts of trees except few salinities tolerate species have restrained due to water logging. Required data were collected through KII, FGD and 20 semi structured interviews and those helps to identify that water logging affects human settlement, habitation of birds, animals and fishes as well as growth of trees and plants in that region.

Tareq et al. (2016) also investigated the impact of water logging on bio diversity. The study was conducted in three unions *Khalishkhali, Islamkathi* and *Jalalpur* union of Tala upazila in *Satkhira* district. Among these areas, *Jalalpur* and *Islamkathi* union remain water logged naturally almost throughout the year. 20 interviews were conducted for data collection to examine the impact of water logging on plant growth, biodiversity and physical environment. They mainly interviewed farmers and businessmen as they lived in the study area for long time. Number of FGDs also involve in the data collection procedure. The outcome of this study is also similar to the previous one. According to the findings most importantly, the number of cows, goats, ducks, chicken and goose have reduced significantly in three unions altogether and there were no changes in number of cats and dogs in *Khalishkhali* union but reduced in *Jalalpur* and *Islamkhati* union. About the fish species findings are mixed. Author also explained the Socio-economic Implication of biodiversity Loss in the study area. The paper concluded with some recommendation to improve the situation. Author opined on behalf of the local people that, to solve the problem it is required to incorporate local people perception and their indigenous knowledge.

Gazi and Moniruzzaman (2014) examined the impact of water logging on agriculture and food security. This research paper is an important one for my research as agriculture is one of the most common occupations in village life. Moreover, due to water logging, there is no more agricultural work in those areas which causes a big change in people's livelihood pattern of the region. The study was conducted in Tala upazila of Satkhira district, one of the worst affected areas by water logging. Authors informed that; the local people are living in a measurable condition as they did not have any work to live on, more over many of them forced to change their livelihood and leave their origin homestead. They were worried that if this situation continues for long time, the population of the study area will be decreased

significantly as agricultural production reduces in a large scale due to water logging which again subsequently deteriorates the socio-economic condition of the area. As a result many people are obliged to leave their homestead forever from the study area.

Langford (2014) investigated the impacts of water logging on life and livelihood in a report supported by Food Security Cluster (FSC), Humanitarian Aid and Civil Protection (HACP) and UK Aid in 2014. The field research was conducted in Satkhira District and it's a comparative study between affected and non-affected area allowing a comparative analysis of total impact on livelihoods and food security. The study determined, long term inundation prevents the cultivation of most of the crops normally cultivated in the area resulting in very significant economic loss to households and villages in the waterlogged areas. The report is based on data derived from interviewing 400 to 500 people with a very specific focus on quantifying household economies. Major findings of the study are the effects of water logging in different sector of life such as: reduced incomes, lower consumption of nutritionally diverse foods such as meat, eggs, vegetables and fruits, seasonal migration and many others. At the end of the report author proposed some measures to solve water logging.

Water logging Situation Analysis, August 31, 2016 a document published by NIRAPOD, in this document we will get an overview of Water logging in Jashore 2016. This paper actually aimed to demonstrate the practical situation of water logged area. Most important focused point of this paper is damages due to water logging of the region. It also discussed on the impact of water logging on life and livelihood. Finally some recommendations were also given in the conclusion.

Rashid et al. (2013) conducted a research to examine the impacts of water logging titled, "Drainage Congestion and Its Impact on Environment in the South-Western Coastal Part of Bangladesh." Authors make responsible some anthropogenic activities which eventually raising the threats of geo-hazards like Flooding and Water logging. These are: a) poldering, b) dam and c) embankment. Authors said, "In the coastal areas government made embankment on both banks of the rivers and also poldering outside the tidal and fluvio-tidal plains and micro-dams on the mouth of the tidal creeks and channels not thought before. Due to such activities, enhance sedimentation took place in the river bed. The rivers are gradually abandoning due to siltation which ultimately causes permanent water logging and flooding in these areas."

Noor (2018) conducted a research titled "Investigation on Polderaization Induced Water Logging and Feasible Adaptation Measures in *Dumuria* Upazila under Khulna District." The study area was in *Dumuria* Upazila of Khulna district which is located within the polder 29 and has a long history of water logging. Main objective of the study is to identify water logged areas within the southwestern region using satellite images (Landsat images) and their relation to anthropogenic interventions and to assess the existing feasible community-based adaptation measures within the selected study area and evaluation of the effectiveness of each of the strategies. The study also investigates the causes of water logging problem in this region. An important finding of the study is that over the years the water-logged area had increased from 32 sq. km in 1990 to 238 sq. km in 2016 and this data is found through the analysis of satellite images. The papers explain the reason of water logging in the south western region with lot of data and information. Author also discussed about short term and long-term feasible adaptation measures in different sectors like Agriculture, Drinking water and Infrastructure with method in a table. The study proves that the extent of water logging has accelerated over the years within the study area. Author makes responsible the Lack of maintenance of polders for catastrophic situation of water logging. Finally, the study ends with some recommendations.

Khan (2017) also conducted a research on Khulna city and investigated the reason and impact of waterlogging in the study area. Tittle of the research "Analysis of Causes and Impact of Water Logging in Khulna City of Bangladesh" which focused on the water logging situation that is caused by high intensity rainfall and runoff in the city area that is inundated due to unplanned and inadequate drainage system, disappearance of natural drainage system and inefficient management. Field survey of the study shows that around 66% of houses are facing the water logging problem during monsoon. About 4% of the total households responded that storm water overflowed the plinth level of their houses. The author pointed out that prolonged water logging is commonly seen in *Tootpara, Santidham, Sonadanga, Fulbarigate* area and short duration water logging is seen in *Rupsa, PTI, Satrasta, Barangatiarea*. In the discussion of causes of water logging in the study area, author focused on several points like excessive rainfall, population growth and unplanned development, disappearance of natural drainage system, Unplanned and inadequate drainage system, Operational performance and maintenance of drainage systems, Filling up the ponds and ditches and siltation in natural drainage system. The paper also illustrates the impact of water logging in the study area. The author also marked social, physical and environmental impact of the problem and finally discussed on economic Problem of Water logging in his writing. In the conclusion author

said, “We need an urgent long-term planning for efficient management of urban drainage system to overcome water logging problem in Khulna city. GIS technique might be very useful tools for overcome this problem in shortly”.

Bahauddin, conducted a research titled, “Impacts of development projects on declining fresh water resources in coastal areas of Bangladesh” was published in a Journal in 2018 named Peoples’ Preface: A Journal of Research Initiatives. Basically, the paper is a critical analysis of two development projects in the lens of the availability of drinking water. The projects are Tidal River Management (TRM) and CEP implemented in the southwestern coastal region of Bangladesh for management the water resources. Main concerning issue of this paper is the environmental impact TRM and CEP. Author point out that, in a certain geographic region, a specific development concept or project if neglects local ecological or cultural characteristics, it may react negatively.

Ray (undated) conducted his research to investigate the causes and problems of water logging in 25 no ward of Khulna City Corporation titled “Report on Water logging: A Case Study of 25 No Ward of Khulna City Corporation”. The researcher marked rainfall as one of the main reasons of water logging in the area. He mentioned that, “About 80 percent roads of the study area go under knee to waist-deep water when there is moderate to heavy rainfall. It is the worst affected area where waterlogging often continues for days. Researcher added, “The study area has some commercial, institutional and most of the part residential. So, the severity of water logging in here is so much high. But KCC don’t take any step to recover people from water logging.” According to authors, the study area has some commercial, institutional and most of the part residential. So, the severity of water logging in here is so much high. But KCC don’t take any step to recover people from water logging. Poor drainage condition also picked as a major reason behind the problem.

Rehan and Raju (2017) in their research identified the causes of water logging in Khulna city. In this research, ward-31 of the city was selected as the study area. Main objectives of this research are to delineate the water logging zones and drainage congestion points, identify the water logging causes and its hazardous impacts on study area, damage caused by water logging and some others. They opined that, quality of drainage network is very poor in the area and identified water logging risk zones in study area. There are found five vulnerable sites in the study area. Authors mentioned, “The site is taken or selected as a risk zone due to the presence of some major water bodies and a canal like water body beside the site. The

present condition of the water bodies surrounding this site is not well functional and that is why every year the roads and adjacent households face the trouble of water logging." The study found out main four factors working behind this hazard.

"Impact of Water Logging in South Western Coastal Zone of Bangladesh: A Case Study" by Gazi **(**2019**)** is a wide-ranging thesis work on impact of water logging in south western Bangladesh. Study area of the research was Tala upazila, Satkhira District. One of the main objectives of the research is to investigate the reason behind the elongated water logging in the study area and to study social and economic impact of it. The author investigated the reason behind the water logged situation by implementing the KII and house hold survey techniques. From the investigation he mentioned several causes of water logging in the area of which topography and elevation of the study area, excessive rainfall, siltation in *Kobadak* River, poor operational performance and maintenance of drainage systems are some important reason. From various findings an important one is a great infrastructural damage in the area. Beside this impact on health, education, socio economic impact, impact on human life and many more demonstrated in the paper.

Kabir **(**2012) focused on the vulnerability of settlement of water logged village in Keshabpur upazila and their copping strategies in a research work titled, "Vulnerability and Adaptation practices in the Settlement Pattern: A Case of Water-Logged Village in Keshabpur Upazila". Author opined, the process of adaptation in settlement is dynamic and hazard specific in a hazard prone area. He added, it is necessary to have a holistic approach of adaptation in the settlement design for a community living in an anticipated geo-climatic vulnerability. From this point of view the study aims to identify the local practices for socio-spatial adaptation in hazard prone areas and possibility to adopt those in the anticipated future context. To achieve the objective of the study, the researcher investigated the structural and non-structural measures of adaptation of a village located in *Keshabpur* upazila as it is located in the most vulnerable zone of the upazila. It is a micro level analysis of settlement pattern and required primary data were collected from field survey and focus group discussion. This study found that both local community and public agencies have employed effort to minimize the impact of water logging. Researcher finally opined that due to these individual efforts the spatial pattern of the indigenous settlement has transformed.

2.3.4 Water Logging in Urban Areas

Some researcher shows their interest to investigate on urban water logging. Some research work on urban water logging cited below.

Causes and effects of water logging in Dhaka city were investigated by Tawhid (2004) in the research paper titled; “Causes and Effects of Water Logging in Dhaka City, Bangladesh” was published. The objectives of the research are to determine the causes of water logging problem in Dhaka city and to investigate the effects of water logging on city life and to provide some recommendations. Author identified a wide range of factors accountable for water logging in the city. It is seen that there is a difference in the type of factors between urban and rural areas. Author revealed that about 82 percent of the interviewers from different development organizations and inhabitants marked waste management as the prime cause of water logging in the city. Beside this encroachment, lack of education and awareness, poor drainage system, mismanagement of drainage network, development work in the rainy season are some important factors marked in the paper. Author also gives a range of effects of water logging in the city life.

Mowla and Islam (2013) discussed the problem of water logging in Dhaka city in their study. Authors in their research, “Natural Drainage System and Water Logging in Dhaka: Measures to address the Problems” focused on the rainfall induced flooding caused by high intensity rainfall runoff in the city area. Researcher observed that, the reason of water logging in the city is lack of proper drainage system and inefficient management. They opined that to mitigate water logging problem in the city an urban design and planning can establish which is responsive to the geo-climate and hydrological characteristics of the place will help. To describe the impact of water logging they mentioned social, physical, environmental and economic problems. Mitigation measures also argued in their writing. According to the researcher socio-economic, physical, vegetation, aquaculture and urban design and planning might be adopted as remedial measures. Authors put emphasis on the close coordination among urban authorities and agencies and collaboration between public and private sectors for effective management and operation of the natural drainage system to improve water logging situation.

Subrina and Chowdhury (2017) explored the causes of water logging disaster in Dhaka. At the same time, they focused on the impacts of it on the quality of life in order to utilize the scope of urban and landscape design at its fullest capacity to reduce the risk of water logging and increase the quality of life. (Urban Dynamics: An undervalued issue for water logging disaster risk management in case of Dhaka city, Bangladesh). The research was conducted with three different objectives, which are: to identify the reasons of water logging, to evaluate the impacts on people, society and the city and finally a proposal for potential urban and landscape design to improve the condition. The author demonstrated the cause and impact of water logging in the city. But most importantly they focused on the inclusion of urban and landscape design as a problem-solving tool and they think that to solve water logging problem, it is required to develop a strategy based on the rejuvenation of human-water relationship. They put emphasis on both macro and micro scale intervention to achieve generous social, economic, environmental, ecological benefits. Authors also suggested that macro scale intervention is a long-term expensive process where as micro scale solutions are comparatively less expensive which can be implemented immediately. They argued for three macro scale solution; these are: 1) Urban Fringe Areas Development 2) Revival of Canal Networking and 3) Retention and Detention Areas Development. Finally, they concluded by giving importance on comprehensive synchronization of different stakeholders, planning authority, urban designers, landscape architects and community leaders as well.

"Water Logging Problems in Urban Areas of Bangladesh and Solution with Analytical Approach" by Hossain (2013) was conducted in Chalna Pourashava. According to the author, "The Pourashava suffers from drainage congestions and water logging especially during rainy season." He observed that there is a lack of planned and adequate drainage network system in the Chalna Pourashava. To improve the drainage system of the pourashava is the main objective of the paper. With an analytical approach author assessed the drainage system of the area by using a sequence of analytical processes which results recommended a drainage system. Finally, author suggested a drainage improvement plan.

Some indigenous technologies were examined by Hossain in 2010**.** Tittle of his research is "Indigenous technology for adapting to water logging situation for sustainable livelihood security in low lying areas of Bangladesh". Author opined that due to water logging arable land decreased gradually which lead to migration of people to other parts of the country. In this changed condition some local knowledge-based practice making the livelihood more sustainable. He mainly discussed about "Floating Agriculture". The author also gave detail

information about the cultivation procedure. Cost and benefit analysis of floating vegetable cultivation given in the paper. Finally, author opined that considering the economic, environmental and social aspects it is a useful method.

Rahman et al. (2009) used GIS approaches to examine the environmental, social and physical impact of water logging in *Khulna* city. The objectives of the study were to find out the existing situation of water logging in *Khulna* city, to enquire the causes of water logging in the city, to assess the direct and indirect damages of water logging and to assess the environmental condition of the water logged area. Authors argued that due to human intervention most of these natural drains are either filled up or were encroached for last three decades. They also illustrated the causes of water logging in the city. Field survey of the study shows that, around 66% of houses are facing the water logging problem during monsoon. About 4% of the total households responded that storm water overflowed the plinth level of their houses. Finally, authors opined that, as water logging affected areas are increasing day by day it needed an urgent long-term planning to solve the problem and they further added that GIS technique might be very useful tools for overcome this problem in shortly.

Another research work done by Anisha and Hossain (2014), on urban water logging. The study was conducted in *Teknaf* city a small urban area of southern part of Bangladesh beside the Bay of Bengal. Author mentioned that, the urban area suffers from drainage congestions and water logging especially during rainy season. This study tries to investigate the reason behind the problem. An important finding of the study is that, 70% of land of the urban area is above the average flood level. The rest of the land ranges from moderate to very deep flooding. It is assessed that 6%, 18% and 6% of land is subjected to moderate (30-90 cm flood depth), deep and very deep (90-180 cm flood depth) flooding in reference to average year flood. Author made responsible the existing unplanned drainage system for water logging. The study identifies *Heccha Khal* and *Kayokkhali Khal* branch as the outfalls for the present and expanding core area of the urban area. A brief discussion on a proposed drainage system for the core area of the urban area as well as for the extended area is an important part of the study. From the study we came to know that the whole urban area has been divided into 9 zones for drainage improvement plan. Here also a discussed about the effects of water logging in an urban area.

"A Rapid Food Security Assessment at Satkhira in the Context of Recent Flood and Water Logging" is an assessment paper jointly conducted in 2011 by the World Food Program (WFP), Food and Agricultural Organization (FAO) and Shushilan. This is informed in the research paper, due to heavy rainfall at the end of July and early August 2011, some districts of southern part of Bangladesh namely *Satkhira, Jashore, Khulna* and *Cox's Bazar* has been suffered from severe water logging. In this paper, it is point out that, though flood waters begin to move away, some unions of *Satkhira, Jashore and Khulna* remain under water and locked in a elongated water logged situation. As *Satkhira* is the most affected districts the assessment on food security focused on the severely affected upazilas of *Satkhira* district. Required data were gathered through FGD, KIIs and a market survey. The paper found out internal displacement of the population resulted from the water logging and flooded areas. The paper stated, around 90 percent of the affected population was forced to leave their homesteads temporarily due to 3 to 4 feet inundation in the area. The majority of the displaced population took shelter in road sides, embankments and schools. The paper gives data on the affected area and population, impact on agriculture, impact on food price and it is important to note that the paper found a significant change on livelihood pattern in the study area. Another important observation of this assessment is deteriorating food security situation of the affected people. In these article priority needs of the community in water logged condition classified into 3 categories. These are a) Immediate priority b) Medium term priority c) Long term need. Important part of the assessment is the response and gap analysis. Finally, the article gives some recommendations to solve the problem.

Sarker (2012) investigated the reason behind water logging in south-western part of Bangladesh. Author in his research pointed out that southwestern part of Bangladesh is unique in many ways due to its special ecological and geological setting. The area faced many natural calamities that included cyclones, floods, tidal surges, repeated water logging, and land erosion, degradation etc. The calamities affected the living patterns of the inhabitants. Author gave a description about the history of water logging. He identifies some reasons for the problem. These are: a) Changes in the Entry of Ganga/Padma River b) Death of River *Mathabhanga* c) Farakka Embankment d) Declination of Land e) Unplanned Structure Development f) Shrimp Cultivation and g) Drainage Capacity losses of rivers in the region.

2.3.5 Water Logging in Other Countries

Khan and Chaudary (2003) showed how water logging and salinization harm to agriculture in Pakistan. They opined that, due to this water logging and salinization agricultural productive lands are turning into nonproductive land. Author marked this problem as an alarm of danger. They also explain the extent and nature of water logging in Pakistan. They highlighted on the history of the problems related to the rise in water table that started after the introduction of weir-controlled irrigation in 1940's. They added, before the start of canal irrigation system, there was no significant physical occurrence of water logging problem. Finally, they concluded with some remedial measures to solve the problem.

Singh (2016) carried out an investigation on water logging in south western Punjab, India. The research studied the spatial and temporal distribution of water logging and salinity areas. It also included studying the impact of climate change and ground water level on salinity and water logging by assessing the changes in temperature, rainfall and ground water level. Author also shows the spatial and temporal changes in waterlogging depending on climatic data of different district.

Singh (2017) evaluated the flood and water logging dynamics by using geospatial techniques in Indo Gangetic Plain. In his work, the author identified the temporal pattern of water logging in the Northern Bihar plains. The study included the evaluation of the effects of different terrain, hydrological and anthropogenic factors on water logging. Author also examined the risk arising from water logging to society based on the hazard proneness and social vulnerability. He envisaged, climate change would heavily affect the agriculture of northern Bihar plains due to excessive rainfall pattern causing long term water logging in the region.

Sahu (2014) identified and mapped Moyna basin with water-logged areas following systematic analysis of the water-logged areas. He tried to understand the linkages between man-made environments from the environmental as well as spatial perspective. To achieve the objectives of the study, researcher used remote sensing techniques. Author identified some reasons of water logging in the area. He said that there are many hydro morphological conditions in the Moyna basin for this water-logged situation. Major causes are extensive near-middle low-lying area with low relief, heavy rainfall within a short span of time, favorable soil to hold water on the land surface, presence of ground water within a very short

depth from the ground level, and a number of canals with haphazard embankments create water-logged condition etc.

Pandey et al. (2010) examined the vulnerability of risk of water logging and floods of Indo Gangetic plain. Actually, this paper aimed to assess the vulnerability of flood and waterlogging and risk based on spatial, Geographic Information Systems of the area. Researcher evaluated waterlogging over the period from 1975 to 2008 through multi-temporal satellite data. Author also considered social element for flood water logging risk evaluation in this region. Findings of the research indicated the central parts of the study area in very high and does not possess significant risk, whereas the western, north-western regions under medium risk, and eastern parts mainly in low-risk zone.

Zaman and Ahmad (2009) demonstrated an empirical analysis of economic loss of agricultural economy of Indus Basin of Pakistan due to water logging. The research identified temporal extent of salinity and water logging in the IBIS. He also highlighted the impact of salinity and water logging on the productivity of crops, loss to the agricultural economy due to salinity, gross value of agricultural production. After analyzing the trends of waterlogging and profile of salinity they found, there is no change in waterlogging and in profile salinity on average. They also identified the crop production losses due to water logging in the IBIS of Pakistan. In the conclusion they said about the performance of canal irrigation system and expected it can be improved significantly by managing irrigation in the IBIS. They also thought that new resources of water in future would come largely from the saving of existing losses.

Ziad et al. (2016) examined the water logging impacts and salinity on crop production in a village under Swabi District of Khyber Pakhtunkhwa. He studied the yield production in water logged and non-water logged soil and found out the vulnerability of different crops to salinity and water logging. Author opined, poor drainage facilities in the irrigation system not only hamper the agricultural lands but also hampers agricultural production due to the threat of water logging and salinity. Hence, salinity and water logging act as severe limitations to the agricultural production in Pakistan. This study found that due to salinity and water logging, crops production reduced to approximately 88% as compared to the non-water logged and non-saline lands. Study also found that rice was greatly tolerant to water logging and salinity. On the other hand tobacco and maize are mostly affected due to water logging and salinity as compared to the wheat.

Sahu (2014) conducted a research in 2014. The research work was done with the aim to identify and mapping of the water-logged areas in the part of Purba Medinipur district of *Keleghai River* basin, India by RS and GIS method. Field data revealed about 80-km^2 areas werewater logged within the study. These affected areas were found to be distributed along the River *Keleghai* and connected canals. Researcher mention some natural and man-made factors which are responsible for the spatial distribution of water logging in the area.

Gebrehiwot (2017) conducted a research on Ethiopian Irrigated Agriculture. The research delineated the waterlogging, salinization and drainage of the country. The author reviewed important technical issues related to drainage problems in Ethiopia. It included water logging and salinization, and their consequences on the agriculture productivity. Researcher informed about the surface drainage method i.e. Broad Bed and Furrow (BBF). In Ethiopia, due to enhanced surface drainage from the application of BBF land management system technology there is a significant increase in grain and biomass crops in many parts of the country. Author finally concluded mentioning drainage is as important as irrigation for a productive and profitable irrigated agriculture to help the country achieving the development goal. The identified the costs and technology in design, implementation, operation and maintenance of drainage systems are the unavoidable challenges.

Ojo et al. (2011) discussed the salinity and water logging problems in South Africa and highlighted the Vaal harts Irrigation scheme (VIS). Authors conducted the research with the view to endorse some effective policy for further development in South Africa. They highly appreciated about the use of modern tools for analyzing issues related to water logging.

Chapter 3

CONCEPTUAL FRAMEWORK

3.1 Introduction

It is important to make the term “water logging” clear. In this chapter an attempt has been made to delineate the viewpoints of water logging. Causes and impacts of water logging discussed as general viewpoints and historical back ground of water logging in south western Bangladesh, reasons, spatial spread and temporal variation, polder development, GOB & NGOs participation discussed as specific viewpoints. The chapter also demonstrated the water logging situation in different countries in the world as global water logging issues and local issues are describe from Bangladesh, mostly from south western part of the country. Polderization also been discussed as the causation of water logging.

3.2 Water Logging: Conceptualization

After a thorough search of literature, it’s been understood that, there are numbers of factors working behind a water logged situation. These factors are active from different sources and they can be grouped into two categories. Such as: a) nature induced factors; b) human induced factors.

3.2.1 Causes of Water Logging

Singh and Pandey (2013) described water logging as a complex phenomenon and the severity depends on a number of natural and anthropogenic factors. Sahu, (2014) said that several natural and manmade issues are responsible to the origination of water logged situation. He also demonstrated in his findings, how physical surroundings of a region control water logging. He showed, generally the water logged areas are low-lying fields which are surrounded by comparatively highlands. The slope and the elevation variation are also low. Surface with high slope do not cause water-logging. Generally, surface water flows following the slope direction and it is accumulated in the lowlands and low-sloped fields.

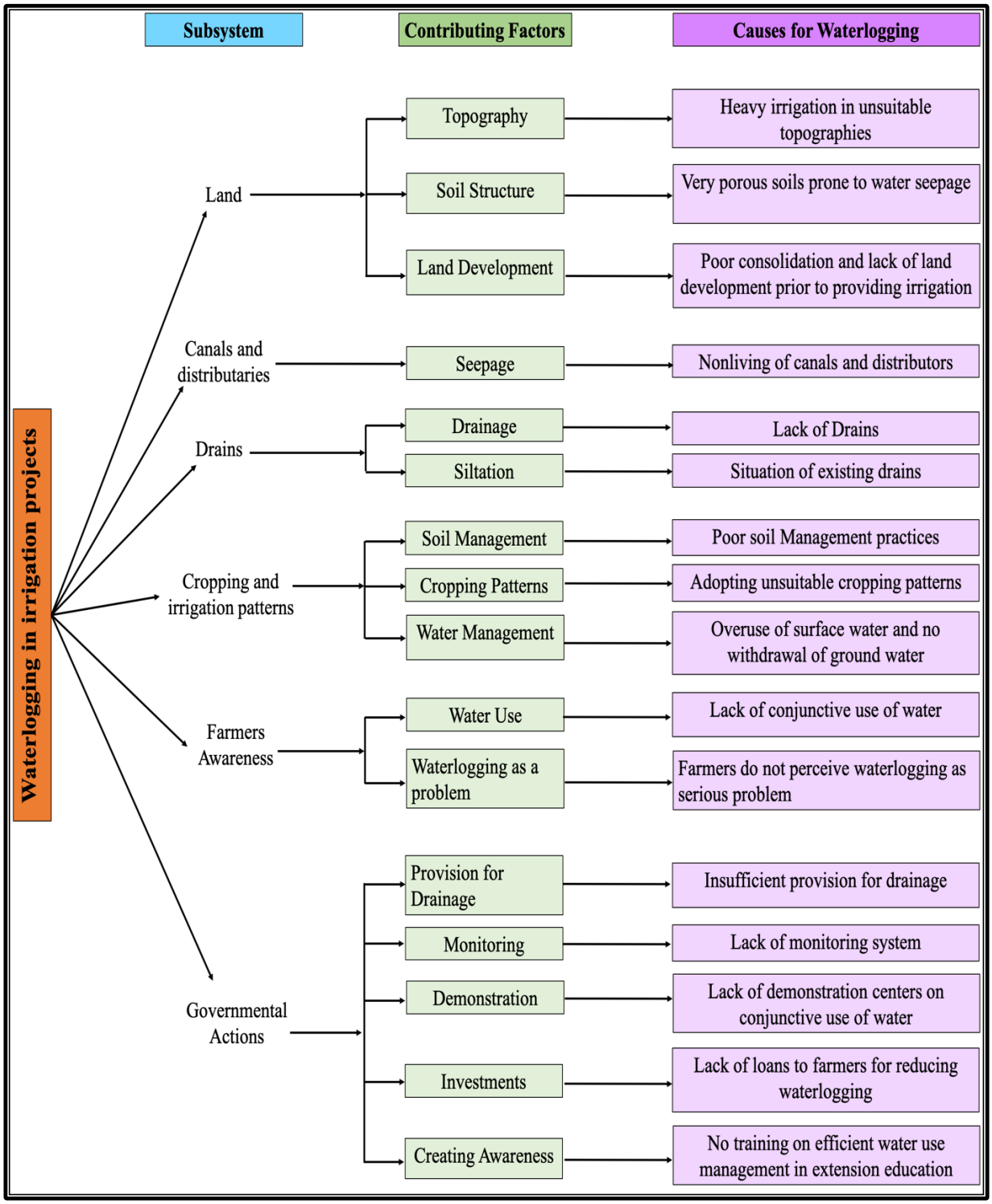
Again, Holden et al. (2009) said about some natural factors; local geology, topography, drainage and the amount of water supplied to a site etc. control water logging. Sahu, (2014) in his research identified the causes of water logging. He also showed the natural and anthropogenic factors as the reason behind water logged situation. He argued that various factors like geological structure, drainage congestion, excessive rainfall, dense haphazard embankments, cyclones, river basin encroachment through siltation, flooding, and finally human activities resulted into water logged situation.

Bowonder et al. (1986) in their research article titled 'Waterlogging in Irrigation Projects' mentioned some important human induced factors responsible for water logging. They marked water logging caused by some interconnected factors; these are: (i) poor drainage provision for surface water; (ii) reduction in the withdrawal of ground water or lack of conjunctive use of ground water; (iii) seepage and percolation from water courses which are not lined; (iv) overuse of water in agriculture caused by poor awareness regarding efficient water use; (v) using crops which are not suitable for the specific soils; (vi) adopting cropping and irrigation patterns not compatible with the area; and (vii) lack of land development prior to the provision of irrigation. They also observed some factors which are accountable for the extension of a water logged situation. They said that the extent of water logging is dependent on topographic factors, soil characteristics, farmers' attitudes and economic factors favoring the use of large quantities of water. Reasons for water logging in irrigation projects are shown in Figure-3.1.

Merot et al. (1995) mentioned two topographic factors for Positional water-logging. They identified those above mentioned factors control the probability of water-logging where water logging increases with the contributing drainage area and decreases with increasing local slope angle Therefore, it is found, water logging is a time and place specific phenomenon. It is most common in an irrigation land. Application of excess irrigation of water than the crop's requirement causes water logging in an irrigation land.

Rainfall is a vital factor for creating water logging and its seasonal and temporal variation. Sometimes, both the rural and urban areas suffer from water logged situation due to excessive rainfall within a very short span of time. Mahmud et al. (2017) also revealed that water logging is a location specific phenomenon which also has high seasonal variations. He added that it depends not only on the amount of rainfall but also on local geologic settings and drainage pattern and mismanagement of it and climate change. Singh and Pandey (2013)

delineated the temporal and seasonal variation of water logging due to rainfall in the North Bihar region of Gangetic Plains. They found a positive relationship between rainfall and surface water logging in their investigation.



(After Bowender et al., 1986)

Figure-3.1: Reasons for water Logging in Irrigation Projects

3.2.2 Polderization: Causation of Water Logging

'Polder' is a Dutch term meaning, enclosure system (Nowreen et al., 2014) to protect a land from inundation. This terminology, "Polder" is widely used in the Water Sector of Bangladesh. It is an area bounded on all sides by an embankment with outlets to control the flow of water into and out of the embankment area. Polderization restrict the water enter into the tidal flat. Because of that sedimentation takes place on the channel bed rapidly. These processes actually make the river bed higher than the adjacent tidal flats and cause inundation in tidal flats and drainage congestion. This is the main cause of water logging and siltation problems in this region (SMEC, 1997 cited in Islam, 2011).

According to the polder Wikipedia there are three types of polders:

a) Land reclaimed from a body of water, such as a lake or the sea bed
b) Flood plains separated from the sea or river by a dike
c) Marshes separated from the surrounding water by a dike and subsequently drained; these are also known as Koogs, especially in Germany.

In WARPO (2009) it is mentioned that, in south western part of Bangladesh CEP constructed high earthen embankments to protect the land from the daily tidal inundation of saline water and to protect it from the monsoon rains and storm floods as well. It is also described the CEP as a complex network of polder, sub-polders, sluice gates, canals.

Bahauddin (2018) described very explicitly about polderization. He opined that Polders make restriction to the river water enter into the wetlands and this water contains lots of sediment, which silt up the coastal wetlands. As a result sediments deposit outside of adjacent polders and riverbeds became high. It is called being '*char*'. Thus riverbeds become higher than wetlands. He added, "Consequently, rainwater never passes completely and it stores inside of the sluice gates. In the store water, some people try to cultivate brackish fish and get more profit than crops. Then gradually spread brackish fish cultivation. So, the total function of CEP is totally altered. Now a day, Sluice gates are used to enter saline water into wetlands through canals for brackish fish cultivation during tide. And pass out saline water during ebb tide. In the monsoon, the adjacent areas become waterlogged. In polders, area of the coastal embankment is affected more or less totally or partially of the southwestern coastal region of Bangladesh".

3.2.3 Impacts of Water logging

Water logging is a disaster, which affects almost every part of human life. It can demise both natural and socio-economic environment of a region. It is not an overstatement to say the direct impact of the waterlogging on livelihoods is massive (Langford, 2014). Bahauddin (2018) warned that if a specific development concept or project neglects local ecological or cultural characteristics of a certain geographic region it may react negatively.

Rahman and Debnath (2015) opined that water logging can cause serious humanitarian crisis as it create challenges in living condition, livelihood, health, food, security, employment, education and communication for a several months. It is important to note that, waterlogging has a close relationship with salinization and/alkalization. As water logging and salinity effects the plant growth and reduce crop production as well, the people who are depends on agricultural activities for their livelihood has become the main sufferer. Moreover, poor drainage facilities in the irrigation system hampered the agricultural lands and agricultural production at the same time. Thus, water logging and salinity creates severe restrictions to the agricultural production which effect life and livelihood badly. Ziad et al. (2016) proved how water logging and salinity reduced agricultural production in Pakistan. The paper explained how plants growth and crop production hampered by water logging and salinity. They found from the investigation that the land which effected by water logging and salinity have decreasing trend of crops production approximately 88% as compared to the non-water logged and non-saline lands. Thus it proved that, water logging and salinity are major problems to the crops and cause great amount of reduction in crops production.

In Bangladesh, agriculture is the most significant livelihood option especially for the coastal people (GOB and UNDP, 2009 cited in Uddin and Nasrin, 2013). According to BBS (2011) it is about 40 million people who are depending on agricultural activities in the coastal areas of Bangladesh. But the coastal agriculture is altering due to the effects of different natural calamities which come frequently such as: cyclones and storm surges etc. and poor management, thus coastal areas have become water logged and saline (Rahman, 1995 cited in Uddin and Nasrin, 2013). Hazards such as floods, river erosion, water logging, drought, cyclonic storm surge, etc. are known phenomena in the monsoon influenced riverine landmass, which is also known for its high population density, flat topography and low elevation; such hazards often give rise to human miseries and bring forth disastrous consequences. As an aftermath of a hazardous event, often beyond the inherent coping capacity of poor households it becomes difficult to maintain livelihoods, which in turn trigger

out-migration (Ahmed and Neelormi, 2008). Neelormi (2005) also opined that, it cannot be utilized the land based production for maintaining livelihoods under a waterlogged conditions, which led to the hunger, loss of livelihoods and later, come out as a determining factor for forced displacement. But the impact of waterlogging is not only focused on forced displacement and aggravates economic hardship, but also imposes on severe healthcare disasters and other social problems (Ahmed et al., 2007 cited in Ahmed and Neelormi, 2008).

3.3 Water logging: Global and Local Issues

3.3.1 Global Water Logging Issues

Bowonder et al. (1986) marked waterlogging as an environmental problem which found throughout the world. Approximately 10% of the global land area is adversely affected by water logging (FAO, 2002; Sing and Pandey, 2013). Sahu (2014) marked it as an environmental issue which needs spatial encounter towards economic management as well as development of an area. He also opined that generally water-logged environment includes flood basins with drainage problem. So, Water logging is very common in our planetary environment but some countries suffer more compared with other for their special geographical location and physiographic settings. Indian sub-continent on account of its geographical position, climate and geological setting is vulnerable to natural hazards (Sing, 2017) and thus, the effects of water logging are most widespread in rice -wheat rotation commonly followed in south and south-east Asia including Bangladesh, Pakistan, India, Nepal and China (Samad et al., 2001 cited in Singh and Pandey, 2013).

On a global scale, irrigation-induced salinity and waterlogging severely affect about 30 million hectares with an additional almost 80 million hectares affected to some extent (El-Ashry and Duda, 1999). Due to the rapid expansion of irrigated area since 1950, the areal extent of the water logging problem is increasing worldwide (World Bank 1992; UNEP 1997 cited in Singh and Pandey, 2013). The Indo-Gangetic plains is occupied nearly 13% of the total geographical area of the country where about 50% of the total food grains produce to feed 40% of the population of the country (Srivastava et al., 1994 cited in Pandey et al., 2010). During the Paleocene time, the Indo-Gangetic foreland basin was developed by the crash of Indian and Eurasian plates (Besse and Courtillot, 1988 cited in Singh and Pandey, 2013), which is one of the largest fluvial plains in the world with active sedimentation. Pandey et al. (2012) opined that in the Gangetic Plains of north Bihar due to recurrent flooding, water logging and subsequent soil salinization is appeared as the major hazard. They

also added, there is massive increase found in water logging in the northern Bihar plains as an increase in waterlogging from 31 sq. km during 1925 to 102.59 sq. km in 2006. According to INCA (1976) in India, an estimated 6 million hectares land is subject to waterlogging of which, 3.4 million hectares are waterlogged due to surface flooding and the rest of the area i.e. 2.6 million hectares due to rise of ground water table.

Singh (2013) noted that at present the new technologies are mostly use in agriculture which increased the demand for water, chemical fertilizers, insecticides and pesticides. As a result the problem of water logging, water depletion and soil salinity also rise up at the same time. The creation of canal irrigation has made some region surplus in food grains but at the same time this gave birth to the serious problem of waterlogging and poor drainage which further leads to socio-economic losses to the rural population. Kerala is the southernmost state of India situated in low-lying areas and well known for rice production. But these areas have serious problems of water logging as it situated below the mean sea level (Jayan and Nithya, 2010).

In Pakistan, 2.2 million hectares (Federal Bureau of Statistics 1984) are waterlogged, and it is increasing at the rate of 40,000 ha per annum (Bokhari, 1980 and Dettmann, 1983 cited in Bowonder et al., 1985). It has been estimated that water logging and salinity affects 25% of irrigated land in Pakistan, reducing crop yields (Yudelman, 1989 cited in Ziad et al., 2016). Moreover, 48% of the soils in Sindh, 18% in Punjab are strongly affected by salinity and water logging (Khan, 1991 cited in Ziad et al., 2016).

Khan and Chaudary (2003) noted that besides Pakistan, water logging is very acute in Iraq, India, Argentina, Mexico, Mali, North Africa and western U.S.A. They also informed based on a report from 1988, in seventeen western states of U.S.A agricultural productivity reduces because of salinization from 25 percent to 35 percent in all irrigated land.

In China, Egypt, Peru, Argentina, Afghanistan, Kampuchea, Vietnam, Syria and Iran the extent of the problem has been increasing (Barney, 1980; Eckholm, 1976; Elgabaly, 1980a, b, pp. 47-66; Holdgate & White, 1977; Polunin, 1979; Ruddle & Manshard, 1981; Smil, 1982 cited in Bowonder et al., 1985). McDonald (2018) informed us, water logging is mainly found in the western part of Australia. Basically it is widespread in winter in the agricultural areas of and is a major factor reducing crop yields, especially in wet years. Author also identified the areas are more susceptible to water logging. He observed that a land with higher rainfall

(mostly greater than 450mm), low relief and low in the landscape are more vulnerable. He also informed that, about 1 million hectares or 5% of agricultural land has a high to very high water logging vulnerability and due to inundation in the agricultural areas of Western Australia the estimated annual opportunity costs of water logging from 2009/10 to 2013/14 was $35 million. Beside this In Australia, the south eastern parts of the country have also been affected by these problems. Agricultural activities, particularly in Murray-Darling Basin, about 96,000 hectares of land have been damaged by salinity and 500,000 hectares may be affected in the future (Jones, 1989 cited in Khan and Chaudary, 2003).

In Canada, water logging and salinity are found in different part of the country. Water logging occurs in the humid arable areas of eastern parts of the country and salinity occurs in the dry and irrigated farming areas located in the south of western provinces of Manitoba, Saskatchewan, Alberta and British Columbia hampering the crop production. About 2.5 million acres of the farm land of Alberta only is affected by this problem, whereas the data about other areas is not available (Broughton, and Paterson, 1989 cited in Khan and Chaudary, 2003).

3.3.2 Local Issues of Water Logging in Bangladesh

Currently, environmental problems are most important issues and acute in of the most countries. These are increasing day by day in many parts of the world. Our future generation is going to face more serious environmental problems and the scenarios could be more alarming in developing countries. The major challenge will be to keep a balance between development and environment. Water logging is one of the problems which will cause devastating effects on human. It is a serious problem especially for developing countries. The human being suffers directly or indirectly from water logging.

Water logging is major water related problem in Bangladesh in the 21st century and considered as a disaster. Flooding is very common part of the life as water logging appears as the after effect of it. Water logging is one of the major problems in urban areas now. With intense growth of population and unplanned urbanization, the drainage and sewer facility are not developing accordingly. Tawhid (2004) highlighted, in last 25 years, rapid unplanned urbanization took place in Dhaka. Considerable increase in built-up areas took place due to insensitive developments of areas at private, land developers and real estate business. Huq and Alam (2003) highlighted that built-up areas resulted in substantial increase in impervious

area, obstructed the natural drainage pattern, and reduced detention basins. The consequence is the shortening of the runoff concentration time and an increase of the peak flow. It resulted in flooding due to rainfall and caused severe problem for Dhaka city. Ultimately causing the city inundated after each severe shower mainly due to the drainage congestion. Mark and Chusit (2002) cited in Mowla and Islam (2013) expressed that the city experiences water logging for last couple of years creating large infrastructure problems and existing property and goods damaged causing a huge economical loss.

In Bangladesh, it is very common to form of water logging in any locality due to heavy rainfall. Heavy rainfall recorded between 3 and 5 July, ranging from 119 to 159 millimeters. It has triggered water logging in *Matarbari* union of *Maheshkhali* Upazila in Cox's Bazar (Bangladesh Meteorological Department 06/07/2018). 22 out of 31 villages, are water logged and inundated, affecting an estimated 10,000 to 15,000 people (Government D-Form 08/07/2018) (Start Network, 2018).

3.4 Historical Background: The Perennial Water Logging in Bangladesh

In general, water is both lifesaving and life killing. Life cannot exist without water. People suffer seriously when there is shortage of water. Again, with excessive water, people die for natural calamities like flooding, tsunami, tornado etc. The people of southwest coastal region of Bangladesh suffer from these complete disasters. Millions of lives in this region become inactive and fight against water. It is surprising to see that these are truly manmade factors.

Suffering of the people of south western Bangladesh from various natural disasters has a long history. Especially water logging is one from which people cannot find any way to escape. The suffering continues over several decades and the miserable conditions of people are unthinkable for this perennial water logging. The situation becomes very harsh and there remains no other option but to suffer. The dimension of water logging problem was little at the initial stages but slowly increased over the years (IFI WATCH, 2006 cited in Awal, 2014).

3.4.1 Traditional Water Management Practice: *Zamindar* Period (Before 1960)

Historical evidence suggests that irrigation and drainage systems were existent since the time of Indus Valley Civilization which flourished between 3300 and 1300 BC (Kenoyer, 1998 cited in Begum, 2011). Before 1960 in *zamindar* period, local people developed an indigenous knowledge system of water and river basin management uniquely adapted to the natural process. In that time, temporary earthen embankments, low dykes and wooden sluice gates around the cultivable area were constructed by the *Zamindar* to protect the arable land from saline water intrusion. In the rainy season, farmers exchanged saline water of their fields with river water when it became almost sweet (Islam and Zakir, 2006). *Zamindars*, or landlords, who were awarded rights of revenue collection to this new coastal land, they were responsible for the construction of temporary earthen embankments during the eight dry months of the year to protect these agricultural lands from saline ingression (Dewan et al., 2015).

Noor (2018) highlighted that communities took part in the construction of these small earthen embankments (bandhs) through compulsory labor. They also maintained the canal structures jointly with the *zamindars*. The *zamindars* supervised the work and arranged the wages for the workers when needed. However, construction of temporary earthen embankments did not disrupt the natural process of the tidal flooding as during monsoon. Natural river floods would sweep away these temporary embankments and a new one would be built after the recession of the floodwater. Tidal flood balanced the land level as silt carried with the water was deposited throughout the floodplain. These deposited sediments raised the land level of the wetland by balancing subsidence. This earthen embankment was known as '*doserbadh'* (community constructed the embankment) or '*Ostomashibadh'* (embankment for 8 months) (Nowreen et al., 2014 cited in Noor, 2018). This traditional community-based practice, based on "solidarity economy" and indigenous ecological knowledge, resulted in a balance between sedimentation and land subsidence in the area. The unique practice of "overflow" irrigation and wise use of sediment by the farming communities in the Bengal delta was noted by pioneer colonial researcher Sir William Willcocks (1930). He said that overflow irrigation causes the nutrient-rich, sediment-laden monsoon floodwaters from the upper regions of the various rivers flowing into the Bay of Bengal. Those were distributed evenly over the delta and helped even distribution of watering, nutrient-rich sediment and fish over the countryside. The shallow canals with minimal earthen embankments that were dismantled in the yearly monsoon seasons were managed through the flow of floodwater. The dismantling caused even

more flooding. The canals also drained the land, preventing water-logging. He further noted that the prime issue of river basin management in Bengal delta had effective management of sediment. But water resource planners and engineers neglected this illuminating observation (Willcocks, 1930 Cited in Islam and Kibria, 2006). However, the disturbance to this well-adapted water management system started in the 19th century. The colonial water management system constructed through railways and irrigation branches negatively affected (Willcocks 1930, cited in Begum, 2011).

3.4.2 Disruption of Indigenous Water Management Practice: Emergence of Colonial Period (From 1960)

In 1950, the *zamindar* system was abolished, after the partition of India. The uncertainty following the partition and gap in leadership coincided with the disastrous floods of 1954, 1955 and 1956 (Dewan et al., 2015). Gradually the temporary embankments were breached and became ineffective and farmers were unable to cultivate crops due to tidal flooding. After the devastating flood of 1954-1955 an international mission (Crook Mission) was sent under the United Nations to solve the flood problems of the East Bengal (Present Bangladesh) and installment of CEP by Water and Power Development Authority (WAPDA) was an initiative to solve the problem (WARPO, 2019).

In the 1960s a centralized state water bureaucracy was established following the Crook Mission report. According to the recommendations of the report, East Pakistan Water and Power Development Board (EPWAPDA) was established and irrigation department merged with it (Kibria, 2005). The polder/enclosure system was developed and implemented in line with the "green revolution" paradigms of "grow more food" to promote cultivation of high yielding variety crops in dry lands with controlled irrigation (Adnan, 2006 cited in Sarker, 2012). The strategy was to increase rice crops, particularly 'Aman' rice during the monsoon. This single objective was focused on satisfying increasing national demand (Chowdhury et al., 1997). According to Bahauddin (2018), in 196 0, during the 'Green Revolution', Govt tried to increase rice production of coastal wetlands from the salt water. CEP was implemented to protect coastal wetlands from the salt-water. The project was funded by a number of donor agencies and was completed in 1973 (Rezve, 2006). Under CEP high earthen embankments were constructed to protect the land from daily tidal inundation of saline water and to protect it from monsoon rains and storm floods (Nowreen et al., 2014).

However, in 1961, CEP started under USAID funding to the EP-WAPDA/BWDB (Dewan et al., 2015) to construct 139 polders in the entire coastal belt of Bangladesh. Of these 136 polders 10, 14,100 acres are in the Khulna-Jashore region. In the south-west region alone, 1566 km of embankments and 282 sluices were constructed (WARPO, 2019). Thirty-seven polders/enclosures were constructed in *Khulna*, *Satkhira* and part of *Jashore* districts (Ali and Ahmed, 2001). 21 vent *Bhabadaha* Sluice Gate- one of the important structures of the design which is now the source of the pains for millions of people (IFI WATCH, 2006). Sluices were built to drain accumulated rainfall from the polders by gravity flow during the periods of low tide level (Noor, 2018).

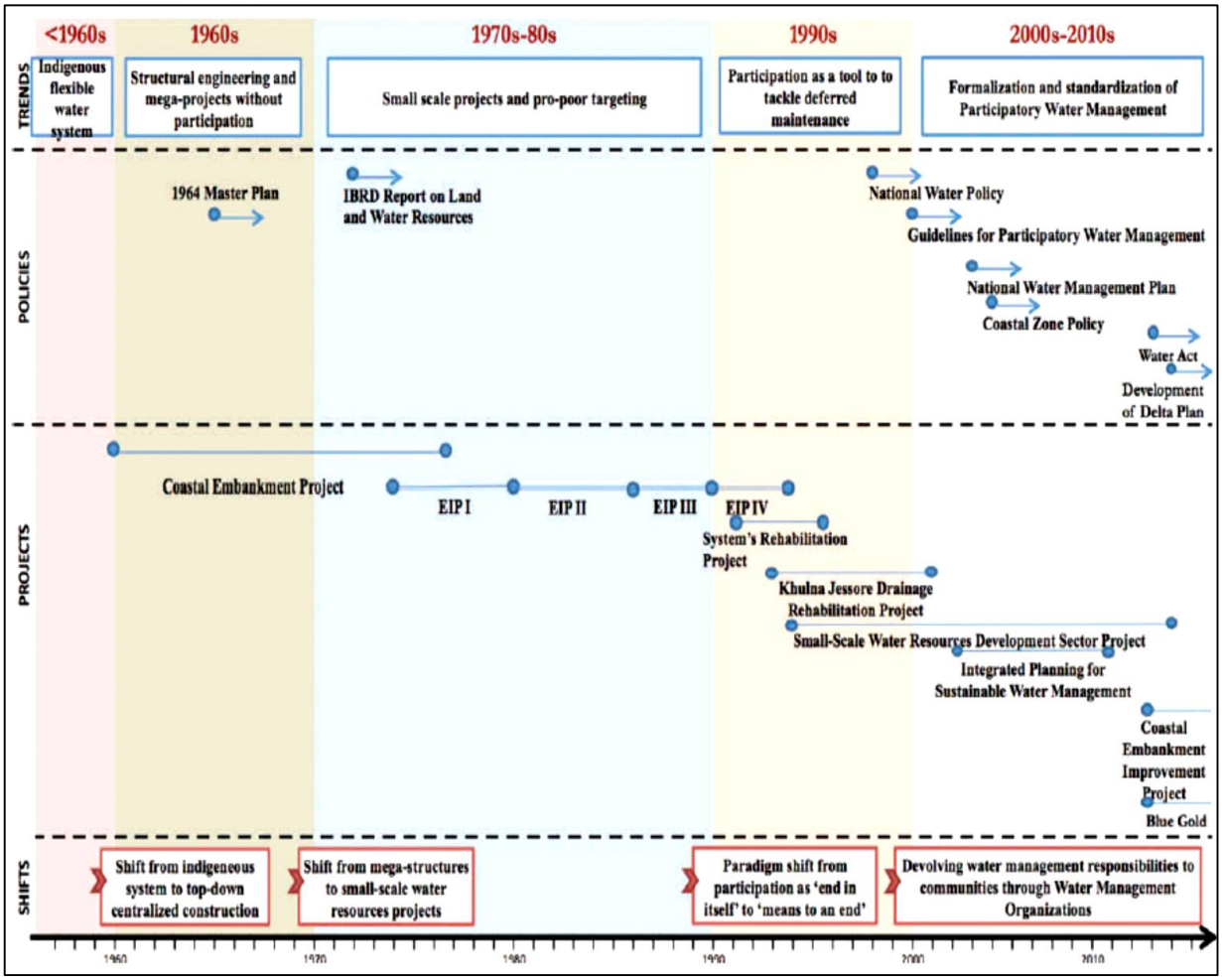
3.4.3 Small-Scale Projects and People's Participation (1970s)

In the 1970s, it became clear that implementing a system inspired by Dutch dykes (polders) in a country with an active delta was problematic. To address the criticisms of top-down engineering in water management, donors again played a key role in reshaping Bangladesh's water policy (Dewan et al., 2015). International Bank for Reconstruction and Development recommended non-structural measures for flood management and attached high priority to low-cost, labor-intensive projects like low embankments, low lift pumps and shallow tube-wells (World Bank, 1972 cited in Dewan et al., 2015). This changed the approach led to implementation of a number of small-scale projects under the flagship program of the Early Implementation Project (EIP). A collaborative project between the governments of Bangladesh and the Netherlands, the EIP started in 1975 and continued until 1995. The projects were characterized by quick implementation of small-scale flood control, drainage improvement and irrigation schemes (Dewan et al., 2015).

3.4.4 Advent of Polderization Effects (1980s to 90s)

The polder system worked well by denying entry of saline water within the polders for 10-15 years, as the land was developed intensively. It increased the agricultural production significantly until the mid-1980s and continued till mid-1980s. So, it was evident that the scale of production was increased by the polder system. Approximately the yields were increased by 200%- 300% (Nishat, 1988 cited in Nowreen et al., 2014). Thus, polderization increased the crop production. In addition, there was an increased belief that the polders encouraged more and more people to settle inside them. It resulted in the rapid increase of the population in the coastal areas (Dewan et al., 2015; IFI WATCH, 2006). It took 10 years to

expose the adverse effects of the polders. Due to siltation, many drainage canals became inoperative, causing large amount of lands water logged all year round (IWM, 2007 cited in Nowreen et al., 2013). Rezve, 2006 identified that the people experienced a decrease in biological productivity of those areas, particularly fish production started to decline. He added, a more serious consequence of the project started to surface in the mid-1980s when the upper portion of the tidal wetland was experiencing water logging. The embankments denied the entry of the tides into the polders. Consequently, the heavy loads of silt carried by the tides settled on the riverbeds. Gradually the bed rose above the level of the lands within the polders and closed the exits of the sluice gates. Again, the polders continued to subside, without compensating silt deposits, which used to maintain the balance (IFI WATCH, 2006). In the post embankment period, sufficient tidal water could not enter into the tidal plain. It caused the silts to get rapid deposition at the upper ends of the estuary and gradually the river-beds began to rise. Inside the polders, the wetlands subsided due to subsidence and non-deposition of silt and gradually took the shape of lakes. Eventually, over 106,000 thousand hectares of land became permanently water logged (Sarker, 2012). Between 1980s to 1990s, water logging covered more than 100,000 ha (Dewan et al., 2015; Noor 2018). Chronological development of waterlogging and formulation of policies is shown in Figure-3.2.



(After Dewan et al, 2015)

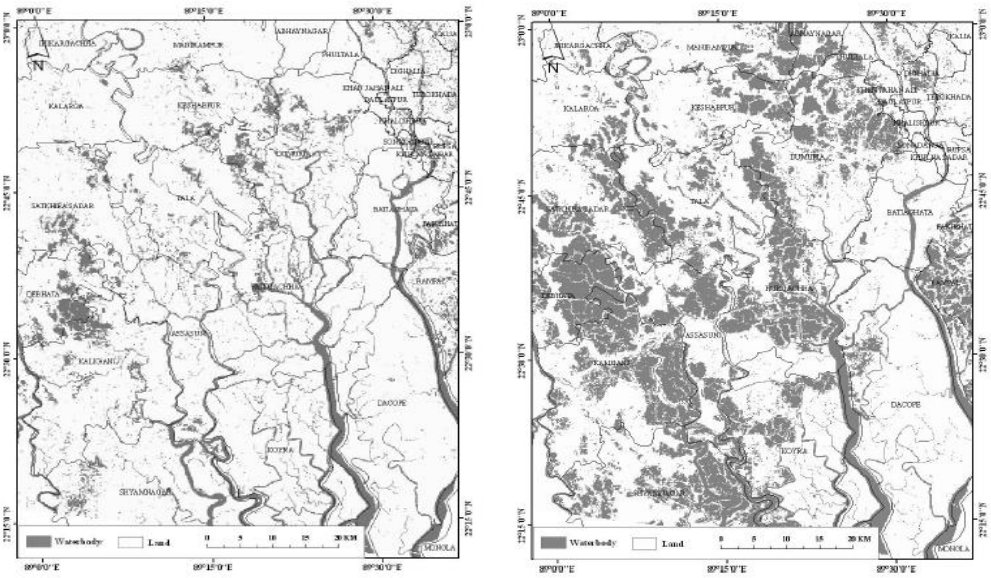
Figure-3.2: Timeline of Projects, Policies and Trends

3.5 South Western Bangladesh is the Worst Sufferer

The southwest coastal region of Bangladesh has been identified as one of the most vulnerable areas to various kinds of natural disasters in the world. The people of this region are suffering for long due to those disasters. (Awal, 2014) identified water logging as a new problem in south-west coastal region of Bangladesh since the beginning of the 21st century. Three south-western coastal districts of Bangladesh namely *Satkhira, Khulna and Jashore* are the worst affected areas and experiencing long lasting water logging and remain submerged every year, especially during the monsoon (UNDP, 2011). The coastal (south west) districts of Bangladesh have been demarcated into three adjoining regions, as south-west constituting *Satkhira, Khulna and Bagerhat*; south-central comprising *Jashore, Patuakhali, Noakhali* and *Barisal*, and south-east consisting of *Chittagong and Cox's Bazar* (BCAS, 2010 cited in Gazi, 2019).

The severity of water logging problem identified in 274 villages of 17 unions under Khulna, Jashore and Satkhira districts (Masud et al., 2014). In Bangladesh about 8,000 hectares of waterlogged lands exist in *Khulna* and *Jashore* areas (BARC, 1991 cited in Edrish et al., 2017). Water greatly influences the lives and livelihoods of the people in the South-western region of Bangladesh. As a resource, water offers huge potentiality in this region by providing income and employment opportunities to most of the people. Local economy in this region is predominantly a fishing economy, which integrates the region's economy into the national and international economy. Contrarily, water resources have particularly detrimental impacts on the peoples' lives and livelihoods, and on biodiversity and environment. In that sense, water is a blessing as well as a curse for the South-western region of Bangladesh (Masud et al., 2014).

According to Rashid et al. (2013) southwestern coastal region of Bangladesh is a part of Ganges-Brahmaputra Delta. Being a part of world's largest delta (Bengal Delta), the river system carries a huge amount of water and sediment. Akter et al. (2015) said, "It drains almost all of the Himalayas, the most sediment producing mountains in the world, through the three main river systems: the *Ganges, Brahmaputra*, and *Meghna*". These rivers are naturally characterized by active deposition of sediment in riverbed. It reduces the drainage capacity. Moreover, coastal polders delinked the flood plains from the rivers, and diminished upstream flow during the dry season and deteriorated the sedimentation problem (Kamal et al., 2018). Natural disasters like cyclones, tidal surges, floods, repeated water-logging and land subsidence are common in this part of Bangladesh. These shaped the lives and livelihood patterns of the people living in these areas (Dhaka Ahsania Mission Regional Strategy Paper). Analyzed data of different time series indicates that, in the south-western coastal part of Bangladesh, specially, *Khulna, Satkhira* and *Jashore* areas, water logging has been increasing during the last 34 years (Figure-3.3). In 19 November 1978 about 107616 hectares area were water logged but in 8 November, 2011 water logged area is about 216297 hectares. During the period 1978 to 2011, increasing rate of water logging is about 3196 hectares/year (Rashid et al., 2013).



19 November, 1978 8 November, 2011

Figure-3.3: Water logged area of *Khulna, Satkhira* and *Jashore* districts in 19 November, 1978 (Landsat MSS image Classification). (After: Rashid et al., 2013)

Recent field study showed that from *Sadar, Tala, Kalaroa, Debhata* and *Asasuni* upazilas of Satkhira District about 48, 69, 36, 55 and 39% of the total population respectively; about 19, 11, 3 and 19% people respectively were water logged. Again, from *Keshabpur, Manirampur, Abhaynagar* upazilas of Jashore District; and 19% population from Paikgachha Upazila of *Khulna* District were affected by water logging during the 2011 monsoon (Awal, 2014).

In *Bhabadaha*, water is a symbol of suffering, hunger, disease, and death. The perennial water logging triggered from *Bhabadaha* point affects mainly three upazilas – *Abhaynagar, Manirampur* and *Keshabpur* home to some 10 lakhs people (Habib & Adhikary, undated). For the heavy pour of September and November in 2005, around 10,825 hectares of cultivable land of 184 villages of *Abhaynagar, Manirampur* and *Keshabpur* Upazila under Jashore district went under water. Only in Jashore district 250 km village path and 32 km road have severely affected (IFI WATCH, 2006). It is evident that in the year 2006 Jashore district was the worst affected where about 19,171 ha area was water logged due to siltation of *Teka* (*Muktessori)-Hari* River (FAO, 2015).

Table-3.1: Upazila-wise Affected People due to Water logging under KJDRP (2006)

Ser No	UZ	Affected Union	Affected Village	People in the UZ	Affected People
1.	Abhaynagar	4	42	1,36,146	68,848
2.	Manirampur	11	90	3,71,529	1,40,697
3.	Keshabpur	6	61	1,66,257	1,03,500
Total		21	193	6,73,932	3,13,045

(After Paul et al., 2013)

According to ECB, 2011 cited in Khadim et al., 2013, people affected by water logging in *Jashore* currently ranges from 2% - 20%, whereas in *Khulna* the number is around 10%. In 2011, around 35% - 70% population were found affected due to water logging at different sub-districts in *Satkhira* (located in the West of *Khulna*).

Table-3.2: Comparison of Water-logging Problem in the Year of 2003 and 2008

Damage/Loss	2003	2008
District	*Jashore* and *Satkhira*	*Jashore*, *Satkhira* and *Khulna (*part*)*
Upazila	*Jhikargacha, Manirampur, Keshabpur*	*Jhikargacha, Manirampur, Keshabpur, Kolaroa, Tala* and *Paikgacha*
Union*	16	55
Affected Villages*	73	426
Waterlogged Area*(km^2)	126.87	223.89
Affected People*	101800	845000

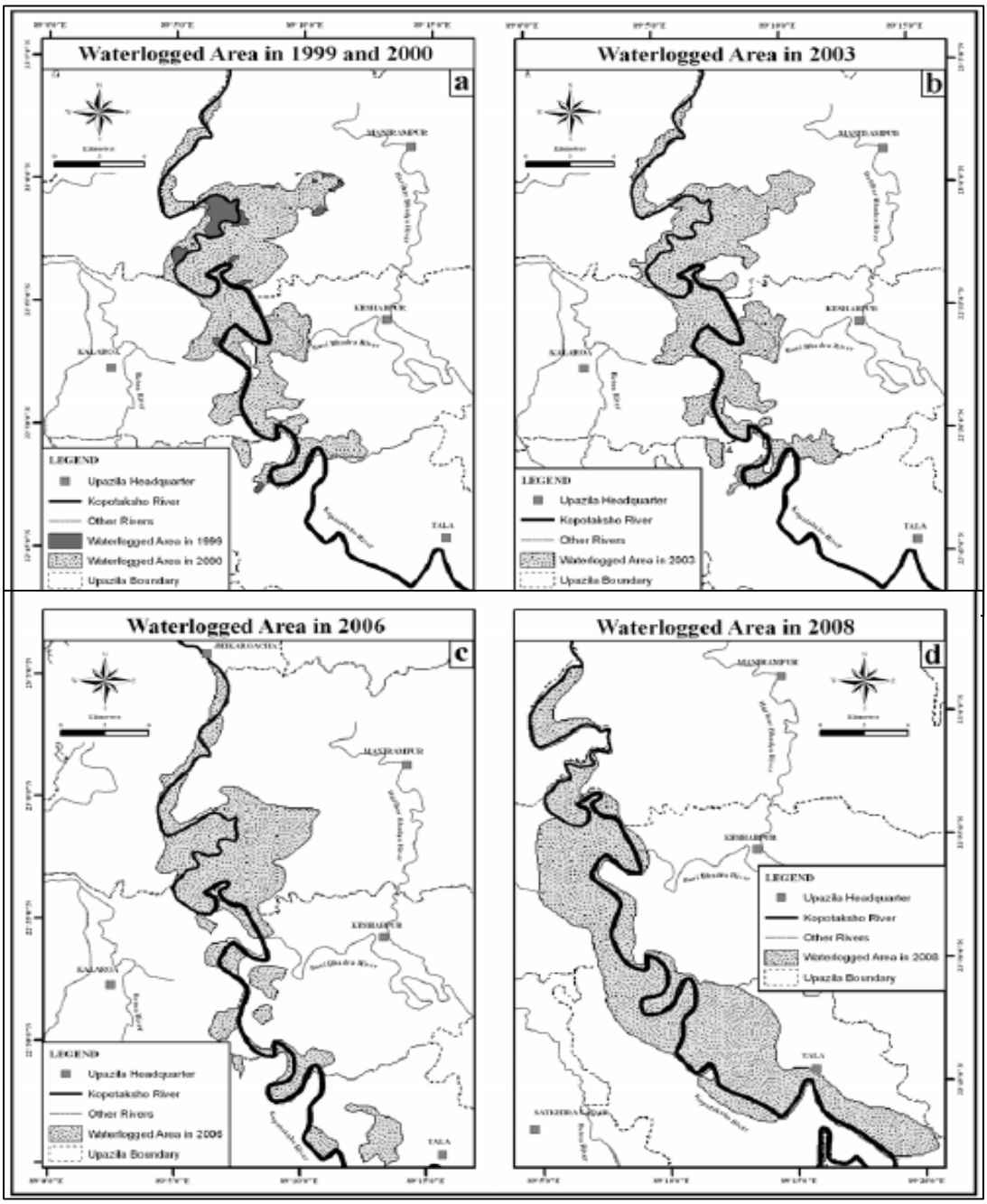
(After Rahman et al, 2010)

Since 2000, water logging had been a regular phenomenon for the hundreds of villages adjacent to the *Kopotaksho* River in Jashore and Satkhira district of Bangladesh. The satellite image analysis revealed that over the years, water logging increased significantly, (Rahman et al., 2010) which is given in Figure 3.4.

Table-3.3: Inundation between 1999 to 2008 at the *Kopotaksho* Basin Area (From Satellite Image Analysis)

Water-logging Extent	Year				
	1999	2000	2003	2006	2008*
Water-logged Area (km^2)	8.65	128.67	122.38	117.23	194.67

(After: Rahman et al., 2010).



(After: Rahman et al, 2010)

Figure-3.4: Water logged area over the years from 2000 to 2008;

The people of these areas constantly lost assets, become highly vulnerable as the victim of disaster. They were forced to change their livelihood pattern and socio-economically they are now very poor (ESWAP Completion Report, 2012). View of Waterlogging at *Keshabpur Upazila* during 2011 is shown in Photo-1 at Annex A.

People of that region suffer a lot and get affected by various water borne diseases. The healthy sanitary systems totally collapse during water-logging period. Social environment, local economy, and ecology hampered and degraded due to prolonged water-logging. In addition to these problems, damages of agriculture crops have been shown to be a major disaster due to water logging (Hasan and Mahmud, 2014). According to WARPO (2005) cited in Hasan and Mahmud (2014), the nearby river bed and sediment system were interrupted which causes intensifying the waterlogging situation. People of *Keshabpur Upazila* are highly vulnerable to water logging for several years. Almost eight months in a year most of the area is inundated. The worst hydro-geophysical vulnerability has been found in *Keshabpur Thana* of Jashore District where most of the land is waterlogged for over seven years (Adree and Islam, 2010). The area is flat and majority of the land is within one meter from mean sea level. Again, a large proportion falls below the high-tide level (Islam, 2005 cited in Edrish et al., 2017). This continuous water logging brought serious damage to the infrastructures related to agriculture, forestry, fisheries, livestock and other physical setups. People of *Keshabpur Upazila* are more vulnerable, because they are highly dependent on the natural resources for their livelihood. (Edrish et al., 2017).

3.5.1 Reason behind Perennial Locked Life in South-West Bangladesh

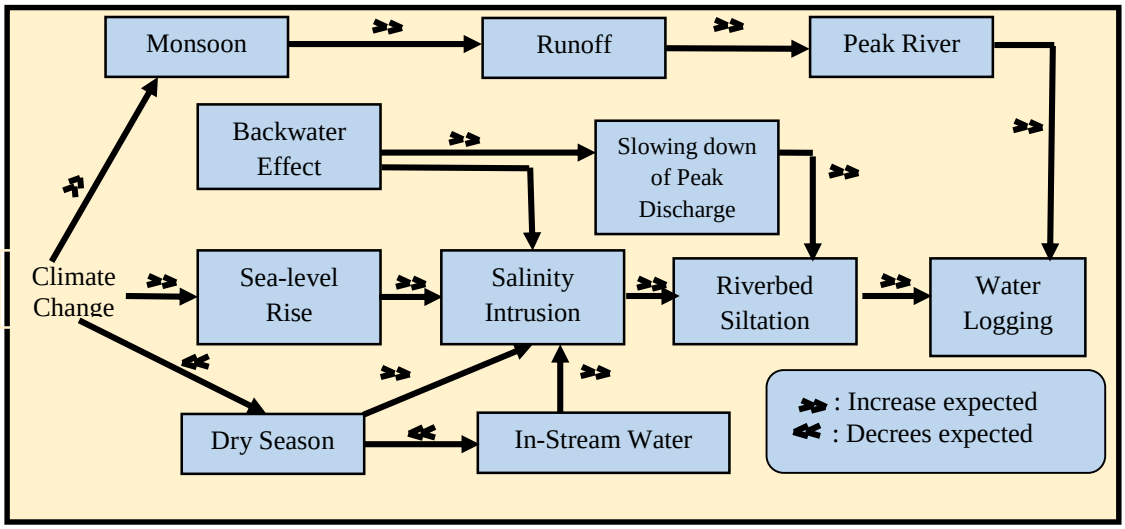
There are a number of researches where the author gives opinions on the reasons behind the water logged situation in different parts of south western region of Bangladesh. From those literatures, it is clear that the reason is mainly human induced. Some of the studies focused on such anthropogenic activities like, polderization through construction of embankment, dam etc. have disrupted the natural land building process and have caused waterlogging in the southwest region of Bangladesh**.**

Rahman et al. (2010) opined that, construction of bridges narrowed down the river sections. Cross dams constructed for different purposes over the years aggravated the situation further. Rejve (2006), in his research also mentioned that, the construction of embankment is the reason of sedimentation. He opined that, this process ultimately raised the riverbeds in comparison to adjacent *beel* or wetlands. Due to non- deposition of sediment, the wetlands subsided and gradually took the shape of lakes and over 106,000 hectares of land became permanently waterlogged. Williams (1919) cited in Rahman et al. (2010) suggested that all the structures planned for the tidal River system should be done cautiously.

Perennial water logging caused by the excessive riverbed sedimentation became the most menacing crisis to the people of South-West region of Bangladesh (Rezaie et al., 2013). Awal (2014) identified the major causes for water logging as rising of riverbed due to siltation. It influenced the upstream river flow by the human intervention, as well as deprivation of floodplain (low land, locally so called *beel*) and silt deposition due to embankment or polderization. Shampa and Pramanik (2012) also said that these troublesome sediments have blocked the rivers and caused upstream drainage congestion and flooding. Top water expert of the region, Tutu (2005) provides a historical description of the cause and consequences of the waterlogging problem in the region. He said, the south west coastal area is part of the tidal floodplain bounded in the north by the Ganges floodplain. In the south it is bounded by the Sundarbans mangrove tidal forest. The tidal floodplain is strongly influenced by tide, salinity and rainfall. This plain is also crisscrossed by numerous tidal creeks or channels and has high drainage density. Naturally, the rivers carry both sweet water from upstream and tides from the sea. The major portion of the floodplain is low-lying, barely one meter above mean sea level and below high tide level. Homesteads, roads, vegetable gardens and orchards were developed on areas artificially raised by digging ponds and ditches.

Kamal et al. 2018 focused on some cases where manmade activities like polderization, dam construction etc. have disrupted the natural land building process and have caused persistent water logging in the south west region of Bangladesh. Coastal Polders constructed in this area without considering the morph dynamics, geological conditions and tectonic of the area. The land and water management of each geologic and geomorphic unit is different from other units. Moreover, the morph dynamics of the boundary zone of two or more units is very complex. During construction of the polders, authority did not consider these units. Due to overlapped polders, morph dynamics become very complex. Ultimately, it causes different types of problems such as water logging, siltation, etc**.** (SMEC, 2002 cited in Islam, 2011).

Ahmed et al. (2007) blamed climate change for water logging and showed the schematic pathway (Figure-3.5) of water logging which will be intensified in the southwest region.



(After Ahmed et al., 2007)

Figure-3.5: Schematic pathways of water logging aggravated due Climate Change

In the south west region of Bangladesh, River *Kopotaksho* is one of the main arteries of the water resources system. Numerous existing drainage channel/*khal* in south-west region drain out water through this river. It drains out water from an area of about 1,067 square kilometer spread over nine upazilas in *Jhenidah, Jashore, Satkhira and Khulna* District (Rahman et al., 2010**).** Main causes of the water logging were identified as unplanned and unauthorized structural interventions and constructions (roads, settlement) and regular encroachment of natural drainage system at the upstream and downstream of the *Kopotaksho River* due to overpopulation (Rahman et al., 2009).

Water logging affects the people's life and livelihood of south western region of Bangladesh in many ways. *Rajnagar Bankabarsi* is a village of *Jashore* district under *Keshabpur upazila* also a part of the region under the 24 polder and suffers from waterlogging for several years which causes significant damage to the life, natural resources, agricultural production and infrastructure in the study area. In Shushilon (2012) also marked siltation in the river bed as the reason of water logging. He also identified the most common problems were water logging and siltation of the canals and rivers. View of siltation on riverbed and water logging problem is shown in Photo-2 at Annex A.

In the final report WARPO (2019) water logging causes in south western region of Bangladesh are mentioned. These are as follows:

a) Change at the entrance of Ganges River.
b) Death of the Mathabhanga River.
c) Farakka barrage.
d) River banks encroachments and poorly constructed infrastructures.
e) Unplanned aquaculture.

Sarker (2004) cited in Islam (2011) also blamed Farakka Barrage for water logging. Farakka Barrage on the *Ganges River* caused a sudden decrease of flow below the Ganges River known as the Padma River and its distributaries. Just after withdrawal of the Ganges water by Farakka Barrage in 1976, the rate of siltation on river beds increased tremendously specially, in the Ganges tidal plain. Ali and Syfullah (2016) cited in WARPO (2019) reported that sluice gate operation and maintenance play a vital role along with the hydrology and hydraulics of the river system causing water-logging problem in the southwest region.

3.5.2 Polder Development in Jashore, Keshabpur

Shushilon (2012) described about the polder development in *Jashore* District. According to the report, Polder 24/G comprised mainly four Union Parishad areas of *Keshabpur* Upazila, district *Jashore*. Other polders had distinct geographical boundaries and surrounded by riverbank embankments, polder 24/G lacks such precise boundaries.

To get a clear boundary of the polder area in the study, it combined the IWM map and LGED Upazila map. In the report it was mentioned that, river Hori from Keshabpur Upazila headquarters to *Chuknagar Bazaar* formed the western boundary; the southern boundary was River *Buri Bhodra from Chuknagar Bazar* to River *Shree Nodi* and eastern boundary was *Shree Nodi* which was also the district boundary between Jashore and Khulna. The northern boundary was unclear, particularly in the northeast as the wetland areas there (beel belonging to two *Upazilas, Keshabpur and Manirampur*) were not bounded by any embankment or road. In the northwest, *Keshabpur Panjia Upazila* road formed the north boundary but in the north-east there was no such boundary. On the whole, the polder area was located about 50 km southwest of Jashore and 30 kms west of Khulna city and was connected to both cities by regional highways. Location of Polder-24/G is shown at Figure-3.6.

(After Shushilon, 2012)

Figure-3.6: Polder Area 24/G

Jashore-Chuknagar-Satkhira regional highway passes through *Keshabpur* Upazila town located in the northwest part of the polder. This highway is only about 500 meters west of the polder's boundary in the southwest and almost parallel to the polder boundary formed by the left bank of the *River Hori*. Another major highway, *Khulna-Chuknagar-Satkhira* is located only 0.5 to 3 km south of the polder's southern boundary formed by the River *Buri Bhodra*.

It was also mentioned in the report that, the then East Pakistan Water and Power Development Authority (renamed BWDB but still locally known as WAPDA) constructed embankment (along the right bank of *Shree Nodi* in the east and the left bank of *Hori Nodi* in the west and *Buri Bhodra* in the south) in 1958. The objective was protecting crops from flood and tidal surge. Crop area and yield increased in the 1960s but in the late 1970s to mid-1980s the rivers silted up and water logging increased. WAPDA embankment was constructed during 1959-63 and crop production increased following it for several years but problem arouse as rivers silted in the 1980 and 1990s. After silted, rivers inside the polder have been occupied by the adjoining land owners further aggravating drainage congestion.

The above information reveals that the "WAPDA" embankment was constructed in the first half of 1960s. It also reveals that after the construction, crop production increased but the rivers and canals silted causing increased water logging and subsequent water logging. As a result, crop production decreased and gradually aquaculture *gher*, both shrimp/prawn and fish increased from 1980s and ultimate aquaculture became main agricultural activity.

3.5.3 GOB and NGO's Participation

Waterlogging affects almost all sector of human life including agriculture, occupation, fish production, grazing land, bio-diversity, live-stocks and many more. This disaster may collops human life completely. People of south western part of Bangladesh are suffering from water logging for last 2 decades. A number of agencies and programs have been trying to analyze and address the underlying causes of water logging within their fields of expertise. These include the BWDB; LGED; the Comprehensive Disaster Management Program (CDMP) of the Department of Disaster Management; local-elected bodies such as the Upazila and Union Parishads; the relevant District administration; and a number of NGOs with operations in SWB such as Shushilan, Uttaran, Agrogoti, Bhumij Foundation, Samadhan, Rupantar, Dhaka Ahsania Mission, BRAC, Grameen Bank, SUS and Paritran. In addition, there are programs of international NGOs like Oxfam, Islamic Relief, ACF, Solidarities, Christian Aid, World Vision, etc. as well as UN agencies UNDP, FAO, WFP, UNICEF, etc. (FAO, 2015). They play a significant role during water logged situation and provide necessary support to the local people along with government support. Again NGOs are working for guiding the government agencies for the project formulation, training and support of Water Management Groups and Associations and also work as a linkage between local people and the government.

3.5.4 Government Projects to Solve Water Logging

To solve the problem, BWDB conducted six studies by engaging international and local consultants between 1986 to 1998. Besides this planning exercise, BWDB dredged some badly silted up channels for immediate relief of the drainage congestion problems. From 1996 to 1998, about 0.610 million cubic meters were re-excavated (manual and mechanical) to keep the main river system active (Rezaie et al., 2013).

1) Khulna Coastal Embankment Rehabilitation Project -1 (KCERP) and Coastal Embankment Rehabilitation Project - 2 (CERP)

After water logging emerged as a problem, and to solve water logging problem of *Beel Dakatia*, "Khulna Coastal Embankment Rehabilitation Project - I" was approved. The project rehabilitated about 78,793 acres of land under *Dumuria, Fultala* and *Batiaghata* thanas of Khulna district. But the people residing in project area rejected the plan. Again, the donor agency also found the technical aspects of the project faulty. Finally, the authority withdrew the project after a year. Later, a new draft plan, CERP-2 was prepared that also included polder no. 24 of Beel Dakatia area within its design (Rejve, 2006)

2) Khulna – Jashore Drainage Rehabilitation Project (KJDRP)

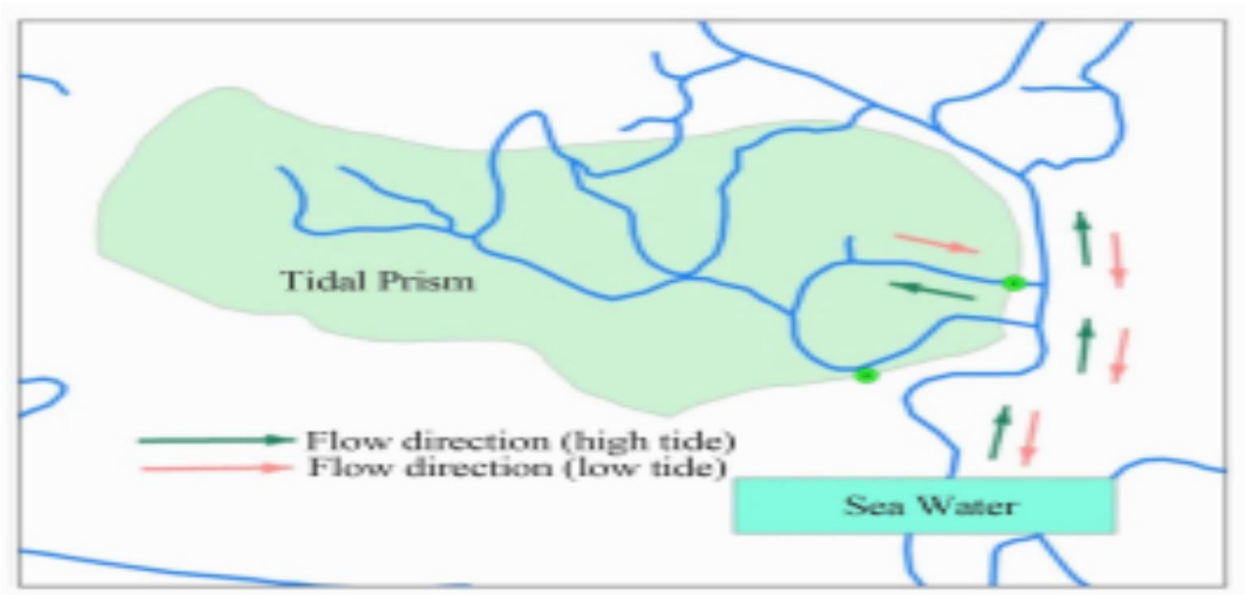
GOB has taken some huge projects to control the water logging situation. To solve these long-standing problems, the Khulna-Jashore drainage rehabilitation project known as KJDRP was implemented during 1994-2002 (IWM, 2007). The project included *Batiaghata, Daulatpur, Dumuria* and *Fultata* upazilas in the district of Khulna and *Abhaynagar, Keshabpur, Jashore Sadar* and *Manirampur* upazilas in the District of *Jashore*, covering about 100,600 hectares (ADB, 2004b cited in Islam and Zakir, 2006). The ADB designed and funded the project to support the efforts of the Government of Bangladesh to reduce poverty by alleviating river drainage cognation (Islam and Zakir, 2006)**.** The Project was formulated under the Second Coastal Embankment Rehabilitation Project (CERP-II) (ADB, 1989 cited in ADB 2007). The Government of Bangladesh requested ADB to include the Project in the country program for 1993. ADB fielded a Fact-Finding Mission in May 1993. The field visit by the Fact-Finding Mission to *Beel Dakatia* included discussions with the villagers and a meeting with NGOs. Villagers highlighted 10 specific concerns whereas 15 similar concerns were echoed by the NGOs. The concerns rose by the villagers and NGOs in May 1993 were very much similar to what the Operations Evaluation Department (OEM) noted during the field visits in March and May 2007 (ADB, 2007). Claimed objectives of the project were to reduce poverty by increasing agricultural production and creating jobs. The project aimed to achieve these by:

a) Participating in design, implementation and maintenance (O & M) of the project facilities.
b) Drainage infrastructure rehabilitation to reduce drainage cognation and protect the project area from tidal and seasonal flooding.
c) Supporting the expansion of agricultural extension services to agricultural lands under the project.
d) Supporting fisheries management in the polder areas to safeguard the supply of fish caught and consumed primarily by the poor. (ADB, 2004b cited in Islam and Zakir, 2006 and ADB 2007)

However, this project failed to solve the drainage problems and the local people denied the project and raised their voice. During the implementation of KJDRP local people launched a movement demanding long term solution of the problem (Islam and Zakir, 2006) because they realized that it will not bring the expected solution. They asked the KJDRP authorities to ensure planned and systematic management of tidal flow in *beel Vaina*. The ideas later become well known as TRM.

3) Tidal River Management (TRM)

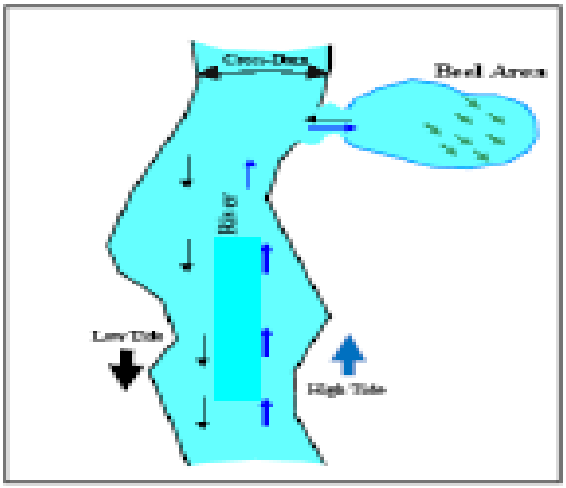
After implementation of KJDRP, the prevailing drainage congestion and water logging problems were partially solved by introducing a popular concept based on TRM. It is a tool under IWRM and it involves peripheral breaching at a polder to allow tidal in-flow and hence accumulate deposited sediments inside the polders to raise land elevations. This ultimately improves river navigability, making the enclosed lands free from water logging. The concept is shown in the Figure-3.7 (Khadim et al., 2013)



(After Khadim et al., 2013)

Figure-3.7: Tidal River Management (TRM)

As part of KJDRP, the GOB implemented different structural interventions entailing construction of embankments, rubber dams and dykes; construction of regulators and flushing inlets, channel re-excavation, construction of bridges, culverts etc. and most notably an innovative practice called TRM (CEGIS, 2007) shown in the figure 3.8. IWRM was first discovered in the United States in the 1920s, but it became popular worldwide in the late 1990s (GWP, 2000 and Khan, 1998 cited in Khadim et al., 2013). The concept of IWRM was introduced in 1994 under a government project named KJDRP (IWM, 2007).



(After Paul et. al., 2013)

Figure-3.8: TRM Mechanism

From the above discussions, we find, most of these projects were effective at the initial stages but with time some could not give desired output as expected. However, the TRM is giving an expected result.

Chapter 4

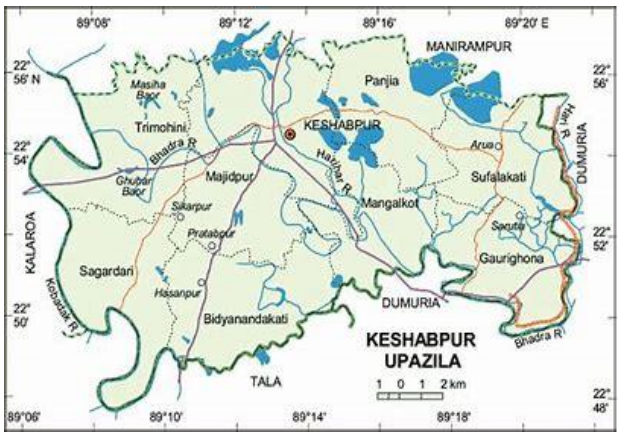
STUDY AREA AND THE RESPONDENTS

4.1 Introduction

This chapter will discuss briefly about the study area where the research survey was conducted on the basis of secondary data sources. This description may include geographical location, demographic pattern, socio economic status, physiographic information, climatic condition etc. It is required for a research to describe the study area for the validity of the research.

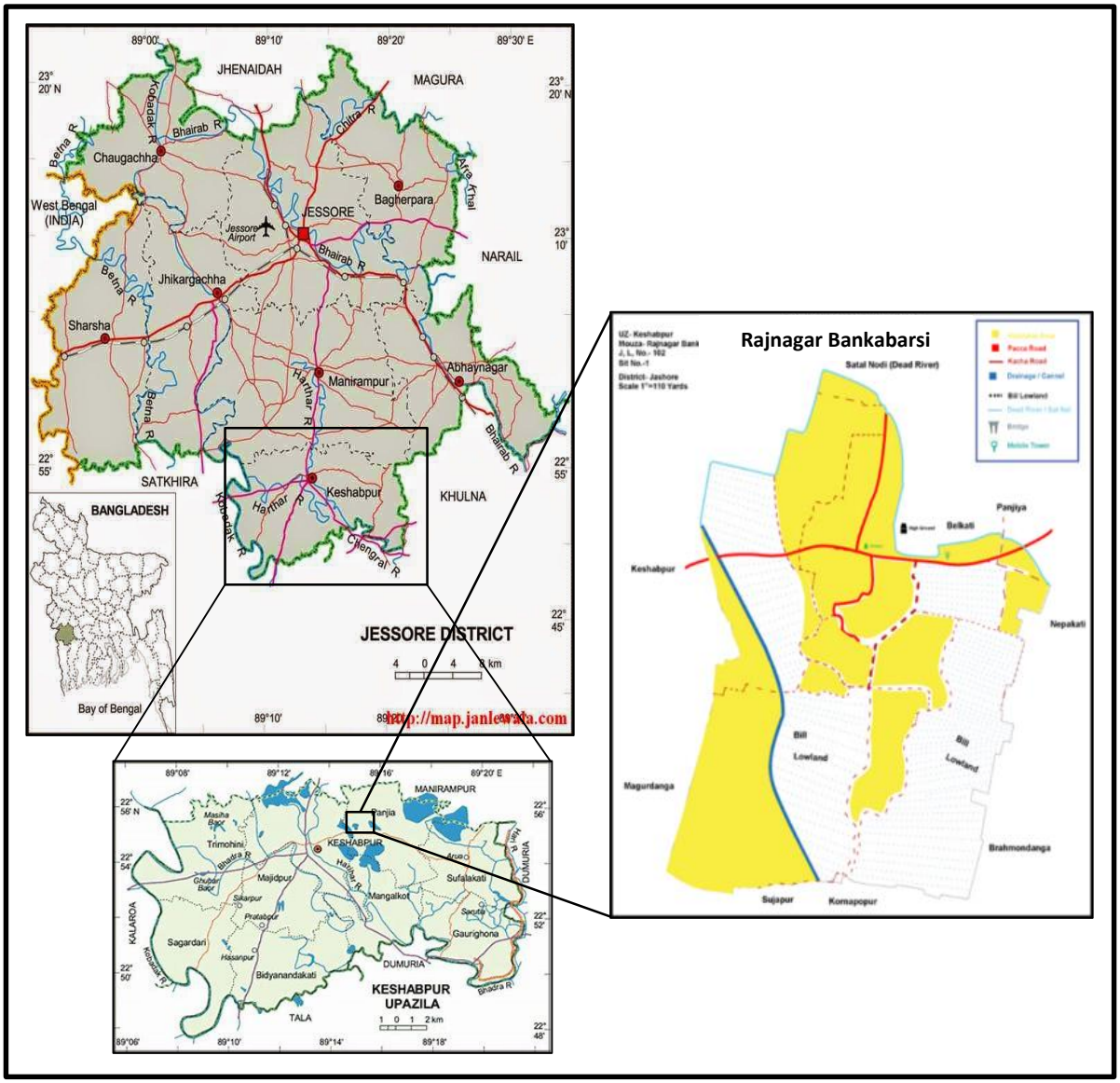
4.2 Geographical Location of the Study Area

Research area of the study *Rajnagar Bankabarsi* village is located under *Panjia* union of *Keshabpur* upazila (Map-4.1) of *Jashore* district. *Jashore* (previously Jashore) is located in the southwestern region of Bangladesh. It consists of 4 municipalities, 36 wards, 8 upazilas. Upazilas are: *Abhaynagar, Bagherpara, Chaugachha, Jashore Sadar, Jhikargachha, Keshabpur, Manirampur* and *Sharsha Upazila*. It is bordered by India to the west, *Khulna* District and *Satkhira* District to the south, *Khulna* and *Narail* to the east, and *Jhenidah* District and *Magura* District to the north. *Jashore* District encompasses 2606.94 km^2**.** (Wikipedia Jashore district). In 1983, *Keshabpur* Thana was turned into an upazila. Nothing is definitely known about the origin of the upazila name. It is learnt that in the past there lived one influential *Zamindar* named *Kashab Chandra* and it is generally believed that the Thana might have derived its name from the name of that *zamindar.* The local people think that the upazila might have derived its name from the name of union where its headquarters is located. The distance of this thana from *Jashore* City is approximately 32 km. The upazila occupies an area of 258.44 sq. km. It is located between 22º48' and 22º57′ north latitudes and between 89º07′ and 89º22′ east longitudes. The upazila is bounded on the north by *Manirampur* Upazila, on the east by *Dumuria* upazila of *Khulna* district, on the south by *Tala* upazila of *Satkhira* zila and on the west by *Kolaroa* Upazila of *Satkhira* district (BBS, 2012). The main rivers are *Harihar* and *Chengral.* *Keshabpur* (Town) consists of seven *mouzas* and the area is



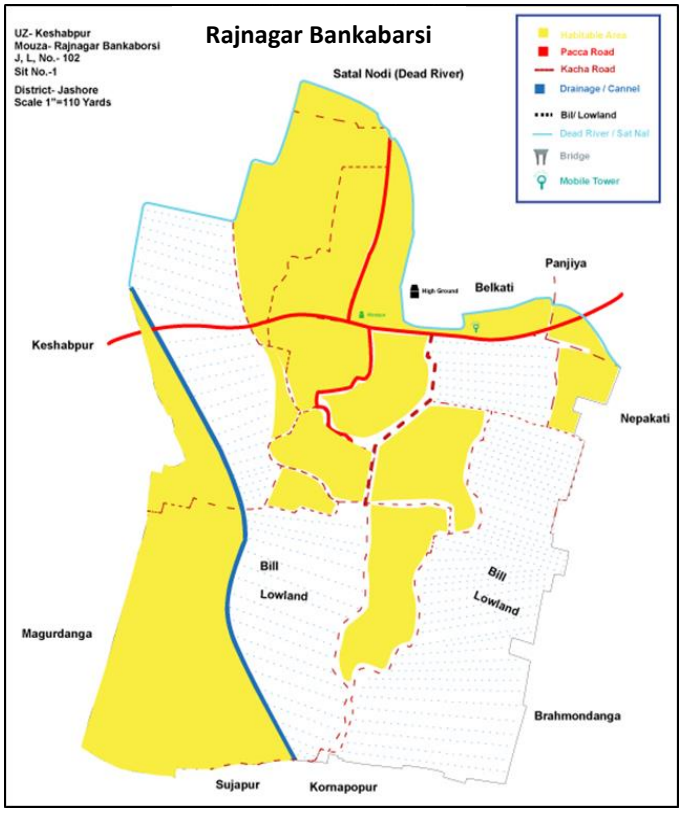
Map-4.1: Administrative Map of *Keshabpur*

18.46 km². The town has a population of 20,697; male 50.88%, female 49.12%. Population density is 1121 per km^2. The literacy rate within the town is 32.9%. *Keshabpur* Thana was turned into an upazila in 1983. It consists of 9 union parishads, 142 *mouzas* and 143 villages. Population is 2,00,229; male 51.16%, female 48.84%; Muslim 80.14%, Hindu 19.5% and others 0.36% **(***Keshabpur* Upazila Wikipedia).



Map-4.2: Geographical Location of the Study Area

The selected study area (N22°54'54" E089°15'22") shown in Map-4.2 for this research is village named *Rajnagar Bankabarsi* of Jashore district, which is situated near the Hari River about 3 kms towards East and about 2 km away from the embankment towards East as well. Total area of the village is 136.17 acres (Union land office). The village is surrounded by *Shatnal* River (Dead River) in the north, *Kashimpur* village in the south, *Magurdanga* village in the east and from west *Bramhndanga* and *Lepakathi* village. East and west portion is basically low land which are water bodies locally known as *Beel*.



Map-4.3: Topographic Map of Study Area *Rajnagar Bankabarsi* Village

Total population is 2068 (BBS, 2011). There is a regulator located at *Khandarpopu*r to drain out the excess rain water from the locality; locals call it 3 vent gates. The non-functionality of regulator and sedimentation in the adjacent river and these makes the village more vulnerable day by day. The *Mouza Map* (Annex F) will give a clear picture of the area. In addition, the topographic map (Map-4.3) will give a general idea of the land pattern.

4.3 Physical Environment of the Study Area

4.3.1 Physiography

Study area *Rajnagar Bankabarsi* is a village of *Jashore* District in the south western region of Bangladesh. Again, south western region of Bangladesh is the part of the Ganges Brahmaputra Delta. The Ganges-Brahmaputra Delta is one of the largest deltas in the world. This delta covers a large part of the Bengal Basin. According to Rezaie et al. (2013) geographically this region is low lying part of the Bengal basin and most of the area belong the characteristics of Tidal Rivers, creeks, swamps and wetlands or Tidal Basin (Beels). The main procreation of the delta is continuing to the south into the Bay of Bengal. The main sediment sources for the delta are the Ganges and Brahmaputra and *Meghna* River systems. It drains almost all of the Himalayas, the most sediment producing mountains in the world, through the three main river systems (Aktar et al., 2015).

These river systems are presently estimated to discharge 1×109 ton/year of sediments (Milliman and Syvitski, 1992 cited in Rashid et al., 2013) of which nearly 80% is delivered during the four monsoon months (Goodbred and Kuehl, 2000b cited in Akter et al., 2015). The Ganges delta is formed by the convergence of the Rivers Padma, *Brahmaputra* (*Jamuna*), and *Meghna* and their respective tributaries. The Ganges unites with the River *Jamuna* (main channel of the Brahmaputra) and later joins the River *Meghna*, finally flowing into the Bay of Bengal**.** The *Ganges* Delta and its surroundings is one of the largest alluvial plains in the world. It faces the *Bay of Bengal* and rivers flowing in the low land take their source from the Himalayan Mountains. The deposition of sediments was vastly controlled by Quaternary sea level fluctuation, climatic conditions and tectonic activities (Umitsu, 1987 cited in Dola et al., 2018). The *Ganges* delta lies at the junction of three tectonic plates: the Indian plate, the Eurasian plate, and the Burma plate. The rivers Ganges and *Brahmaputra* flow into the delta from the northwest and the north. The landforms of the Bengal lowland, including the Ganges delta and its surrounding region, consist of Pleistocene uplands and alluvial lowlands. The relative height of the Pleistocene upland above the surface of the alluvial lowland is 3-10 m in the north and 0-5 m in the south (Umitsu, 1993 cited in Dola et al., 2018). The alluvial lowlands are subdivided into three geomorphological regions, namely the *Brahmaputra-Jamuna* floodplain in the north, the *Sylhet* basin in the northeast, and the Ganges Delta in the south of the region (Umitsu, 1985 cited in Dola et al., 2018).

Bangladesh occupies the major part of the basin. Geographically, the basin is the entire lowland, which is bounded by the *Shillong* Plateau on the north, the *Burma* Arc fold belt on the east, the Bay of Bengal on the south, and the *Indian* craton on the west (Steckler et al., 2010)**.** The basin is separated from the *Chittagong* region by the Feni River. The sediment carried by the *Ganges*, *Brahmaputra*, and *Meghna* Rivers has contributed to the present size of the delta, which is about 100,000 km^2 (Akter et al., 2016).

4.3.2 Climate

According to Banglapedia climatic zone, Bangladesh is located in subtropical monsoon region. There are widespread differences in the intensity of the seasons at different places of the country. On the basis of entire climatic condition Bangladesh can be divided into seven distinct climatic zones. According to the climatic zone, *Jashore* is under the south western zone. Here the extremes of the zones to the north are somewhat tempered. Rainfall is between 1,500 mm and 1,800 mm. Maximum mean summer temperature is below 35°C. Dew-fall is heavier than in Western zone. Table-4.1 shows the climate pattern of the *Jashore* Districts.

Table-4.1: Climate Data of Jashore

Climate data for Jessore													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C (°F)	22.9 (73.2)	27.0 (80.6)	33.4 (92.1)	41.0 (105.8)	38.1 (100.6)	32.6 (90.7)	31.4 (88.5)	31.6 (88.9)	32.1 (89.8)	31.5 (88.7)	29.2 (84.6)	24.9 (76.8)	31.3 (88.4)
Daily mean °C (°F)	15.4 (59.7)	19.3 (66.7)	26.1 (79.0)	34.6 (94.3)	33.0 (91.4)	29.2 (84.6)	28.4 (83.1)	28.6 (83.5)	28.7 (83.7)	27.2 (81.0)	23.1 (73.6)	17.8 (64.0)	26.0 (78.7)
Average low °C (°F)	9.0 (48.2)	11.7 (53.1)	18.9 (66.0)	28.3 (82.9)	27.9 (82.2)	25.8 (78.4)	25.5 (77.9)	25.6 (78.1)	25.4 (77.7)	23.0 (73.4)	17.0 (62.6)	10.6 (51.1)	20.7 (69.3)
Average precipitation mm (inches)	11 (0.4)	19 (0.7)	40 (1.6)	77 (3.0)	168 (6.6)	314 (12.4)	304 (12.0)	293 (11.5)	245 (9.6)	144 (5.7)	28 (1.1)	8 (0.3)	1,651 (64.9)
Average relative humidity (%)	46	35	36	44	60	76	75	76	74	70	51	44	57

Source: Jashore District Wikipedia

4.3.3 Soil and Agriculture

In Jashore, silty clay loam of the *Ganges* meander flood plain is found on the northern parts, calcareous dark clay loam of the old Ganges in the central part and dark grey clay mixed with peat is found in the northern part of the district. Moving south and eastwards towards Khulna, black brown peat is found in the sub-surface layers on the northern parts, dark grey clay of the old Ganges flood plain in the central parts and acid sulfate grey silty clay soils dominate the southern tidal flood plain (Brammer, 2013 cited in FAO, 2015). There are 30 Agro-Ecological Zones in Bangladesh (AEZ). This 30 AEZ are sub divided into 88 agro-ecological sub regions. Again, these are divided into 535 agro-ecological units (Banglapedia Agro-ecological Zone). According to Quddus (2009), *Jashore* district is under the High *Ganges* River Floodplain Agro-ecological Zone. Where the land elevation is high to medium high and soil type is Silt loam, Silt clay-loam and organic matter and fertility status is low. Again, this zone sub-divided into 3 sub regions, these are: a) Central and Southern; b) *Ganges-Mahananda* Floodplain; c) Northern.

According to Banglapedia, the zone is about 13,205 sq. km. This region includes the western part of the *Ganges* River floodplain which is predominantly highland and medium highland. Most areas have a complex relief of broad and narrow ridges and inter-ridge depressions. The upper parts of high ridges stand above normal flood level. Lower parts of ridges and basin margins are seasonally shallowly flooded. General soil types predominantly include calcareous dark grey floodplain soils and calcareous brown floodplain soils. Organic matter

content in the brown ridge soils is low but higher in the dark grey soils. Soils are slightly alkaline in reaction. General fertility level is low.

In the study area there are two types of land for cultivation. These are 1) high land 2) low land. There is a difference in crop cultivation pattern between these lands. One thing is mentioned before that, the low lands are mainly water bodies that is *Beel*, mainly used for fish cultivation; locally known as '*Gher*' High lands are cultivable all over the year and farmers can produce different types of crops there. Like: Rice, jute, wheat, mustered, potato and onion whereas in low land they can produce only paddy in dry season. Low lands are mainly use to cultivate fish and this also considered as a crop. The cropping pattern and production is given in a table (Annex G). The crop calendar will give a clear idea about the crops seeding, growing and harvesting time.

4.4 Cultural Environment

4.4.1 Population

According to 2011 Census, *Jashore* District had a population of 2,764,547. 85.5% of the population is Muslims, 14.21% are Hindus and the remaining 0.29% practices another religion. Main occupations are agriculture 39.84%, agricultural laborer 24.13%, wage laborer 2.68%, commerce 11.99%, service 8.66%, industry 1.41%, transport 3.11% and others 8.18.

4.4.2 Settlement and Infrastructures

In *Rajnagar Bankabarsi* village under Jashore district, there are two mosques, two primary schools, one secondary school and one Madrasa for girls. According to the FGD participants the village has two types of roads. 5 km *kacha* road and 3.5 *pacca* road and there is no hospital or financial establishment in the area.

4.4.3 Economy

The economy of Jashore is predominantly agricultural. Out of the total 591 thousand holdings of the district, 63.38% holding are farms that produce varieties of crops, namely local and HYV paddy, wheat, jute, vegetables, spices, pulses, oilseeds, sugarcane and others (BBS, 2013)**.** The main factor of economics of *Jashore* is Benapole Land Port which is situated in *Sharsha* Upazila. Much of the import and export trading between Bangladesh and India is done through this port. The port is important for making govt. import taxes (Wikipedia Jashore District)**.**

4.5 Respondents

Before going to the impact assessment, it is necessary to discuss about the profile of the respondents previously. Profiling the people of the study area is very important for any socio-economic research because socio economic factors varied depending on it.

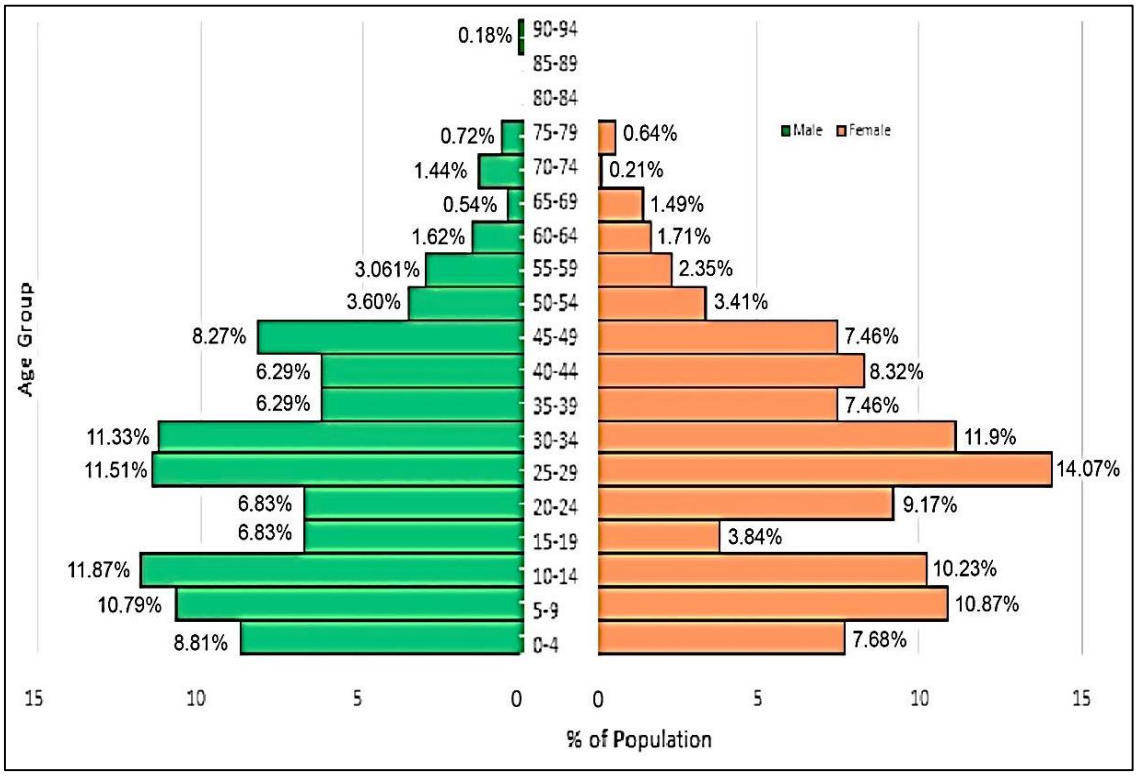
4.5.1 Age and Gender Distribution of Respondents

The distribution of age is one of the most important issues for my research as the main objective of the research is to assess the impact of water logging in peoples' life and livelihood of the study area. From the survey, the given bar provides the data of the age distribution and gender profile of the study area. It is important to note that, most of the elements and factors related to our life and livelihood such as education, marital status, occupation, migration and health issues are varied greatly depending on age and gender. Beside these, impact of any environmental or man- made hazards may differ on the basis of age and gender.

From the house hold survey it is observed that for male the 1st and 2nd dominant age group are 10-14 and 25-29 where the percentage of the population are 11.87 % and 11.51% respectively (total 23.37% of the population). On the other hand, for female 1st and 2nd dominant age group are 25-29 and 30-34 where the percentage of population are 14.07% and 11.9% respectively (total 25.97% of the population). Comparison with dominant age group it is observed that percentage of female is greater than male in the study area.

Population holding by the age groups 0-4, 5-9 and 10-14 can be considered as children (UN, 1982). In the study area the total percentage of male children is 31.47% and female is 28.78%. So, the total percentage of children is (31.47+28.78)/2 = 30.12% in the study area.

Population holding by the age group above 65 can be considered as elderly people. In the study area, total percentage of male elderly population is 2.88% and female elderly population is 2.34%. So, the total percentage of elderly is (2.88+2.34)/2 = 2.62% in the study area.



Source: Field Survey, 2018

Figure-4.1: Age and Gender Distribution of Respondents of the Study Area

Table-4.2: Age Distribution Comparison between National and the Study Area

Age Group	National (Rural)			Rajnagar Bankabarsi		
	Male	Female	Avg	Male	Female	Avg
0-14 Children	30.80	30.10	30.45	31.47	28.78	30.13
15-44 Youth to Middle Adult	46.90	48.30	47.60	49.1	53.95	51.52
45-64 Elderly Adult	16.50	16.10	16.30	16.55	14.93	15.74
65 + Elderly	5.80	5.50	5.65	2.88	2.34	2.61
Total	100.00	100.00	100.00	100.00	100.00	100.00

Source: BBS 2011-2017 and Field Survey, 2018

Table-4.2 shows, the percentage of the elderly people of the study area are less than the overall national standard, i.e. people do not live long as compared to the national standard.

4.5.2 Family Types

Type or pattern of family is an important issue for socio economic assessment of a region. An impact of water logging in life and livelihood partially depends on the family type of people. The respondents were asked about their family. It is seen that nuclear family has the dominant percentage in the study area, there are 87.7% families found as nuclear and 10.8% found as combined family.

Table-4.3: Type of Families in the Study Area

Family Type	Frequency	Percent
Nucleated	244	87.7
Combined	31	10.8
Total	275	100.0

Source: Field Survey, 2018

4.5.3 Education

Education status of population of an area is an important factor which has a connection with most of the socio-economic factors. Living standard, occupation, income, health, migration of people is greatly connected with education level. Education profile is necessary for comparative analysis of other statistical data gathered from field survey.

Table-4.4: Education Profile of the Respondents

Respondent's Education	Frequency	Percentage (%)
Not Applicable	120	11.6
Illiterate	121	11.7
Primary Education	550	53.3
Class 8 pass	114	11.0
S.S.C	52	5.0
H.S.C	53	5.1
Graduate/honors.	14	1.4
Masters	5	.5
Others	3	.3
Total	1032	100.0

Source: Field Survey, 2018

Chapter 5

PERENNIAL WATER LOGGING SAGA

5.1 Introduction

When the water logging persists for a longer period of time and people suffer for years together is regarded as the Perennial Water Logging. In this chapter, factors related to the objectives are assessed to show the impact of water logging in life and livelihood in the study area. Discussion has been done about the current water logging scenario and impacts of water logging on different factors of socio-economic life and livelihood in the study area. It will also

5.2 Current Water Logging Scenario

This is a requirement of the research to determine the current water logging scenario of the study area. To determine the current water logging scenario information are collected from the respondents on the duration, spatial spread and causes of water logging. Spatial spread and temporal variation of different year are demonstrated by using satellite images.

5.2.1 Duration of Water logging

Respondents were asked about the duration of water logging in study area over the year. According to the respondent's opinion, water logging basically started in the rainy season (before mid-June) and continued till winter season (after mid-September). Table-5.1 depicts that majority percentage (about 65%) of the respondents identified 4 months water logging in the area all over the year. On the other hand, about 35 percent identified 6 months water logging over the year.

Table-5.1: Duration of Water Logging over the Year

Event	Duration Over the Year	Number of Respondents	Percentage (%)
Water Logging	Up to 4 months	178	64.72%
	Up to 6 months	97	35.27%
Total		275	100.0%

Source: Field Survey, 2018

5.2.2 Water Logging Syndrome in the Study Area

Water logging syndrome at ***Rajnagar Bankabarsi*** is shown in Figure-5.1

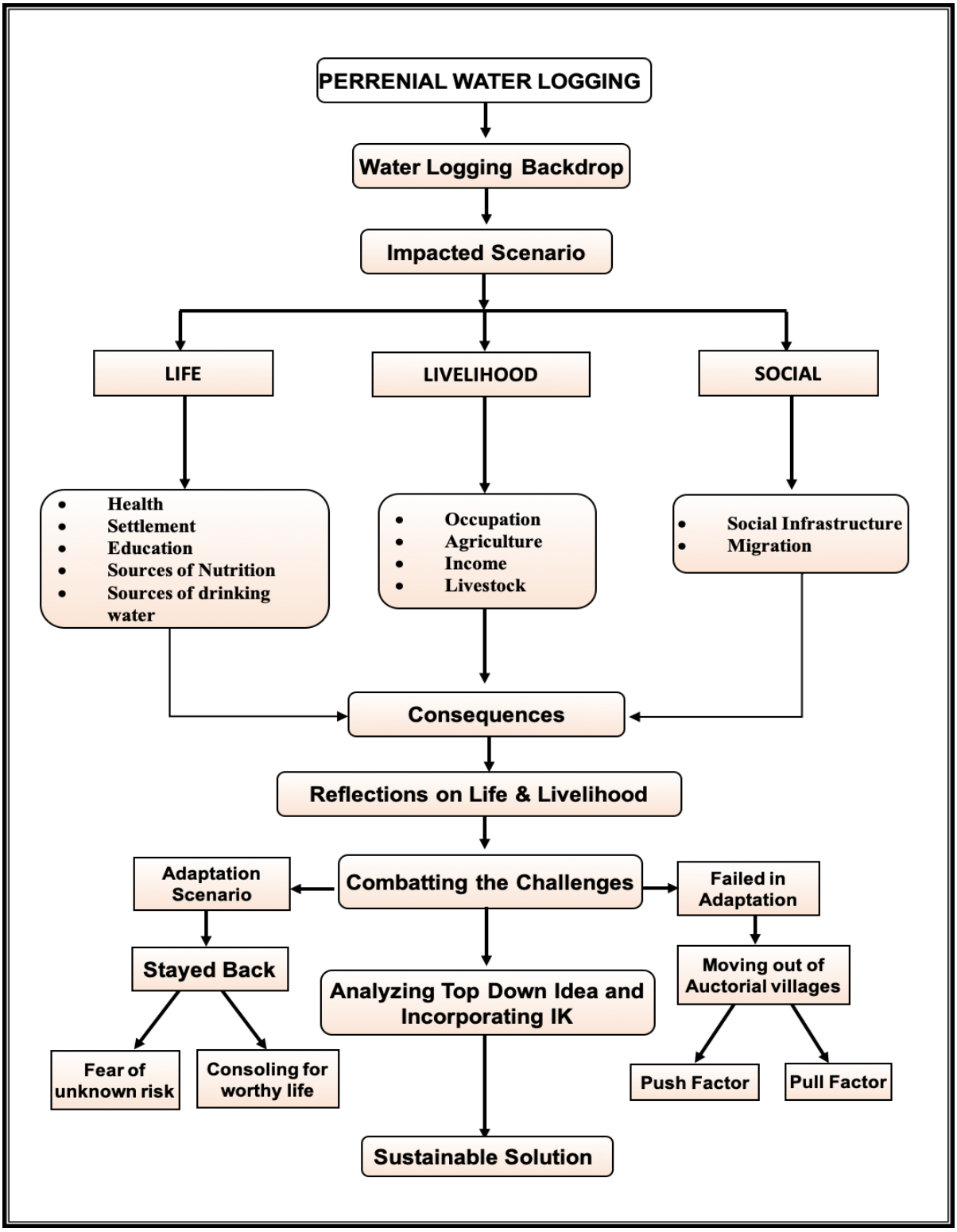


Figure-5.1: Water Logging Syndrome in the Study Area

5.2.3 Spatial Spread and Temporal Variation

To assess the spatial spread and temporal variation, respondents were asked about the spatial range of inundation. According to the field data, almost 77 percent respondents said that three quarter of the area go under water during the time of water logging and little more than 23 percent respondent's opinion was about more than three quarter of the area locked due to water logging.

Table-5.2: Spatial Spread of Water Logging in the Study Area

Spatial Spread	Number of Respondents	Percent (%)
Three quarter of the area	211	76.9
More than three quarter	64	23.1
Total	275	100.0

Source: Field Survey, 2018

5.2.3.1 Analysis of Landsat Images of the Study Area

Spatial spread and temporal variation are required to identify the water logging of an area. For last several years, RS and GIS have widely been applied for the purpose of finding the temporal variations. It is a necessity, of a spatial and temporal analysis of a phenomenon of an area towards the regional as well as national planning and management.

To identify the spatial spread and temporal variation of water logging of the study area, Temporal Satellite images of different years are studied. According to the local people there were no water-logging problem before 2000 but after that time it has become a regular occurrence in the study area. Based on that information the year of 2002, 2005, 2008, 2011 and 2015 are considered to show the temporal variation of water logging in the study area. It is to be noted that from 2002 to 2011 the years are taken with 3 years of interval but the year 2015 are considered as local people informed that, in this year one of the biggest water logging occurred in the study area after 2011.

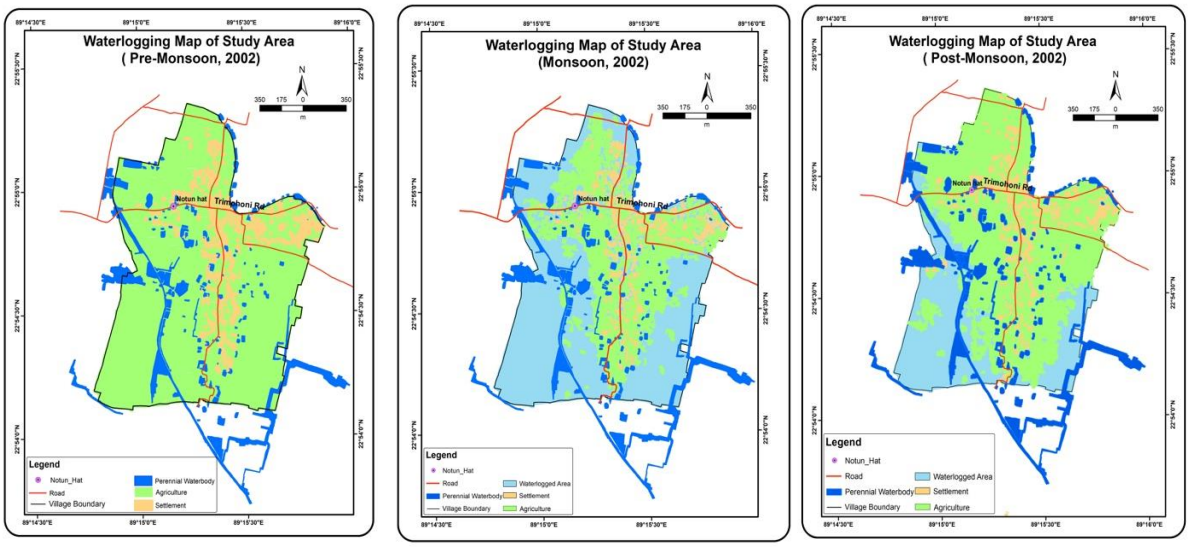
To identify temporal variation images are collected for pre-monsoon, monsoon and post monsoon seasons in every selected year. According to Khatun et al. (2016), June to September is monsoon for Bangladesh. Image representing pre – monsoon is considered May to Mid-June (Before mid-June) and image representing post- monsoon is considered Mid-September to October (After mid-September).

Landsat-8 and Landsat 4-5 TM images of 2002, 2005, 2008, 2011 and 2015 are collected from USGS. Water and vegetation are categorized by calculating NDWI and NDVI values. ERDAS 2014 are used for image processing. The collected images are mainly classified with unsupervised classification. Later map is prepared by using Arc GIS 10.5 to present the changes of water logged areas over the specified years and image accuracy assessment is done by using Google Earth Pro for delineation of surface waterlogged area.

5.2.3.2 Result and Discussion

The pre-monsoon, monsoon and post-monsoon surface waterlogged areas in the study area for the year 2002, 2005, 2008, 2011 and 2015 are delineated applying RS and GIS techniques which reveals that, seasonal inundation occurs due to rigorous rainfall throughout the monsoon season. So, water bodies on the water logging map of the study area during November/December that is post-monsoon (just after the monsoon season) are considered as seasonal waterlogged areas and permanent waterlogged areas are those where land remains waterlogged throughout the year. Water bodies on the water logging map of the study area during March/April that is pre-monsoon (peak of the dry season) are considered as permanent water logged areas. During the field observation it is noticed that due to elevation difference south portion of the village faces the problem mostly. Findings from the map also support the statement. However, based on the analysis of maps resulting from satellite image, temporal variations of water logging in the study area have been estimated. The calculated area of water logging is shown in Table- 5.3a to 5.3e with map (Map-5.1a to 5.1e).

Map- 5.1a: Seasonal Variation of Water Logging in the Study Area, 2002



Pre-Monsoon Monsoon Post Monsoon

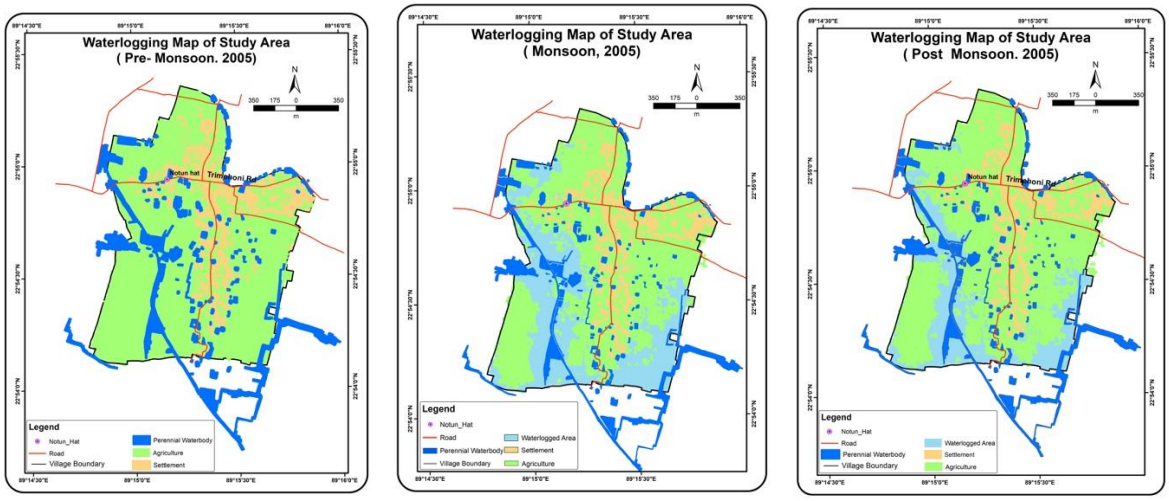
Table-5.3a: Water Logging in the Study Area, 2002

Year	Different Season	Water Logged Area (km^2)	Percentage of Total Area
2002	Pre-monsoon	0	0
	Monsoon	1.383732	**51.30 %**
	Post-Monsoon	0.658143	24.16 %

Source: Field Survey, 2018

Analyzing the above three maps of different seasons of the year 2002, it is evident; water logging starts in monsoon and continues up to post-monsoon. Coverage of water logging is highest in monsoon that is almost 52% of total area which indicates the devastating nature of the disaster.

Map- 5.1b: Seasonal Variation of Water Logging in the Study Area, 2005



Pre-Monsoon Monsoon Post-Monsoon

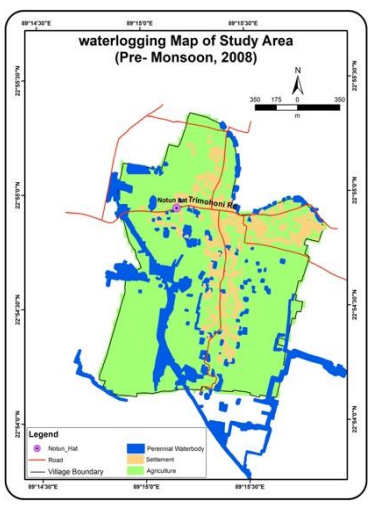
Table-5.3b: Water Logging in the Study Area, 2005

Year	Different Season	Water Logged Area (km^2)	Percentage of Total Area
2005	Pre-monsoon	0	0
	Monsoon	0.561148	20.81 %
	Post-Monsoon	0.374883	13.38 %

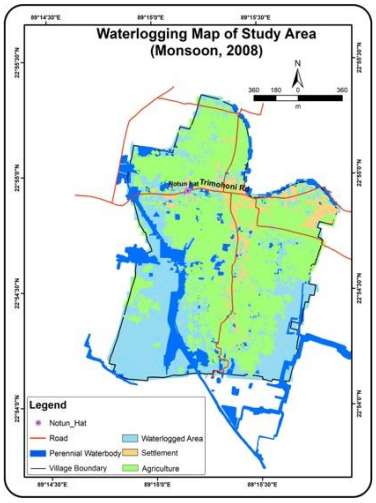
Source: Field Survey, 2018

In 2005, water logging starts in the monsoon season and ends in the post-monsoon but the area coverage of water logging reduced in comparison to year 2002.

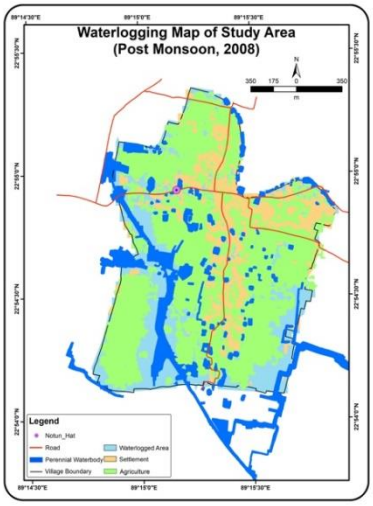
Map- 5.1c: Seasonal Variation of Water Logging in the Study Area, 2008



Post-Monsoon



Monsoon



Post-Monsoon

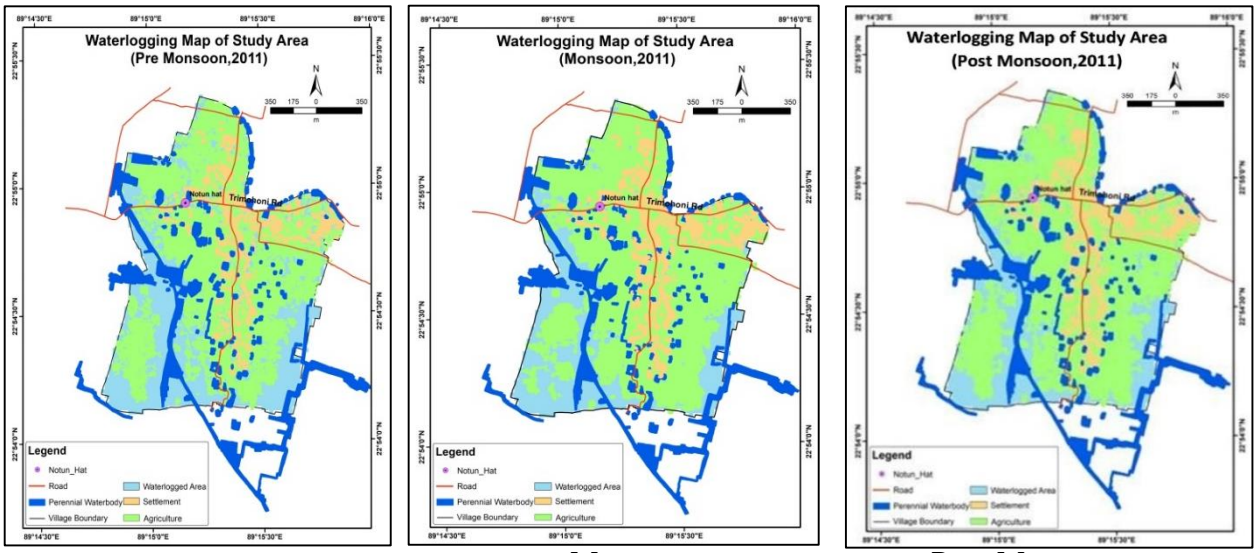
Table-5.3c: Water Logging in the Study Area, 2008

Year	Different Season	Water Logged Area (km^2)	Percentage of Total Area
2008	Pre-monsoon	0	0
	Monsoon	1.392811	51.67%
	Post-Monsoon	0.399001	14.49%

Source: Field Survey, 2018

In the year 2008, the water logging coverage increased which starts in the mon-soon season and continues up to the post-monsoon. In this year it is found that the monsoon area coverage is similar to the year 2002 which is nearly 52%.

Map- 5.1d: Seasonal Variation of Water Logging in the Study Area, 2011



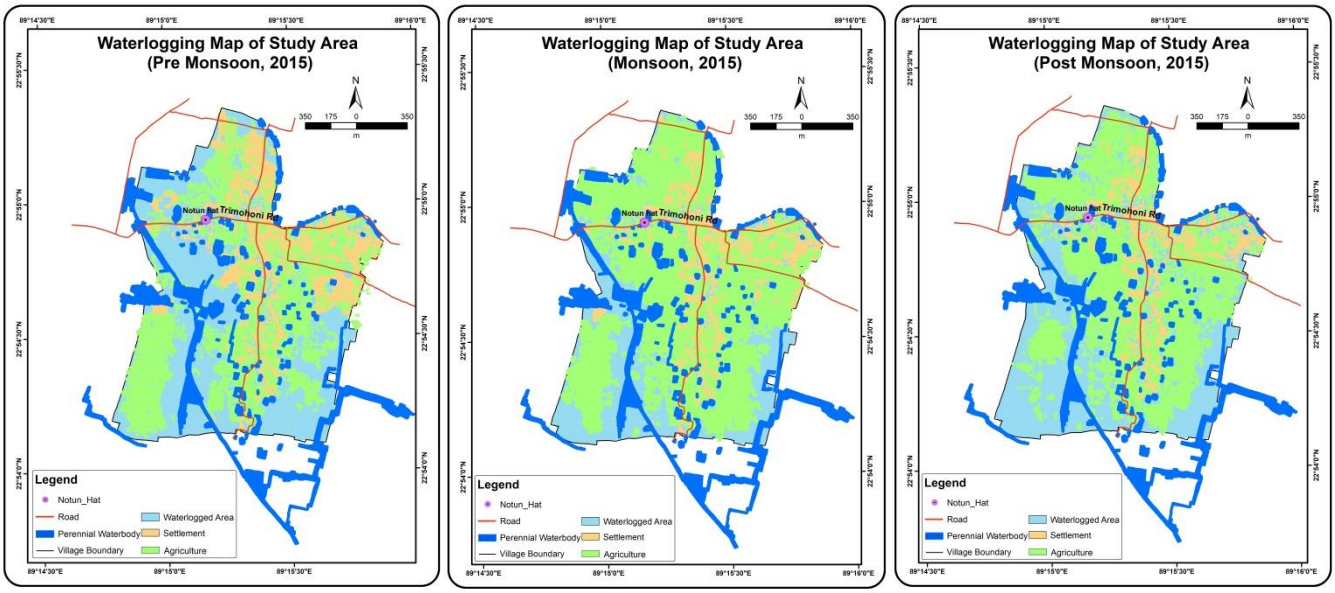
Pre-Monsoon Monsoon Post-Monsoon

Table-5.3d: Water Logging in the Study Area, 2011

Year	Different Season	Water Logged Area (km^2)	Percentage of Total Area
2011	Pre-monsoon	0.722024	26.76 %
	Monsoon	0.818188	30.11 %
	Post-Monsoon	0.599679	21.39 %

Source: Field Survey, 2018

In the year 2011, though water logging coverage reduced but it started in pre-monsoon season and continued up to post-monsoon season which indicates the long duration of the adversity. View of water logging at Keshabpur Upazila in the year 2011 is shown as photo- 1 at Annex-A.



Map- 5.1e: Seasonal Variation of Water Logging in the Study Area, 2015

Pre-Monsoon Monsoon Post-Monsoon

Table-5.3e: Water Logging in the Study Area, 2015

Year	Different Season	Water Logged Area (km^2)	Percentage of Total Area
2015	Pre-monsoon	0.432772	23.36 %
	Monsoon	0.722024	26.76%
	Post-Monsoon	0.818188	30.11 %

Source: Field Survey, 2018

In the year 2015, water logging started in pre-monsoon and continued up to post-monsoon and the area coverage increased gradually. Highest coverage found in the post–monsoon season which is different from the previous years.

Table-5.4 Trend of Water Logging in the Study Area 2002 to 2015

Season	Year									
	2002		2005		2008		2011		2015	
	km^2	%	km^2	%	km^2	%	km^2	%	km^2	%
Pre-monsoon	0	0	0	0	0	0	0.72	26.76	0.43	23.36
Monsoon	1.38	51.3	0.56	20.81	1.39	51. 67	0.82	30.11	0.72	26.76
Post-monsoon	0.65	24.16	0.37	13.38	0.39	14.49	0.59	21.39	0.82	30.11
Total area : 2.696891 km^2										

Source: Derived from Study Landsat-8 and Landsat 4-5 TM

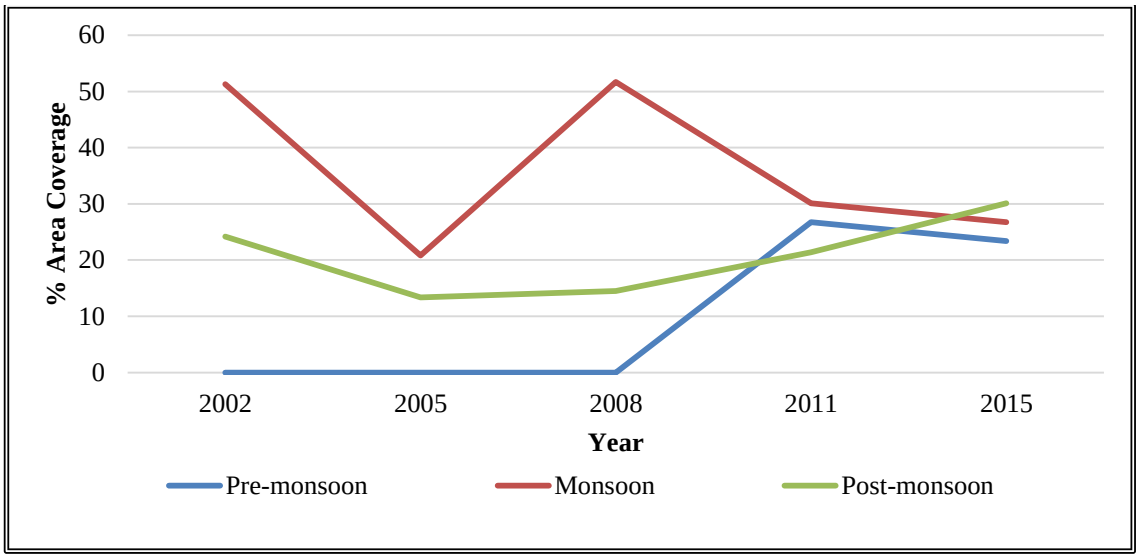
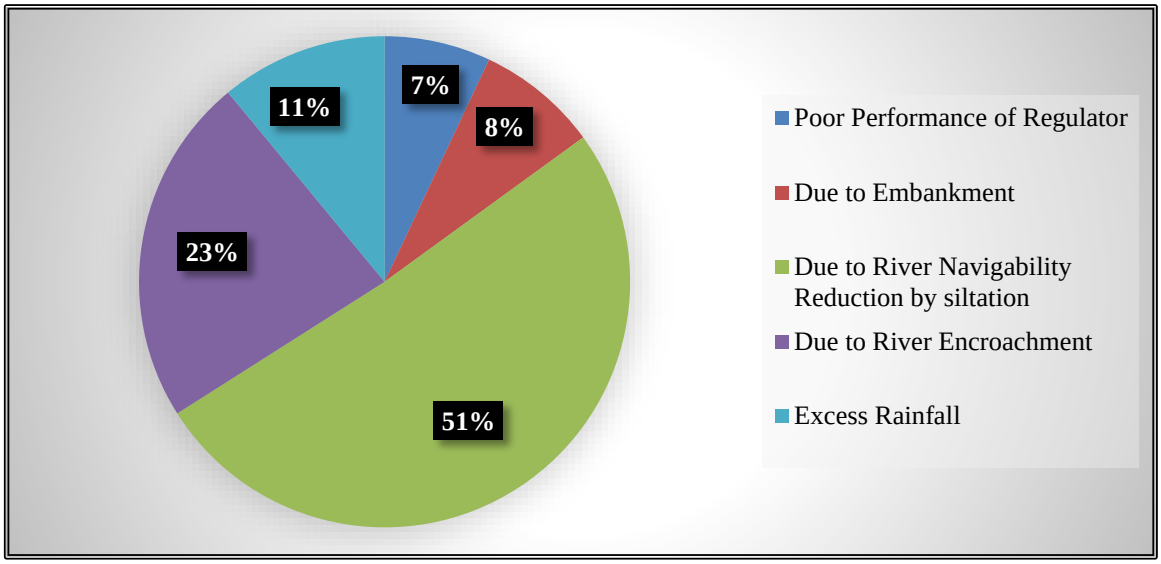


Figure-5.2: Trend of Water Logging in the Study Area 2002 to 2015

According to the local people, though water logging is a common phenomenon for the area but after 2000 the intensity and frequency are increased. Analyzing the satellite images of the study area, trend of waterlogging has been detected. From the above temporal data, it is found that all of the considered years except 2011 and 2015, highest water logging coverage is found in the monsoon time. In the year 2015, highest coverage is found in the pre-monsoon time and 2015 in the post-monsoon. It is detected from the temporal data; highest water logging is found in the year 2002. In this year 1.38 km^2 went under the water in mon-soon season, which was almost 52 percent of the total area. It is also observed that though initially the area coverage of water logging is greater but the duration was short as there is no water logging found in pre-monsoon season in the year 2002, 2005 and 2008. But in the year 2011 and 2015 the area coverage of water logging reduced and duration became long as in those years water logging started from pre-monsoon season in the study area.

5.2.4 Causes of Water Logging in the Study Area

Water logging of the study area is a combined consequence of different aspects. In searching the causes of water logging in the study area field observation, house hold survey, KII and FGD techniques have been conducted. Respondents were asked about the reason of water logging in their locality. They gave different opinions about it. Figure 5.2 reveals the opinion of the respondents regarding water logging which shows that, some collective issues are the reasons behind the development of water logging in the study area. However, on the basis of household survey, KII and FGD information, the basic reasons are discussed below:



Source: Field Survey, 2018

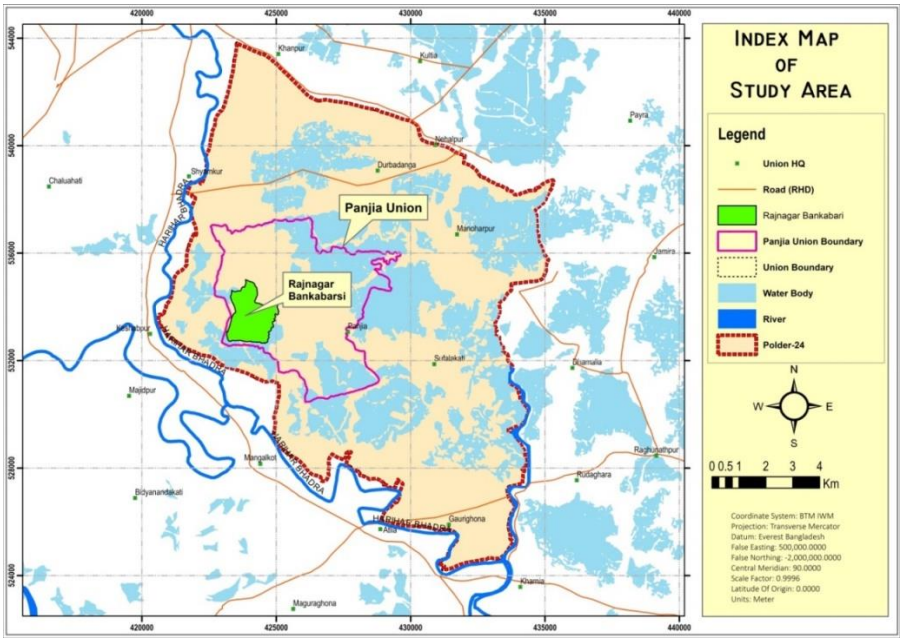
Figure-5.3: Causes of Water Logging

5.2.4.1 Poor Maintenance and Operational Performance of Drainage Systems

About 7 percent of the respondents thought the poor performance of the regulator is responsible for water logging. During the field observation, it is found that the channel (main pathway to flow the storm runoff from settlement area in the rainy season) which is connected with the adjoining river of the area is silted up and the regulator (three-vent gate) is not workable at present due to poor maintenance. This reduces the effectiveness of natural drainage of the area. Moreover, both the village and the river sides of the channel also silted up and are not capable to discharge the excess rain water from the settlement area (shown in Photo-3, Annex A). Again, when heavy rainfall occurs, the rain water accumulates inside the village and everything goes under water. Ray (undated) in his research titled "Report on Water Logging: A case study of 25 no ward of Khulna City Corporation" also found poor drainage system for water logging in Khulna city corporation.

5.2.4.2 Construction of Permanent Embankment

Due to the construction of permanent embankment tidal flow cannot enter the polder (Map-5.2). Before the construction of embankment, the high tides used to deposit silt on the tidal wetlands. Due to the construction of polders sedimentation deposition becomes very rapid in river channels. This process ultimately raised the riverbeds in comparison to adjacent areas or wetlands. About 8 percent respondent opined that construction of embankment is responsible for water logging.



Map-5.2: Study Area and the Polder

5.2.4.3 River Navigability Reduction by Siltation

River *Kopotaksho* flows from the west of Keshabpur upazila. Drainage capacity of the river has been reduced remarkably after construction of the embankment. From FGD and KIIs it was evident; the drainage capacity of the river has been reduced remarkably. The adjoining River *Harihar* faced the same consequence and silted up over the years. Photo-2, Annex A, shows the silted-up *Hari* River in May, 2005 and the water logging in August, 2006. From the household survey it has been found that, 51 percent made siltation in the river bed responsible for water logging in the study area. FAO (2015) also found out, siltation in the river bed as the primary cause of water logging.

5.2.4.4 River Encroachment

The adjoining River *Harihar* has now become a narrow channel due to encroachment (Photo-4, Annex A). It is a real threat for blockade of river drainage in the study area. About 23 percent respondents figured the river encroachment as the cause of water logging. FGD participants found similar opinion like the household respondents. They added, to make the river free from encroachment, local government took some initiatives which were not enough. Related to this issue FAO, 2015 mentioned in a report, “The critically silted up reaches of the major rivers in the study area are being encroached by those seeking to ‘grab’ the land (illegally), for construction or other land use, which further hampers drainage.”

5.2.4.5 Excessive Rainfall

Excess rain fall is a vital reason for water logging for any locality. Excessive rainfall within a very short duration of time creates water logged situation in any area. Due to geographical location, in the monsoon, heavy rainfall occurs in the country, especially in the coastal area. According to the field data, about 11 percent of respondents marked excessive rainfall as the reason of water logging in their locality. One participant of KII, [Chairman of WMA (Water Management Association) of Keshabpur upazila], gave an important view. He highlighted, low lands of the area used for fish farming, filled up through withdrawal of underground water before the monsoon. As a result, during monsoon when it rains heavily, the storm runoff does not get space to discharge. Thus excess rain water accumulates over the settlement area and creates the measurable water logging condition. It also impacts on the duration of water-logging changes in relation to the amount of rain. Khan, 2017 found out the similar situations in his research**.** He found in his study, excessive rainfall is one of the major reasons for water logging in Khulna city. Sahu, 2014 also identified the impact of rainfall on ground water and water logging of *Moyna Basin***.** The statements come from household survey are being justified by the KII and FGD participants as they also mentioned all the factors told by the household respondents. So, after evaluating the above discussion based on field data, it is found, there are a number of issues working collectively for creating the precarious situation. At the same time, a disastrous situation prevails in the area collapsing the community from their normal life.

5.3 Impacts at Homestead Level (Dwelling Sites)

During the field survey it is assumed, the impact of water logging at home stead level is remarkable. In this section, some analysis regarding the impact of water logging at the home stead level are discussed on the basis of field data. It is a comparative analysis based on the context of three different period of time. Before, during and after water logging period are considered for most of the variables for the impact analysis.

5.3.1 Type of Damage during Water Logging (House)

To determine the water logging situation in the study area, the respondents are asked about the damage of their houses due to water logging. Information is collected from the sufferers of last water logging incident in this area. Field data showed, nearly 20 percent houses are completely damaged (Photo-5, Annex A) and little more than 18 percent houses are partially damaged due to water logging. Almost 21 percent houses (main living block) are completely

damaged and almost 29 percent household's main living block are partially damaged. Major portion of the houses of nearly 5 percent houses are damaged due to water logging.

Table-5.5: Type of Damages during Water logging (Houses)

Type of Damage (Houses)	Number of Respondents	Percent (%)
Completely Damaged	54	19.5
Partially Damaged	50	18.1
Main living block completely damaged	56	20.9
Main living block partially damaged	80	28.9
Major part of the house damaged	14	4.3
Others	21	7.6
Total	275	100.0

Source: Field Survey, 2018

5.3.2 Present Condition of Houses due to Water logging

Respondents are asked about the condition of houses at present. According to the respondents, little more than 4 percent of respondent's houses are slightly under water, almost 29 percent respondent said that their homestead is not water logged but in worse condition. About 53 percent mentioned that at present their homestead condition is habitable. 14 percent opined that at present their homestead is not habitable (Figure-5.3).

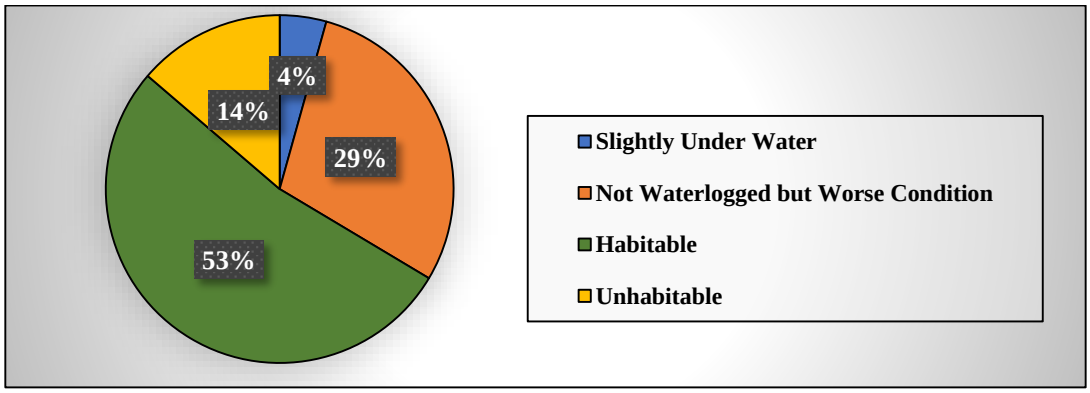


Figure-5.4: Present Condition (during Field Survey) of Houses

5.3.3 Impact on the Type of Houses (Main Dwelling Unit)

Different types of settlement patterns are found in the study area during the field observation. Such as: *kacha, semi-pacca* and *pacca*. But there is a variation in the *kacha* houses and these are classified on the basis of materials the houses are made off (Table-5.6). However, the answers are taken on the basis of 3 different periods of time i.e. before, after and present (during the time of data collection). As per the respondent's opinion before water logging

(year 2000), lowest percentage of houses (main dwelling unit) was *pacca* (little more than 1%) and *semi-pacca* (4%). Whereas highest percentage of main living block of the homesteads are found *kacha* type (Tin,bamboo and thatch 36%). Before water logging, the percentage of different types of *kacha* houses are shown in the Table-5.6. Again, in the study area mud made houses also exist in a considerable percentage for all the time. But the percentage is found highest (18%) in the time before waterlogging and lowest (7%) at present time.

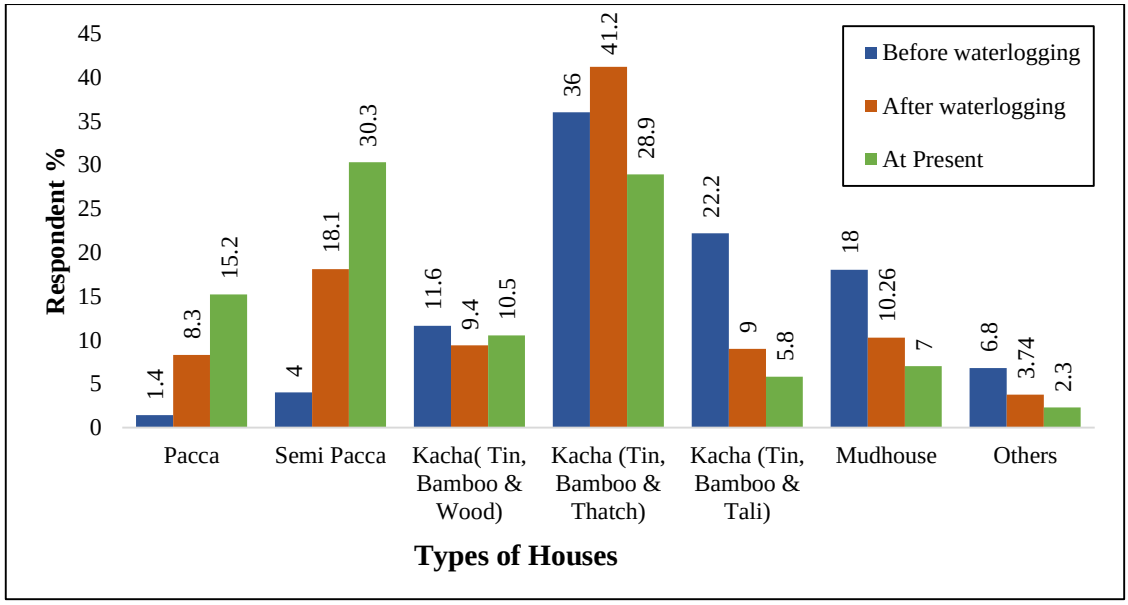
Table-5.6: Settlement Pattern in the Study Area

Type of Houses	Before Waterlogging (%)	After Waterlogging (%)	At present (%)
Pacca	1.4	8.3	15.2
Semi Pacca	4.0	18.1	30.3
Kacha (Tin, bamboo & Wood)	11.6	9.4	10.5
Kacha (Tin, Bamboo & Thatch)	36.0	41.2	28.9
Kacha (Tin, Bamboo & Tali)	22.2	9.0	5.8
Mudhouse with Tali	18.0	10.26	7
Others	6.8	3.74	2.3

Source: Field Survey, 2018

So, it is observed (Table-5.6) that after water logging there is a significant change in the types of houses. Most importantly the numbers of all types of *kacha* houses in the study area have decreased with time. On the other hand, *pacca*, *semi-pacca* types of houses have an increasing tendency. It can be said that most of the households are upgraded with time in the study area. Photo-6 & 7, Annex A, shows the different types houses (pacca, mud etc) in the study area. Before starting the survey, it was assumed, the impact of water logging on these types of houses will have negative value. But from the field data it is found, there is no negative impact of water logging on these types of houses in the study area. Cause of such impact needed an explanation, as water logging effects the area every year and the local people become highly concerned to improve the condition of their homestead to reduce the vulnerability (Figure-5.4). Kabir (2012) investigated the vulnerability and adaptation practice in the settlement pattern of a water logged area named *Moynapur* village at *Keshabpur* upazila of Jashore district. A finding of this research also represented the same facts that, settlement of the village follows increasing trend of constructing the house with more permanent building material. According to the researcher, “The spatial composition of the

settlement pattern was evolved historically to cope better with the physical and hydro-morphological characteristics of the landscape rather than of cultural."

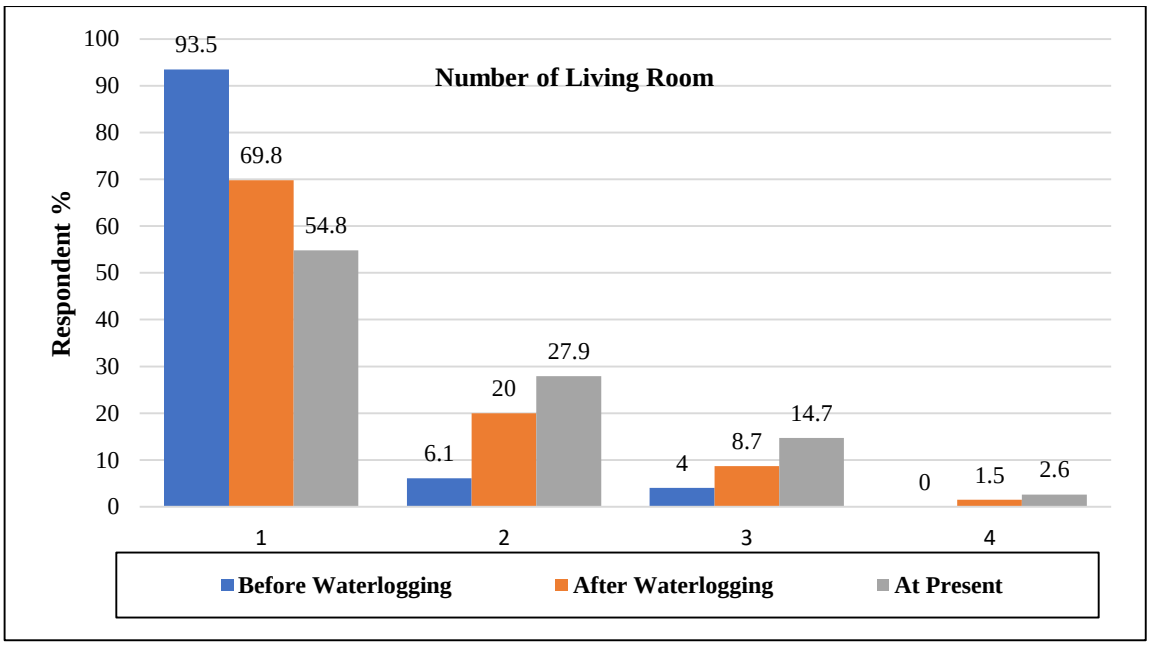


Source: Field Survey, 2018

Figure-5.5: Changes in the Types of Houses

5.3.4 Changes in the Number of Rooms (Main Dwelling Unit)

Number of rooms is important for any household. During the field survey the respondents are asked about the number of rooms in their main dwelling unit and the answer is taken from 3 different periods of time. Field data reveals (Figure-5.6), before water logging nearly 94 percent households had 1 living room, little more than 6 percent had 2 living rooms and below 1 percent had 3 main living rooms. On the other hand, after water logging almost 70 percent households had 1 living room whereas 20 percent had 2, almost 9 percent had 3 and nearly 2 percent had 4 living rooms. At present, approximately 55 percent, almost 28 percent, 15 percent and nearly 3 percent had 1, 2, 3 and 4 living rooms respectively in their dwellings. So, it is found that number of rooms in the main dwelling unit increased with time.

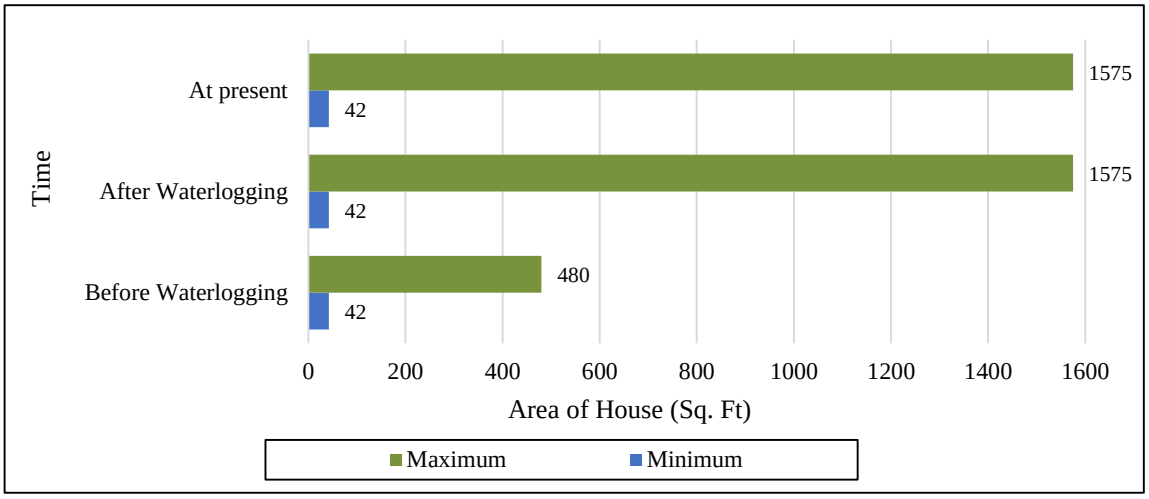


Source: Field Survey, 2018

Figure-5.6: Changes in the Number of Living Rooms

5.3.5 Changes in the Area of Houses (Main Dwelling Unit)

In terms of area of houses, field data showed that before water logging maximum range is 480 sqft and minimum range is 42 sqft (Figure-5.7). On the other hand, after water logging maximum range 1575 sqft whereas the minimum range is still 42 sqft. At present there is no change in the amount. As an explanation, it was seen before in the analysis of type of houses that, there is a significant structural change in the houses done by local people and when they reconstruct the houses, they not only change the construction material but increased the area at the same time. From FGD it is found that, when the mud made houses modified into



Source: Field Survey, 2018

Figure-5.7: Changes in the Area of Houses

Semi-pacca generally the area of houses has been increased. Beside this field data also revealed that the income level of some respondents has been increased after water logging. So, with the increase of income the local people make their houses sustainable with expansion the area of houses.

5.3.6 Market Price of Houses (Main Dwelling Unit)

Changes in the market price of houses (main dwelling unit) are also investigated in the study. As it is found that there is a change in the structure and increase in the area of houses, eventually the prices of the houses get an increasing tendency. Figure-5.8 revealed that before water logging the lowest market price of houses were 2,000.00 BDT and the highest price was 1,00,000.00 BDT. But after water logging lowest and highest prices are 1,000.00 BDT and 14, 00,000.00 BDT respectively. At present the highest price remain same but lowest price got little increase, 2,000.00 BDT.

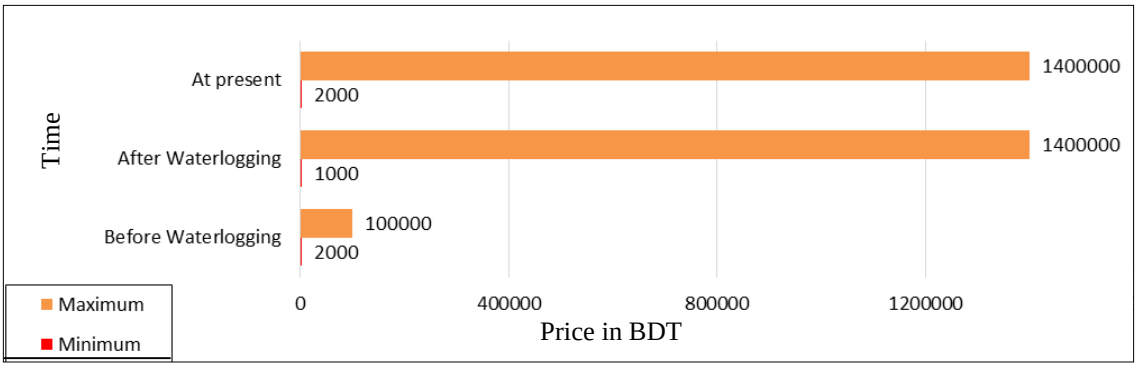


Figure-5.8: Market Price of Houses

5.4 Impacts on Socio-economic Life

Impacts on socio-economic life are explained subsequently:

5.4.1 Changes in the Livelihood Pattern

In terms of livelihood, Agriculture, wage-based labor market, fishing and business are the backbone of the economy of the village. Day laboring is the prominent type of occupation for all the period of time and holding the highest percentage of respondents. After day labor agriculture found as the second and business as third prominent occupation in the study area. According to field data before water logging approximately 43 % of the respondents were making a living by the day laboring while 35 % earned by the agricultural activities. And third highest livelihood was business that was approximately 6%. It is found that, very small

percentage of respondents was worked as paid employee at that time (little more than 1 percent). Fishing from open water bodies also adopted by some of them, before water logging little more than 8 % of respondents were engaged in fishing for their livelihood. Beside these some other livelihood before water logging are, crafts work below 1%, poultry farm near about 2 %, dairy farm little more than 1%, van driving little more than 1 percent and other nearly 3 % in the village. The percentage of different livelihoods after water logging and at present is as follows: agriculture nearly 21 % and little more than 22 %, day labor almost 32 and 37 %, fishing nearly 17 and almost 6 %, paid employee nearly 3 and almost 4 %, business almost 17 and almost 19 %, crafts work below 1 percent and little more than 1 %, remittance (sent money) nearly 1 % and little more than 1 %, poultry farm 1 % and nearly 1 %, dairy farm little more than 2 % and almost 3 %, van driving little more than 2 % and almost 6 % and other livelihoods are 5 % and 2 %.

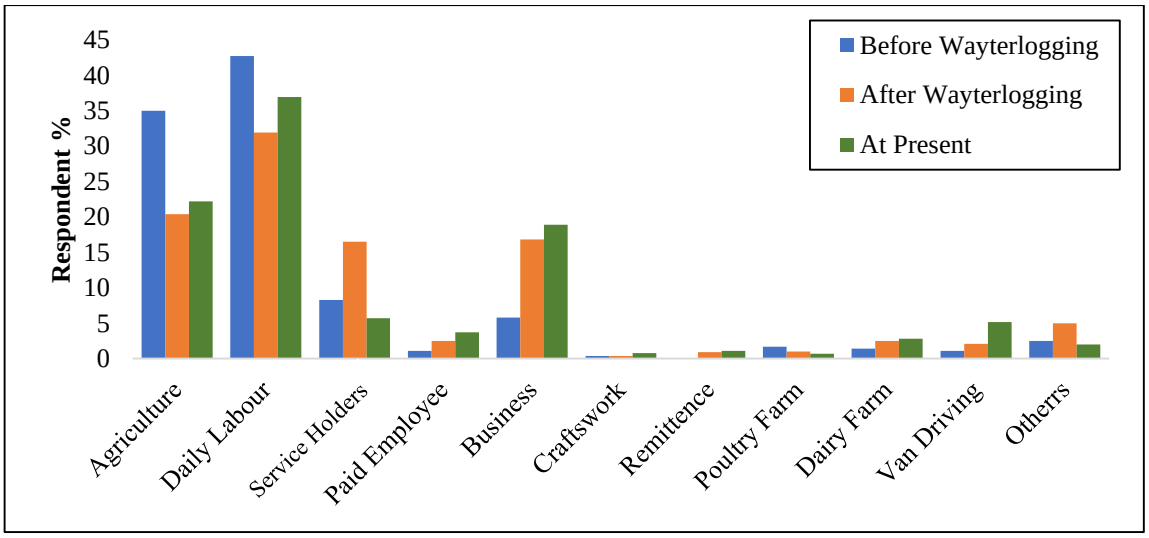
After having all the percentage (Figure-5.9), it is seen that after water logging both the percentage of agricultural livelihood and day labor decreased on the other hand business activities increased in a big ratio. And most importantly at present again the percentage of livelihood related to agriculture and day labor increased. Such variation in the percentage of agricultural activities has some reason. One participant of FGD with the farmers revealed that, after water logging when the seeding time comes especially for paddy, the land is totally inundated with water and the farmer literally have nothing to do. In recent time some of them (specially the well-off farmers) reduce water from the land through pump machine and make the land capable for cultivation. This is actually costly for many marginal farmers and they either sold the land or give it to another farmer for cultivation and changed their occupation. So, after water logging in a changed environment for agriculture some marginal farmer forced to change their livelihood.

The percentage of day laborer also decreased after water logging but increased at present. The reason is, after water logging local people engaged more with business related occupation as they found it more economic for them. Here one thing is need to mention that, the day laborers are the people can be considered as marginal people who lives hand to mouth. They mostly engaged in other's agricultural land and fish land (locally known as *gher*) and earned their livelihood. The percentage of business activities has an increasing tendency with time. It is noticed from FGD, there is variation in the type of business and most of them are doing small business like: fruit and vegetable selling, poultry, selling food item in a cart and

medium to big size business are included fish cultivation (*Gher* business) wood, furniture and cow buying and selling.

Field data revealed that, the overall percentage of service holders is less in the study area. It is a secondary type of activities and related with education. As the literacy rate found very low from the house hold survey, the people have less opportunity to involve with this type occupation. But field data also found that, at present the percentage of service holders greater than before.

After water logging livelihood related with fishing increased due to the availability of water. In the study area the percentage of van driving also increased with time. Most of them work inside the village but very few of them go outside of the village at the same time.



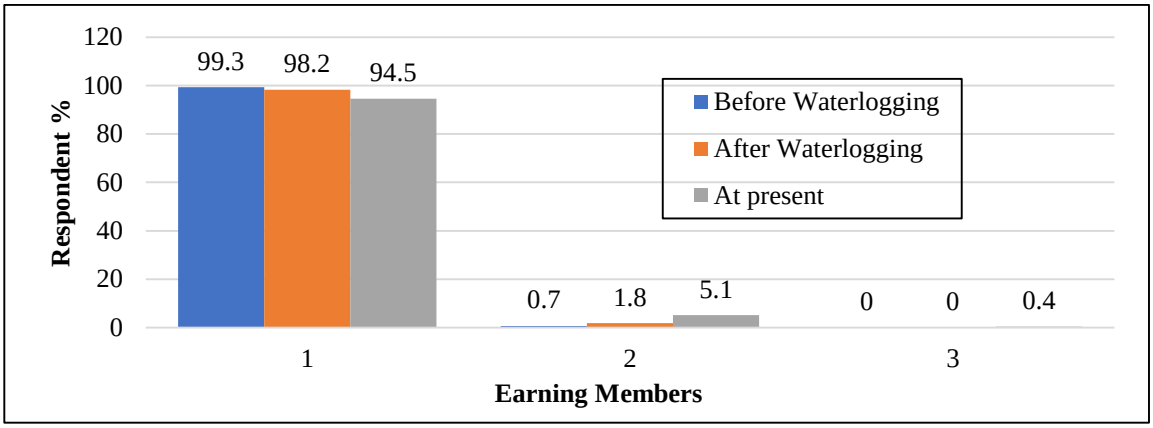
Source: Field Survey, 2018

Figure-5.9: Changing Pattern of Livelihood

5.4.2 Changes in the Number of Earning Member

Number of earning members is very important not only for a house hold economy but also for a socio-economy. Respondents were asked about the number of earning member and the answers were taken on the basis of before water logging, after water logging and present time (during data collection). From the graphical presentation (Figure-5.10) shows that, before water logging almost 100 % house hold had 1 earning member, below 1 % had 2 and no house hold had 3 earning member in their family. After water logging and at present there is a

very little growth identified in the number earning member. Nearly 2 % and little more than 5 % household has 2 earning person found respectively after water logging and at present.

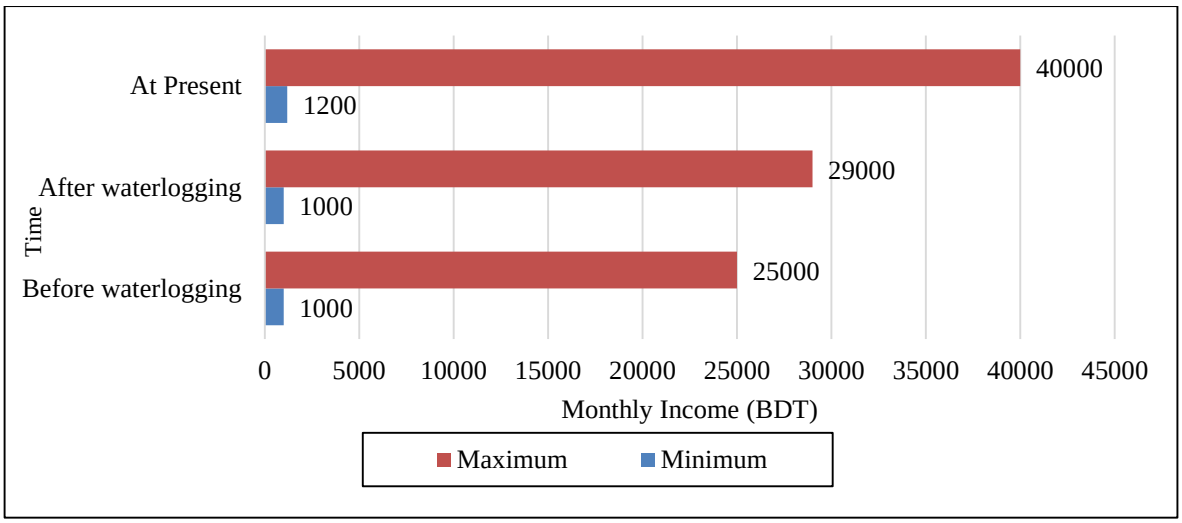


Source: Field Survey, 2018

Figure-5.10: Changes in the Number of Earning Members

5.4.3 Changes in Monthly Income

In searching the impact of water logging in livelihood, respondents are asked about their monthly income. In continuation to the comparative analysis, respondents are asked to give their answer from the time, before water logging, after water logging and at present. Figure-5.11 revealed that before water logging minimum range of income is 1,000.00 BDT and the maximum range is 25,000.00 BDT. After water logging the minimum range found still BDT 1,000.00 whereas the maximum range found greater than before, 29,000.00 BDT. Finally, at present the minimum range increased a little bit that is, 1,200.00 BDT but the maximum range got more growth and reach into 40,000.00 BDT. So, it is seen that, people living on the bottom line, that means the poor people could not make any change in their income whereas the people who have maximum income before water logging could make remarkable change in their income.

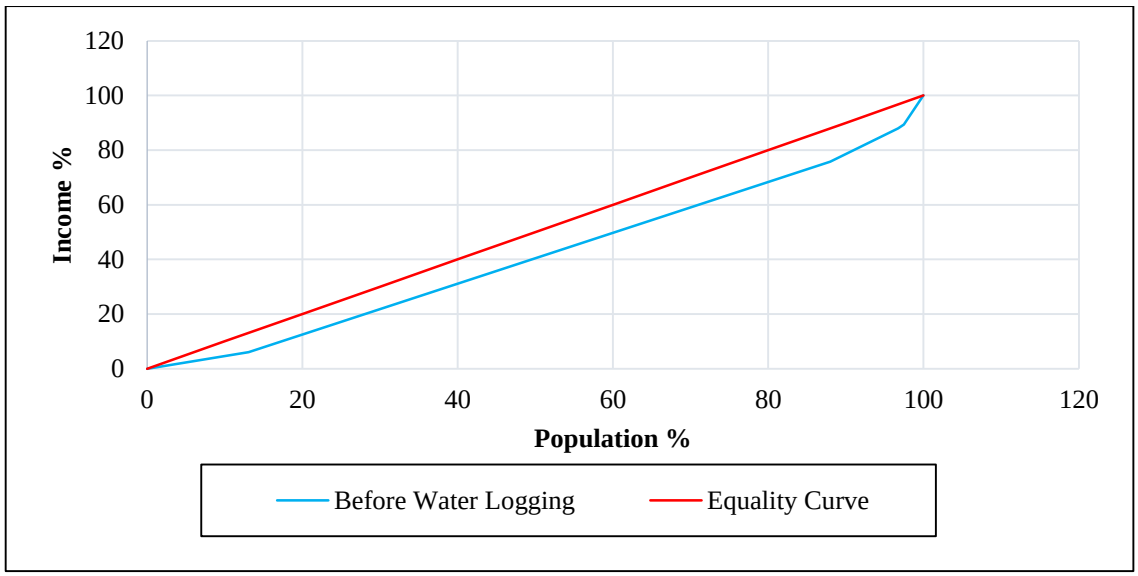


Source: Field Survey, 2018

Figure-5.11: Changes in Monthly Income

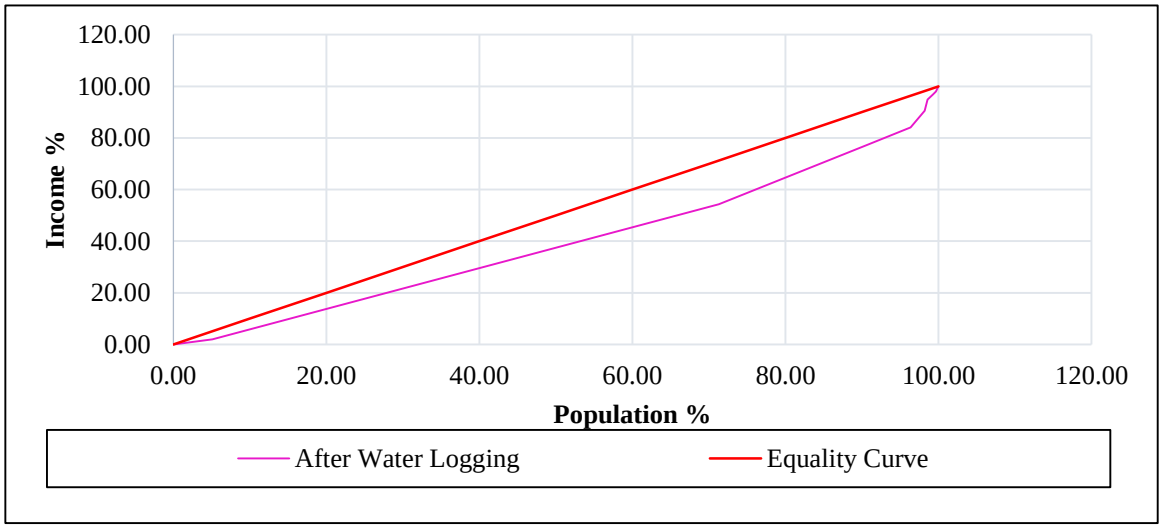
5.4.4 Income Group Analysis

This is a prerequisite that, socio economic condition of the study area needs to be looked through Gini analysis to understand the impact of water logging in the socio-economic life, which will represent the income inequality of the study area. In order to do that, a comparative analysis of Gini co-efficient between present, before and after water logging will represent the true change in socio economic structure of the study area. As per the Gini calculation (Figure 5.11a to 5.11d), before water logging the co-efficient value is 0.17 which indicates a minor inequality in the society (the Lorenz curve is closer to the equality curve) and majority of the population were in the bottom line that means poor. After water logging the value is 0.21 which indicates the disparity of income in the society got little increased than before (the distance between equity curve and Lorenz curve increased) and at present the value is 0.25 which indicates the highest inequality of income comparatively. From the above discussion based on the findings of Gini coefficient it can be said that, the poor people of the area failed to adjust with the changed socio-economic condition could not make changes to their income. On the other hand, the inhabitants who belong to the high-income group adjust with the changed socio-economic condition after water logging and made a significant increase in their income at the same time. So, it is seen that, the water logging has widened the income inequality in the study area. A major portion of the earnings is now concentrated in the hand of a few rich people of the area. The remaining mass people are passing a miserable life. As a result, the poor people remain poor but the rich become richer with time in the study area. Gini coefficient of the study area is shown in the subsequent figures.



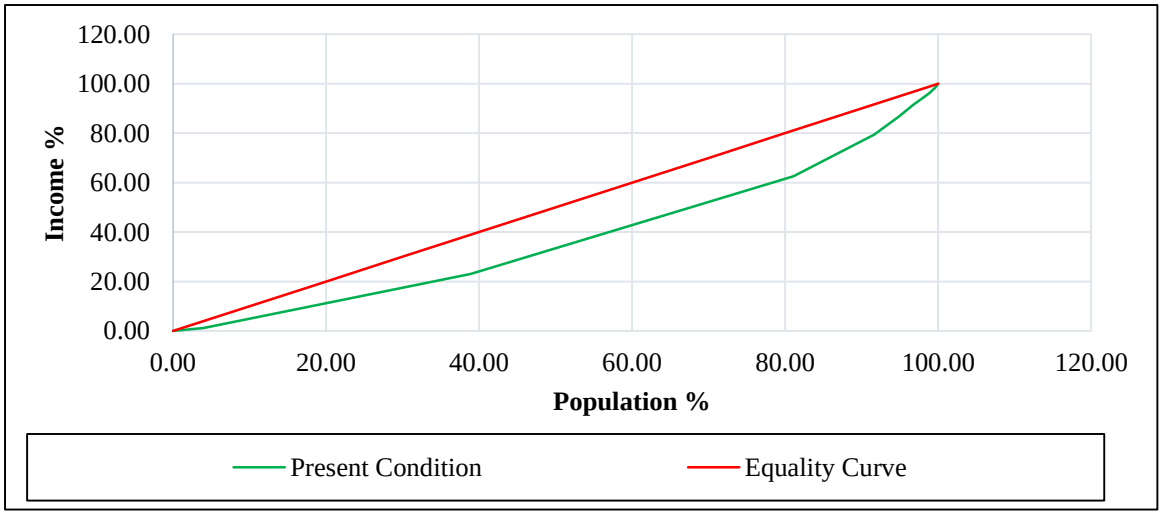
Source: Field Survey, 2018

Figure-5.11a: Income Inequality before Water Logging



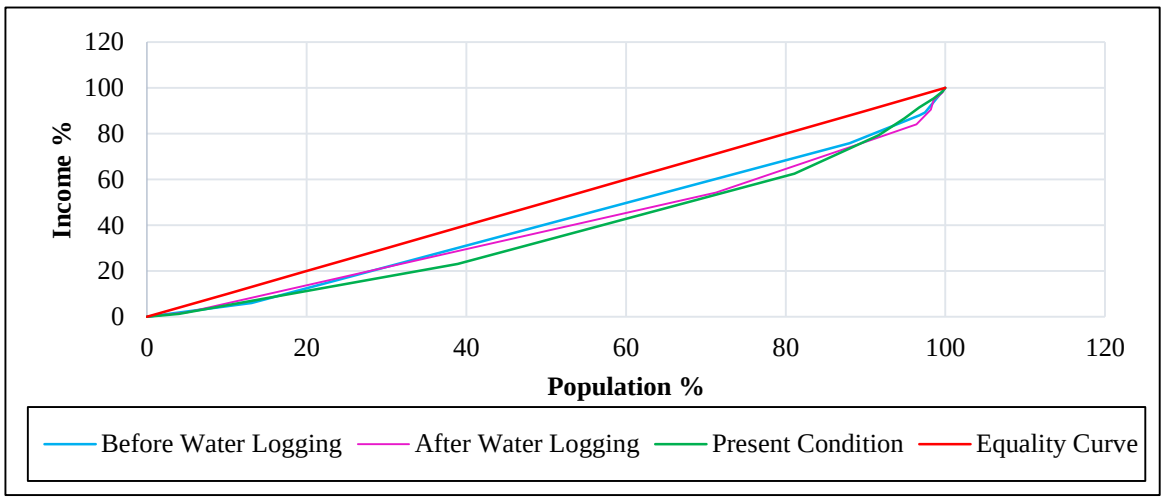
Source: Field Survey, 2018

Figure-5.11b: Income Inequality after Water Logging



Source: Field Survey, 2018

Figure-5.11c: Income Inequality at Present

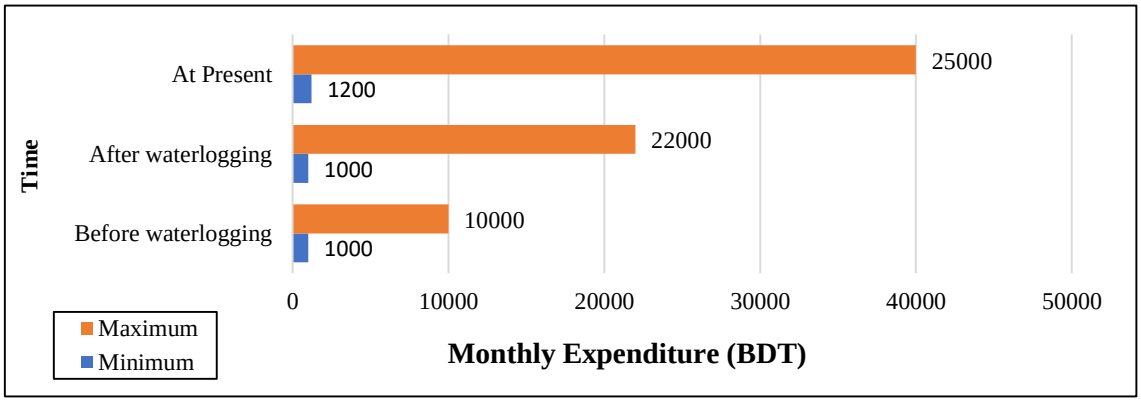


Source: Field Survey, 2018

Figure-5.11d: Combined Representation of Income Inequality at Present

5.4.5 Changes in Monthly Expenditure

Data on respondent's monthly expenditure also been collected. Figure-5.12 revealed that before water logging the amount of minimum expenditure BDT 1,000.00 and maximum amount is 10,000.00 BDT. On the other hand, after water logging the amount of minimum income still 1,000.00 but the maximum amount got a notable change, 22,000.00 BDT. And finally, at present time the minimum amount has got a little increase but the maximum amount increased more i.e. 25,000.00 BDT. So, the expenditure is showing a similar type of behavior like the monthly income of the respondents.

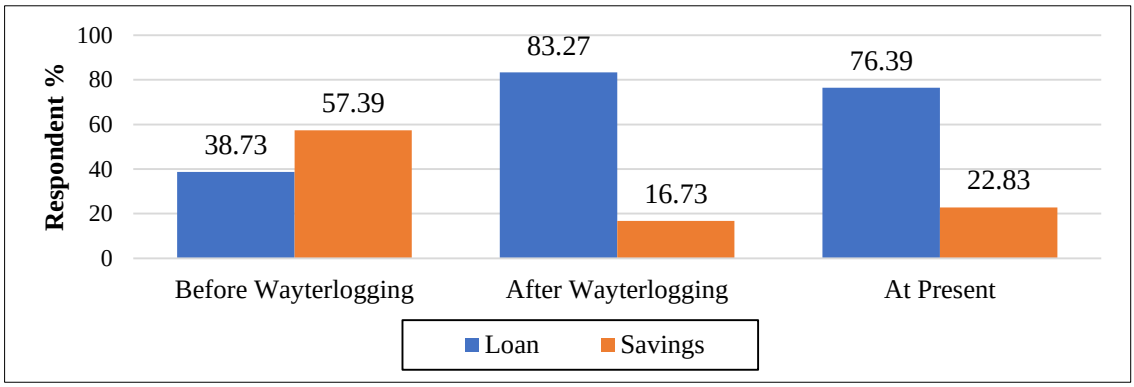


Source: Field Survey, 2018

Figure-5.12: Changes in Monthly Expenditure

5.4.6 Loan and Saving Status of the Respondents

Respondent were asked about their loan and saving status. To make a comparative analysis answers were taken from before and after water logging and present time (during data collection). Figure-5.13 revealed that comparatively the saving status is very low for all the considered time. From their monthly income it was came to know that most of the people are poor to extreme poor and lives from hand to mouth. In this economic condition it is hard to make savings for them. Field data revealed that before water logging nearly 58 percent



Source: Field Survey, 2018

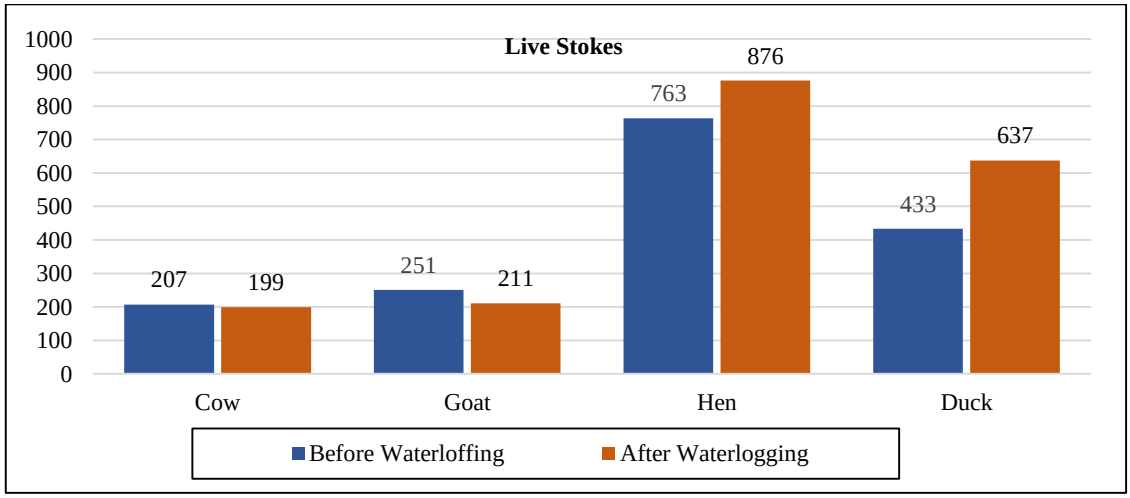
Figure-5.13: Loan and Saving Status of the Respondents

respondent had saving but after water logging and at present the percentage decreased significantly (after about 18 percent and at present 23 percent). One participant of FGD with farmer reveled that, after water logging a number of farmer and other people took loan and could not pay it back. Thus, those people are leading a measurable economic life.

5.5 Impacts on Livestock

To investigate the impact of water logging on livestock, respondents were asked about the number of livestock. Their answer was taken from two different period of time, before the recently occurred water logging and at present. The Figure-5.14 compares the number of livestock in the village. Number of cows supposed to be decreased due to water logging. Field data reveals that, there is a slight change in the number of cows in the study area (number of cows before water logging and at present 207 & 199). As an explanation, it is found previously in the livelihood pattern; some people are engaged with cow buying and selling business. By rotation they buy and sell the cows. And thus, there is a minor change found in the number of cows. There is a big reduction found in the number of goat (before water logging and at present 251 and 211 respectively). Basically, in a water logged situation it is hard to maintain domestic animal due to space and food crisis. Most importantly some people

have sold their domestic animal to have money for house maintenance and reconstruction. So, in case of goat significant change has occurred in the village than the cows. In case of chicken the number increased at present than before (before 763 and at present 876). It is important to note that, at present there is a little increase in the poultry farm in the village and thus the number of chickens found greater than before. In case of duck the number found increased (before 433 and at present 637). One participant of FGD with women informed that, now they more interested about duck due to availability of water.



Source: Field Survey, 2018

Figure-5.14: Impact of Water logging on livestock

5.6 Impacts on Agriculture

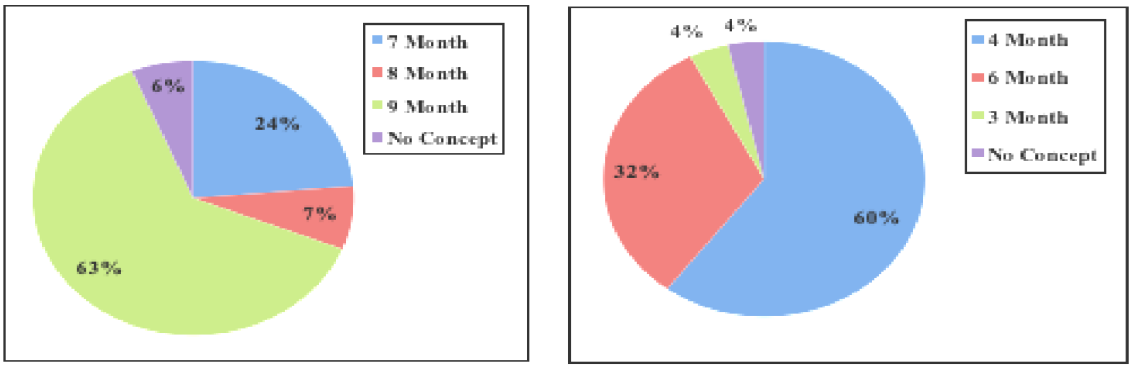
Impact of water logging on agriculture also investigated. Field data found agriculture as the second prominent livelihood in the study area. *Rajnagar Bankabarsi* is a small village where the variation in agricultural product is very poor. According to the Upazila Agricultural Office, total area of the village Rajnagar Bankabarsi is 277 acres of which 194 acres low land used only for paddy and fish cultivation. Another 83 acres land is under high land including settlement, water body, agricultural and non-agricultural land. Cropping pattern is important for agricultural impact analysis.

From the informal discussion with local people, FGD with farmers and KII it was noticed that in the study area the cultivable lands are of 2 types. These areas; *Uchu vumi* (High land) where the farmers can cultivate 3 or more type of crops over the year, such as: a) Rice (very small amount) *Gom* (Wheat). Sometimes *Kolai Daal* (Pulses) instead of *Gom* (wheat), jute, mustered, potato, onion etc. This cropping pattern is known as '*Tin Fosholee'* and b) *Nichu Vumi* (Low land) where they can cultivate only one crop in the dry season that is, paddy. As those low lands fill-up with water during the rainy season they cultivate fish at that time.

Locally those low lands are called '*Beel'*. As this low land can cultivate only in the winter and the rainy season the cropping pattern is known as '*Do Fosholee'*. During the FGD with farmer they informed that, usually they grow vegetable in the high land but for last few years they have started vegetable cultivation beside the fish land and the amount of production is satisfactory. They mainly grow: sneak bean, pumpkin, bean, vegetables (locally known as *puishak*, *laau*, *mula*, *palong shak* etc). Photo-8, Annex A, shows some of the agricultural practices in high land (rice and vegetable cultivation). In addition, on the basis of seeding, cultivation and harvesting time, a typical crop calendar of major crops is prepared (Annex G).

5.6.1 Duration of Agricultural Activities

In the study area agricultural land are of 2 types: medium to high land and low land. Water logging is most acute in the low lands and these low lands are used only for paddy cultivation. During the discussion with farmers, one participant informed, before water logging farmers can cultivate even this low land 7 to 8 months in a year. The respondents are asked about the time duration, the lands are capable for cultivation or agricultural purpose in a year.



Duration of Agricultural Activities (Before Water Logging)

Duration of Agricultural Activities (After Water Logging)

Source: Field Survey, 2018

Figure-5.15: Duration of Agricultural Activities

Figure-5.15 reveals that before water logging most of the respondents opined that (60%) the time length is 4 months and rest of them (32%) said about 6 months, lands are capable for cultivation over the year after water logging. So, it is found, due to water logging the duration of agricultural activities reduced in the lowland whereas the high lands are capable for crop production all over the year. There are a number of studies conducted on the impact of water logging on agriculture where the researcher explains how water logging effects plant growth as well as agricultural production. Agricultural production is affected directly by water logging conditions. Socio-economic and agricultural activities hampered due to water logging (Awal, 2014).

5.6.2 Amount of Cultivable Land and Crop Production

It is already informed; agriculture of the study area is very poor and main crop is only Rice. According to the local agricultural office the amount of land for Rice cultivation is 194 acres which is under the low land. Rice cultivation also seen in the high land but in a very little amount. From the discussion with farmers it is revealed that, in the study area there is a variation in the type of rice (Table-5.7).

Table-5.7: Production of Rice at Different Durations

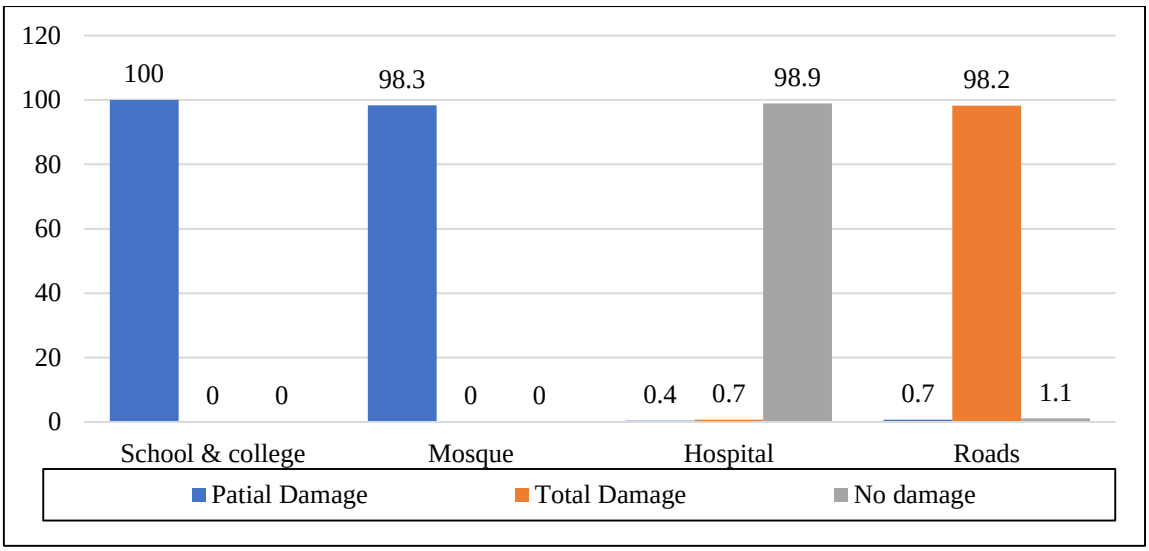
Production Year	Type	Quantity in Avg (MT)
2000-2008	IR-50 and China	485
2009-2013	BR-28 Zia	533
1014-2016	BR-28 Hira & Super-28 Hira	582
2017-2018	Super-28 Hira & Shuvolota	630

Source: Upazila Agriculture Office

5.7 Impacts on Community Level

5.7.1 Community Structures

The respondents were asked about the damage of community structures. There are 2 primaries, 1 secondary school and 1 madrasa for girls in the study area. Beside this the village has 2 mosques. But no hospital or health center in short distance. Figure-5.16 depicted that all most all of the respondents gave one specific opinion on that. The table given below shows the respondents opinion on the impacts of water logging on community structures. Field data shows that, all of the respondents (100%) give their opinion about the inundation and partial damage of school (Photo-9 & 10, Annex A) and total damage of road in the study area (Photo-11, Annex A). From FGD and KII, it was revealed, there are 5 kilometers of mud road *(kacha road)* and 3.5 kilometers of concrete road *(pacca road)* of which 3.5 kilometers of mud road and .5 kilometers of concrete road inundated during the water-logged time.



Source: Field Survey, 2018

Figure-5.16: Damage of Community Structures

5.7.2 Education

Respondent were asked about the damage of school building. All the respondents mentioned that due to water logging there was no structural damage in school buildings in the study area. However, academic activities are disturbed in many ways. From the KII participant (one of the principal of local primary school), it was noticed that, due to water logging the children have been forced to discontinue their education as the school building went under water for long time. He informed that, during the water-logged time educational institutes remain closed for 2 to 3 months in the area. Sometimes reading and learning materials get damaged. Some of the FGD participants (women) in the study area did also highlight these difficulties.

Chapter 6

HARDSHIP IN PEOPLES' LIFE

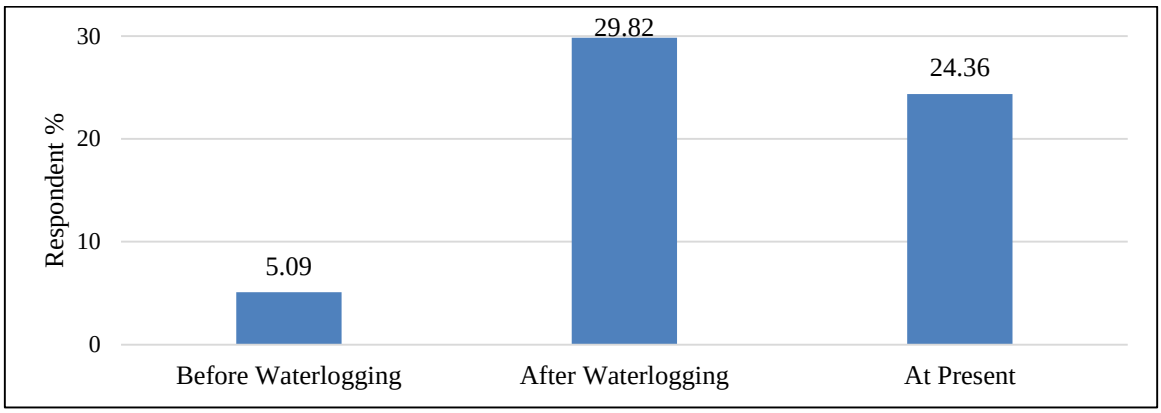
6.1 Introduction

It's that time of the year again. The rains are pouring and the water seems to be going nowhere. Certainly, the land is all soaking up and water is just rising up! People forced to leave their homes, while in the farms, crops are sinking under the water and some are dying out. Peoples are affected from various water borne diseases. They can hardly meetup their 3-time meals in a day. In this chapter, an attempt has been made to demonstrate the hardship in people's life in the study area due to water logging.

6.2 Migration

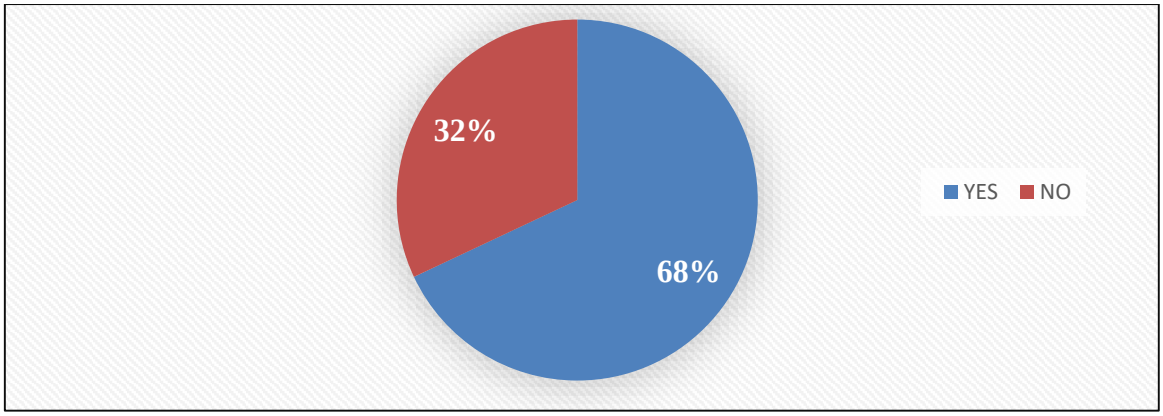
There is an attempt to investigate the people's migration pattern of the study area. After the field survey it is found that, very few people involve with migration of the study area. The percentage of out migration before water logging was only 6 % (Figure-6.1) but after water logging it becomes almost 30 % and at present it is nearly 25 % which involves rural to urban migration, migration to the large city, international migration etc. Field data revels that, some respondent involved in the business purpose mobility. From the occupation pattern of the respondents it was found that, respondents are mostly involved in business (small or medium) after water logging. Among them a notable percentage are involved (about 68 %) in business purpose mobility (Figure-6.2).

From the informal discussion with local people it is found that, some people travel long distance for cow buying and selling. Beside this some of them do seasonal traveling for job purpose. They mostly travel *Magura* and *Faridpur* in rice harvesting time to work as a labor in the agricultural land. According to them, duration of this type traveling varies from minimum 1 week to maximum 2 months. Those who engaged with buying and selling of domestic animal; like cow, goat, buffalo etc, mostly travel in *Barisal, Kuakata, Faridpur, Magura* from where they usually buy small size cow and after 1 or 2 year when it becomes grown enough, they sell it in the local market. Beside this a few percentages of them travel long distance for their business raw materials like wood, fertilizer etc.



Source: Field Survey, 2018

Figure-6.1: Percentage of Out Migration of the Respondents

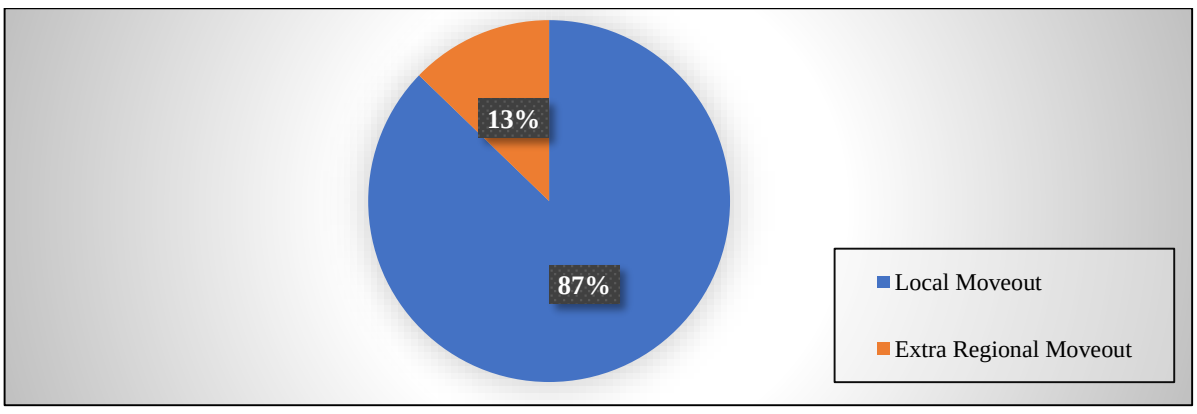


Source: Field Survey, 2018

Figure-6.2: Percentage of Respondents Engaged with Business Purpose Mobility

6.2.1 Local and Extra Regional Move Out (During Water logging)

To determine the impact of water logging in people's life, respondents are asked about migration during water logging. Figure-6.3 revealed that about 87% respondent do local move out during water logging and other 13% respondent involve with extra regional move out. From the FGD with women, it is revealed that, in some cases women are sent to their in-laws or parents houses to avoid the vulnerability.

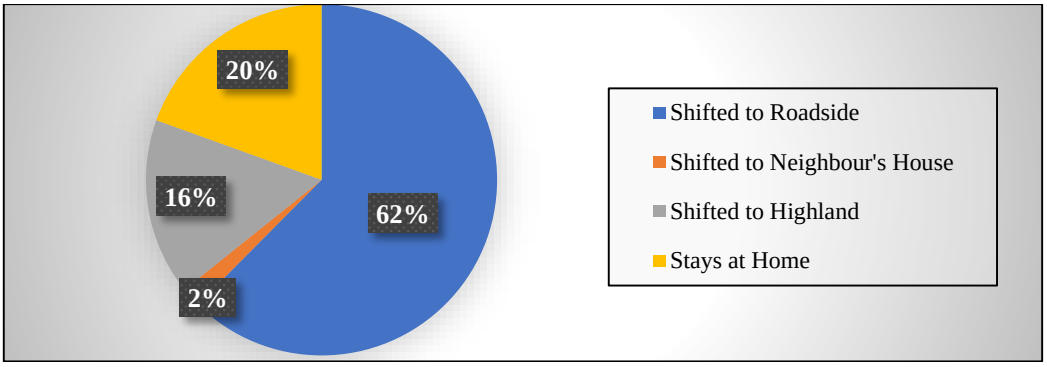


Source: Field Survey, 2018

Figure-6.3: Move out during Water Logging

6.2.2 Local Mobility during Water Logging

Field data revealed that, most of the people didn't leave the area during water logging and involved with mobility inside the area (local mobility). Respondents were asked about their local mobility during water logging. According to them, during water logging, 62% respondent evacuated to road side, 20% stays at home, 16% shifted to the available highland inside the village and some 2% shifted to the neighbor's house (Figure-6.4).



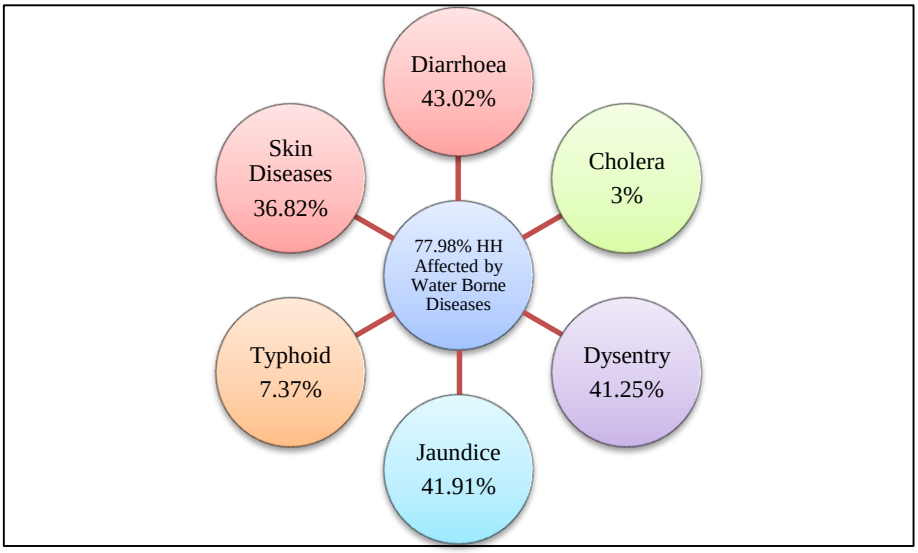
Source: Field Survey, 2018

Figure-6.4: Local Mobility during Water Logging

6.3 Impacts on Health Issues

6.3.1 Diseases Due to Water Logging

In terms of water borne and contaminated water related diseases, approximately 78 percent Households suffered from diarrhea, dysentery, skin disease, cholera, typhoid, jaundice etc. Respondents were asked to give information from recent water logging in the area. Of these, skin disease, diarrhea and dysentery spreads like epidemic during water logging and jaundice occurred after water logging (Figure-6.5).

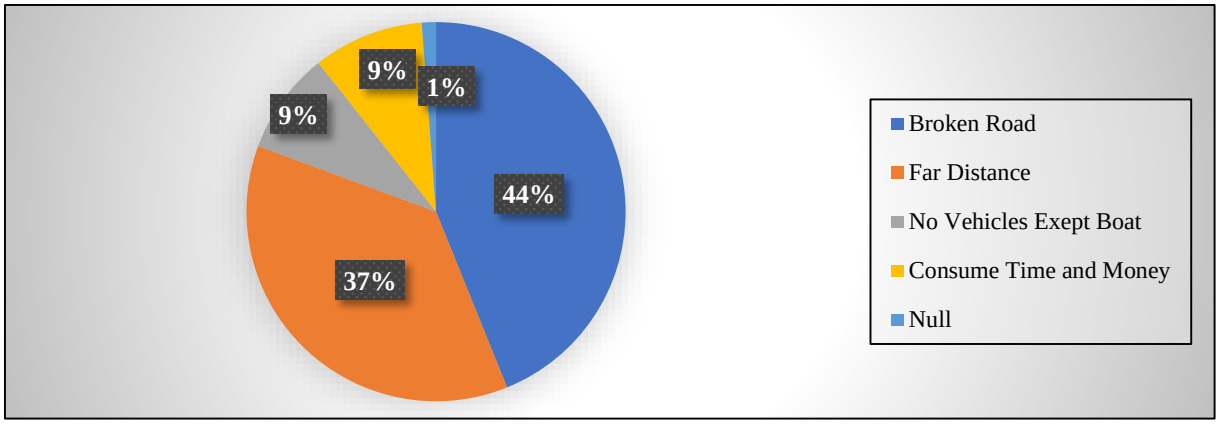


Source: Field Survey, 2018

Figure-6.5: Diseases Suffered during Waterlogging

6.3.2 Difficulties on the way to Hospital

There is no hospital or health complex inside the village. Villagers have to travel long distance to reach the health complex. According to the respondent the nearest hospital is about 7 km away from their locality. As a result, during water logging people have to face difficulties on the way of hospital. Majority of the respondent (about 44%) said about the broken road. It is observed that; recurrent water logging left the road inside the village in a contemptible condition. About 37% opined that the distance of hospital from their locality is the main problem, 9% respondent mentioned that during water logging there is no vehicle except boat and another 9% of the respondent found it is money and time consuming to go to the hospital during the water-logged time (Figure-6.6).

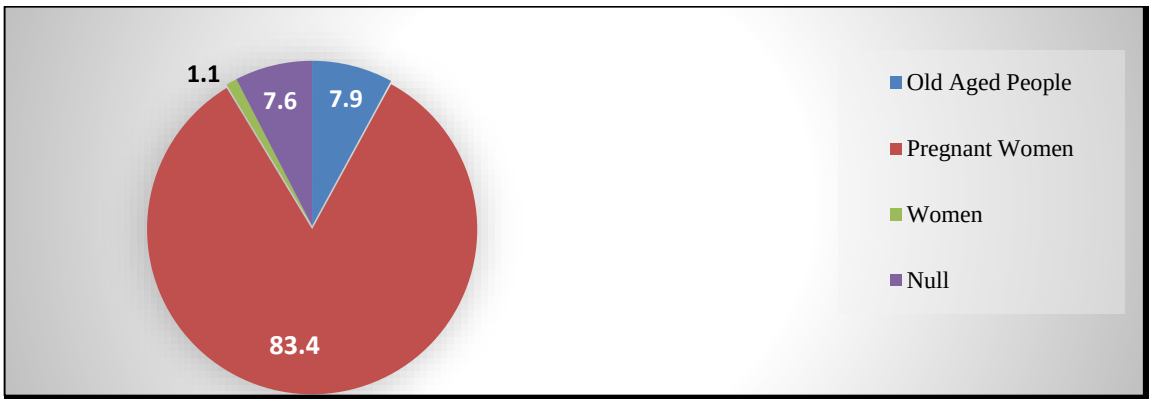


Source: Field Survey, 2018

Figure-6.6: Difficulties on the Way to Hospital

6.3.3 The Worst Sufferers

From the household survey and FGD with women it was informed that during the peak time of water logging women, children and aged people faces more difficulties than other (Figure-6.7). The respondents especially mention about the vulnerability of pregnant women. They mentioned about the insecurity and awkward situation among women and young girls relating to the desiccation. From the age and gender distribution of the study area (Figure- 4.1) the percentage of children, elderly people and female (in the dominant age group) are shown. In table- 4.2 a comparative analysis has given with the national age and gender distribution (year 2017) from which it is observed that the percentage of children, elderly people and female in the study area is almost similar and may be considered as vulnerable group for the disaster-prone area Rajnagar Bankabarsi.



Source: Field Survey, 2018

Figure-6.7: Main Sufferers during the Water Logging

6.4 Daily Requirements

6.4.1 Source of Drinking Water and Way of Water Purification

Tube-well is the only source of drinking water in the study area (Figure-6.8). During the peak time of water logging most of the tube-well go under water and sometimes this source of water also gets contaminated. Again, people affected with diarrhea, dysentery etc. Due to drink this polluted water. Another problem related to water is the increased hardship relating to water collection. Respondents were also asked about the water purification technique. According to household survey,

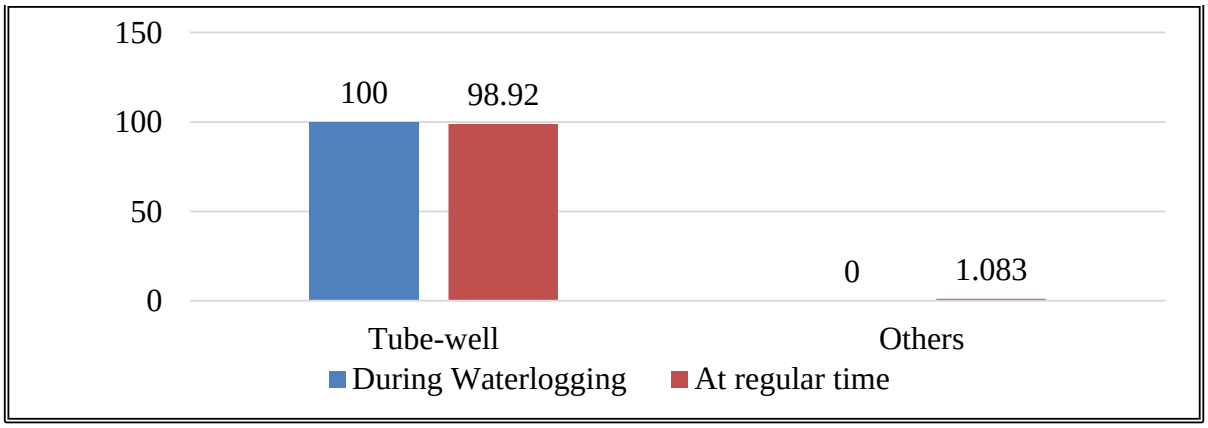
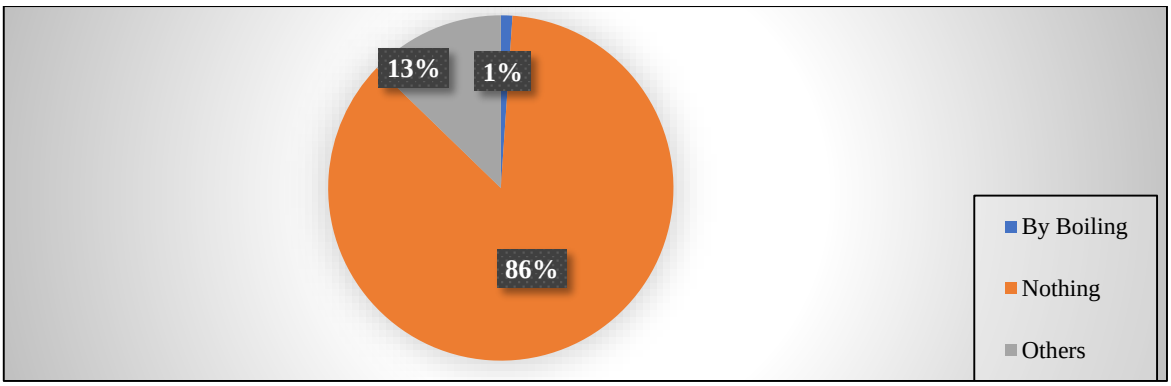


Figure-6.8: Respondents' Opinion about the Source of Drinking Water

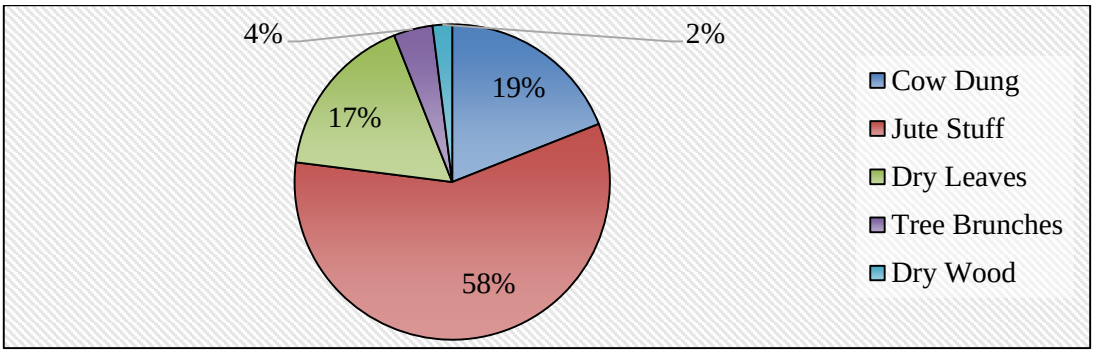


Source: Field Survey, 2018

Figure-6.9: Water Purification Techniques

6.4.2 Sources of Fuel

According to the respondents, they mostly (58%) use jute stuff as fuel. From agriculture data it is found that, jute is cultivated in a large amount by the farmers. And they not only sell the fiber but also the stick. It is very suitable to fire up and readily available; the respondents commonly use it. 19% of the respondents use cow dung for their fueling purpose and some of them attach cow dung with jute stick (Photo-13, Annex A). 17% said about dry leaves, about 4% depends on tree brunches and only 2% of the respondents use dry wood as fuel. At present due to available electricity some people are using electric items for cooking also (Figure-6.10).



Source: Field Survey, 2018

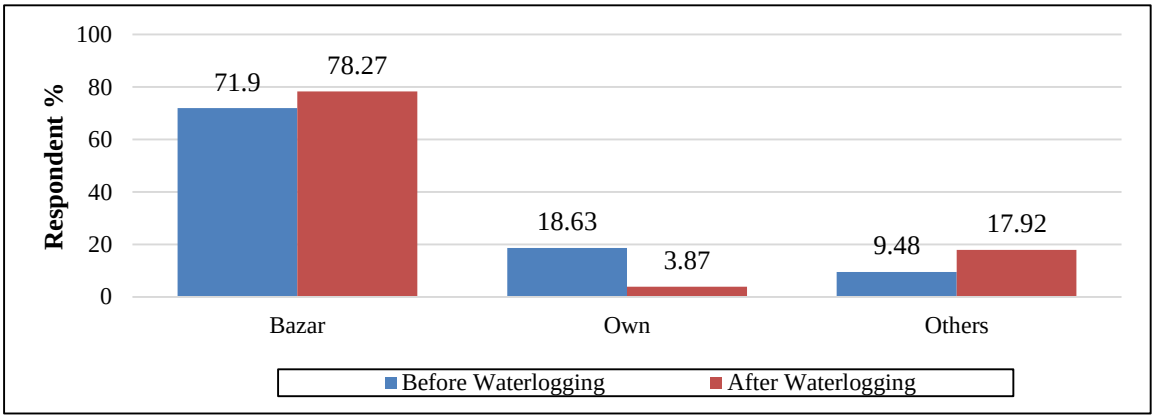
Figure-6.10: Percentage of Using Different Type of Fuel

6.5 Food Securities

6.5.1 Type of Food (Vegetable, Rice & Fish)

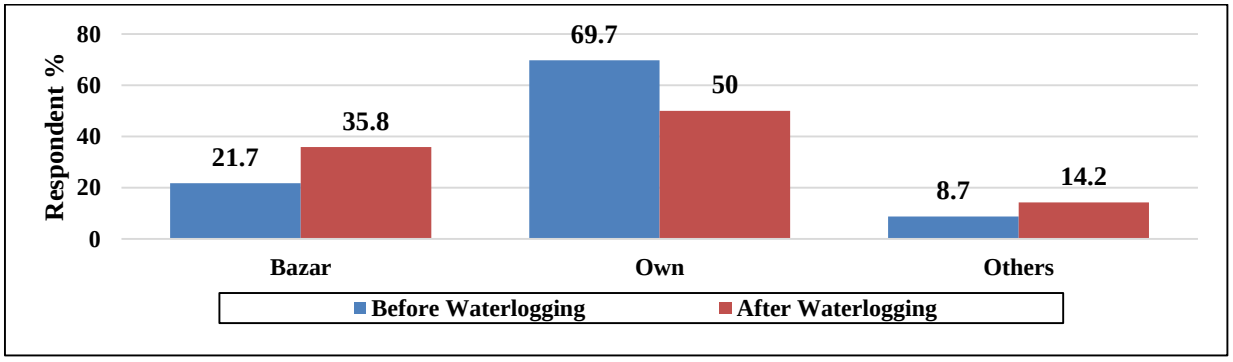
In searching the impact on food securities respondents were asked about their daily food items. Their answers were taken from the time before and after water logging. In terms of vegetable, respondents are mainly depends on bazar for their daily requirement, it is observed that, before water logging almost 72% and after water logging little more than 78% respondents depends on bazar for vegetable. From the overall findings it can be said that, as

the percentage of dependency on own production decries with time respondents are now mostly buy their vegetable from bazar (Figure-6.11).



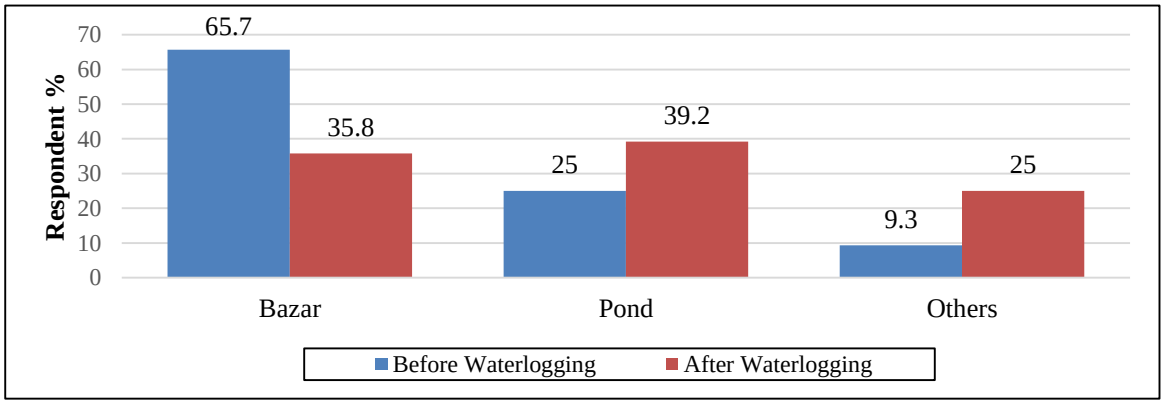
Source: Field Survey, 2018

Figure-6.11: Source of Vegetables



Source: Field Survey, 2018

Figure-6.12: Sources of Rice



Source: Field Survey, 2018

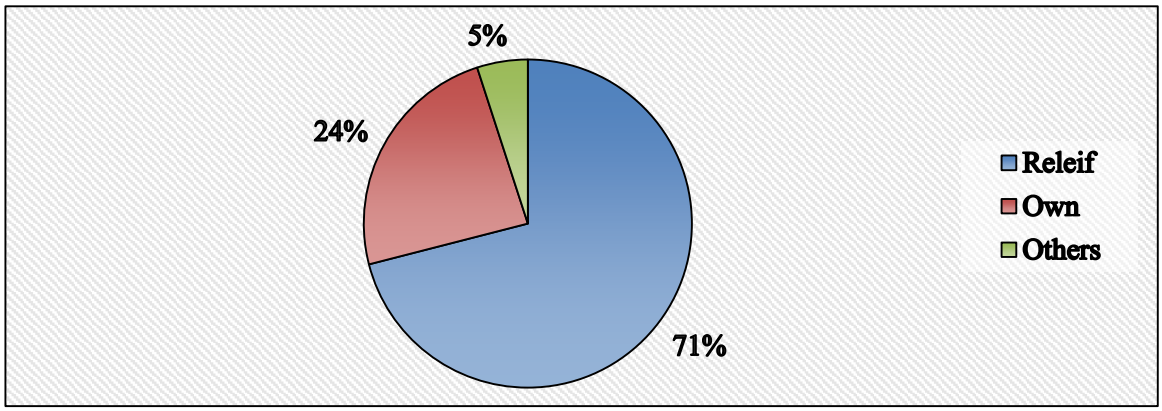
Figure-6.13: Source of Fishes

In terms of rice, before water logging nearly 70% respondents are produced their won rice, nearly 22% said bazaar is the main source for them and about 9% mentioned others sources. After water logging there is a decreased in own production of rice **(**50%**)** and the dependency

on bazar increased. At the same time other sources also increased, nearly 15% (Figure-6.12). In case of fish dependency on bazar decreased approximately by 30%. According to the FGD respondents, after water logging more people are engaged in 'gher' business as a result the own production of fish increased.

6.5.2 Sources of Food during Water Logging

Respondents were also asked about the food source during the water logged time. Most of the respondents (about 71%) informed, relief is the main source of food for them during the disaster. Some other 24 respondent can manage food with their own and 5 percent said about other different sources: from relative or neighbor. It was unfolded in the FGD with women and discussion with local people, there are a number of NGOs working with GOB who provides dry food, medicine and other necessary items during the water logged time. Food item given by the NGOs and GOB includes: *Chira* (flat rice), *Muri* (puffed rice), Bread, drinking water, medicine, Oral saline etc. They also provide potato, wheat, rice after water logging but in small amount.



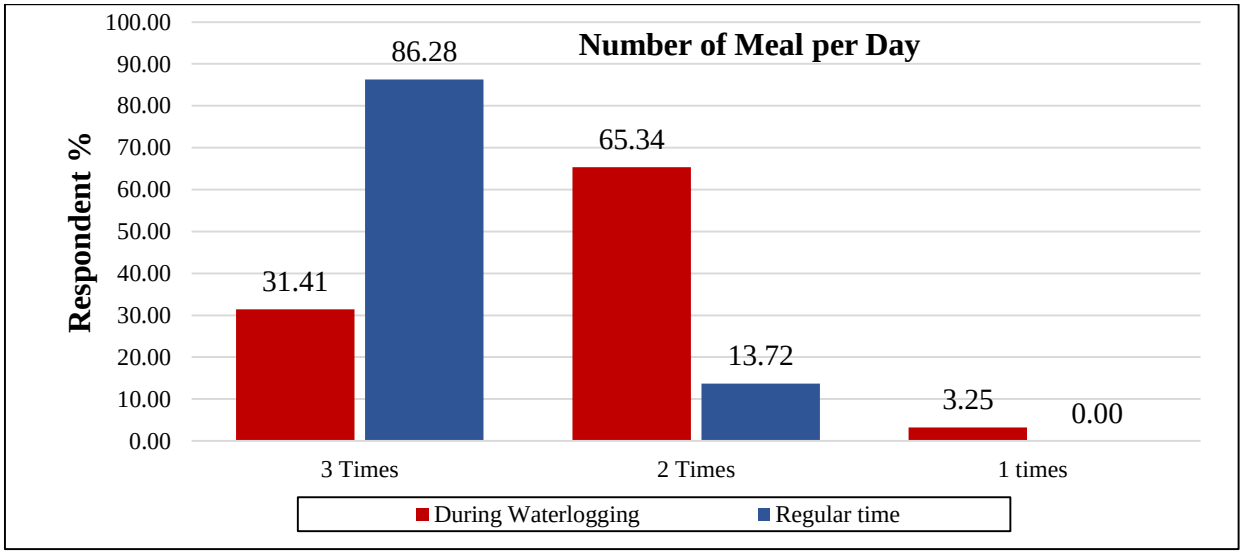
Source: Field Survey, 2018

Figure-6.14: Sources of Food during Water Logging

6.5.3 Three Proper Meals a Day

Water logging also affect the food security of a community. Due to loss of production and income people reduce their food consumption. The current assessment portrays a deteriorating food security situation for the population affected by water logging. In searching the food security respondent are asked about the number of meals they have in a day. Source of food are also investigated. Their answers are taken on the basis of regular time and during water logged time. Figure-6.15 shows, in terms of comparison with regular and during water logged time, in regular time nearly 87% of House Hold (HH) can ensure three meals in a day

properly while in the water logged time only 32% HH are able to manage proper three meals in a day. Field data further revealed, about 66% HH can manage 2 times meal during water logged time and almost 14% respondents have meals 2 times even in the regular time. Nearly 4% respondents take only 1 meal per day during the water logged time. One participant (FGD with women) informed that sometimes the adult members of the family consume 1 meal to let the children and the elderly eat 2 times a day during the water logged time. So, the quantity and quality of meals has reduced significantly during the time of inundation which increased the vulnerability of food security.

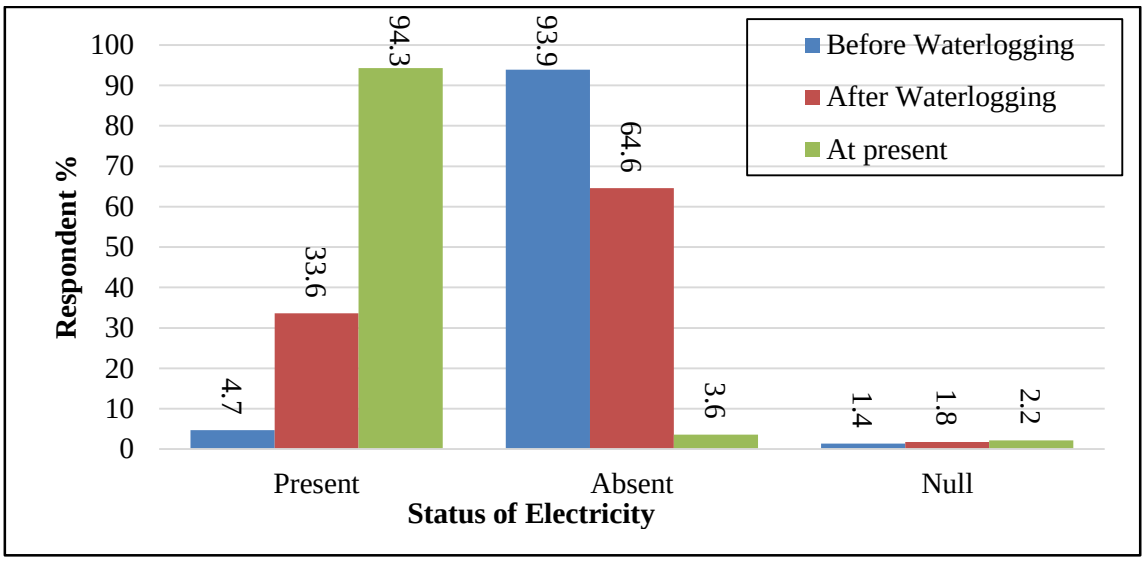


Source: Field Survey, 2018

Figure-6.15: Food Security Profile of the Respondents

6.6 Electricity Supply

Socio economic development of any society greatly depends on the supply of electricity and sanitation facilities is an important indicator of living standard. From the field data, it is seen that; before water logging the supply of electricity was almost 5% whereas after water logging it is nearly 34% and at present it is little more than 94%. Although water logging covers the area almost for 4 months over the year (Figure-6.16) the supply of electricity increased day by day. On the other hand, if we look on the data of sanitation facilities; 88.4% people said that before water logging the condition of sanitation was unhealthy. But after water logging and at present there is very little change in the condition of sanitation.



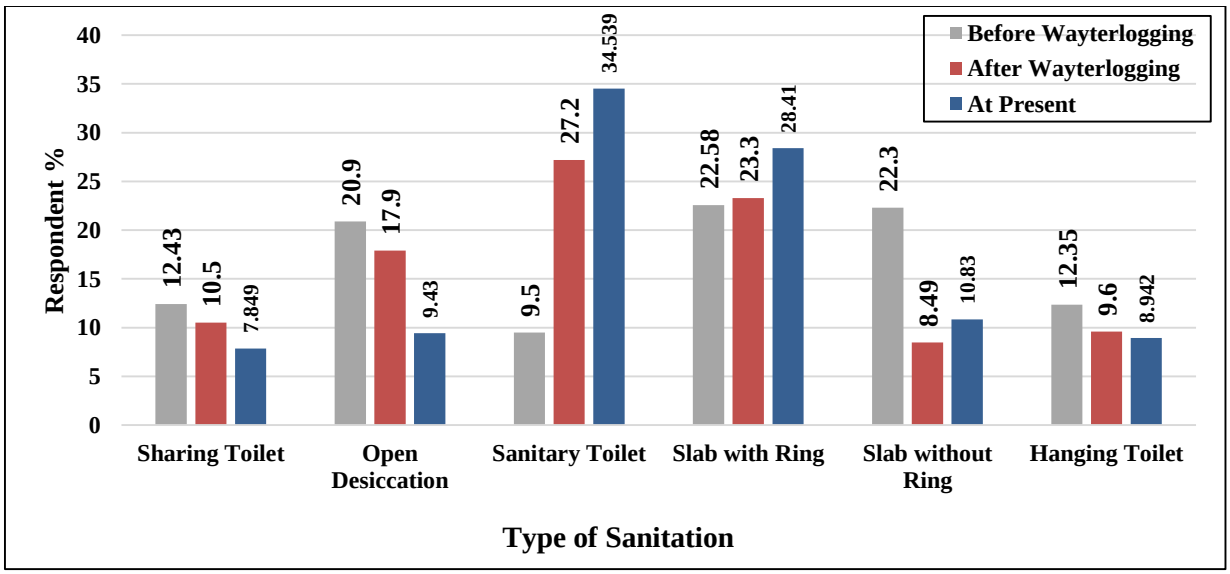
Source: Field Survey, 2018

Figure-6.16**:** Status of Electricity Supply in the Study Area

6.7 Sanitation

The water-logging has a considerable impact on the overall sanitation status of the population. There was an investigation about the type of latrines and their opinion about it. Figure-6.17 shows before water logging nearly 10% households had access to use sanitary toilet while about 23% respondents said they have toilet slab with ring but condition was not good. Little more than 22% told they are using toilet slab without ring with very unhealthy condition. Before water logging little more than 12% respondents had hanging type of toilets in their household. Almost 13% respondents have no toilets of their own and they shared the toilet of neighbors and almost 21% respondents said about open defecation at that time which was hazardous for health. Field data reveled that in the study area the number of sanitary toilets increased with time. After water logging and at present the percentages of sanitary toilet are little more than 27% and approximately 35% respectively. The percentages of other type of latrines are given considering the time after water logging and at present respectively: latrines slab with ring little more than23 percent and nearly 29%. Latrines slab without ring after water logging nearly 9% and at present approximately 11%. Hanging latrines nearly 10% and about 9% found from field data. After water logging the percentage of sharing toilets decries that is nearly 11% and at present with more reduction the percentage became approximately 8%. In terms of open defecation, the percentage also decries with time, after water logging approximately 18% and at present nearly 10%. So, it is seen that the sanitation profile improves with time in the study area. The reason is, there are a number of NGO working in

the village to improve the situation. As the part of their different activities they also provide sanitary toilets to the people in free of cost. According to a field worker of NGO SHAMADHAN, they have provided almost 34 sanitary toilets to the villagers in the year of 2016 (8 toilets), 2017 (12 toilets) and 2018 (14 toilets).



Source: Field Survey, 2018

Figure-6.17: Sanitation Profile of the Study Area

Chapter 7

ADAPTATION MECHANISM

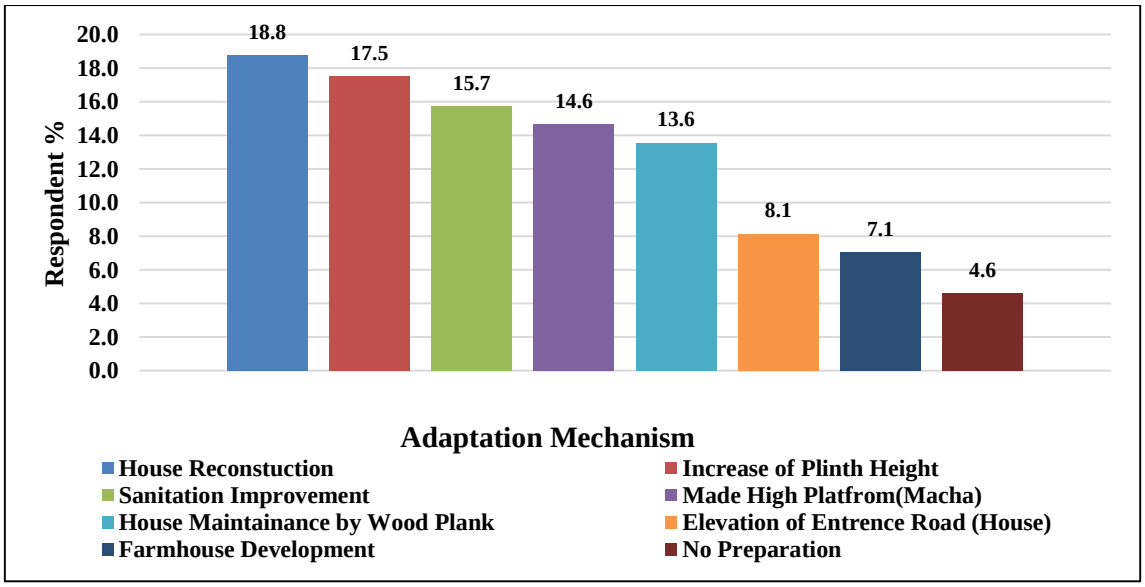
7.1 Introduction

Every community has to adjust with the social and natural features and conditions of it. To adjust with the characteristics of a natural environment is very challenging. As the villagers are suffering every year from a perennial water logging, they identified some strategies to deal with the situation. During the field observation it is found that people are following different type of measures according to their priority.

And these strategies are taken by the local people from homestead level to community level. In this chapter an attempt has been made to demonstrate some strategies and techniques practiced by the local people in the study area.

7.2 Adaptation at Homestead Level

Respondents were asked about the taken measures to protect them from next water logging and reduce vulnerability. The answer was taken from homestead level to know the techniques, what measures they have taken to protect their homestead and other settlement related components. Some adaptation techniques at the homestead level are demonstrated in Figure-7.1:



Source: Field Survey, 2018

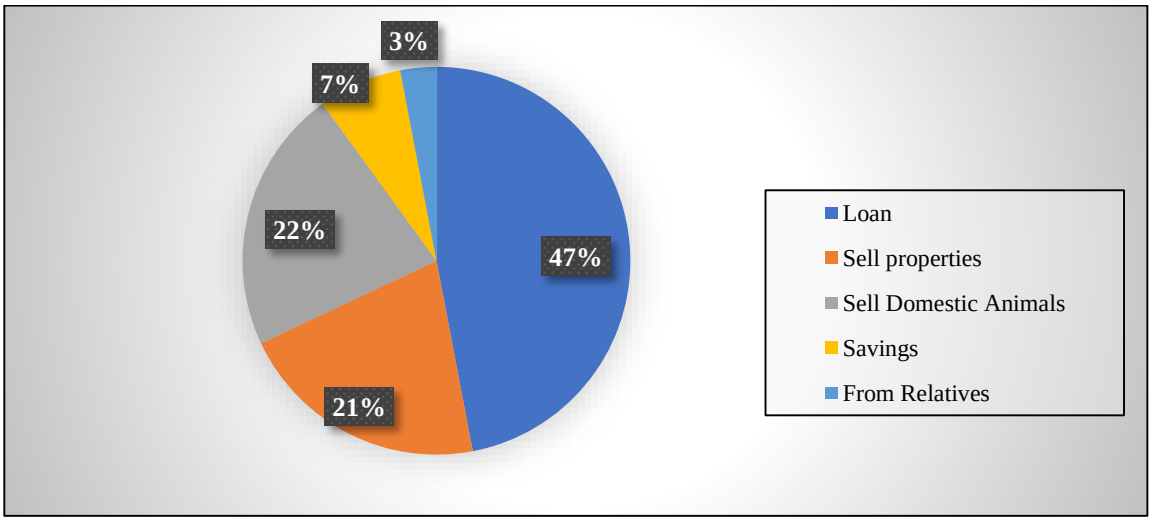
Figure-7.1: Adaptation Mechanism at Homestead Level

7.2.1 Structural Modification

To adapt with the water logged situation local people are modifying their settlement structure from *kacha* to *pacca* or *semi-pacca*. Field data revealed that to adopt with the water logging situation nearly 19% of the respondent made structural modification with more permanent building material (Photo-14, Annex A).

7.2.1.1 Sources of Capitals for House Reconstruction

From the analysis of settlement type, it is noticed that local people are highly concern about to change the type of their homestead for adaptation. Respondent are asked about the money source for house reconstruction. About 47% respondents took loan from local NGOs and bank**.** 21% respondent sold their agricultural land, about 22% respondent sold their domestic animals and make money for house reconstruction. About 7% said about previous saving and only 3% collected money from their relatives as loan (Figure-7.2).



Source: Field Survey, 2018

Figure-7.2: Source of Capitals for House Reconstruction

7.2.2 Increase in Plinth Height with Structural Change

In terms of plinth (*Bhiti*) height some previous discussion is needed. The study area has both high and low land and the low lands (local name *Beel*) surround the village from east and west direction. Water logging is very acute in the *beel* side low land area and the depth of water during water logging is more compared with the other part of the village. Not only that, water logging caused a generous damage to the mud plinth. That is the reason in this part of the village people increasing the height of plinth of their homestead as adaptation measure.

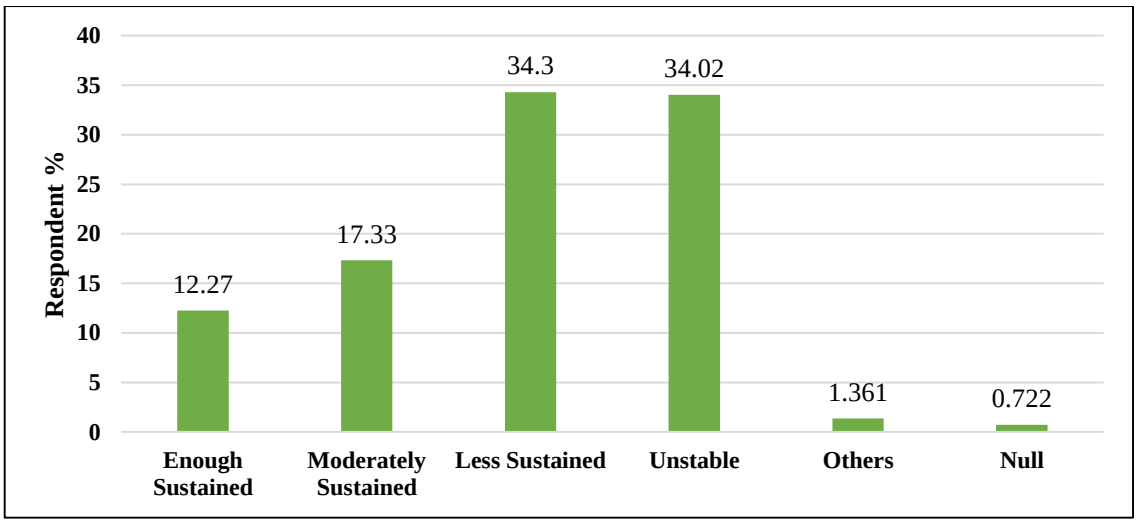
Nearly 16% respondents said that, they have increased the plinth height at the same time some of them reconstruct the plinth with permanent materials (Photo-15, Annex A).

7.2.3 House Maintenance

Some of the respondents (basically poor) carry out some maintenance of their houses with cheap and readily available materials like wood plank or bamboo. Poor people's houses naturally built with poor materials which falling-off during the prolong water logging. Poor households are much more vulnerable than the others type. But due to money crisis they just keep up their homestead instead of reconstruct. According to field data nearly 12% respondents said that, they have just sustained their home stead by wood or bamboo as the part of adaptation work (Photo-16, Annex A).

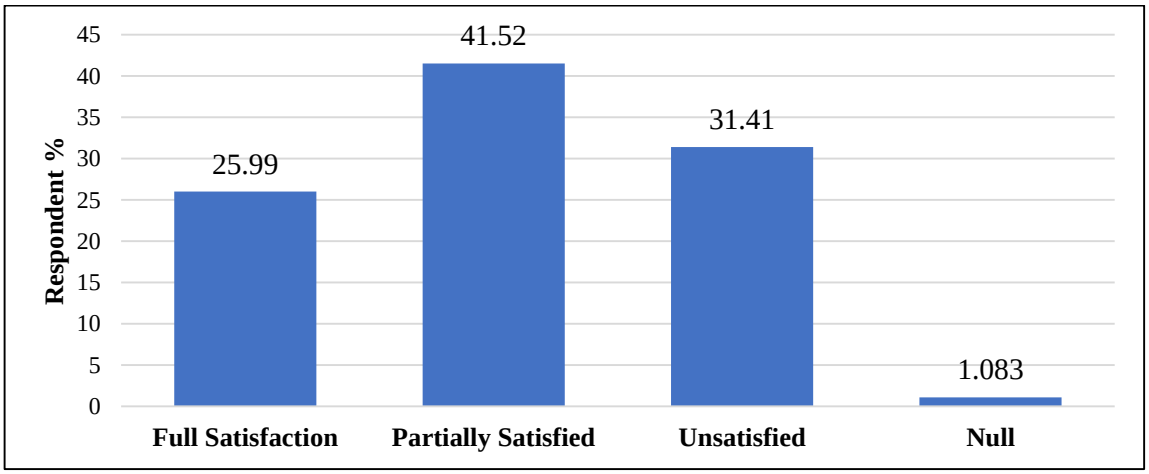
7.2.4 Important Opinions on Reconstructed Houses

Respondents were asked different opinions related to their homestead. They gave their opinions about the sustainability of recently maintained or constructed houses. About 13% people said that the house is fully sustainable (Figure-7.3). Nearly 18% said, the house is moderately sustainable whereas little more than 34% said less sustainable and 34% said the house is not stable. So, generally there is a question has come about their satisfaction level on the newly maintained houses. Among the respondents, 26% are fully satisfied with the newly maintained or constructed houses. On the other hand, 42% are partially and 32% are not satisfied at all (Figure-7.3). In another question, people were asked to give their opinions about the participation of local people in the settlement rehabilitation program as an advisor. It is seen that almost 96% of the people think that it is required to participate in the settlement re-habilitation program so that they can project or share their requirements (Figure-7.3). From the above discussion, it is seen still a good percentage of the houses are unstable.



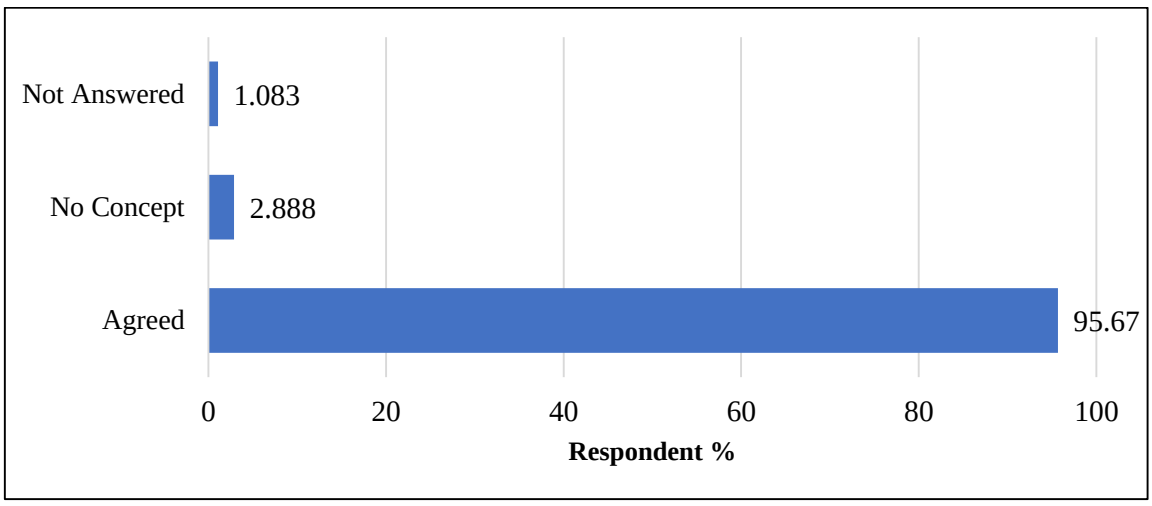
Source: Field Survey, 2018

Figure-7.3: Opinions about Reconstructed Houses



Source: Field Survey, 2018

Figure-7.4: Level of Satisfaction on Reconstructed Houses



Source: Field Survey, 2018

Figure-7.5: Opinion on Participation in Local House Resettlement Program

7.2.5 Sanitation Improvement

According to local people, during water logging, sanitation condition appears as one of the most awkward problems in the area. House hold survey shows, 13.72% respondents said, they improved their sanitation quality as the part of adaptation work. In the FGD with women, one participant informed that at present some NGO are providing sanitary latrines to the village people. It was found from further investigation that NGO named SHAMADHAN and BRAC provides almost 55 sanitary latrines to the people for the betterment of sanitation status in the area (Photo-17, Annex A).

7.2.6 Elevation of Courtyard and House Entrance Roads

As the part of adaptation activities some respondent elevate their courtyard and the house entrance road. To protect the home stead from water logging vulnerability this is an effective mechanism and widely practiced by the local people. As per the field survey little more than 6% said about this kind of activities. Actually, this type of activity depends on their requirements at the same time the location of homestead.

7.2.7 Farm House Development (Adaptation for Livestock)

Household-based livestock suffered significantly during water logging. As per field data, some respondent took some measurers for the domestic animals. About 5% respondent developed their farm house to protect their domestic animals from water logging vulnerability. Photo-18, Annex A, shows the techniques, local people are following as the part of adaptation mechanism for their livestock.

7.2.8 Elevated Platform for Fuel and Raw Materials (*Macha)*

Sometimes, water enters into houses and the floor and wall remains wetted for a long time and it damages the household goods, stored food grains etc. It was found during the field observation that some of the respondent made elevated platform locally called '*Macha*' to protect their fuel and raw materials from inundation (Photo-19, Annex A). Almost 13% respondent made this according to their necessity.

7.3 Adaptation at Community Level

During the questionnaire survey, it was informed by some the respondents, north side of the village is relatively higher and less vulnerable to water logging. That is why, many of the villagers shifted to the north side of the village. From the KII and FGD it was confirmed, with time, more people shifted to that portion of the area permanently. Besides, even in the south part of the village have many depressed land and people are also thinking of relocating from that area to a safer place to avoid the water logging situations in future.

7.4 Adaptation in Agriculture

It is found from the field data, like other water logged areas there is no impact of water logging in the agricultural sector of the study area. From the discussion with farmer and local people two points came out as the reason. And these could be considered as the adaptation mechanism in agriculture.

7.4.1 Agricultural Land Turned into Fish Land (*Gher*)

During the FGD with farmer, it has been informed that farmers started fish cultivation in low lands since 1998. Locally this fish lands are called '*Gher*'. Though at starting time the size was small, after 2000 when water logging started to appear in regular basis, farmers started to consider this fish cultivation as more economic for them. As the lands remain water logged for long time which reduced the duration of agricultural activities, to minimize the loss they turned that vast inundated agricultural land into fish land in the peak time of water logging.

According to the FGD participants, there are 2 types of *Gher*: a) *Baromashi Gher*, it is the part of permanent water bodies where they can cultivate all over the year and b) *Moushumi Gher* (seasonal) where the cultivation starts at June and ends at January. After mid-January they leave the land for paddy cultivation. Business man gets this land by lease. For whole year cultivation pay amount is 25,000.00 to 30,000.00 BDT and for seasonal cultivation 10,000.00 to 15,000.00 BDT. In this fish land a number of people work as labor who lost their livelihood due to water logging. Thus, a very effective adaptation mechanism developed in the agricultural system in the village.

7.4.2 Using Modern Cultivation Techniques

Cropping pattern of village *Rajnagar Bankabarsi* has already been discussed in Chapter-5, serial 5.6. The main crop is rice in the study area. Data of crop production from the Upazila Agricultural Office unfold that, after water logging there is no reduction in the amount of agricultural land and the amount of production increased significantly than before. After a wide range of formal and informal discussion with local farmer it was revealed that, with time the farmers started to apply modern cultivation techniques. When the seeding time of paddy arrived at mid- January, they reduce water from the low lands through pump machine and make the land capable for paddy cultivation. Beside this, local Agriculture Officer suggested different type of hybrid Rice to the farmer. According to the agriculture office, as it is a water logging vulnerable area, they mostly suggest the paddy which can survive in a water logged situation and also give a good amount of production. Thus, they developed an effective adaptation mechanism for agriculture especially for rice.

Chapter 8

SUMMARY AND CONCLUSION

8.1 Summary of the Study

The present study has been taken to investigate the causes of water logging, to examine the impact of water logging in life and livelihood and to demonstrate the adaptation mechanism of local people of *Rajnagar Bankabasri* village. Previous analysis reveals that nature and severity of water logging problem affect the study areas in different ways. Water logging in the study area is the combined consequence of some factors and of which natural and man-made both are included. Water logging due to excess rainfall is the main reason now a day for the study area and this happens mainly due to the drainage congestion. It is a comparative analysis of variables between different periods of time for a better perception of the impacts of water logging.

The water logging has a number of impacts on human settlement, measures taken at the homestead level to adapt also dynamic in response. Structural measure of adaptation is one of them and due to this adaptation strategy significant change found in the settlement pattern. Households taken adaptation techniques individually but it is important to mention that, no significant effort is seen for community-based adaptation. In the study area *kacha* road are fully damaged due to water logging which leading to the movement problem and interrupts the journey. There is no structural damage in the educational institutions of the study area, but for long time inundation students can't continue their learning.

As a result of prolonged inundation the instability of economic condition increased. From the income disparity analysis between before, after water logging and present time, it was found the income inequality increased with time. A major portion of the earnings is now concentrated in the hand of a few rich people of the area. Livelihood pattern also changed due to the continuous effect of water logging. Agricultural activity is one of the prominent types of occupation in the study area. After water logging due to long term inundation of agricultural land most of the people forced to change their occupation from agriculture to business related occupation. As a result, it is found in the livelihood pattern analysis, after water logging the number of business-related occupations increased in the study area and number of agricultural activities decreased. Other socio-economic variables like loan and saving status also effected by the prolong inundation. Impact on agriculture is also investigated. In terms of agriculture, it was found that impact of water logging is not

significant like other water logged areas. The water logging impact was evident in the reduction of duration of agricultural activities. According to the local farmers after water logging the time length of agricultural activities has become short than before. But the amount of rice production increased significantly after water logging due to the application of modern cultivation method.

Based on the above discussion it is seen in the socio-economic condition, poor people are the main victim of such perennial water logging condition. They could not adjust with the changed condition after water logging and remain poor and the condition of some people goes down from poor to extreme poor. On the other hand, the rich people are in the safe side as they make a significant change in their income after water logging.

Analyzing the impact on life, it appeared that water logging creates actual hardship in people's life of the study area. A comparative analysis of different variables reveals that, almost all of the factors related to life facing difficulties during and after water logging time. People being forced to leave their homestead even their locality during the water logged time and hundreds of them evacuate beside the road and made a temporal shelter there with plastic, bamboo etc. Staying beside the road without sanitation is really tough and miserable.

Different types of water born disease during the water logging bring indescribable situation for the people of the study area. Beside these women especially pregnant women, aged people and children are faces more difficulties than other people. During the water logged time collection of drinking water come to be a real straggle for them not only that for most of the household it becomes impossible of cooking their daily food dew to the crisis of fuel and damage of their cook house. During that time the poor people mainly depends on relief for their daily food and the amount of daily food consumption reduced significantly as a result the overall nutrition status of the people is most likely to go down.

About the adaptation, it is found from homestead level to community level. Different type of attempt has been taken by them as the part adaptation to protect their homestead. Best adaptation found in the agriculture. It is found, crop production has increased after water logging in the study area by adopting effective adaptation mechanism.

So, on the basis of major findings of the research it can be summarized, in the village Rajnagar Bankabarsi water logging is the combined consequences of different factors. Due to water logging there is a significant change occurred in the settlement pattern, some people

have to change their occupation which consequently brought a deteriorated socio-economic condition. From the income group analysis, it is seen the disparity of income increased with time. In agriculture the impact is only on the duration of agricultural activities. Most importantly, it is the poor people who are the main victim of water logging in the study area.

8.2 Ways Forward and Conclusions

The present study has amply portrayed the prolonged sufferings of the poor families in the study area. The sufferings are so impending that an immediate measure from government and NGOs are called upon. It is also to be noted that the neighboring areas of the study area has a record of bumper crops, and this reality aspired the people who has been suffering quite sometimes. These people dream to see initiatives that will erase them from impending sufferings.

In a large scale, the water logging calamities brought curse for the majority of the people, but some people were able to achieve a better quality of life through different means.
In light of above, here are some measures, I think off for the distress people, which I termed as ***way forward***:

- The natural drainage canals are to be restored to store the rain water at Khandarpopur. Due to the damage of road hard ship in life increased significantly. People are facing lots of problems on the road especially when they traveling for hospital. So, it is an urgent necessity for the local people of the area.

- Approximately, 60% of total road in the area is earth road. As such, internal communication and transportation of goods are time consuming and expensive. As a medium of modern communication system this is insufficient to necessity.

- In agriculture, most of the cultivated lands are involved in mono crop cultivation. The main agricultural product is rice. People are insignificantly familiar with the new variety of crops. Agricultural activity is one of the prime livelihoods in the area. By promoting agricultural diversification more people will involve with this and thus employment for livelihood opportunities will increase.

- People are vulnerable to health issues, loss of crops, loss of properties, food security, poverty etc. To address the above stated vulnerabilities some measures can be implemented through creating and expanding alternative livelihood options. In addition, promoting agricultural diversification, increased family income and strengthened women participation in decision making process will also solve the issues.

- To addressing the problem, separate activities can be taken for specific targeted groups. Community based approach can be implemented. Extreme poor should be given priority in this formation of groups. Open discussion and active participation of the poor people on their needs and requirements and priority can be fixed.

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ANNEX A

PHOTOGRAPHS

Photo-1: View of Waterlogging at Keshabpur Upazila during 2011
(After: ESWAP Completion Report, 2012)

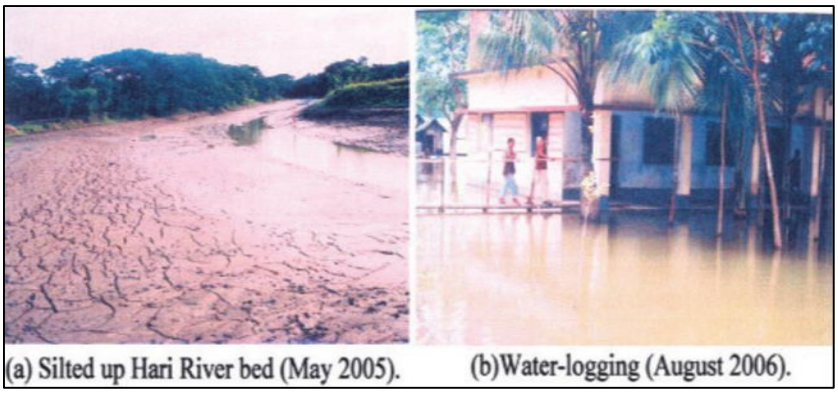

Photo-2: Siltation on Riverbed and Water Logging Problem
(Source: IWM, 2007). After: Rezaie et al., 2013

Countryside of the Regulator

Riverside of the Regulator

Photo-3: Three-vent Gate Regulator at Khandarpapur

Photo-4: River Encroachment in the Study Area

Photo-5: Fully Damaged House due to Water logging
(Photo credit: SHAMADHAN, NGO)

Photo-6: Pacca Type House in the Study

Photo-7: Mud House with Tali and Kacha House with Tin Bamboo and Tali Area

Photo-8: Agricultural Practice in High Land, (Rice and Vegetable Cultivation)

Photo-9: Government Primary School in the Study Area

Photo-10: School Principle Showing the Water Level

Photo-11: Damage of Kacha Road inside the Village

Photo-12: Source of Drinking Water
in the Study Area

Photo-13: Fuels Used in the Study Area

Photo-14: Villagers Constructing Permanent Houses

Photo-15: Increasing the Plinth Height with Structural Change

Photo-16: House Maintenance by Cheap and Available Materials

Photo-17: Improved Sanitation as Part
of Adaptation Program

Photo-18: Farm House Development (Livestock Adaptation)

Photo-19: Elevated Platform (*Macha*) for Fuel

QUESTIONNAIRE FOR HOUSEHOLD SURVEY

এম ফিল প্রোগ্রাম

ভূগোল ও পরিবেশ বিভাগ
ঢাকা বিশ্ববিদ্যালয়
গবেষণা এলাকা ঃ রাজনগর, বাঁকা বরশী, যশোর

নমুনা নম্বর

(বাংলাদেশের দক্ষিণ-পশ্চিমাঞ্চলে জলাবদ্ধতায় স্থানীয় জনগণের জীবন ও জীবিকার উপর প্রভাব ঃ যশোর জেলার কেশবপুর উপজেলার অধীনে রাজনগর বাঁকা বরশী গ্রামের উপর একটি সমীক্ষা)

মাঠ পর্যায়ের তথ্যভিত্তিক এই গবেষণাটি ঢাকা বিশ্ববিদ্যালয়ের ভূগোল ও পরিবেশ বিভাগের অধীনে "এম ফিল" প্রোগ্রামের শিক্ষা কার্যক্রমের অংশবিশেষ এবং এ গবেষণার স্থান হিসেবে রাজনগর বাঁকা বরশী, যশোর নির্বাচন করা হয়েছে। রাজনগর বাঁকা বরশী, যশোর একটি অন্যতম জলাবদ্ধ এলাকা। বর্তমান গবেষণায় রাজনগর বাঁকা বরশী, যশোর অধিবাসীদের স্থায়ী জলাবদ্ধতার ফলে জীবন-জীবিকার উপর প্রভাবের সার্বিক চিত্র তুলে ধরা হলো। এছাড়া জলাবদ্ধতার কারন এবং কিভাবে স্থায়ী জলাবদ্ধতা দূর করে জনগণের দূর্ভোগ কমিয়ে জীবনযাত্রার মান উন্নয়ন করা যায়- এ সম্পর্কে আলোকপাত করা হবে। মাঠ পর্যায়ের সংগৃহীত তথ্যাদি শুধুমাত্র ছাত্র-ছাত্রীদের শিক্ষা কার্যক্রমে ব্যবহৃত হবে। এ বিষয়ে সম্মানীত উত্তরদাতাদের মূল্যবান সময় ও তথ্য দেয়ার জন্য ভূগোল ও পরিবেশ বিভাগ বিশেষভাবে কৃতজ্ঞ থাকবে।

খানা পরিবার জরিপ প্রশ্নমালা

সমীক্ষা এলাকাঃ গ্রাম ..... ইউনিয়ন ..... উপজেলা .....

স্বাক্ষাত গ্রহীতার নাম ..... স্বাক্ষাত গ্রহণের তারিখ ....

স্বাক্ষাতদার বয়স..... পরিবার প্রধানের সাথে সম্পর্ক..... .....

১। পরিবারের ধরণঃ ক) একক পরিবার খ) যৌথ পরিবার গ) বর্ধিত পরিবার ঙ) অন্যান্য.....

২। পরিবারের সদস্যদের সম্পর্কে কিছু তথ্যঃ

সদস্যদের নাম	পরিবারের প্রধানের সাথে সম্পর্ক	বয়স	লিঙ্গ	শিক্ষাগত যোগ্যতা	বৈবাহিক অবস্থা	কি কাজ করেন	জন্মস্থান	কোথায় কাজ করেন
০১	০২	০৩	০৪	০৫*	০৬*	০৭*	০৮*	০৯*

*০৫ঃ ৬ বছরের নীচে প্রয়োজ্য নয়
ক) অশিক্ষিত
খ) প্রাথমিক শিক্ষা
গ) ৮ম শ্রেণী পাশ
ঘ) এসএসসি পাশ
ঙ) এইচএসসি পাশ
চ) স্নাতক/সম্মান
ছ) মাস্টার্স
জ)অন্যান্য.....

*০৬ঃ ক) অবিবাহিত
খ) বিবাহিত
গ) বিপত্নীক
ঘ) তালাক প্রাপ্ত
ঙ) পৃথক

*০৭ঃক) প্রযোজ্য নয়
খ) গ্রহস্থালীর কাজ
গ) ছাত্র
ঘ) বেকার
ঙ) কৃষিকাজ
চ) ছোট ব্যবসা
ছ) চাকুরী (নির্দিষ্ট করু ন)
জ) অন্যান্য.....

*০৮ঃক) গবেষণা এলাকা
খ) গবেষণা উপজেলায়
গ) গবেষণা জেলায়
ঘ) খুলনা বিভাগ
ঙ) অন্যান্য (জেলার নাম).....

*০৮ঃক) গবেষণা এলাকা
খ) গবেষণা উপজেলায়
গ) গবেষণা জেলায়
ঘ) খুলনা শহরে
ঙ) অন্যান্য (নির্দিষ্ট করুন)....

৩। ক। আপনার এলাকায় কতদিন জলাবদ্ধ থাকে?

বর্ষাকালঃ.....

শীতকালঃ.....

খ। জলাবদ্ধতার কারন কি বলে আপনি মনে করেন?

.....

৪। জলাবদ্ধতায় আপনার বাড়ির কি অবস্থা হয়েছে?

ক) সম্পূর্ণরুপে ক্ষতিগ্রস্থ হয়েছে।

খ) ঘর আংশিক ক্ষতিগ্রস্থ হয়েছে।

ঘ) প্রধান ঘর সম্পূর্ণরুপে ক্ষতিগ্রস্থ হয়েছে।

ঙ) প্রধান ঘর আংশিকরুপে ক্ষতিগ্রস্থ হয়েছে।

চ) ঘরের গুরুত্বপূর্ণ অংশ ক্ষতিগ্রস্থ হয়েছে।

ছ) অন্যান্য.....

৫। বাড়ি-ঘরের অবস্থা সম্পর্কে কিছু তথ্য দিন ঃ

ক্রমিক নং	তথ্যের ধরন	জলাবদ্ধাতার আগে	জলাবদ্ধাতার পরে	বর্তমান অবস্থা	মন্তব্য
০১	প্রধান ঘরের সংখ্যা				
০২	প্রধান ঘরের ধরন*				
০৩	প্রধান ঘরের আয়তন (বর্গফুট)				
০৪	বাড়ির অবস্থা*				
০৫	প্রধান ঘরের মূল্য/খরচ				
০৬	বৈদ্যুতিক সুবিধা (আছে/নেই)				
০৭	সৌচাগার সুবিধা*				

*০২ ঃ ক) পাকাৎ
খ) আধা-পাকা
গ) কাঁচা (টিন+কাঠ)
ঘ) কাঁচা (টিন+বাস)
ঙ) কাঁচা (সন+বাস)
চ) ঝুপড়ি
ছ) অন্যান্য .....

*০৪ঃ ক) এখনও পানির নিচে
খ) আংশিক পানি রয়েছে
গ) পানি নেই তবে খারাপ অবস্থা
ঘ) বাসযোগ্য
ঙ) বাসযোগ্য নয়
চ) অন্যান্য .....

*০৭ঃ ক) সুযোগ সুবিধা নেই
খ) অস্বাস্থাকর পরিবেশ
গ) স্বাস্থকর পরিবেশ
ঘ) অন্যান্য .....

৬। সৌচাগারের ধরণ সম্পর্কে বলুনঃ

ক) স্যানিটারি টয়লেট

খ) স্ল্যাব এবং রিং

গ) স্ল্যাব এবং রিং ছাড়া

ঘ) ঝুলন্ত

ঙ) প্রতিবেশির টয়লেট ব্যবহার

ছ) খোলা জায়গায়

৭। পরবর্তী জলাবদ্ধতা থেকে রক্ষার জন্য পদক্ষেপঃ

ক) ব্যক্তিপর্যায় .....

খ) সামাজিকপর্যায় .....

৮। বাড়ি মেরামতের অর্থের উৎস কি ছিল

ক) অর্থের উৎস ঃ ১) সঞ্চয়ের মাধ্যমে ২) ব্যাংক ঋণ ৩) আত্মীয়দের থেকে ঋণ ৪) বন্ধক ৫) জমি বা সম্পত্তি বিক্রি ৬) বেসরকারী/এনজিও

০৯। মেরামতকৃত ঘরের স্থায়িত্ব নিয়ে আপনার মতামত কি?

ক) ঘর যথেষ্ট টেকসই খ) মোটামোটি টেকসই গ) খুব টেকসই নয় ঘ) মোটেই টেকসই নয় ঙ) অন্যান্য .....

১০। পুনঃনির্মিত ঘর সম্বন্ধে আপনার সন্তুষ্টি/অসন্তুষ্টির মাত্রা কি রকম?

ক) পূর্ণ সন্তুষ্টি খ) আংশিক সন্তুষ্টি- কেন? .....

গ) মোটেও সন্তুষ্ট নই- কেন? .....

১১। জলাবদ্ধাতায় আপনার বাড়ী/ঘর নষ্ট হওয়ার পূর্বে বাড়ী / ঘরের বয়স কত ছিল? ..... বছর

১২। যখন কোন ধরনের ঘরবাড়ি পুনর্বাসন কর্মসূচী গ্রহণ করা হয় তখন স্থানীয় জনগণের পরামর্শ দাতা হিসেবে যুক্ত থাকা উচিত বলে আপনি মনে করেন কি না?

ক) সম্মত খ) অসম্মত গ) ধারণা নেই ঘ) অন্যান্য .....

১৪। জলাবদ্ধতার কারণে ঘরবাড়ির পুনর্বাসন সম্পর্কে আপনার কোন মতামত আছে কি না? ক) হ্যাঁ খ) না

উত্তর হ্যাঁ হলে মতামত বলুন .....

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

ক্রমিক নং	তথ্যের ধরন	জলাবদ্ধতার আগে	জলাবদ্ধতার পরে	বর্তমান অবস্থা
০১	উপার্জনক্ষম লোকের সংখ্যা			
০২	পরিবারের দ্বিতীয় আয়ের উৎস			
০৩	পরিবারের মাসিক আয়			
০৪	পরিবারের মাসিক ব্যয়			
০৫	আয়ের উৎসের সংখ্যা			
০৬	আয়ের উৎসের ধরন*			
০৭	কোন সঞ্চয় আছে কি না			
০৮	কোন ঋণ আছে কি না			
০৯	কৃষি জমির পরিমাণ (শতাংশ)			
১০	বসতবাটির জমির পরিমাণ (শতাংশ)			

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

১৬। জলাবদ্ধ এলাকার অবকাঠামো বর্তমান/ক্ষয়ক্ষতির চিত্রঃ

আবকাঠামো		আংশিক ক্ষতিগ্রস্থ	সম্পুর্ণ ক্ষতিগ্রস্থ	মন্তব্য
ক)	স্কুল ও কলেজ			
খ)	হাসপাতাল			
গ)	রাস্তা (কিঃ মিঃ)			
ঘ)	অন্যান্য			

১৭। গৃহপালিত পশুর সংখ্যাঃ

গরু	ছাগল	হাস	মুরগী

১৮। আপনার গৃহের সদস্যগণ কোন অভিগমন করিকি না? ক) হ্যাঁ খ) না

* কি ধরণের অভিগমন করঃ.....

১৯। * জলাবদ্ধতার সময় পরিবারের সদস্যরা কি অভিগমন করে? ক) হ্যাঁ খ) না ,

যদি অভিগমন করে তাহলে, কোথায় যায়?

ক) .....
খ) .....
গ) .....
ঘ) .....

*যদি অভিগমন না করে তাহলে, জীবন ধারনের উপকরণ সমূহ কি কি ? কোথায় যায়?

ক) নিজ খরচে
খ) ত্রানের উপর (সরকারি+বসরকারি/এনজিও)
গ) অন্যান্য

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) আপনি কি মনে করেন যে আগামী বর্ষায় জলাবদ্ধতা থেকে আপনি যথেষ্ট সুরক্ষিত ? ১। হ্যাঁ ২। না

ঙ) মোবাইল ফোন ব্যবহার করেন কি না? ১। হ্যাঁ ২। না

চ) পরিবার প্রধানের জাতীয় পরিচয়পত্র আছে কি না? ১। হ্যাঁ ২। না

ছ) দৈনন্দিন খাদ্যের উৎসগুলি কি কি?

১। মাছ_____
২। সবজি_____
৩। চাল_____

জ) বছরে কতদিন জমিগুলি চাষযোগ্য থাকে?

১। জলাবদ্ধতার আগ.....
২। জলাবদ্ধতার পর.....

ঝ) শিক্ষাক্ষেত্রে জলাবদ্ধতার প্রভাব কি কি

১। .....
২। .....
৩। .....
৪। .....

ঞ) জ্বালানীর উৎসগুলো কি কি

১। .....
২। .....
৩। .....
৪। .....

২১। আপনার এলাকা থেকে হাসপাতাল কতদূর?

.....

২২। হাসপাতালে যাতায়াতের প্রধান সমস্যাগুলো কি?

ক। জলাবদ্ধ সময়েঃ .....

খ। শুকনো মৌসুমেঃ .....

২৩। এই অবস্থায় কাদের বেশী কষ্ট হয়?

.....

২৮। জলাবদ্ধতায় হাসপাতালের কোন ক্ষতি হয়েছে কিনা? হ্যাঁ/না, হলে সেটা কি?

.....

২৫। জলাবদ্ধতার কারণে পরিবারের কোন সদস্যের কি অসুখ হয়েছিল

বয়স	লিঙ্গ	অসুস্থতার কারণ	চিকিৎসার জন্য কোথায় গিয়েছিলেন	যাতায়াতে কি কি অসুবিধা হয়েছিল
১৫ বছরের নীচে				
১৫-২০ বছর				
২০-৪০ বছর				

ANNEX C

QUESTIONNAIRE FOR FOCUS GROUP DISCUSSION (FGD)

নমুনা নম্বর

এম ফিল প্রোগ্রাম

ভূগোল ও পরিবেশ বিভাগ

ঢাকা বিশ্ববিদ্যালয়

গবেষণা এলাকা ঃ রাজনগর, বাঁকা বরশী, যশোর

(বাংলাদেশের দক্ষিণ-পশ্চিমাঞ্চলে জলাবদ্ধতায় স্থানীয় জনগণের জীবন ও জীবিকার উপর প্রভাব ঃ যশোর জেলার কেশবপুর উপজেলার অধীনে রাজনগর বাঁকা বরশী গ্রামের উপর একটি সমীক্ষা)

মাঠ পর্যায়ের তথ্যভিত্তিক এই গবেষণাটি ঢাকা বিশ্ববিদ্যালয়ের ভূগোল ও পরিবেশ বিভাগের অধীনে "এম ফিল" প্রোগ্রামের শিক্ষা কার্যক্রমের অংশবিশেষ এবং এ গবেষণার স্থান হিসেবে রাজনগর বাঁকা বরশী, যশোর নির্বাচন করা হয়েছে। রাজনগর বাঁকা বরশী, যশোর একটি অন্যতম জলাবদ্ধ এলাকা। বর্তমান গবেষণায় রাজনগর বাঁকা বরশী, যশোর অধিবাসীদের স্থায়ী জলাবদ্ধতার ফলে জীবন-জীবিকার উপর প্রভাবের সার্বিক চিত্র তুলে ধরা হলো। এছাড়া জলাবদ্ধতার কারন এবং কিভাবে স্থায়ী জলাবদ্ধতা দূর করে জনগণের দূর্ভোগ কমিয়ে জীবনযাত্রার মান উন্নয়ন করা যায়- এ সম্পর্কে আলোকপাত করা হবে। মাঠ পর্যায়ের সংগৃহীত তথ্যাদি শুধুমাত্র ছাত্র-ছাত্রীদের শিক্ষা কার্যক্রমে ব্যবহৃত হবে। এ বিষয়ে সম্মানীত উত্তরদাতাদের মূল্যবান সময় ও তথ্য দেয়ার জন্য ভূগোল ও পরিবেশ বিভাগ বিশেষভাবে কৃতজ্ঞ থাকবে।

সমীক্ষা এলাকাঃ (গ্রাম)..... ইউনিয়ন ..... উপজেলা .....

অংশগ্রহণকারী□র নাম..... স্বাক্ষাত গ্রহণের তারিখ.....

.....

এফজিডি প্রশ্নমালা(দিনমজুর)

১। এ অঞ্চলের দীর্ঘ জলাবদ্ধতার কারণ সম্পর্কে আপনাদের ধারণা বলুন।

ক) প্রাকৃতিক কারণঃ.....

খ) মানবসৃষ্ট কারণঃ.....

২। জলাবদ্ধতায় অপনার এলাকার বিভিন্ন ক্ষেত্রে কি ধরনের সমস্যা দেখা দিয়েছে?

ক্রমিক নং	ক্ষেত্র সমূহ	সমস্যা ও ধরন
১।	আবাসন	
২।	কৃষি ফসল	
৩।	মৎস্য চাষ	
৪।	গৃহপালিত জীবজন্তু পালন	
৫।	গাছপালা ও বন সংরক্ষণ	
৬।	শিক্ষা প্রতিষ্ঠানসমূহ সচল রাখা	
৭।	স্বাস্থ্য ব্যবস্থা ঠিক রাখা	
৮।	যাতায়াত ব্যবস্থা ও অবকাঠামো	
৯।	শিল্প কারখানা সচল রাখা	
১০।	হাট বাজার সচল রাখা	
১১।	অন্যান্য	

৩। জলাবদ্ধতায় আপনার এলাকায় মানুষের জীবিকার কি ধরনের পরিবর্তন সাধিত হয়েছে?

ক) কৃষিক্ষেত্রঃ.....

খ) মৎসক্ষেত্রঃ.....

গ) দিনমজুরঃ.....

ঘ) ব্যবসা বানিজ্যঃ.....

৪। জীবিকার নিরাপত্তার ক্ষেত্রে নিচের বিভিন্ন শ্রেণীর মানুষের ঝুঁকি মাত্রা চিহ্নিত করুন (√ দিন)।

ক্রমিক নং	বেশি বিপদাপন্ন	মাঝারি বিপদাপন্ন	নিম্ন বিপদাপন্ন	ঝুঁকিহীন
১।	বড় কৃষক			
২।	মাঝারি কৃষক			
৩।	ক্ষুদ্র কৃষক			
৪।	মৎস্যজীবি			
৫।	মৎস্য ব্যবসায়ী			
৬।	কৃষি দিনমজুর			
৭।	অকৃষি দিনমজুর			
৮।	বর্গাচাষী			
৯।	মহিলা পরিবার প্রধান			
১০।	ভূমিহীন কৃষক			
১১।	ক্ষুদ্র ব্যবসা			
১২।	যানবাহনের কাজ			
২৩।	অন্যান্য			

৫। জলাবদ্ধাতার ফলে অপনার এলাকা থেকে স্থায়ী/অস্থায়ীভাবে গ্রামবাসীর অভিগমন করে থাকলে সে সম্পর্কে ধারণা দিন?

অভিগমনের ধরন		কোথায় গিয়েছে	কেন সেখানে গিয়েছে
ক)	সম্পূর্ণ পরিবারের স্থায়ী অভিগমন		
খ)	সম্পূর্ণ পরিবারের অস্থায়ী অভিগমন		
গ)	সম্পূর্ণ প্রধান/উপার্জনক্ষম সদস্যের স্থায়ী অভিগমন		
ঘ)	পরিবার প্রধান/উপার্জনক্ষম সদস্যের অস্থায়ী অভিগমন		

৬। জলাবদ্ধাতা সমস্যা সমাধানে আপনার এলাকায় এ পর্যন্ত কোন সংস্থা/প্রতিষ্ঠঅন সহায়তা প্রদান করেছে কি না? করে থাকলে বিস্তারিত তথ্য দিনঃ

ক্রমিক নং	সংস্থা/প্রতিষ্ঠান	কি কি পদক্ষেপ	পদক্ষেপ সম্পর্কে মন্তব্য
১।	ব্যক্তিগত উদ্যোগ		
২।	এলজিইডি		
৩।	জনপ্রশাসন		
৪।	এনজিও (নির্দিষ্ট করে বলুন)		
৫।	দাতা সংস্থা (নির্দিষ্ট করে বলুন)		
৬।	দাতা দেশ		
৭।	অন্যান্য		

৭। জলাবদ্ধাতা স্থায়ী নিরসনে নিচের বিভিন্ন শ্রেণী/গোষ্ঠী/প্রতিষ্ঠান কি ভূমিকা পালন করতে পারে?

ক্রমিক নং	শ্রেণী/গোষ্ঠী/প্রতিষ্ঠান	করণীয়	মন্তব্য
১।	পরিবার		
২।	এলাকাবাসী		
৩।	স্থানীয় জনপ্রতিনিধি		
৪।	জনপ্রশাসন		
৫।	এলজিইডি		
৬।	এনজিও		
৭।	জাতীয় সরকার		
৮।	অন্যান্য		

৮। দীর্ঘস্থায়ী জলাবদ্ধাতার কারণে এই এলাকায় কোন পরিবেশগত, সামাজিক ও অন্যান্য সমস্যার সৃষ্টি হয়েছে কি? হলে এর ধরন সর্ম্পকে বলুন?

ক) পরিবেশগত সমস্যাঃ.....

খ) সামাজিক সমস্যাঃ.....

গ) আইনশৃংখলা সংক্রান্ত সমস্যাঃ.....

ঘ) জমিজমার ক্রয় ও বিক্রয় সংক্রান্ত সমস্যাঃ.....

ঙ) জমিজমার মূল্য সংক্রান্ত সমস্যাঃ.....

চ) অন্যান্য.....

৯। আপনার এলাকায় জলাবদ্ধতা নিরসনে স্থায়ী সমাধান কি হতে পারে?

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১০। আপনাদের/আপনার এলাকায় জলাবদ্ধতা নিরসনে সরকারী কোন পদক্ষেপ আছে কিনা? কি কি পদক্ষেপ নেয়া হয়েছে? এ সকল পদক্ষেপ কতটুকু কার্যকরী বলে আপনি/আপনারা মনে করেন।

১১। জলাবদ্ধতার কারণ কোন কোন জীবিকার সবচেয়ে বেশি পরিবর্তন হয়েছেঃ

ক) কৃষিকাজ

খ) দিনমজুর

গ) ব্যবসা বাণিজ্য

ঘ) মৎস চাষ

১২। জলাবদ্ধতার কারণে আপনাদের পেশাগত প্রতিবন্ধকতা গুলো কি কি

ক) .....

খ) .....

গ) .....

ঘ) .....

১৩। জলাবদ্ধতার কারণে আপনাদের পেশাগত প্রতিবন্ধকতা গুলো কি কি

ক) .....

খ) .....

গ) .....

ঘ) .....

১৪। আয়ের পার্থক্য(টাকা)

ক) বর্ষাকাল.....

খ) শীতকাল.....

১৫। আয়ের পার্থক্য(টাকা)

ক) বর্ষাকাল.....

খ) শীতকাল.....

QUESTIONNAIRE FOR FOCUS GROUP DISCUSSION (FGD)

নমুনা নম্বর

এম ফিল প্রোগ্রাম
ভূগোল ও পরিবেশ বিভাগ
ঢাকা বিশ্ববিদ্যালয়
গবেষণা এলাকা ঃ রাজনগর, বাঁকা বরশী, যশোর

(বাংলাদেশের দক্ষিণ-পশ্চিমাঞ্চলে জলাবদ্ধতায় স্থানীয় জনগণের জীবন ও জীবিকার উপর প্রভাব ঃ যশোর জেলার কেশবপুর উপজেলার অধীনে রাজনগর বাঁকা বরশী গ্রামের উপর একটি সমীক্ষা)

মাঠ পর্যায়ের তথ্যভিত্তিক এই গবেষণাটি ঢাকা বিশ্ববিদ্যালয়ের ভূগোল ও পরিবেশ বিভাগের অধীনে "এম ফিল" প্রোগ্রামের শিক্ষা কার্যক্রমের অংশবিশেষ এবং এ গবেষণার স্থান হিসেবে রাজনগর বাঁকা বরশী, যশোর নির্বাচন করা হয়েছে। রাজনগর বাঁকা বরশী, যশোর একটি অন্যতম জলাবদ্ধ এলাকা। বর্তমান গবেষণায় রাজনগর বাঁকা বরশী, যশোর অধিবাসীদের স্থায়ী জলাবদ্ধতার ফলে জীবন-জীবিকার উপর প্রভাবের সার্বিক চিত্র তুলে ধরা হলো। এছাড়া জলাবদ্ধতার কারন এবং কিভাবে স্থায়ী জলাবদ্ধতা দূর করে জনগণের দূর্ভোগ কমিয়ে জীবনযাত্রার মান উন্নয়ন করা যায়- এ সম্পর্কে আলোকপাত করা হবে। মাঠ পর্যায়ের সংগৃহীত তথ্যাদি শুধুমাত্র ছাত্র-ছাত্রীদের শিক্ষা কার্যক্রমে ব্যবহৃত হবে। এ বিষয়ে সম্মানীত উত্তরদাতাদের মূল্যবান সময় ও তথ্য দেয়ার জন্য ভূগোল ও পরিবেশ বিভাগ বিশেষভাবে কৃতজ্ঞ থাকবে।

সমীক্ষা এলাকাঃ (গ্রাম)..... ইউনিয়ন ..... উপজেলা .....

অংশগ্রহণকারী□র নাম..... স্বাক্ষাত গ্রহণের তারিখ.....
.....

এফজিডি প্রশ্নমালা(কৃষক)

১। এ অঞ্চলের দীর্ঘ জলাবদ্ধতার কারণ সম্পর্কে আপনাদের ধারণা বলুন।

ক) প্রাকৃতিক কারণঃ.....

খ) মানবসৃষ্ট
কারণঃ.....

২। জলাবদ্ধতায় অপনার এলাকার বিভিন্ন ক্ষেত্রে কি ধরনের সমস্যা দেখা দিয়েছে?

ক্রমিক নং	ক্ষেত্র সমূহ	সমস্যা ও ধরন
১।	আবাসন	
২।	কৃষি ফসল	
৩।	মৎস্য চাষ	
৪।	গৃহপালিত জীবজন্তু পালন	
৫।	গাছপালা ও বন সংরক্ষণ	
৬।	শিক্ষা প্রতিষ্ঠানসমূহ সচল রাখা	
৭।	স্বাস্থ্য ব্যবস্থা ঠিক রাখা	
৮।	যাতায়াত ব্যবস্থা ও অবকাঠামো	
৯।	শিল্প কারখানা সচল রাখা	
১০।	হাট বাজার সচল রাখা	
১১।	অন্যান্য	

৩। জলাবদ্ধতায় আপনার এলাকায় মানুষের জীবিকার কি ধরনের পরিবর্তন সাধিত হয়েছে?

ক) কৃষিক্ষেত্রঃ.....

খ) মৎসক্ষেত্রঃ.....

গ) দিনমজুরঃ.....

ঘ) ব্যবসা বানিজ্যঃ.....

৪। জীবিকার নিরাপত্তার ক্ষেত্রে নিচের বিভিন্ন শ্রেণীর মানুষের ঝুঁকি মাত্রা চিহ্নিত করুন (√ দিন)।

ক্রমিক নং	বেশি বিপদাপন্ন	মাঝারি বিপদাপন্ন	নিম্ন বিপদাপন্ন	ঝুঁকিহীন
১।	বড় কৃষক			
২।	মাঝারি কৃষক			
৩।	ক্ষুদ্র কৃষক			
৪।	মৎস্যজীবি			
৫।	মৎস্য ব্যবসায়ী			
৬।	কৃষি দিনমজুর			
৭।	অকৃষি দিনমজুর			
৮।	বর্গাচাষী			
৯।	মহিলা পরিবার প্রধান			
১০।	ভূমিহীন কৃষক			
১১।	ক্ষুদ্র ব্যবসা			
১২।	যানবাহনের কাজ			
২৩।	অন্যান্য			

৫। জলাবদ্ধাতার ফলে অপনার এলাকা থেকে স্থায়ী/অস্থায়ীভাবে গ্রামবাসীর অভিগমন করে থাকলে সে সম্পর্কে ধারণা দিন?

অভিগমনের ধরন		কোথায় গিয়েছে	কেন সেখানে গিয়েছে
ক)	সম্পূর্ণ পরিবারের স্থায়ী অভিগমন		
খ)	সম্পূর্ণ পরিবারের অস্থায়ী অভিগমন		
গ)	সম্পূর্ণ প্রধান/উপার্জনক্ষম সদস্যের স্থায়ী অভিগমন		
ঘ)	পরিবার প্রধান/উপার্জনক্ষম সদস্যের অস্থায়ী অভিগমন		

৬। জলাবদ্ধাতা সমস্যা সমাধানে আপনার এলাকায় এ পর্যন্ত কোন সংস্থা/প্রতিষ্ঠঅন সহায়তা প্রদান করেছে কি না? করে থাকলে বিস্তারিত তথ্য দিনঃ

ক্রমিক নং	সংস্থা/প্রতিষ্ঠান	কি কি পদক্ষেপ	পদক্ষেপ সম্পর্কে মন্তব্য
১।	ব্যক্তিগত উদ্যোগ		
২।	এলজিইডি		
৩।	জনপ্রশাসন		
৪।	এনজিও (নির্দিষ্ট করে বলুন)		
৫।	দাতা সংস্থা (নির্দিষ্ট করে বলুন)		
৬।	দাতা দেশ		
৭।	অন্যান্য		

৭। জলাবদ্ধাতা স্থায়ী নিরসনে নিচের বিভিন্ন শ্রেণী/গোষ্ঠী/প্রতিষ্ঠান কি ভূমিকা পালন করতে পারে?

ক্রমিক নং	শ্রেণী/গোষ্ঠী/প্রতিষ্ঠান	করণীয়	মন্তব্য
১।	পরিবার		
২।	এলাকাবাসী		
৩।	স্থানীয় জনপ্রতিনিধি		
৪।	জনপ্রশাসন		
৫।	এলজিইডি		
৬।	এনজিও		
৭।	জাতীয় সরকার		
৮।	অন্যান্য		

৮। দীর্ঘস্থায়ী জলাবদ্ধাতার কারণে এই এলাকায় কোন পরিবেশগত, সামাজিক ও অন্যান্য সমস্যার সৃষ্টি হয়েছে কি? হলে এর ধরন সর্ম্পকে বলুন?

ক) পরিবেশগত সমস্যাঃ.....

খ) সামাজিক সমস্যাঃ.....

গ) আইনশৃংখলা সংক্রান্ত সমস্যাঃ.....

ঘ) জমিজমার ক্রয় ও বিক্রয় সংক্রান্ত সমস্যাঃ.....

ঙ) জমিজমার মূল্য সংক্রান্ত সমস্যাঃ.....

চ) অন্যান্য.....

৯। আপনার এলাকায় জলাবদ্ধতা নিরসনে স্থায়ী সমাধান কি হতে পারে?

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১০। আপনাদের/আপনার এলাকায় জলাবদ্ধতা নিরসনে সরকারী কোন পদক্ষেপ আছে কিনা? কি কি পদক্ষেপ নেয়া হয়েছে? এ সকল পদক্ষেপ কতটুকু কার্যকরী বলে আপনি/আপনারা মনে করেন।

১১। জলাবদ্ধতার কারণে কোন কোন জীবিকার সবচেয়ে বেশি পরিবর্তন হয়েছেঃ

ক) কৃষিকাজ

খ) দিনমজুর

গ) ব্যবসা বাণিজ্য

ঘ) মৎস চাষ

১২। জলাবদ্ধতার কারণে আপনাদের পেশাগত প্রতিবন্ধকতা গুলো কি কি

ক) .....

খ) .....

গ) .....

ঘ) .....

১৩। আয়ের পার্থক্য(টাকা)

ক) বর্ষাকাল.....

খ) শীতকাল.....

১৪। কৃষিক্ষেত্রে সমস্যাগুলো কি কি

ক) বর্ষাকাল.....

খ) শীতকাল.....

১৫। মূল ফসল কি কি

ক) বর্ষাকাল.....

খ) শীতকাল.....

QUESTIONNAIRE FOR FOCUS GROUP DISCUSSION (FGD)

নমুনা নম্বর

এম ফিল প্রোগ্রাম
ভূগোল ও পরিবেশ বিভাগ
ঢাকা বিশ্ববিদ্যালয়
গবেষণা এলাকা ঃ রাজনগর, বাঁকা বরশী, যশোর

(বাংলাদেশের দক্ষিণ-পশ্চিমাঞ্চলে জলাবদ্ধতায় স্থানীয় জনগণের জীবন ও জীবিকার উপর প্রভাব ঃ যশোর জেলার কেশবপুর উপজেলার অধীনে রাজনগর বাঁকা বরশী গ্রামের উপর একটি সমীক্ষা)

মাঠ পর্যায়ের তথ্যভিত্তিক এই গবেষণাটি ঢাকা বিশ্ববিদ্যালয়ের ভূগোল ও পরিবেশ বিভাগের অধীনে "এম ফিল" প্রোগ্রামের শিক্ষা কার্যক্রমের অংশবিশেষ এবং এ গবেষণার স্থান হিসেবে রাজনগর বাঁকা বরশী, যশোর নির্বাচন করা হয়েছে। রাজনগর বাঁকা বরশী, যশোর একটি অন্যতম জলাবদ্ধ এলাকা। বর্তমান গবেষণায় রাজনগর বাঁকা বরশী, যশোর অধিবাসীদের স্থায়ী জলাবদ্ধতার ফলে জীবন-জীবিকার উপর প্রভাবের সার্বিক চিত্র তুলে ধরা হলো। এছাড়া জলাবদ্ধতার কারন এবং কিভাবে স্থায়ী জলাবদ্ধতা দূর করে জনগণের দূর্ভোগ কমিয়ে জীবনযাত্রার মান উন্নয়ন করা যায়- এ সম্পর্কে আলোকপাত করা হবে। মাঠ পর্যায়ের সংগৃহীত তথ্যাদি শুধুমাত্র ছাত্র-ছাত্রীদের শিক্ষা কার্যক্রমে ব্যবহৃত হবে। এ বিষয়ে সম্মানীত উত্তরদাতাদের মূল্যবান সময় ও তথ্য দেয়ার জন্য ভূগোল ও পরিবেশ বিভাগ বিশেষভাবে কৃতজ্ঞ থাকবে।

সমীক্ষা এলাকাঃ (গ্রাম).....ইউনিয়ন .....উপজেলা .....

অংশগ্রহণকারী দের নাম..... স্বাক্ষাত গ্রহণের তারিখ.....
.....

এফজিডি প্রশ্নমালা(ভ্যান চালক)

১। এ অঞ্চলের দীর্ঘ জলাবদ্ধতার কারণ সম্পর্কে আপনাদের ধারণা বলুন।

ক) প্রাকৃতিক কারণঃ.....

খ) মানবসৃষ্ট কারণঃ.....

২। জলাবদ্ধতায় অপনার এলাকার বিভিন্ন ক্ষেত্রে কি ধরনের সমস্যা দেখা দিয়েছে?

ক্রমিক নং	ক্ষেত্র সমূহ	সমস্যা ও ধরন
১।	আবাসন	
২।	কৃষি ফসল	
৩।	মৎস্য চাষ	
৪।	গৃহপালিত জীবজন্তু পালন	
৫।	গাছপালা ও বন সংরক্ষণ	
৬।	শিক্ষা প্রতিষ্ঠানসমূহ সচল রাখা	
৭।	স্বাস্থ্য ব্যবস্থা ঠিক রাখা	
৮।	যাতায়াত ব্যবস্থা ও অবকাঠামো	
৯।	শিল্প কারখানা সচল রাখা	
১০।	হাট বাজার সচল রাখা	
১১।	অন্যান্য	

৩। জলাবদ্ধতায় আপনার এলাকায় মানুষের জীবিকার কি ধরনের পরিবর্তন সাধিত হয়েছে?

ক) কৃষিক্ষেত্রঃ.....

খ) মৎসক্ষেত্রঃ.....

গ) দিনমজুরঃ.....

ঘ) ব্যবসা বানিজ্যঃ.....

৪। জীবিকার নিরাপত্তার ক্ষেত্রে নিচের বিভিন্ন শ্রেণীর মানুষের ঝুঁকি মাত্রা চিহ্নিত করুন (√ দিন)।

ক্রমিক নং	বেশি বিপদাপন্ন	মাঝারি বিপদাপন্ন	নিম্ন বিপদাপন্ন	ঝুঁকিহীন
১।	বড় কৃষক			
২।	মাঝারি কৃষক			
৩।	ক্ষুদ্র কৃষক			
৪।	মৎস্যজীবি			
৫।	মৎস্য ব্যবসায়ী			
৬।	কৃষি দিনমজুর			
৭।	অকৃষি দিনমজুর			
৮।	বর্গাচাষী			
৯।	মহিলা পরিবার প্রধান			
১০।	ভূমিহীন কৃষক			
১১।	ক্ষুদ্র ব্যবসা			
১২।	যানবাহনের কাজ			
২৩।	অন্যান্য			

৫। জলাবদ্ধাতার ফলে অপনার এলাকা থেকে স্থায়ী/অস্থায়ীভাবে গ্রামবাসীর অভিগমন করে থাকলে সে সম্পর্কে ধারণা দিন?

অভিগমনের ধরন		কোথায় গিয়েছে	কেন সেখানে গিয়েছে
ক)	সম্পূর্ণ পরিবারের স্থায়ী অভিগমন		
খ)	সম্পূর্ণ পরিবারের অস্থায়ী অভিগমন		
গ)	সম্পূর্ণ প্রধান/উপার্জনক্ষম সদস্যের স্থায়ী অভিগমন		
ঘ)	পরিবার প্রধান/উপার্জনক্ষম সদস্যের অস্থায়ী অভিগমন		

৬। জলাবদ্ধাতা সমস্যা সমাধানে আপনার এলাকায় এ পর্যন্ত কোন সংস্থা/প্রতিষ্ঠঅন সহায়তা প্রদান করেছে কি না? করে থাকলে বিস্তারিত তথ্য দিনঃ

ক্রমিক নং	সংস্থা/প্রতিষ্ঠান	কি কি পদক্ষেপ	পদক্ষেপ সম্পর্কে মন্ত
১।	ব্যক্তিগত উদ্যোগ		
২।	এলজিইডি		
৩।	জনপ্রশাসন		
৪।	এনজিও (নির্দিষ্ট করে বলুন)		
৫।	দাতা সংস্থা (নির্দিষ্ট করে বলুন)		
৬।	দাতা দেশ		
৭।	অন্যান্য		

৭। জলাবদ্ধাতা স্থায়ী নিরসনে নিচের বিভিন্ন শ্রেণী/গোষ্ঠী/প্রতিষ্ঠান কি ভূমিকা পালন করতে পারে?

ক্রমিক নং	শ্রেণী/গোষ্ঠী/প্রতিষ্ঠান	করণীয়	মন্তব্য
১।	পরিবার		
২।	এলাকাবাসী		
৩।	স্থানীয় জনপ্রতিনিধি		
৪।	জনপ্রশাসন		
৫।	এলজিইডি		
৬।	এনজিও		
৭।	জাতীয় সরকার		
৮।	অন্যান্য		

৮। দীর্ঘস্থায়ী জলাবদ্ধাতার কারণে এই এলাকায় কোন পরিবেশগত, সামাজিক ও অন্যান্য সমস্যার সৃষ্টি হয়েছে কি? হলে এর ধরন সর্ম্পকে বলুন?

ক) পরিবেশগত সমস্যাঃ.....

খ) সামাজিক সমস্যাঃ.....

গ) আইনশৃংখলা সংক্রান্ত সমস্যাঃ.....

ঘ) জমিজমার ক্রয় ও বিক্রয় সংক্রান্ত সমস্যাঃ.....

ঙ) জমিজমারমূল্য সংক্রান্ত সমস্যাঃ.....

চ) অন্যান্য.....

৯। আপনার এলাকায় জলাবদ্ধতা নিরসনে স্থায়ী সমাধান কি হতে পারে?

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.....

.....

১০। আপনাদের/আপনার এলাকায় জলাবদ্ধতা নিরসনে সরকারী কোন পদক্ষেপ আছে কিনা? কি কি পদক্ষেপ নেয়া হয়েছে? এ সকল পদক্ষেপ কতটুকু কার্যকরী বলে আপনি/আপনারা মনে করেন।

১১। জলাবদ্ধতার কারণ কোন কোন জীবিকার সবচেয়ে বেশি পরিবর্তন হয়েছেঃ

ক) কৃষিকাজ

খ) দিনমজুর

গ) ব্যবসা বাণিজ্য

ঘ) মৎস চাষ

১২। জলাবদ্ধতার কারণে আপনাদের পেশাগত প্রতিবন্ধকতা গুলো কি কি

ক) .....

খ) .....

গ) .....

ঘ) .....

১৩। আয়ের পার্থক্য(টাকা)

ক) বর্ষাকাল.....

খ) শীতকাল.....

১৪। জলাবদ্ধতার কারণে কতদিন কর্মবিরতি দিতে হয়

.....(দিন)

QUESTIONNAIRE FOR FOCUS GROUP DISCUSSION (FGD)

নমুনা নম্বর

এম ফিল প্রোগ্রাম
ভূগোল ও পরিবেশ বিভাগ
ঢাকা বিশ্ববিদ্যালয়
গবেষণা এলাকা ঃ রাজনগর, বাঁকা বরশী, যশোর

(বাংলাদেশের দক্ষিণ-পশ্চিমাঞ্চলে জলাবদ্ধতায় স্থানীয় জনগণের জীবন ও জীবিকার উপর প্রভাব ঃ যশোর জেলার কেশবপুর উপজেলার অধীনে রাজনগর বাঁকা বরশী গ্রামের উপর একটি সমীক্ষা)

মাঠ পর্যায়ের তথ্যভিত্তিক এই গবেষণাটি ঢাকা বিশ্ববিদ্যালয়ের ভূগোল ও পরিবেশ বিভাগের অধীনে "এম ফিল" প্রোগ্রামের শিক্ষা কার্যক্রমের অংশবিশেষ এবং এ গবেষণার স্থান হিসেবে রাজনগর বাঁকা বরশী, যশোর নির্বাচন করা হয়েছে। রাজনগর বাঁকা বরশী, যশোর একটি অন্যতম জলাবদ্ধ এলাকা। বর্তমান গবেষণায় রাজনগর বাঁকা বরশী, যশোর অধিবাসীদের স্থায়ী জলাবদ্ধতার ফলে জীবন-জীবিকার উপর প্রভাবের সার্বিক চিত্র তুলে ধরা হলো। এছাড়া জলাবদ্ধতার কারন এবং কিভাবে স্থায়ী জলাবদ্ধতা দূর করে জনগণের দূর্ভোগ কমিয়ে জীবনযাত্রার মান উন্নয়ন করা যায়- এ সম্পর্কে আলোকপাত করা হবে। মাঠ পর্যায়ের সংগৃহীত তথ্যাদি শুধুমাত্র ছাত্র-ছাত্রীদের শিক্ষা কার্যক্রমে ব্যবহৃত হবে। এ বিষয়ে সম্মানীত উত্তরদাতাদের মূল্যবান সময় ও তথ্য দেয়ার জন্য ভূগোল ও পরিবেশ বিভাগ বিশেষভাবে কৃতজ্ঞ থাকবে।

সমীক্ষা এলাকাঃ (গ্রাম).....ইউনিয়ন ..... উপজেলা .....

অংশগ্রহণকারী দের নাম..... স্বাক্ষাত গ্রহণের তারিখ.....
.....

এফজিডি প্রশ্নমালা (মহিলা)

১। এ অঞ্চলের দীর্ঘ জলাবদ্ধতার কারণ সম্পর্কে আপনাদের ধারণা বলুন।

ক) প্রাকৃতিক কারণঃ.....

খ) মানবসৃষ্ট কারণঃ.....

২। জলাবদ্ধতায় অপনার এলাকার বিভিন্ন ক্ষেত্রে কি ধরনের সমস্যা দেখা দিয়েছে?

ক্রমিক নং	ক্ষেত্র সমূহ	সমস্যা ও ধরন
১।	আবাসন	
২।	কৃষি ফসল	
৩।	মৎস্য চাষ	
৪।	গৃহপালিত জীবজন্তু পালন	
৫।	গাছপালা ও বন সংরক্ষণ	
৬।	শিক্ষা প্রতিষ্ঠানসমূহ সচল রাখা	
৭।	স্বাস্থ্য ব্যবস্থা ঠিক রাখা	
৮।	যাতায়াত ব্যবস্থা ও অবকাঠামো	
৯।	শিল্প কারখানা সচল রাখা	
১০।	হাট বাজার সচল রাখা	
১১।	অন্যান্য	

৩। জলাবদ্ধতায় আপনার এলাকায় মানুষের জীবিকার কি ধরনের পরিবর্তন সাধিত হয়েছে?

ক) কৃষিক্ষেত্রঃ.....

খ) মৎসক্ষেত্রঃ.....

গ) দিনমজুরঃ.....

ঘ) ব্যবসা বানিজ্যঃ.....

৪। জীবিকার নিরাপত্তার ক্ষেত্রে নিচের বিভিন্ন শ্রেণীর মানুষের ঝুঁকি মাত্রা চিহ্নিত করুন (√ দিন)।

ক্রমিক নং	বেশি বিপদাপন্ন	মাঝারি বিপদাপন্ন	নিম্ন বিপদাপন্ন	ঝুঁকিহীন
১।	বড় কৃষক			
২।	মাঝারি কৃষক			
৩।	ক্ষুদ্র কৃষক			
৪।	মৎস্যজীবি			
৫।	মৎস্য ব্যবসায়ী			
৬।	কৃষি দিনমজুর			
৭।	অকৃষি দিনমজুর			
৮।	বর্গাচাষী			
৯।	মহিলা পরিবার প্রধান			
১০।	ভূমিহীন কৃষক			
১১।	ক্ষুদ্র ব্যবসা			
১২।	যানবাহনের কাজ			
২৩।	অন্যান্য			

৫। জলাবদ্ধাতার ফলে অপনার এলাকা থেকে স্থায়ী/অস্থায়ীভাবে গ্রামবাসীর অভিগমন করে থাকলে সে সম্পর্কে ধারণা দিন?

অভিগমনের ধরন		কোথায় গিয়েছে	কেন সেখানে গিয়েছে
ক)	সম্পূর্ণ পরিবারের স্থায়ী অভিগমন		
খ)	সম্পূর্ণ পরিবারের অস্থায়ী অভিগমন		
গ)	সম্পূর্ণ প্রধান/উপার্জনক্ষম সদস্যের স্থায়ী অভিগমন		
ঘ)	পরিবার প্রধান/উপার্জনক্ষম সদস্যের অস্থায়ী অভিগমন		

৬। জলাবদ্ধাতা সমস্যা সমাধানে আপনার এলাকায় এ পর্যন্ত কোন সংস্থা/প্রতিষ্ঠঅন সহায়তা প্রদান করেছে কি না? করে থাকলে বিস্তারিত তথ্য দিনঃ

ক্রমিক নং	সংস্থা/প্রতিষ্ঠান	কি কি পদক্ষেপ	পদক্ষেপ সম্পর্কে মন্তব্য
১।	ব্যক্তিগত উদ্যোগ		
২।	এলজিইডি		
৩।	জনপ্রশাসন		
৪।	এনজিও (নির্দিষ্ট করে বলুন)		
৫।	দাতা সংস্থা (নির্দিষ্ট করে বলুন)		
৬।	দাতা দেশ		
৭।	অন্যান্য		

৭। জলাবদ্ধাতা স্থায়ী নিরসনে নিচের বিভিন্ন শ্রেণী/গোষ্ঠী/প্রতিষ্ঠান কি ভূমিকা পালন করতে পারে?

ক্রমিক নং	শ্রেণী/গোষ্ঠী/প্রতিষ্ঠান	করণীয়	মন্তব্য
১।	পরিবার		
২।	এলাকাবাসী		
৩।	স্থানীয় জনপ্রতিনিধি		
৪।	জনপ্রশাসন		
৫।	এলজিইডি		
৬।	এনজিও		
৭।	জাতীয় সরকার		
৮।	অন্যান্য		

৮। দীর্ঘস্থায়ী জলাবদ্ধাতার কারণে এই এলাকায় কোন পরিবেশগত, সামাজিক ও অন্যান্য সমস্যার সৃষ্টি হয়েছে কি? হলে এর ধরন সর্ম্পকে বলুন?

ক) পরিবেশগত সমস্যাঃ.....

খ) সামাজিক সমস্যাঃ.....

গ) আইনশৃংখলা সংক্রান্ত সমস্যাঃ.....

ঘ) জমিজমার ক্রয় ও বিক্রয় সংক্রান্ত সমস্যাঃ.....

ঙ) জমিজমার মূল্য সংক্রান্ত সমস্যাঃ.....

চ) অন্যান্য.....

৯। আপনার এলাকায় জলাবদ্ধতা নিরসনে স্থায়ী সমাধান কি হতে পারে?

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১০। আপনাদের/আপনার এলাকায় জলাবদ্ধতা নিরসনে সরকারী কোন পদক্ষেপ আছে কিনা? কি কি পদক্ষেপ নেয়া হয়েছে? এ সকল পদক্ষেপ কতটুকু কার্যকরী বলে আপনি/আপনারা মনে করেন।

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১১। জলাবদ্ধতার সময় মহিলারা সাধারণত কি কি সমস্যার মু□মুখি হয়

ক) .....

খ) .....

গ) .....

ঘ) .....

১২। জলাবদ্ধতার কার□ মহিলা□র ঝুঁকিসমূহ কি কি

ক) .....

খ) .....

গ) .....

ঘ) .....

LIST OF FGD PARTICIPANTS

1. FGD with Farmers
Date: 20. 10. 2018
Number of Participants: 8

No.	List of the participants	Age of the participants (Years)
1.	Hanef Shardar	62
2.	Kashem Morol	51
3.	Abdul Hamid	45
4.	Gafur	53
5.	Amjad Shardar	45
6.	Alek	42
7.	Anar Shadar	42
8.	Habibur Dafadar	30

2. FGD with Van Driver
Date: 20. 10. 2018
Number of Participants: 4

No.	List of the participants	Age of the participants (Years)
1.	Md. Muktar	40
2.	Md.Abdur Rahman	50
3.	Nazrul	35
4.	Rabbani	20
5.	Md Khalil	34
6.	Abdul Barik	47
7.	Md Monjurul Islam	28
8.	Mozid Sarder	62

3. FGD with Women:
Date: 20. 10. 2018
Number of Participants: 8

No.	List of the participants	Age of the participants (Years)
1.	Saleha Begum	70
2.	Renu Begum	64
3.	Sheulee	45
4.	Shefalee	50
5.	Rekha Begum	28
6.	Sufia Begum	40
7.	Hajera Khatun	27
8.	Rabeya Khatun	37

4. FGD with Day Labor
Date: 22. 09. 2018
Number of Participants: 8

No.	List of the participants	Age of the participants (Years)
1.	Md. Kamrul Islam	31
2.	Habibur Rahman	35
3.	Shirajul Islam	50
4.	Shariful Islam	29
5.	Md Wazed	67
6.	Hafizur	33
7.	Rana Ahmed	31
8.	Jahangir	34

ANNEX E

QUESTIONNAIRE FOR KEY INFORMANT INTERVIEW (KII)

নমুনা নম্বর

এম ফিল প্রোগ্রাম
ভূগোল ও পরিবেশ বিভাগ
ঢাকা বিশ্ববিদ্যালয়
গবেষণা এলাকা ঃ রাজনগর, বাঁকা বরশী, যশোর

(বাংলাদেশের দক্ষিণ-পশ্চিমাঞ্চলে জলাবদ্ধতায় স্থানীয় জনগণের জীবন ও জীবিকার উপর প্রভাব ঃ যশোর জেলার কেশবপুর উপজেলার অধীনে রাজনগর বাঁকা বরশী গ্রামের উপর একটি সমীক্ষা)

মাঠ পর্যায়ের তথ্যভিত্তিক এই গবেষণাটি ঢাকা বিশ্ববিদ্যালয়ের ভূগোল ও পরিবেশ বিভাগের অধীনে "এম ফিল" প্রোগ্রামের শিক্ষা কার্যক্রমের অংশবিশেষ এবং এ গবেষণার স্থান হিসেবে রাজনগর বাঁকা বরশী, যশোর নির্বাচন করা হয়েছে। রাজনগর বাঁকা বরশী, যশোর একটি অন্যতম জলাবদ্ধ এলাকা। বর্তমান গবেষণায় রাজনগর বাঁকা বরশী, যশোর অধিবাসীদের স্থায়ী জলাবদ্ধতার ফলে জীবন-জীবিকার উপর প্রভাবের সার্বিক চিত্র তুলে ধরা হলো। এছাড়া জলাবদ্ধতার কারন এবং কিভাবে স্থায়ী জলাবদ্ধতা দূর করে জনগণের দূর্ভোগ কমিয়ে জীবনযাত্রার মান উন্নয়ন করা যায়- এ সম্পর্কে আলোকপাত করা হবে। মাঠ পর্যায়ের সংগৃহীত তথ্যাদি শুধুমাত্র ছাত্র-ছাত্রীদের শিক্ষা কার্যক্রমে ব্যবহৃত হবে। এ বিষয়ে সম্মানীত উত্তরদাতাদের মূল্যবান সময় ও তথ্য দেয়ার জন্য ভূগোল ও পরিবেশ বিভাগ বিশেষভাবে কৃতজ্ঞ থাকবে।

সমীক্ষা এলাকাঃ (গ্রাম)..... ইউনিয়ন .....

উপজেলা .....

স্বাক্ষাত দাতার নাম.....

স্বাক্ষাত গ্রহণের তারিখ.....

KII প্রশ্নমালা

১। আপনার এলাকার জলাবদ্ধতার কারণগুলো কি কি?

২। জলাবদ্ধতার আর্থসামাজিক প্রভাবগুলো কি কি?

৩। কৃষি এবং মৎস ক্ষেত্রে কি ধরণের প্রভাব পরেছে?

৪। জীবন ও জীবিকার উপর কি কি ধরণের প্রভাব পরিছে?

৫। জলাবদ্ধতার কারণে মানুষের অভিগমনে কি ধরণের পরিবর্তন এসেছে?

৬। শিক্ষাক্ষেত্রে কি ধরণের প্রভাব পরেছে?

৭। জলাবদ্ধতা দূরী করণের সরকারী পদক্ষেপ গুলো কি কি?

৮। জলাবদ্ধতায় আপনার এলাকায় কোন সংস্থা বা প্রতিষ্ঠান কাজ করছে কি না বিস্তারিত বলো?

MOUZA MAP OF RAJNAGAR BANKABARSHI VILLAGE

CROP CALENDAR