Water Insecurity and Poverty:
Changing agriculture-based livelihood in coastal Bangladesh

Monishankar Sarkar

Prepared and submitted in accordance with the requirements for the degree of
Doctor of Philosophy

Institute of Disaster Management and Vulnerability Studies
University of Dhaka

Dated: August 31, 2020

The candidate ensures that the research work presented here is his own, and the areas that are dependent on ongoing literature is acknowledged properly. Some part of this research work is under process of review for publication in research journals, where the contribution of candidate and other authors has been properly mentioned.

Chapter six and parts of chapter seven of this thesis is under review as:
Sarkar, M., Nasreen, M., Salehin, M. M. and Hoque, S. F. 2019. Water Security, Poverty and Livelihoods: Trajectories and adaptation among water-poor in coastal Bangladesh, Target journal: *Regional Environmental Change*

Chapter eight of this thesis is under review as:
Sarkar, M., and Nasreen, M. 2019. Gendered approach in understanding adaptation barriers and differential impacts caused by water insecurity: responses from coastal Bangladesh, Target journal: *Gender and Development*.

In the case of two research papers that are based on PhD chapters, Monishankar Sarkar collected and analyzed the literature and data and wrote the article, with guidance feedback and some editorial contributions from Professor Dr Mahbuba Nasreen (PhD supervisor), Professor Mushfiqus Salehin and Dr. Sonia Ferdous Hoque.

Acknowledgements

I am expressing my deepest gratitude to my honorable supervisor Professor Dr. Mahbuba Nasreen for everything. Her sincere support, guidance and words of inspiration have been invaluable throughout the entire journey. It has been a wonderful experience and a matter of deep pleasure working with her and I definitely hope there are immense opportunities for us to work together in the upcoming years. At the same time, I would like to take the opportunity to thank Professor Dr. Khondoker Mokaddem Hossain, the Founding Director of the Institute of Disaster Management and Vulnerability Studies, University of Dhaka, for inspiring with many helpful comments and guidance throughout the entire research activity.

I am also expressing my heartfelt thanks to Professor Mashfiqus Salehin, Institute of Water and Flood Management at the Bangladesh University of Engineering and technology, for many helpful comments on my article's drafts and research presentations. My cordial thanks to Professor Mohammad Rezaur Rahman for nice comments and instructions in the beginning of this research. My special thanks to Muammar Jumlad (REACH Bangladesh country coordinator) and Md. Ashraf Mahamud (REACH Administrative Officer), IWFM, BUET.

My cordial thanks to Professor Robert Hope (Director, REACH), Smith School of Geography and Environment, University of Oxford for providing full-fledged REACH scholarship to pursue my PhD research. I also thank him and Dr. Sonia Ferdous Hoque (post-doctoral researcher, REACH) for helpful comments on my research design and writing phase.

My field experience with Ashroy Foundation is memorable, specially I acknowledge the information support I receive from Momtaz Khatun (Executive Director of Ashroy Foundation), Sheikh Helal Uddin and Robiul Islam. I am cordially thankful to all the 15 field research assistants who conducted the household questionnaire survey in two different phases. In addition to these, while qualitative

survey, I was benefited with excellent research assistance from a good number of students from University of Dhaka as well as Khulna university, I am indebted to them.

Most importantly, I must acknowledge the cordial support I receive from the study participants, without whose sincere cooperation this study would not be possible at all. The respondents from Baro Aria, Chandgarh, Gajendrapur and so many villages we conducted initial survey during our four consecutive scoping visits.

I would like to thank my colleagues and friends connected with REACH project, specially Shamima Prodhan (IDMVS), Md. Abdul Khaleque (DU), Sabrina Zaman, Mohammad Saif Uddin (BWDB), Md. Mostafizur Rahman, Tanzila Akhter (IWFM), Tazrina Ananya (UNDP) -whose interaction was of much helpful throughout the research.

Finally, I would like to take the opportunity to thank all the members of my family, whose continuous support liberated me to invest my time, conduct research and write this thesis.

Abstract

Water insecurity poses severe threat to water-dependent agriculture and livelihoods in coastal Bangladesh. Different factors, most related to water insecurity, influence poor to leave their conventional subsistence farming and other agriculture based-livelihoods. The specific objectives of the present research are to explore how water insecurity is connected to agriculture-based livelihoods in coastal Bangladesh; to find out the drivers of poverty (along with water related drivers) among the studied villages; to figure out the present strategies, and possible solution to avoid livelihood vulnerability and poverty situation among the water-poor under study; and to explore if there is any difference between male and female headed households in terms of coping and adaptation strategies. With a mix-method approach, using household questionnaire survey and a number of qualitative tools, this research intends to capture the linkage between water and poverty in general and its impacts on agriculture-based livelihood decisions in particular.

This research has an extensive discussion on the key livelihood options of the coastal communities and how those livelihood patterns are closely connected to water related parameters. The research also focuses on the way water stress influences the agriculture-based livelihood opportunities and threats for people on the basis of empirical evidences and observed facts. The seasonality and spatial variability also receive attention to identify dimensions of those connections in different time periods. Findings suggest that the rich households are capable to undertake often different strategies and diversify their livelihoods in the areas where water-related risks are high whereas the poor have very limited opportunities and often try to engage themselves in various non-farm activities for their subsistence. Differential impacts on livelihood options to different wealth class has been observed, which suggests that the rich people have better chance and adaptation capacity whereas the poor are adversely affected and their chances are also limited. Study suggests that if poor have greater access to resources like fresh water, land and agricultural inputs, there may have greater chance to diversify their livelihoods and to improve their condition.

As per last objective, the research covers the gendered water-poverty relations. It also argues that the impacts created by water-related barriers are heterogeneous in nature and affect different actors differently, which did not receive much attention in contemporary literature. The respondents/participants of the research included female and male headed households, who are facing a number of challenges related to water. Purposive sampling method has helped to investigate how male and female headed households adapt to waterborne challenges like breaching, tidal water intrusion and salinity. To understand the gendered water-poverty relations, a Sustainable Livelihood Framework-based conceptual framework is adopted to observe how different types of capitals work in the adaptation process. Findings of the study suggest that the gender-based adaptation strategies are often influenced by social, cultural, economic and institutional barriers which create the key differences. The barriers produced differential impacts which affect female and male headed households differently. The findings aim to attract the attention of policy makers and development workers to shape the policies more inclusively that may benefit all actors.

Keeping pace with the objectives and aims, this advanced research monograph is divided into nine chapters. The first three chapters concentrate on introduction of the research theme, methodology and related conceptual notes with their theoretical framework, the later part explores the field data analysis and the examination of the collected facts along with their linkages with the specific objectives. The key and specific objectives are covered and specific findings are analyzed in subsequent chapters. The analyzed data suggest that it is hard to ignore the strong connection between water poverty in general, and water security, which has a positive influence on livelihood opportunities among the communities. The final chapter explores the in-context problem specific recommendations drawn from the survey and qualitative study participants, whereas the observations of the researchers and research assistants are given importance to a separate caption within the distinct headline.

Table of Contents

List of tables

List of figures

Abbreviations and conversion units

Abbreviations

BDT	Bangladeshi Taka
FGD	Focus Group Discussion
IDI	In-depth Interview
IPCC	Intergovernmental Panel on Climate Change
KII	Key Informant Interview
NGO	Nongovernmental Organization
PCA	Principal Component Analysis
MDGs	Millennium Development Goals
SDGs	Sustainable Development Goals
SLF	Sustainable Livelihood Framework

Conversion units

Regarding land

1 Bigha	= 33 decimal
1 Acre	= 100 decimal

Regarding money

1 USD	= 85 Bangladeshi taka (BD

Chapter One: Introduction

1.1 Introduction and Background

Rural livelihoods in developing countries are primarily based on agriculture. The rural agriculture is practiced in order to ensure of food and fiber to meet family needs (Becker & Jahn, 2001; Conway, 1987). The agriculture production is dependent on availability of better irrigation water and humidity. Fresh irrigation water is one of the key prerequisites of better agricultural production. There are some other factures which are also crucial for agricultural production, which include natural or bio-physical (Sallu, Twyman, & Stringer, 2010), socio-cultural (Curry et al., 2015; Jones & Boyd, 2011), economic or financial (Bryan, Deressa, Gbetibouo, & Ringler, 2009)(Bryan et al., 2009), institutional (Quinn, Ziervogel, Taylor, Takama, & Thomalla, 2011), technological (Islam, Sallu, Hubacek, & Paavola, 2014), and physiological (Gifford, 2011; Grothmann & Patt, 2005). As local agriculture-based livelihood often shifts or gets affected by a factor or combination of factors, it is crucial to have an understanding of the pathways of influence of these drivers.

The existing water-livelihood connections become worsen if the situation is further exacerbated by water-related hazards and challenges. It is hard to find households in rural setting that are not connected with farming. Households usually practice farming as a basic strategy for their survival. Households are available who are engaging in various other types of activities, but they have an immediate or close connection with farming. Most of the households engage with farming for their subsistence and other usually connect for subsistence and sell. The occupations that are directly or indirectly related to agricultural production may be affected. The agriculture-based livelihood practices become affected by sudden onset disasters (such as flood, embankment erosion, collapse and or breaching etc.) or slow onset disasters (salinity, gradual decrease in water and soil quality due to many water-borne factors other than salinity). Both have a dramatic and negative impact on the agricultural fields, and the soil fertility which poses threats to agriculture-based livelihoods.

Waterborne challenges and disasters caused by climatic alterations have been creating a powerful negative influence on the agricultural production and vulnerability context in many parts of South Asia (Orchard et al 2016, Abdullah et al 2016). The coastal communities in the South Asian region has been experiencing a number of challenges in recent decades due to various environmental transformations, increased aquaculture practices and industries, frequency and severity of environmental stresses and shocks (Abdullah, Myers, Stacey, Zander, & Garnett, 2017; Orchard, Stringer, & Quinn, 2016). Households often try to cope with these changes and reshape their livelihood choices based on available opportunities (Nasreen, 2012; 2019). A good number of factors (broadly covered biophysical, knowledge, financial, with less mentioned political, social and psychological barriers) interplay in such coping mechanism and the households coping capacity to keep pace with the changes (Shackleton, Ziervogel, Sallu, Gill, & Tschakert, 2015).

The households in rural communities are not fall in homogenous categories; rather they are very different in terms of their socioeconomic characteristics. It is hard to ignore the rich-poor divide in rural setting of developing countries. People from all wealth categories practice agriculture, though the ownership is clearly different. Rich farmers often choose to invest on own land and water for producing more crops, where the off-farm day laborers often do not have this opportunity. Agricultural fields that are managed by wealthy farmers and are not rainwater dependent only, use shallow-pumps to draw groundwater for irrigation, have better chance in boosting agricultural productions. In such cases, the technology allows them to produce and draw more than one crop in a year. Such production also needs the quality ground water and accessibility to ground water table. The sharecroppers often try to invest in water for better crop production. Farmers who do not have the capacity to afford such technology or to pay the provider are compelled to limit their production in rainy season only. All of these factors largely affect agricultural production and rural agriculture dependent livelihoods. The households with limited or no resources may receive the worst shock from waterborne problems.

Water security denotes “the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to

people, environments and economies" (Gray and Sedoff 2007). Water insecurity occurs if there is any serious disruption of the required standards of water security. It may occur- when water becomes unavailable; when amount of water or water flow exceeds acceptable level; when the quality of water is not good enough for using drinking or irrigation purposes or any other purposes of ecosystems and production; when water-related risks are high or if waterborne challenges pose threat to overall environment or economy.

Sources, availability and access to irrigation water are the major determinant factors of agricultural production. Rural areas practice rain-dependent monsoon crops and second crop throughout a year. For other than monsoon period, people depend on ground water or fresh river water to irrigate their fields. Agriculture in many parts of South Asia get directly influenced by seasonality and rainfall variability (Christensen et al., 2007; FAO, 2016; Salack et al., 2016; Sultan & Gaetani, 2016). The over-dependent rain-fed agriculture (Antwi-Agyei, Stringer, & Dougill, 2014) -based rural livelihoods can be badly affected if there is water shortage or the irrigated water quality is not suitable (saline, for example) enough to produce crops. Saline water-bodies near to agricultural fields may also adversely affect the growth and production of crops.

Adaptation strategy varies among the wealth class. The strategies of reach and poor are not only very different, but also very much depended on their abilities. The adaptation strategies for reach and poor are different. The poor and extreme poor households do not have the required capacity to cope with the short and long-term waterborne disasters. The better off households can manage the situation and arrange better and viable strategies for themselves, whereas the poorer fail to afford them. The condition of small agricultural land holder households falls in real peril when they face these disruptive events. Particularly the poor and extreme poor household faces probably the worst heat of waterborne disasters. The lack of resources and capacity push them into disadvantaged positions and further vulnerability.

This situation is very much different if we see the context through gender lens. Pioneering study (Nasreen, 1995) conducted on disaster coping in Bangladesh following a gender perspective

identified the fact that the coping, adaptation and resilient strategies taken by female and male headed households significantly differ (Nasreen, 2012; Mersha Von Laveron 2016). These signify the different abilities of those households which increases the vulnerability of the poorer households. When stronger and weaker social positions (household headedness) are correlated with gender, the context of disparity in terms of adaptation strategies taken by male and female headed households takes different shapes. Households with stable economic base may take viable livelihood and adaptation strategies compared to weaker ones. The former has better chance to maintain wider social network than the latter, which help them in terms of emergencies caused by waterborne challenges.

The linkage between irrigation water quality and shortage and its impacts over the livelihoods is not new. Irrigation water insecurity affects agricultural production and associated livelihoods in different ways. Inadequate supply of water affects crop production, threats food and livelihood security (Chapagain, Ghimire, & Shrestha, 2016; Scott et al., 2019; Tiwari & Joshi, 2014; Tse-ring, Sharma, Chettri, & Shrestha, 2010). Rural communities, river ecosystems and agriculture are deeply interrelated and the livelihoods of the communities can be affected much if agriculture is disrupted (Everard et al., 2019). Irrigation water has a close connection with poverty alleviation and therefore it is needed to trigger set of interventions (Hussain & Hanjra, 2003). Problems with irrigation water supply and socio-ecological externalities hampers agriculture production (Rosegrant & Svendsen, 1993; Sampath, 1992). The productivity growth in own cropland is a dominant strategy for cereal production and poverty alleviation in Asian countries (Hussain & Hanjra, 2003). Sustainability in irrigation system decreases productivity gap, deter resource degradation and accelerates growth of agricultural productivity (Chand, 2014). Therefore, the key objectives in investing in agriculture in Asia are to protect rural communities from famine, ensure food security and uplift socioeconomic status of the rural people (Sampath, 1992). However, the available literature is not sufficient enough to assess the waterborne challenges poor and extreme poor effectively. There is a gap in the understanding of water-poverty nexus and how it affects different wealth-classes differently.

This research addresses the gap and attempts to figure out the heterogeneous impacts on different wealth class and various adaptation strategies (Antwi-Agyei et al., 2014; Berman, Quinn, & Paavola, 2012) -like livelihood diversification (Assan, 2014; Barrett, Reardon, & Webb, 2001; Martin, Lorenzen, & Bunnefeld, 2013; Meert, Van Huylenbroeck, Vernimmen, Bourgeois, & van Hecke, 2005; Niehof, 2004; Walingo, Liwenga, Kangalawe, Madulu, & Kabumbuli, 2009; Woolcock & Narayan, 2000a) and migration (Hunter, Luna, & Norton, 2015; Mersha & Van Laerhoven, 2016; Morrissey, 2013; Rademacher-Schulz, Schraven, & Mahama, 2014; Wiederkehr, Beckmann, & Hermans, 2018) - taken by households to cope with those challenges. There are many impediments to adaptation and livelihood choices to the local communities -though their feature and magnitude is seemingly different, they produce homogeneous or uniform impacts and broadly overlooks the differential impacts to individual actors (Hoque, Quinn, & Sallu, 2018; Mersha & Van Laerhoven, 2016).

Simultaneously, this research extends its research coverage to enhance understanding on the underlying barriers of livelihood choices, which are very important to understand the scenario of poverty (Goffner, Sinare, & Gordon, 2019; Shackleton et al., 2015), which lead the poor to make volatile or temporary decisions about the livelihood options.

This study adopts livelihood-based approaches (Carney, 1998; Chambers, 1997; Sen, 1999; Woolcock & Narayan, 2000b) with a special understanding of the study sites. The term 'livelihood' is defined as 'the activities, the assets and the access that jointly determine the living gained by an individual or household' (Ellis, 2008), or and the livelihood strategies are considered as 'diverse portfolio of activities' that poor people engage in an attempt to fulfill their needs and increase their welfare condition. Some examples of livelihood and the livelihood strategies may include any formal or informal employment, production of crop and livestock, permanent or temporary migration, collection of different products from forests or aquatic bodies, trading or food processing (Kristjanson, Mango, Krishna, Radeny, & Johnson, 2010).

1.2 The Contextual Backdrop

Bangladesh is a South Asian country with a diverse geographical setting. The country has both hilly and low-land *haor* areas in the north, plain land almost the rest part with a low-land coastal area in the south. The country is situated in the Ganga-Brahmaputra-Meghna basin and enriched with a wider river-network. Large number of rivers is lying throughout the country like net, which labeled the country as 'riverine Bangladesh'. The coastal zone is composed of 19 sea-facing districts and nearly 600 kilometers of coastline. The wider network of rivers creates a significant impact on people throughout the country. The rivers and canals are important source of irrigation water for the people who practice agriculture and also people who directly and indirectly depend on river and other aquatic water bodies for their livelihoods.

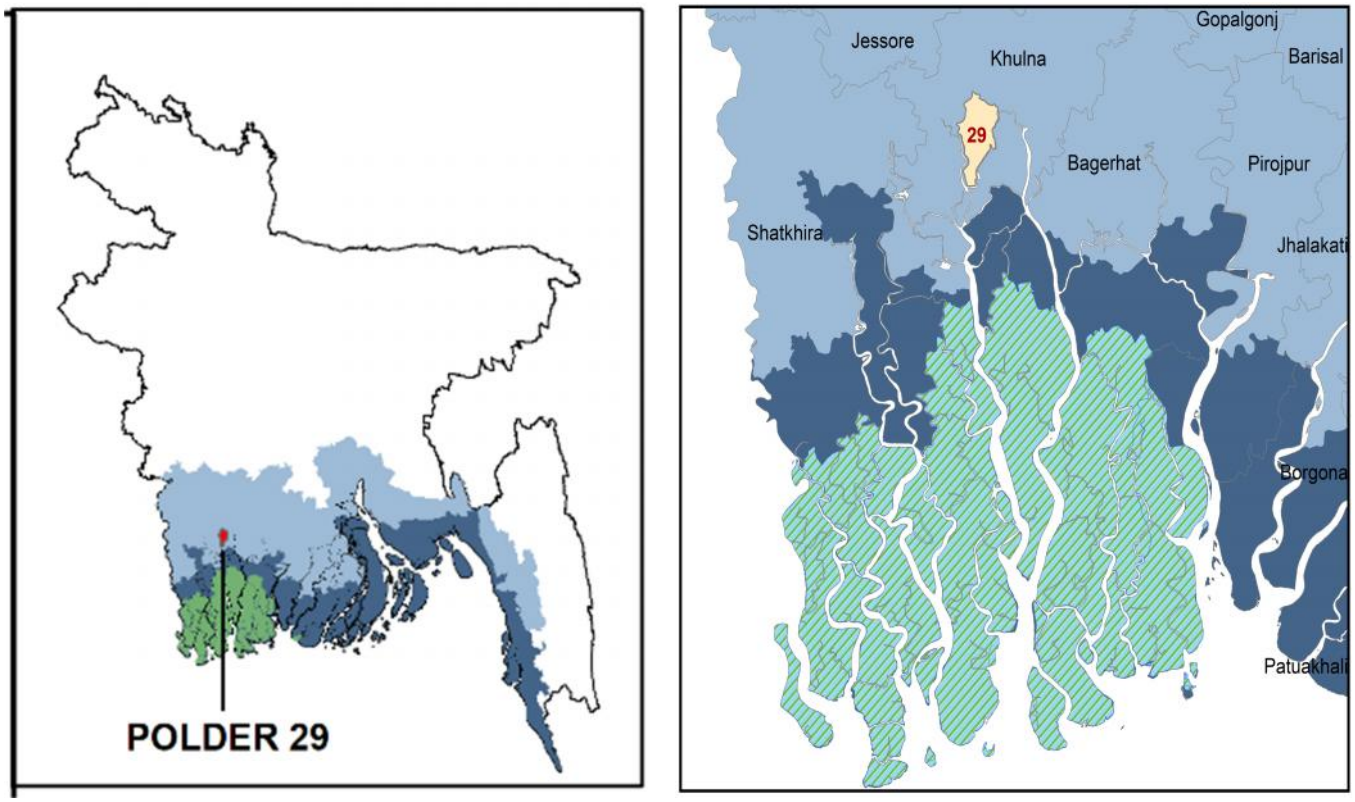


Figure 1.0.1: Country map and polder 29 location map

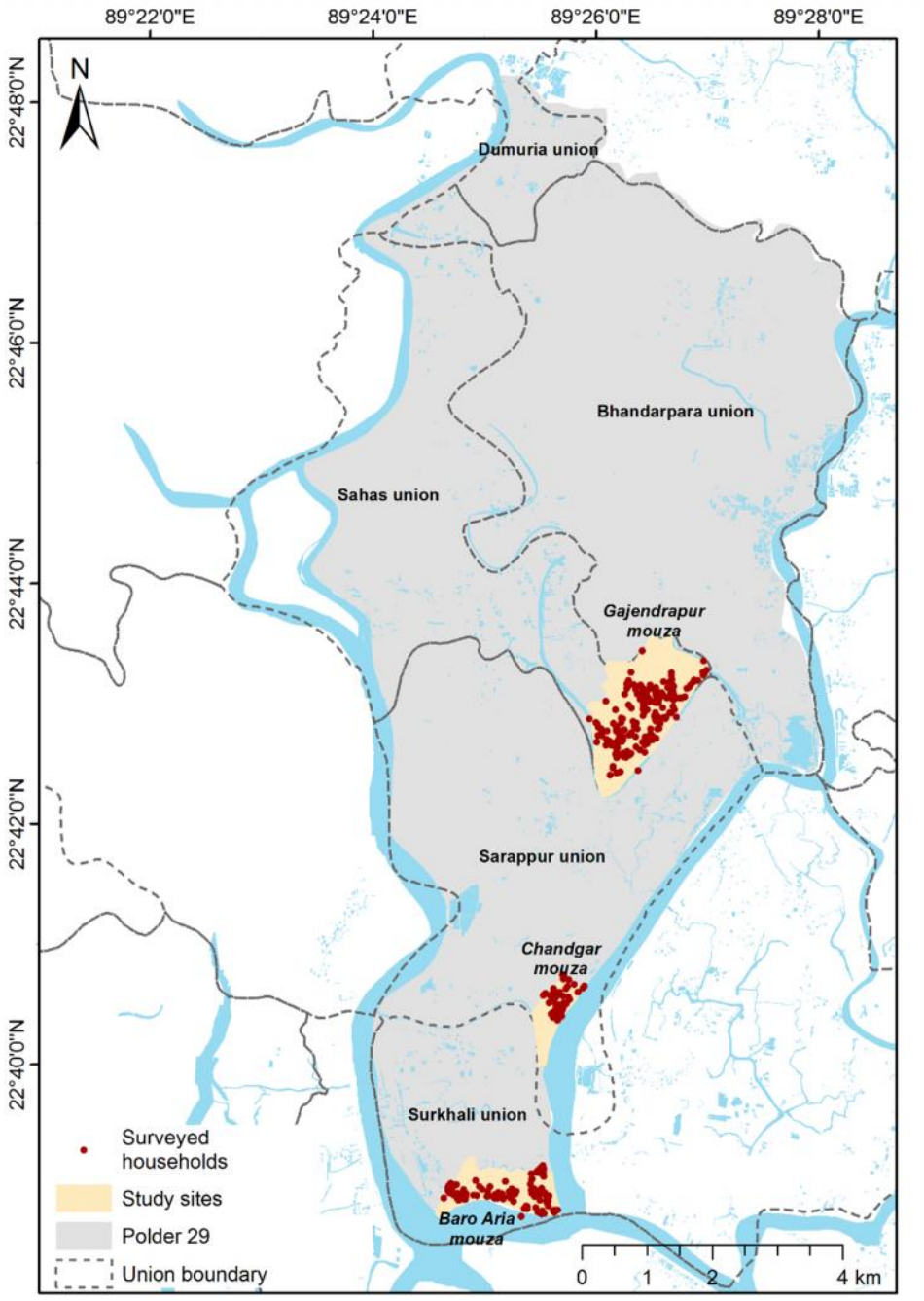


Figure 1.0.2 : Polder 29 and the location of the study villages

1.2.1 Waterborne challenges in coastal Bangladesh

Along with the advantages of rivers, the low land, *haor* zone[1] and coastal belt often experience the many disadvantages. The vast area of low land and coastal zone experience different types of waterborne disasters like cyclone, flood, surge, riverbank erosion, long-term waterlogging, overflow of river water, and tidal flooding (Choudhury et. al., 2019; Sarker et. al., 2019; Haque and Jahan, 2015; Juran and Trivedi, 2015). Though these are not frequent cases, but when they occur the coastal inhabitants are to suffer for long to compensate the damages and havoc. As most of the poor inhabitants live in coastal part are of poor economic base, their coping and adaptation strategies are not strong enough to combat with high-profile disasters. Therefore, the disasters in coastal zone often exacerbates immediate and long-term poverty.

Rivers and water are deeply associated with prosperity and impoverishments of the people residing in coastal belts. Many wealthy farmers are practicing saline water aquaculture (gher[2]) and improving their assets over the years, simultaneously the saline water is becoming a curse for people doing fresh water farming. The saline water aquaculture is far more profitable than the traditional crop production in agriculture fields. Consequentially, the fresh water farming is gradually losing its appeal and the traditional crop fields are being turned into saline water aquaculture for shrimp production. The people who are associated with traditional crop production are losing their jobs and dependent on other nonfarm sources.

1.2.2 The increasing frequency and severity of waterborne challenges: the growing concerns and vulnerability

In terms of disasters, the geographical vulnerability of the country lies in the low-laying plain and alluvial land and over 310 major rivers and rivulets spreading across the country, and also in wider coastline approaching the southern Bay. Because of its geographical position and environmental condition, the country experiences frequent natural disasters like floods, storm surges, cyclones, tornados, erosion, salinity and drought. Some parts of the country experience seismic threats as

[1] *Haor* is a wetland ecosystem located in the Northern Bangladesh (the actual location is in the Northeast part of Bangladesh)

[2] *Gher* is a saline water shrimp farming and is popular in Southern Bangladesh, especially in costal zone

well. The frequency and severity of natural disasters not only make the country vulnerable, but forces to retain as one of the poorest agents among developing countries.

Some fatal disasters visited coastal zone in recent past include Tsunami (2004), Sidr (2007), Nargis (2008), Aila (2009), Mahasen (2013), and Bulbul (2019). The devastation and death toll indicates their severity in respective years. The country disaster management efforts have been advanced in many ways over the last three decades, which work in pre, during and post-disaster periods -almost throughout year. Those efforts are successful in most cases, and can be observed by examining the gradual reduction of deaths in recent disasters. Among those disasters, most of the cases are waterborne challenges. Both riverbank erosion and salinity are major challenge in coastal zone along with many parts of the country. These two problems are waterborne too. These waterborne challenges usher serious water insecurity in respective areas. These events, caused by waterborne challenges, pose serious threat to assets, peoples' life and livelihoods keeping them in the vicious cycle of e poverty. Government efforts and investments in poverty reduction programmes have been seriously destroyed by such natural and human-made events. The central focus of this thesis therefore is to knowhow the water insecurity or waterborne challenges force people to leave their traditional agriculture-based livelihoods and chose various nonfarm activities for their subsistence.

1.3 Aims and Objectives of this research

The aim of this research is to explore the interrelationships between water insecurity and poverty and how do they create impact on the livelihood choices to the people who have been practicing agriculture over generations in coastal Bangladesh. The research was conducted in selected villages of southwest coastal Bangladesh keeping poor and waterborne challenge issues in the center. To dig up the actual scenario, the present research has a core focus on rich, poor and extreme poor households of agriculture-based livelihood and the challenges they face.. The central aim is divided into a number of objectives, noted bellow, for the sake of organizing this research and also for better understanding.

Objective 1: To explore how water insecurity is connected to agriculture-based livelihoods in coastal Bangladesh

To capture an actual scenario in line of this objective, the following key research questions have been developed:

a) What type of farming practices are followed by different households? Is farming the main livelihood option of the household?
b) What are the sources of irrigation water? Does the household depend on single or multiple water sources to irrigate agricultural fields?
c) Do the existing sources influence agricultural production of the households? Has the respondent's household experienced increased or decreased production in last 5 years?
d) How does the irrigation water influence respondent's (increased/decreased) production?

Objective 2: To find out the drivers of poverty (along with water related drivers) among the water-poor

Few sub objectives and research questions are developed to capture the drivers of poverty. With support from existing literature, this study follows the following main research questions:

a) What is/ are the main livelihood strategies of the respondent's household? Can s/he follow/ apply those strategies throughout a year (last 5-year experience)?
b) Do the respondent's HH face any type of barrier in following current livelihood strategies?
c) What are those barriers and how do they work as barriers? Is there any water related barrier?]

Objective 3: To figure out the present strategies, and possible solution to avoid livelihood vulnerability/ poverty condition among the studied water-poor

A number of research questions were developed to see the present adaptation strategies of the respondents with heterogeneous socioeconomic background. The specific questions follow:-

a) What adaptation strategies do the respondent's HH follow? Does the household face any problem while following those strategies?
b) What are the best strategies to face the waterborne challenge? Are the all the poor and extreme poor households have access/ ability to follow those? If not, what are the reasons?
c) What possible measure/ steps should be taken in future?

Objective 4: to explore if there is any difference between male and female headed households in terms of coping and adaptation strategies

To capture the difference between male and female headed households in terms of their experiences with the waterborne challenges and adopted adaptation strategies and the main research questions include-

a) What type of coping and adaptation strategies do male and female headed households follow?
b) Are those strategies different and depend on their differential ability of both types of households?
c) Are the strategies taken by female headed households are weaker/ more fragile than male headed households? Are the strategies taken by male headed households are stronger? What are the reasons?
d) What are the possible interventions that may lift up the weaker group/ households?

1.4 Organization of thesis and concentration of chapters

This advanced research monograph is completed in nine chapters. The introductory chapter is followed by the second chapter, where an interdisciplinary literature has been reviewed with broader focus on water security, poverty, livelihoods, vulnerability, residence and a range of concepts. Research methodologies were presented elaborately in chapter three. The rest of the chapters concentrate on study findings and the final chapter conclude the research with mentioning some clear future interventions.

Chapter one introduces the research theme from its general to specific background. This introduces the waterborne challenges and how they are connected to poverty and livelihood literature. It shows that the livelihoods that are related to farming activities have the chance to be negatively affected by water insecurity or waterborne challenges. It also introduces major aims, objectives of the research and the main research questions in line of those objectives. The later part of this chapter presents a brief overview on the organization of the chapters with the major concentration of individual chapter.

Chapter two addresses the literature review on interdisciplinary approach to explore the specific relationship between water and poverty. This chapter provides an understanding on the review of water security concepts and its relation to poverty, growth and development. It discusses poverty literature, how the concept has been evolving over time. It also introduces the existing literature on vulnerability and how it is related to poverty and livelihoods. It argues that the concept has changed a lot from its initial state, and vulnerability should be measured from wider view if one tries to capture the actual feature of it. This section also conveys discussion on livelihood and its core connection with poverty. It argues that if households fail to pursue their key livelihood options, leaving less viable or no alternative, they may fall into poverty. This chapter also introduces the idea of adaptation strategies, which were initiated in climate change literature. The greater application of the concept is seen in livelihood and poverty literature. This section concludes with the salient barriers and limitations, for which the adaptation strategies may be hampered and people who follow them do not get their expected outcome.

Chapter three focuses on the methodological approach and the specific research techniques that are used to focus on research objectives for this study, and it also introduces the selected three study sites selected for this study. The methodological approach of this chapter provides an introduction of underlying research philosophy -the ontological and epistemological stance, and also about the research strategy -the case study approach. It discusses about the study sites, purposes behind selection criteria and selection process. This section also provides a succinct explanation of country and sub-national or coastal context along with study sites. It also introduces

the key research methods applied including -household questionnaire survey, focus group discussion, key informant interview, in-depth interview and case studies. In the later part, the chapter also address on quantitative and qualitative data analysis methods applied for this research.

Chapter four disaggregates the households in terms of socioeconomic wealth class and provides detailed account of the socioeconomic condition and livelihoods. The housing condition often portraits the socioeconomic picture of a household, and therefore it is important to measure these features to get a complete picture. In high risk areas people are less motivated to build their houses in a better way because of hazard. Poverty is often one of the major reasons for poor housing condition and structure. Better picture can be observed in the areas where there is no or less risk. This chapter provides the detailed overview of these conditions on the basis of data collected from household survey and some other qualitative data collection techniques. It is found that the better off categories of households possess houses with good number of rooms, whereas the less better off households maintain poor living houses with one or two living rooms.

The chapter also presents the wealth class-specific housing scenario in the three study sites, which section examines the housing condition and housing materials including -the materials of house roof, exterior walls, house floor, number of living rooms, homestead land occupancy, toilet sharing etc. to know the true scenario of poverty condition of the three study sites. This chapter also examines the key livelihood choices of different wealth-category of people residing in the three study sites. The study also examines the livelihood diversification opportunities for both rich and poor households. The chapter also explores some basic features of poverty condition of three study sites.

Chapter six concentrates on adaptation and barriers to waterborne disasters and their gendered challenges. The findings and methodology for this chapter is slightly different and the study was conducted on female and male headed households, facing a number of waterborne challenges. The gender based waterborne challenge and adaptation strategies are the key concerns of this chapter.

This chapter also presents a modified Sustainable Livelihood Framework-based conceptual framework which was developed to observe how different types of capitals work in the adaptation process. This chapter also shows how gender-based adaptation strategies are often influenced by social, cultural, economic and institutional barriers which create the key differences. The barriers produced differential impacts which affect female and male headed households differently.

Chapter seven elucidates the drivers of poverty on the basis of poverty literature and observed facts. The drivers of poverty, along with water related drivers, receive special attention as they have a combined influence in the choice of livelihood strategies in rural areas. Significant alteration among these drivers may create a greater impact on livelihood choices. This chapter also analyzes how these water-related drivers are creating significant poverty-trap for the poor people of selected villages of polder 29. Special focus is also given on water related drivers and the way they create significant influences on the livelihood choices.

This chapter treats poverty through its multidimensional nature, where a range of drivers play differential role and produce poverty across households. It presents the wealth class-specific employment scenario, their partially employment and precarious jobs and their relationship with poverty. It deals with the accounts of the access to agriculture, food and water. The later part of the chapter concentrates on socioeconomic inequality, labor market and local economy; the intra household vulnerability; the hazard and environmental condition and the government and basic social support, which usually help people in lifting out of poverty.

Chapter eight focuses on the existing adaptation measures taken by rich and poor households and the reasons behind such strategies. This chapter observes that the strategies taken by rich and poor households are very heterogeneous in nature and often reflect the households' affordability. This chapter concentrates on the barriers faced by rich and poor households in water-stressed villages and explores that the barriers are not only different in water-stressed and less stressed villages, but they vary within water-stressed villages. This chapter also has a focus on the functioning of those chosen strategies. Well-functioning better strategies give households necessary security against

waterborne challenges, which the weak strategies fail to offer. This chapter also concentrates on the adaptation strategies taken and barriers faced by both male and female headed households. This chapter observes that the adaptation strategies taken by the male headed households are different in most cases, which are more powerful to combat challenges. Patriarchy, in terms of sociocultural relations, empowers men to play vital role within households and other community decisions. Poverty reduces the strength of the poor to raise their voices in community decisions. The women, in that sense, remain as poorest of the poor in intrahousehold and community decision making. The female headed households often fail to afford opportunities like male and fall into further vulnerability.

Chapter nine summarizes the key discussions and links the way the finings chapters, from chapter 3 to 8, may help us to enrich our understanding on water insecurity and poverty linkages and how the poor are facing the waterborne challenges differently with their weaker adaptation strategies in recent years in coastal Bangladesh. It also reflects the scenario which compels poor and extreme poor households to search for new livelihood opportunities that are often very different from their traditional agriculture-based activities. To understand this connection, this chapter summarizes the concepts that are delineated in conceptual framework and statistical graphs throughout the chapters and shows how the way poor and extreme poor households face challenges, and experience difficulties in choosing better adaptation strategies and compels to change their livelihood choices for their survival. In the end, this chapter concludes with a discussion on possible pro-poor future strategies to address the challenges.

Chapter Two: An Interdisciplinary approach to explore water-poverty connections

2.1 Introduction

The present research attempts to discover the divers of poverty and various adaptation strategies taken, as well as well-being outcomes with the altering water-security situations in coastal Bangladesh. In doing so, present study adopts sustainable livelihood approach to see how the water security influences the traditional agriculture-based livelihoods of the people in three study sites. This study, therefore, has covered a good range of concepts including water security, poverty, livelihoods, vulnerability, resilience, adaptation, and well-being.

This chapter addresses the literature review following interdisciplinary approach to address the specific relationship lies in water security scholarship and poverty analysis. The section 2.2 of this chapter provides an understanding on the review of water security concepts and its relation to poverty, growth and development. The section 2.3 discusses about the poverty literature, how the concept has been considered and measured with the course of time. Section 2.4 introduces the existing literature on vulnerability and how it is related to poverty and livelihoods. It argues that the concept has changed a lot from its initial state, and vulnerability should be measured from wider view if one tries to capture the actual feature of it. The section 2.5 addresses the concept of livelihood and how it is linked with poverty. It argues that if households fail to pursue their key livelihood options, leaving less viable or no alternative, they may fall into poverty. Section 2.6 introduces the concept of adaptation and adaptation strategies, which were initiated in climate change literature. The greater application of the concept is seen in livelihood and poverty literature. This section concludes with the barriers and limitations, for which the adaptation strategies may be hampered and people who follow them do not get their expected outcome.

2.2 Water Security

2.2.1 The conceptualization

The term water security has been receiving an increasing attention in recent years, as the concept is closely connected with growth and development. Grey and Sadoff (2007) defines water security as "*the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to topple, environments and economies*" (2000: 545). They argued that even minimum investments in water institutions may produce positive contribution to growth, but if water is insecure, that may play a reverse role to growth and development. The water-insecure countries in the world confront greater challenges with regard to hydrological features than the countries with water security. 'Water-insecure' countries are, therefore, to pay higher costs like "*human suffering, sustained poverty, constrained growth and social unrest*" (Grey and Sadoff, 2007: 546).

Water security has a crucial role in the economic growth and development (Grey and Sadoff, 2007) and therefore Sullivan (2002) argues that "*water-poverty needs to be quantified in a universally accepted way, through the derivation of a water-poverty index*" (Sullivan 2002: 1195). The same work developed the links between water use and economic development, water availability and water demand and also indicators that can be possible to use with better water management policy to contribute to economic development.

2.3 Poverty

2.3.1 The conceptualization

There has been a substantial alteration observed in terms of the selection of development indicators and development paradigms in the past century. Notable advancement is observed in the poverty discussion in the last few decades, although there is a considerable disagreement on the definition of poverty. Each definition tends to portrait the term differently with distinct dimensions. The definition ranges from shorter form of uni-dimensional calculating income to broader form of multi-dimensional concept with a comprehensive focus on range of subjective and objective analysis.

Poverty was observed as lack of basic physical resources such as food, clothing or shelter in the early phase of 20th century (Bootch 1886-1903, Rowntree 1901). In later period, Rowntree developed income-based method-the idea of poverty line, which is considered the first exertion to develop poverty line distinguishing poor and non-poor of a given locality. The first formal poverty line, the thresholds which separate poor from non-poor, was developed on the basis of income-based methods by Rowntree (1922, 1901). Such monetary approach, developed by Rowntree, dominated the development discussion until the 1960s; the following years of World War II, the economic growth was considered the single most important factor for poverty alleviation (Niemietz 2011, Misturelli and Heffeman 2008). The basic needs approach was developed by International Labor Organization in 1970s and the concept of 'subsistence' further expressed by this approach (Streeten *et al*, 1984). The basic needs approach included, in addition to minimum requirements for physical survival, essential services provided by and for community as a whole, like the provision of health care, education, safe drinking water, sanitation, public transport and cultural facilities (Hoque 2018, Streeten *et al*, 1984).

Both the monetary and basic needs approaches fail to address the social norms that may create impediments to the participation of people to the society. In line of this thought, the social exclusion approach was developed by Council of the European Union, where the term social exclusion is the "*process through which individuals or groups are wholly or partially excluded from full participation in the society in which they live*" (Deakin *et al*, 1995). Social exclusion approach observes poor as "*individuals or families whose resources are so small as to exclude them form the minimum acceptable way of life of the Member State in which they live*" (European Commission, 1981: 16). This approach has a close connection with Peter Townsend's notion of seeing poverty as 'relative deprivation', which denotes a condition characterized by the "*lack the resources to obtain the type of diet, participate in the activities and have the living conditions and the amenities which are customary, or at least widely encouraged or approved in the societies to which they belong*" (Townsend, 1979: 31). Accordingly, with the process of economic advancement, new obligations as well as expectations were placed on individual members so that they remain integrated into society where they live.

The development discourse in late 20th century started concentrate on the perception of poor about their own poverty, well-being, and the 'being and doing' they valued as most important. This trend was greatly facilitated by the 'capability approach' of Amartya Sen. The approach sees poverty and well-being in the context of the abilities of individuals to transform resources into valuable achievements (functioning), like- being nourished, being sheltered, being entertained and their freedom to choose among various functioning combinations (Sen 1999, 1993, 1985). In line of the work by Amartya Sen a good number of exertions observed that were to develop a specific list of basic capabilities (Alkire 2002, Saith 2001, Nussbaum 2000). The central human capabilities, as developed by Nussbaum in 2000, includes life, bodily integrity, health, senses, affiliation, emotions, practical reasons, other species, play and control. The capability approach of Sen laid the conceptual foundation of Human Development Report, yearly prepared by United Nations Development Programme (UNDP), the report usually monitors the progress of nations in terms of human development index (HDI) -a comprehensive measure of three dimensions: life expectancy, educational attainment as well as command over resources for a decent living (UNDP, 2013).

2.4 Vulnerability

2.4.1 The conceptualization: The term 'vulnerability' has been receiving notable attention in recent years with the discussions of global environmental change and climate variability and notable alteration in the lives of the affected communities across the globe. Both the living conditions, livelihoods and overall well-being of the affected communities have been receiving a notable attention. Research in these cases are trying to explore the vulnerabilities of the exposed communities so that viable alternative can be drawn for survival and betterment (Palliyaguru et al., 2014; Doberstein and Stager, 2013; Ibem, 2011; Ingram et al., 2006; McEntire, 2001; Weichselgartner, 2001; Boyce, 2000). Research on vulnerability has been conducted from different angles, namely- from the perspectives of political economy and political ecology, in terms biophysical risk-hazard perspective, human ecological perspective -with notable distinctions in explanation, emphasis and approaches (Adger 2006, Eakin and Luers 2006, Mclaughlin and Dietz 2008). The risk-hazard approach focuses on the identification of risks, their approximate timing to occur and possibility of recurrence. (e.g. Iglesias et al 1996, Burton et al, 1993); perspectives of political economy-and political ecology try to

identify vulnerable populations, reasons of their vulnerability and the way they become vulnerable (Sen 1981, Pelling 1999). Beside these approaches, the excursion of developing integrated frameworks are also evident (Frasher et al 2011, Ostrom 2009, Reed et. al 2013, Turner et al 2003, Scoones 1998) and these have tried to propose a comprehensive understanding of the nature and consequences of shock and also the way vulnerable affected communities respond.

Although there is a considerable dissent in the definition of vulnerability among researchers, 'consensus' in the definition also exists. For example, vulnerability -in general- identifies the individual or groups that are prone/susceptible to and are not capable to cope with the negative consequences of the external shocks (Kelly and Adger 2000, Perry et. al. 2007). Vulnerability is, as IPCC defines, "the nature and degree to which a system is exposed to significant climatic variations" (IPCC: 2001), sensitivity is "the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli" (IPCC: 2011) and adaptive capacity is "the ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (IPCC: 2011;McCarthy et. al. 2001). The definition has been revised by IPCC in later years (IPCC Fifth Assessment, 2014?), which tells that vulnerability is "propensity or predisposition to be adversely affected" (p.28). This new definition has a notable similarity with recent literature (Tucker et al 2015, Bennett et al. 2015, McDowell and Hess 2012, Pouliotte et all 2009) where vulnerability is seen as susceptibility to 'multiple stressors' arise from various socio-economic and environmental situation where climate change exacerbates the existing condition.

On the basis of climatic factors and recent global environmental change, the concept of vulnerability is portrayed into two different lines of interpretations in the climate change literature - one is coined as 'starting-point' or 'contextual' vulnerability and another is 'end-point' or 'outcome' (Kelly and Adger 2000, O'Brien et al 2007). Vulnerability concept is treated, by starting-point or contextual points of view, as of multidimensional nature and complex interaction between climate and society. Vulnerability is, as the end-point or outcome approach depicts, "a linear result of the projected impacts of climate change on a particular exposure unit (which can be either biophysical or social), offset by adaptation measures" (O'Brien et al 2007). The definition of vulnerability by

IPCC is influenced by this approach. It is depicted that the climate variability and climate change occur in the context of socio-economic, institutional and political structures and alterations.

Research gaps

Research conducted on vulnerability assessment also received considerable amount of criticism, at it is conceived that the studies are not flawless completely. Usually, the studies on vulnerability assessment face criticism for lack of engagement with the root causes, as the assessment deserves much engagement with the individuals and communities to be studied.

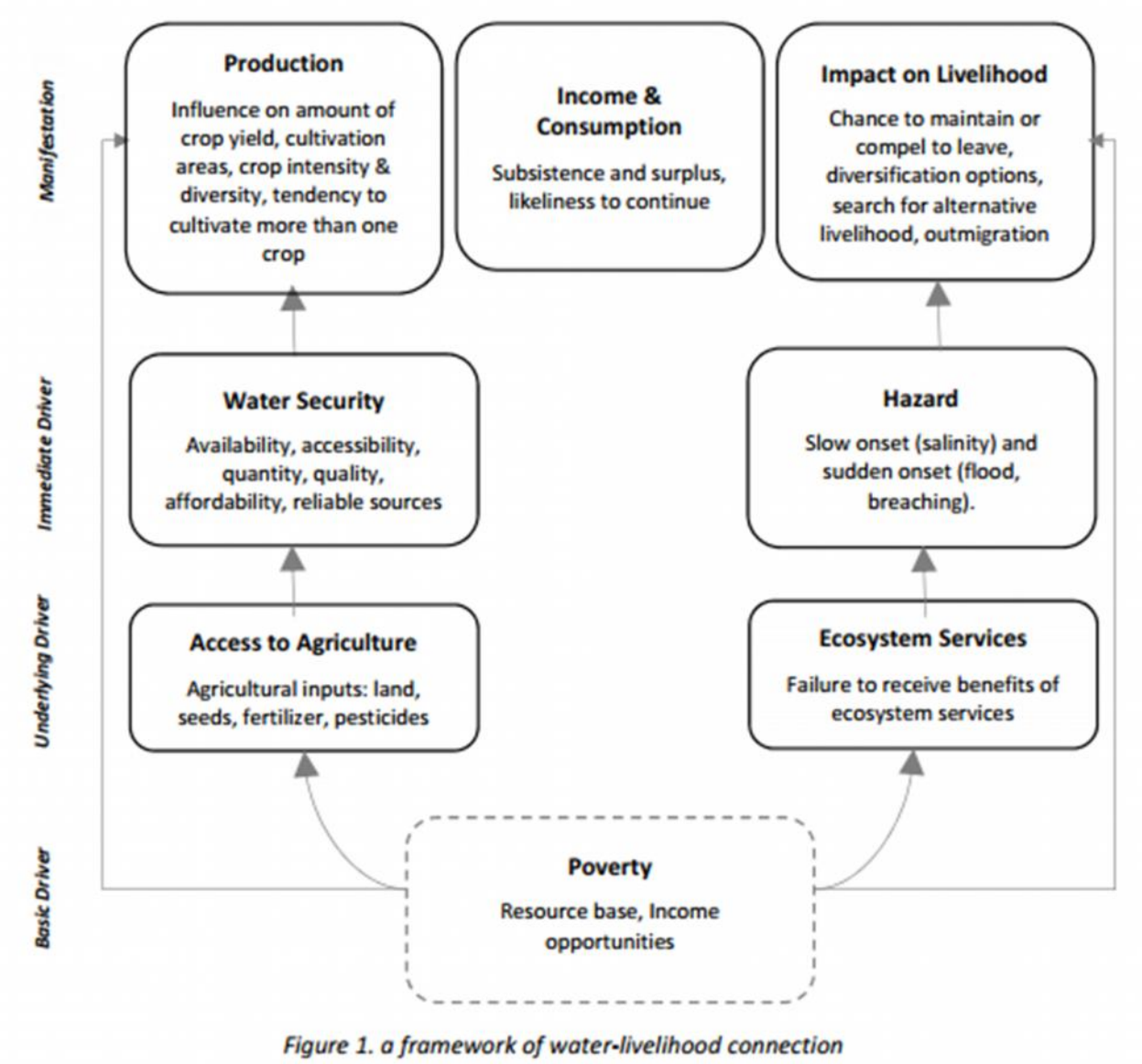


Figure 2.0.1: A framework of water-livelihood connection

2.5 Livelihoods

2.5.1 The Conceptualization

The term livelihood is originated in the field of economics. The concept can be found in the earlier mono-disciplinary discussions proposed by economists where they engaged in discussions of macro-level economic and political relations of capitalism in post-colonial regions (Scoones, 2009, Hoque 2016). The greater shift in development approaches been observed in 1980s and 1990s, and the key shift was from a focus of economic growth to overall human well-being and sustainable

development, these traditions propels the discussion of livelihoods issues (Solesbury 2003, De Haan and Zoomers 1987). The further discussion appeared in the Brundtland commission report (Brundtland et al 1987) and later in the earlier publication of Human Development Report (UNDP 1990), the later publication was influenced by the view of Sen where development was viewed as an expansion of human capabilities (Sen 1983, 1985). The livelihood concept come in central focus with the publication of 'Sustainable rural livelihoods, by Chambers and Conway (Chambers and Conway 1982) which provides a clear definition of livelihood, which was used recurrently in later years.

> "A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term".

The discussion of livelihood received greater importance throughout 1990s. One of the central roles was played by Institute of Development Studies and Overseas Development Institute with its remarkable sustainable livelihood approach (Ellis 1998, Hussein and Nelson 1998, Leach et al 1999). Another major role played by Department of International Development with the adoption of sustainable livelihood framework (SLF) as a core theme of DFID's development policy (DFID 1999). One of the salient characteristics of SLF include its notable departure from traditional top-down interventions to long desired people-centered bottom-up approach which seeks the opinions and comments of the grass-root people and communities in a way which they consider meaningful in their everyday lives (De Haan and Zoomers, 2005). Individuals and households operate, as SLF depicts, within a vulnerability context (which is determined by that specific bio-physical and socio-economic context) and their level of access to the capital assets. Five capital assets (namely-natural, social, human, physical and financial capital) play the central role in the sustainable livelihood framework and the capitals are usually governed by existing or dominant institutional and political structures, which include formal and informal laws, functioning of local governments and NGOs, beliefs and cultural norms (Scoones 1998, DFID 1999). The actual interaction between

the existing local contexts, level of individual or household access to different capital assets and resources as well as transforming existing structures and processes define their ability to adopt specific livelihood strategies, which finally translate into livelihood outcomes (for example, increasing income, better health, reduced vulnerability etc.) to those individuals or households (Scoones 1998, DFID 1999).

The sustainable livelihood framework was developed as a tool for the practitioners of development projects, and therefore large volumes of research reports are available in the application fields, and less academic discussion papers have been published on the framework (Small 2007, Morse and McNamara 2013). A different research trends have been observed in late 1990s- academics, rather than using SLF as a whole, were trying to concentrate on different aspects of livelihoods. Some, (for example, Ellis 1998, 2000) focus on livelihood diversification, some (for example, Moser 1998) focused on asset vulnerability approach to reduce urban poverty, Chambers tried to develop participatory approaches to explore rural poverty (Chambers 1995). In the continuing decade, the livelihood discussion has become an indispensable part of climate change related vulnerability and adaptation context. These discussions include- viability of diversification as a risk reduction strategy across communities (Assan 2014, martin and Lorenzen 2016, Gautam and Andersen 2016), the development of livelihood vulnerability index (Hahn et al. 2009, Antwi-Agyei et al. 2012), investment of the use and role of social capital in adaptation and coping mechanism (Adger 2003, Pelling and High 2005) and exploring the role of institutions in determining the individual or household access to resources (Eakin 2005, Agarwal 2010, Berman et al. 2012).

Throughout this period, academics tried to arrange livelihood strategies differently- Scoones (1998), for example, categorized general livelihood strategies taken by rural people (like intensification and extensification of agricultural activities, livelihood diversification, migration to more viable areas); Ellis (2000) classified the practiced strategies such as farm, off-farm and non-farm activities; Zoomers (1999) made distinction among the strategies as accumulation, consolidation, compensatory and security. Livelihood strategy, as Zoomers (1999) noted, should be conceptualized as a stage rather than of a structural category, which means that the same individual can pursue

different strategies in different time periods. There is a clear distinction between livelihood strategy and livelihood pathway in the analysis by de Bruijn and van Dijk (2004), where livelihood strategy is portrayed to obtain a pre-determined goal on the basis of rational evaluation of the preference of the actor, whereas livelihood pathway indicates an iterative process where the goals, preference as well as means are in relation to previous experiences and present conditions.

> "A pathway evolves over time as a combination of contextual factors, the way in which the social actors perceive these factors and the cultural and psychological predispositions and assets owned by the actor" (de Bruijn and van Dijk 2004).

The differentiation in the conceptualization may call for differentiation methods and strategies to gather and analyze distinct and relevant information.

2.5.2 Connection between livelihoods and poverty

Substantial literature has been developed with a clear focus on interlink between the poverty condition of households and the livelihood strategies adopted by them in different socio-economic and political contexts (Martin and Lorenzen 2016, Man den Berg 2010, Neegaard 2011, Cramb et al 2004, Gautam and Andersen 2016). Studies are pointed out the condition and context within which the households are maintaining their everyday lives. A study (Smith et al. 2001) conducted in two distinct districts of rural Uganda, it was observed that the 'very poor' people who lack the necessary means needed to engage any type of economic activity other than engagement as day-laborer or beggar, were unable to diversify their livelihoods; whereas the people with much wealth were engaged in one or more than one income generating activities related to in agriculture. The people with 'poor' or 'average' income earning categories are usually engaged in variety of activities like- small-scale services, fish trading, production and selling of livestock and laboring in the farms to supplement their subsistence crop production (Hoque 2016). Another study, conducted by Reardon et. al (1992) in three areas of Burkina Faso, explained that the people with greater amount of livestock holdings have greater opportunities for diversification. The greater stock of animals permits them to get better loan opportunities for further investment and greater profits permit them to invest in various off-farm enterprises. On the contrary, the poorer households are engaged

in subsistence farming, working as wage-laborer and similar activities, where the lack of capital and lack of access to resources does not permit them for further diversification. The researchers conclude that the cash in hand or liquidity plays the central role and permits people to further diversification of their livelihoods and income intensification. The household poverty does not lead them towards further diversification, which in turn, leaves household in stagnant poverty conditions.

The study findings, mentioned above, have also been supported by some recent studies on livelihood strategies and scope of diversification. In a recent study conducted in Nepal, Gautam and Andersen (2016) observed that comparatively richer households have better access to social and human capital and have greater chance of diversification as well as higher chance of engaging high return sectors like emerging trade and business, which let them to maximize their capital and invest further. Conversely, the poor households do not have such scope and therefore they usually engage in various unstable income generating activities that ensures only subsistence. Many of them are compelled to engage in unequal systems like patron-client relations, were the powerful higher caste rich people play the dominant role -leaves small or negligible share for the poor. Many poor choose to migrate seasonally to distant places like india to sell their labor. In another study conducted in Laos, Martin and Lorenzen (2016) discovered that the landlords and rich people are able to diversify their economic activities with their income from agriculture (for example, engaging many non-farm activities), while the land-poverty plays as the major barriers to poor people and therefore they fail to diversify. The authors concluded that the wealthier households are able to carry out 'progressive diversification', whereas the poor households follow 'distress diversification' only. These findings support the complementary evidences for the distinct between 'diversification for accumulation' and 'diversification for survival' (Dimova and Sen 2010, Assan 2014, Whitehead and Kabeer 2001, Dercon and Krishnan 1996, Reardon et al 1992). The 'diversification for accumulation' creates only for the wealthier class when any strategic decision is needed to enhance standard of living with the support form wealth creation, whereas the 'diversification for survival' happens with poor classes and arises only from dispersion like natural stress and shocks, lack of assets and capital.

A good number of studies are devoted to find out the connection between the influence of non-farm income and the wealth status of a household, though there is difference between empirical findings of various studies. Studies by Ellis (2000) and Reardon (2000) mentioned three patterns for three types of contexts. First, in the areas like Asia and Latin America, where land ownership is the key determinant factor for the identification of poor and non-poor in rural areas, there a linear negative relationship is evident between gross household income or land ownership and non-farm income. Second, there are areas (like rural Africa) where the livestock and human capital is the key determinant factors in identifying poor and non-poor, there exists a linear positive relationship between household gross income and share of non-farm income (Reardon 1997, Reardon et. al 1992). Third, there are rural areas where poor people are totally landless and rich people are landowners and produce most of their income from their lands, there creates a U-curve relationship. The poor household, in the context of latter case, the non-farm income sharing is relatively high, middle income farm size range declines, therefore raises the higher end farm sizes and gross income.

2.6 Adaptation

Substantial literature has been developed both on livelihood and adaptation but the literature on these related concepts developed very separately. The livelihood concept is more discussed in close connection with poverty and development analysis, but the adaptation literature is discussed more with the study of climate change. In recent years, both the concepts received prominent importance with the discussion of global environmental change. The following section concentrates on the literature of adaptation, with special focus on rural livelihoods of poor people.

2.6.1 The conceptualization

The concept 'adaptation' has a rich history of multidisciplinary research and investigation. A brief discussion may illustrate the matter: in biological or ecological terms, adaptation indicates the change in an organism or species to be fit for its environment (Abercombie et al. 1997, Lawrene 1995), in social sciences, adaptation denotes to the adjustments by individuals and also the collective behavior of socio-economic systems (Hardesty 1986, Denevan 1983), in the study of

climate change, IPCC defines adaptation as an "*adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities*" (parry et al. 2007:869) and it is the mostly cited definitions till date. However, beyond the disciplinary boundary, there is a growing understanding is that adaptation is something more than just a concept of climate change alone. The discussion of adaptation is given more importance in various socioeconomic, political as well as environmental stressors (McDowell and Hess 2012, Moser and Ekstom 2010). Additionally, it is worthy here to note, adaptation is considered as "*change in socio-ecological systems in response to actual and expected impacts of climate change in the context of interacting non-climatic changes*" (Moser and Ekstom 2010: 220). More importantly, from livelihoods perspective adaptation covers the activities undertaken by individuals and households to improve their livelihood maintenance and security and reduce poverty, as well as respond to the climactic drivers (Williams et al. 2015, Sabates-Wheeler et al 2008).

2.6.2 Adaptation Opportunities, Barriers and limitations

On the one hand, the literature on adaption to existing and projected impacts of global climate change has been increasing, large number of research have been concentrating on the social conditions and factors which make adaptations efforts less effective or make more costly on the other (Antwi-Agyei et al 2015, Shakleton et al. 2015, Eisenack et al 2014, Islam et al, 2014, Klein et al. 2014, Biesbroek et al 2013, Moser and Ekstom 2010). Such research trends propel an extensive focus on 'barriers' and 'limits' to adaptation process. Biesbroek et al (2013) conducted a systematic review of 81 studies and observed that most of research were concentrated on local or regional levels and grounded in qualitative case studies with a very limited sample sizes and done on basis of interview, workshops and survey method. Although the terms 'barriers' and 'limits' have very distinctive meanings, there are many researchers who uses the terms interchangeably. The IPCC AR5 considers adaptation barriers as factors that "*restrict the variety and effectiveness of options for an actor(s) to secure their existing objectives*" (Klenin et al. 2014:8) and limits as "the point at which an actor's objectives cannot be secured from intolerable risks trough adaptation actions" (Klein et al 2014: 8). There are pathways too. The barriers can avoided, overcome or moderated with intensive effort, creative management, alteration in the way of thought, effective political will

and reprioritization of resources, use of lands and institutions (Moser and Exstrom 2010) limits are incalculable with incremental adaptations and deserve transformational adaptations on the basis of redefinition of the objectives of the actor (Dow et. al 2013). Eisenack et al defines the concepts barriers as an "*impediment to specific adaptations for specified actors in their given context that arise from a set of conditions*" (Eisenack et. al 2014: 868).

2.6.3 Gaps in Research

Livelihood adaptation to waterborne stress is affected by number of factors which can work in combination or individually to hamper the planning, implementation and effective adaptation strategies. Although the adaptation has a rich history and wider literature, the term barrier to adaptation is comparatively new, and limited research has been done to cover this concept. Such limitation in research deserve extensive and greater attention to study the various influence of barriers on individuals, households and different social groups, various wealth class, ethnicity and other demographic factors. It is very important to understand the way the adaptation strategies taken by one household may be affected by another because of conflict of interests and power imbalances (Shackleton et al 2015). Some relevant studies conducted in recent years have documented the way barriers may combine to hamper adaptation strategies or increase exposure (Antwi-Agyei et al 2015, Islam et al 2014). Considerable number of research regarding this were conducted in Sub-Saharan Africa, while the paucity of literature South and Central Asia is evident. A large number of extensive studies are required to develop a greater understanding regarding this matter as the adaptation decisions usually are highly context specific.

Chapter Three: Study Areas and Research Methods

3.1 Introduction

Chapter Two covers an extensive review of existing empirical work and theoretical development which are related to a range of concepts including water security, livelihoods, poverty, resilience, vulnerability and human well-being. These concepts have been linked and organized under a conceptual framework for the present research. The literature review part addressed some research gaps in cases of various drivers and methods of multidimensional poverty analysis, some methodological issues in the analysis of resilience, differential impacts on livelihood strategies and livelihood decisions, ecosystems services and poverty, differential impacts on adaptation options and viable strategies, interpretation of differential impacts on livelihood dynamics and well-being outcomes, opportunities and barriers faced by different wealth class.

The present chapter addresses the methodological approach and the specific research techniques that are used to focus on objectives of the study, and it also introduces the three study sites selected for this study. The methodological approach, section 3.2, of this chapter provides an introduction of underlying research philosophy -the ontological and epistemological stance, and also about the research strategy -the case study approach. The section 3.3 discusses about the study sites, purposes behind selection criteria and selection process. This section also provides a succinct explanation of country and sub-national or coastal context along with study sites. Section 3.4 introduces the key research methods applied including -household questionnaire survey, focus group discussion, key informant interview, in-depth interview and case studies. The following section 3.5 address on quantitative and qualitative data analysis methods applied for this research. Finally, section 3.6 some underlying issues like how the fieldwork was conducted, positionality and the research ethics maintained.

3.2 Methodological approach

3.2.1 Ontological and epistemological stance

This study adopts critical realist ontological stance, in place of positivist or realists, to examine the research questions and case study approach has been used to do that. The positivists or realists maintain that an external reality exists in the belief of the people independently; whereas the constructivists or idealists consider that there is no single reality in everyday social live and that all knowledge is connected to social construction, whereas critical realists believe that an external reality exists independently, that could be known only through the representation of people, or through meanings that are socially constructed (Ritchie and Lewis, 2003). Critical realism, like positivism, focuses on the objective world with special emphasis on patterns, causalities and generalization. It considers that to study the observable facts is so superficial that it fails to acknowledge the underlying structures (Bhaskar 2011, Alvesson and Skoldberg 2009). Critical realist approach is best match for this study, that tries to discover the underlying drivers of poverty condition, various livelihoods and adaptation strategies taken by inhabitants, and the well-being outcomes of the households studied.

It is crucial to note that the stance the critical realism offers is very much relevant for present study, as there is an application of both induction and deduction (Bhaskar and Lawson 1998) in this research. It is important to clarify that the induction or 'theory seeking' research seeks patterns and associations which are drawn from observations of the world and use empirical evidences and draw conclusion, whereas the deduction or 'theory testing' studies theoretically produce propositions and hypotheses with the help of logically derived steps and apply evidence to draw conclusion (Ritche and Lewis, 2003). Purely inductive studies, as (Perry et al. 1999) argues, are not able to benefit from the primary understanding of existing theory; while research that were purely deductive in nature, support theory testing but do not contribute to the development of new theories. The present study applies mixed method approach, where the combination of both quantitative and qualitative data will generate further evidence of existing knowledge and help to develop new understanding about the subjects of this research.

3.2.2 Case study approach

Table 3 0.1: Level, purposive sampling criteria and the contexts

Level	Criteria of purposive sampling	The context
National	▪ Peoples' level of dependence of natural resources for their livelihood ▪ The level of poverty ▪ National vulnerability to natural shocks and stress. Frequency of disaster incidence. Proneness to shocks. ▪ Water and poverty connectivity	▪ The area is in the lower reaches of Ganga-Brahmaputra-Meghna catchment and is in high-risk of natural shocks like flood, cyclone, coastal surge, flash flood, river-erosion, soil salinity and droughts. Bangladesh is considered as one of the most vulnerable countries in the world. ▪ The poverty scenario of Bangladesh is gradually changing and poverty reduction scenario is surprising, but the rural population is still highly dependent on natural resources and directly related to water, land and associated activities.
Sub-national (coastal context)	▪ One of the most vulnerable zones of the country ▪ Record of frequency and severity to disasters ▪ Highly in risk area in terms of climate change	▪ The coastal zone of Bangladesh consists of 19 districts and considered the most vulnerable part of the country. The coastal part is frequently disturbed by fatal disasters like *Aila*, *Sidr*, *Mohasen*, *Nargis* etc. Although the recent disaster management strategies have become successful in reducing death-toll, the disasters destroy notable assets of people and also development efforts from government and the international organizations.
Local/study sites	▪ Area of high risk ▪ Two of the three sites are highly affected by breaching and salinity ▪ Agriculture dependent livelihood are under threat in both village ▪ Another village is practicing agriculture through water management, facing less or no risk to follow traditional livelihoods	▪ The study sites were selected on the basis of a number of scoping visits conducted in different sites of coastal zone. After a good number of discussions and interviews in each site, the present sites have been finally selected. In addition to group discussion with local people (which were not pre-determined), a number of individual discussion were taken place with union parishad (local govt.) chairman and member, school teachers, local leaders, members of volunteer association, member of water management group, local experienced person knowledge about the long-term breaching and salinity and local agriculture and livelihoods history.

3.3.3 Study Location

The study location is in an 'active deltaic floodplain' situated at a lower reaches of Ganga-Brahmaputra-Meghna catchment (Abdullah et al., 2017) and the exposure is high in pre and post-monsoon phase. The embankment breaching makes saline water intrusion in some parts and creates significant alteration in vegetation and overall socio-economic condition of the residents of flooded villages for longer period.

Present study collects information on the basis of empirical evidences from some selected villages of a polder[3]. The polders were constructed between 1960s and 70s and a total of 123 polders were constructed in coastal belt which include 49 sea-facing polders and the key objective of those construction was to protect those areas and agricultural land from tidal flows and salinity intrusion (Islam, 2006) as well as to protect inhabitants from direct tidal-flood water intrusion and salinity. Another aim was to boost agricultural production within polders or the embanked enclosure to ensure food security (Islam, 2006) of the inhabitants of the polders and beyond. At present the embankment breaching is often observed in many polders because of excessive flow of water in rivers and poor maintenance of embankments.

[3]The embanked deltas in the Southern Bangladesh. Usually, a polder is a low-lying area, generally enclosed by earthen embankment. This practice of protecting low-lying land in this way is very much common in coastal Bangladesh.

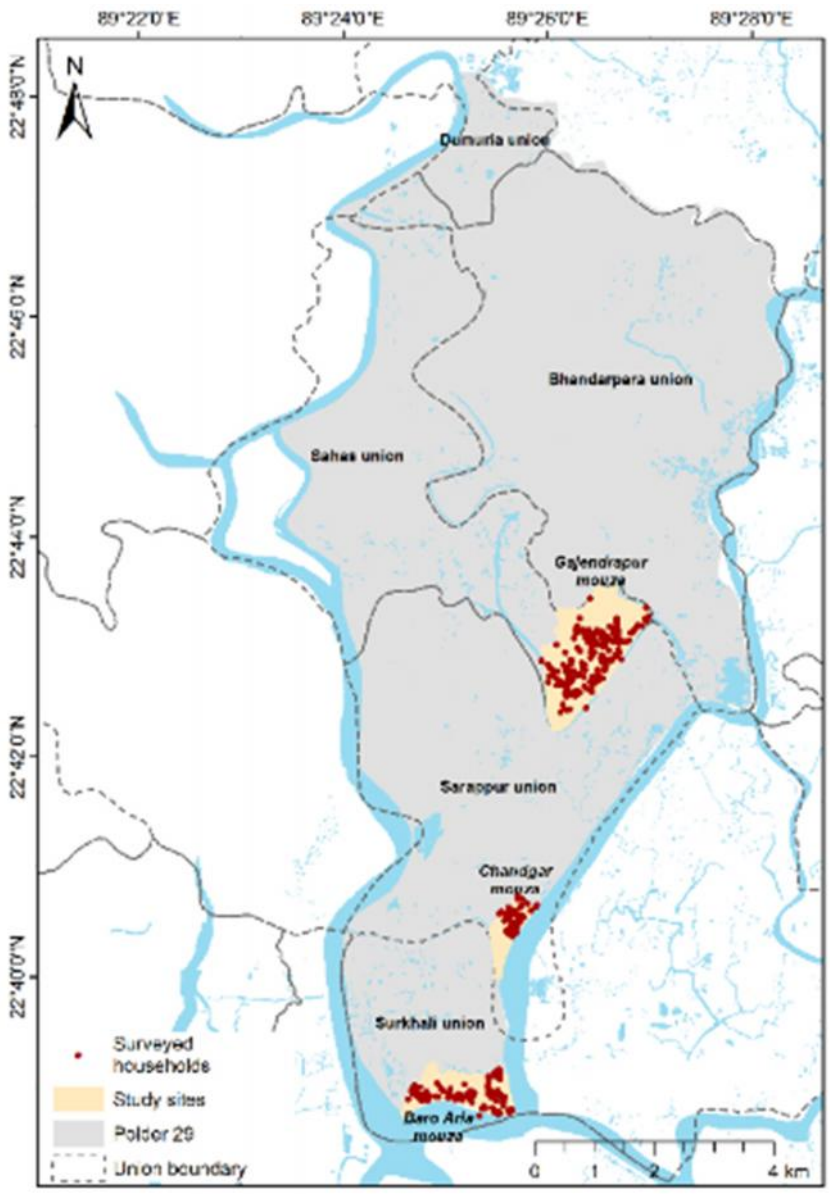


Figure 3.0.1: Study location and data collection points

From the outset, the polders were working excellent and serving local communities as expected, however, gradually rivers been sited up and riverbeds were becoming higher. The polders were not reconstructed, in many cases; those were not properly maintained even. Consequentially, the overflowing and breaching become frequent events in comparatively weaker points of the polders. The saline water, thus, started to the comparatively low agricultural lands (as the height of the local homesteads and croplands remaining the same after polder construction in comparison to raising riverbeds) and logged saline water been staying for long. The salinity thus has a central role in

diminishing agricultural productivity of croplands and others vegetation in raised land like homesteads. In many cases, the embankment breaching washes away villages -one after another over a longer course of time. The 'insecure' water thus creates a long-term impact on peoples' traditional agriculture-based livelihoods and dependency. The socio-economic and environmental contexts of such agrarian transitions often reshaping societies in terms of poor and non-poor categories (Swapan and Gavin, 2011, Adnan, 2013). The present paper tries to explore how the insecure water influences on agriculture-based livelihoods and the livelihood decisions as well as opportunities of community people.

Chandgarh is one of the study villages in Sharafpur union under Dumuria upazila, and is situated on the bank of mighty Bhadra river. Embankment breaching is a major threat for Chandgarh and some nearby villages. Due to frequent erosion, the part of the village is already gone under water. If the tidal wave is high, the river water enters to the village and forces people to move to the highlands like partially eroded embankment or raised land of decayed earthen basement of old houses. Frequent saline water intrusion and discrete logged-saline water in ponds and canals increases the soil salinity in the area and the villagers cannot practice homestead gardening.

Chandgarh was a village of solvent households with rich soil and well-vegetation before breaching started. Most of the households owned crop fields, and the people single crop they drawn supports them throughout the year. The agriculture was totally rain-fed and very few households draw shallow-water driven second crop. People practiced subsistence agriculture and rich households produces large number of crops for sale. Ponds of the villages were usually filled with fresh rain-water and were used for homestead vegetation. Rich households also leased their lands out and villagers with less or no land take the opportunity and managed their families. People uses distant river (which has come closer and engulfed some part of villages already) for fishing and as a way of communication. The river has changed everything dramatically, for the last 15 years the major part of the village is engulfed by Bhadra river, salinity increased exponentially, the altered soil quality is not suitable enough for vegetation, and people are to change their traditional agriculture-based occupation and grabbed whatever available.

The village Baro Aria, in Surkhali union under Batiaghata upazila, is also situated on the bank of Bhadra river, and the villagers also face the challenges of embankment breaching. The part of the village is already eroded and the existing partly damaged earthen embankment is not strong enough to save the village for long. The people who have already lost their homestead are residing on the gradually eroding embankment or moved to distant villages. The community people build pocket embankment after each breaching to protect the village from further erosion and breaching. Thus, people made the place possible for both habitation and vegetation.

Unlike the two villages depicted above, the people of Gajendrapur, a village in Sahas union under Dumuria upazila, do not face such challenges of river erosion or direct hit of sudden river overflow. Although the villagers had been suffering from both irrigation water and drinking water problems over a long period of time, the situation has been changed a lot. The villagers have successfully managed both irrigation and drinking water problems and, therefore, are able to boost the agricultural production. Most of the villagers are engaged in agricultural activities and many of them draw more than one crop from their homestead and agricultural fields. Consequently, people are able to retain the traditional livelihood practices, and are comparatively better-off than earlier two villages.

3.4 Mixed Method Research

Present research adopts a mixed method approach including both quantitative and qualitative methods and is dedicated to draw primary data. Individually each of two different methods distinctive information allows a broader understanding which on one method alone cannot offer (Ritchie and lewis, 2003). Quantitative research can propel statistical investigation, or may support statistical inquiry, or it is used to follow up of the findings from quantitative data (Ritchie and Lewis, 2003). Qualitative research is valuable and useful in finding social constructs and constructing structured questions for quantitative research (Ritche and Lewis, 2003). When both the quantitative and qualitative methods are applied to study same phenomenon, the quantitative method may provide statistical data that can produce generalization, whereas qualitative methods can produce an in-depth, rich understanding of the nature of that phenomenon (Ritche and Lewis, 2003).

Present study has carried out focus group discussions (FGDs) and in-depth interviews (IDIs), Key Informant Interviews (KIIs) and Case Studies to generate an overall understanding of the local context in terms of socioeconomic conditions, resource availability, nature of distribution of wealth among different groups, major livelihood activities, major hazard and shocks. In addition to gather information about the nature of local phenomena, these methods also help to generate, revise and ameliorate the questionnaire for household survey. As quantitative method, he household questionnaire survey help to produce statistical data on socioeconomic condition, asset ownership status, livelihood strategies and change, adaptation strategies and well-being of people of various wealth categories. In addition, the interviews on livelihood trajectory provided extended narratives on the life and livelihoods of the people and helped to understand how initial asset ownership influence asset management strategies and livelihood choices in the confrontation of stress and shocks.

The combination of quantitative and qualitative methods helps to generate some influential functions, especially in terms of triangulation, the completion of study, cross-checking, verification and analyzing data. The triangulation indicates to the comparison of results from various sources which ensure greater validity; completeness indicates to achieve a comprehensive account of area of inquiry by developing on the strengths and offsetting the weakness of various research methods; explanation indicates to the process of using one method to explain findings from another (Brayman, 2012). It must be mentioned here that the term case study often indicates qualitative research in nature, but a case study approach may involve either quantitative or qualitative method or both (Eisenhardt 1989, Yin 1984).

The study villages were selected through a series of scoping visits in different polders across Dacope, Dumuria and Batiaghata Upazila (sub-district) of Khulna district in South-western coastal Bangladesh. The scoping visits were supported by a good number of discussions, courtyard meetings, appointments and discussions with key personnel including local leaders, local water administration, school and college teachers, chairman and members of Union Parishads (lowest unit of local government), experienced representatives of leading NGOs working in the same area. Polder 29 was finally chosen for study which is located in Dumuria and partly Batiaghata upazila.

Three villages from Polder 29 were selected as study sites. The three villages studied in the research comprises of 1347 households (BBS, 2011).

A mixed method was applied to collect empirical evidences. As part of quantitative study, a Household Questionnaire Survey was conducted. A total of 384 household has been surveyed, which covers almost 35 percent households from each village, to understand the linkage between water insecurity and livelihood decisions. The survey was followed by a series of qualitative techniques including Focus Group Discussions (FGDs), In-depth Interviews (IDIs), Key Informant Interviews (KIIs), Semi-structured Interviews (SSIs), Case Study and observation. The data collection was completed in several stages between January 2016 to May 2018. The research methods and study concentration is presented below-

Table 3.0.2: Research activity, selection and focus

Activity	Selection	Coverage	Focus of Activity
1. Household Questionnaire Survey	Individuals from households have been selected on the basis of poverty, gender and age balance	384 households (nearly 35% from each site) from Chandgarh, Baro Aria and Gajendrapur	Socio-economic and demographic profiles, status of water security and livelihood choices, agricultural production, impact of water related hazards on poverty
2. Focus Group Discussion	FGD with female only, with male only, and with both participants	9 discussions (3 from each village)	Relationship between water security and poverty, impact on agriculture and livelihoods, existing vulnerability and interventions, possible solutions
3. in-depth Interview	Poor facing water related complexities (livelihood shifted), local experienced persons	12 interviews (2 men, 2 women from each study village)	Water and food production, livelihood choices and poverty, reasons, adaptations, possible solution
4. Key Informant Interview	Responsible local officials and leaders, water board and agriculture officials, NGO personnel	6 interviews (2 from each area)	Status of water security and its impact on agricultural production, livelihood options, coping strategies
5. Case Study	individuals facing water problems and livelihood challenges	6 case studies (2 from each village)	Water and agriculture, backdrops, livelihood strategy and challenges to pursue traditional livelihoods

3.4.1 Household questionnaire survey

The households were selected following a random route/walk sampling strategy and consents were taken from each respondent prior to the survey. While conducting the survey, the heads of the

households were the primary respondents and, in some occasions, other members were permitted to take part and discuss for the sake of drawing actual data and for intra-household verification. The survey questionnaire was concentrated on household location, demography, water and sanitation, drinking and irrigation water source and accessibility, exposure, poverty condition, household power source, priority concerns, concerns regarding water and natural environment, land ownership and agriculture, income sources, crop production, homestead land livestock, aquaculture, hazard scenario, water related risks and its impact on livelihoods, and regarding water management group.

The survey data, as noted earlier, are validated and verified by a number of qualitative techniques like FGDs, KIIs, case studies, in-depth interviews. In each village, 3 separate FGDs were conducted: - one with male, one with female and one with both male and female -and thus a total of 9 FGDs were conducted. Each discussion comprises of 8-12 adult participants from different socio-economic background and who are familiar with the issues discussed. The FGD concentrated the issues of key drivers of such socio-environmental change and their common impacts to the study villages; how the different wealth class cope with the environmental concern and water related problems; the type of livelihood options the different wealth classes chooses; the welfare situation in the past and present etc. The information collected through FGDs show the causes and consequences of water related problems, the way different wealth classes try to cope with the water concerns and strategies and options different wealth classes usually choose.

A total of 9 individual case studies, 3 from each village, were conducted and the victims of water-driven problems have been selected for case studies. The case study reveals how the water insecurity creates notable impact on their lives and livelihoods and forced them to choose different livelihood options for their subsistence. A total of 6 KIIs have been conducted in the study areas and administrative personnel who are closely connected to the area and have in-depth understanding on the issues studied. The key informants were asked different water-related issues and the coping mechanism of inhabitants. A number of administrative issues were also there like how the concerned administration trying to adjust the problem, their future strategies and goals to protect people who are the most at risk of water insecurity.

Information gathered from household survey, transact walk and discussions helped to classify the survey respondents into five specific wealth classes with the statistical help of principal component analysis (PCA). The specific five categories are rich, upper middle, lower middle, poor and extreme poor. Present study observes that there last three wealth classes share almost some homogeneous characteristics with different severity and reality. However, the heterogeneous features with notable distinctive division. The data analysis measured the asset ownership of the household and plotted them to the specific group of different wealth class.

3.5 Data Analysis

3.5.1 Qualitative data analysis

The analysis of qualitative data is completed in two stages -preparing and organizing data for analysis; and reducing data into different themes through coding (Cresswell, 2013). In the first stage of data collection, the field notes and audio recording, discussion notes with other research assistants are translated from Bangla to English and then transcribed. During translation, some specific phrases and words are kept in Bangla so that those may not lose their cultural importance and nuance. Different ways of collecting primary data include field notes, audio files, photographs, discussion notes with research assistants and transcribed texts. For secondary data collection, techniques involve local official records, newspaper reports.

In the second stage, the transcripts were revised thoroughly and were organized in codes. Coding include tagging a certain portion of a text, in a way that single piece of information belong to the similar themes can be organized and grouped together (Baseley and Jackson, 2013, Creswell 2013). The coding also involved the inductive and deductive approaches. Some coding was developed on the basis of literature review, the understanding of researchers developed during visits and the specific categories embedded in research questions (known as a priori approach), whereas others were produced from raw data (inductive approach) (Strauss, 1987). The literature review, for instance, highlighted a good number of categories for grouping the adaptation strategies taken and barriers faced including economic, institutional and or informational.

The initial codes then further concatenated into broader categories and sub-categories. To organize data under codes usually help to generate order out of randomness, it help to clarify ideas and indicate patterns that are linked between groups of nodes (Bazeley and Jackson, 2013). The categories and sub-categories were identified by a specific type of scrutiny as developed by Ryan and Bernard (2003) with a view to search for repetitions, metaphors, indigenous typologies, and analogies, similarities and transitions and differences as well as linguistic connectors. The categories then were connected to theoretical concepts and sorted in line of research objectives and the key questions that are needed to be addressed.

3.5.2 Quantitative data analysis

The quantitative survey data were collected with the online supported software in two different phases. The household questionnaire survey was administered through an electronic from developed in ONA (https://ona.io/), a mobile survey platform which provides a hosted server for uploading, editing, viewing and submitting necessary forms. The data was collected with the help of 15 trained local enumerators, and finally, the collected data was downloaded as Microsoft Excel files from ONA. In the next step, the data were entered into IBM SPSS 25 for calculating wealth indices.

In order to disaggregate households into different wealth categories, Principal Component Analysis (PCA) was applied. PCA is widely used method in the assessment of multidimensional poverty, where the factor loading of the first principle component (PC_1) which serves as the weights of selected asset variables (Vyas and Kumaranayake 2006, Filmer and Pritchhett, 2001). A total of 10 selected variables were used (see in appendix) and all components were extracted with eigenvalues >1, followed by a k-means cluster analysis of factor scores of PC_1. The latter technique segments the data in a way that the within-cluster variation was minimized, which enable categorization of households into specific and distinct wealth classes. The derived wealth classes, with the help of PCA, was further validated with subjective judgments of the field enumerators who conducted the survey and correlated with agricultural land ownership, which is considered as the most important indicator of wealth in rural Bangladesh.

After the household disaggregation into different wealth groups, both the poor and extreme poor households (who were traditionally pursuing agriculture-based livelihoods) received additional attention in the observation of livelihoods they are following at present. The quantitative data also applied to understand the different non-farm activities they are choosing for their subsistence and how the well-being of the poor is being observed by themselves.

3.6 Summary

This chapter covers the methodological issues that play crucial role in collecting and analyzing data. The methodological issue has been designed in line of four specific objectives that are finalized and delineated in earlier chapter. On the basis of diverse realities in three different communities, the methodological design tries to cover the required issues with the help of different tools for the sake of agglomeration of information and verification. Different location and communities were selected for the sake of generating insights on water security and poverty relations and how water stress may influence the livelihood decisions of the studied population. Present study employed a mixed method approach with a variety of techniques. The quantitative technique employs household questionnaire survey, whereas the qualitative tool employs unstructured interviews, case studies, focus group discussions, in-depth interviews and key informant interviews. Analyzing qualitative data include transcribing, translating and coding the collected information. For quantitative data analysis, various a number of statistical software including STATA, Pivot table of Microsoft Excel worksheet were used to generate statistics on the opinion of respondents in terms of socioeconomic condition, water related information, farming information, livelihood options and adaptation strategies, existing welfare condition etc. of households. Moreover, to disaggregate the studied households into different wealth classes PCA was applied. The upcoming chapters and sections analyze the collected information together with insights from literature so that the study objectives can be covered in a better way.

Chapter Four: Disaggregating households and assessing their socioeconomic contexts

4.1 Introduction

This chapter disaggregates the households in terms of socioeconomic wealth class and provides detailed account of the socioeconomic condition and livelihoods. The housing condition often portraits the socioeconomic picture of a household, and therefore it is important to measure these features to get a complete picture. In high risk areas people are less motivated to build their houses in a better way because of hazard. Poverty is often one of the major reasons for poor housing condition and structure. Better picture can be observed in the areas where there is no or less risk. This chapter provides the detailed overview of these conditions on the basis of data collected from household survey and some other qualitative data collection techniques. It is found that the wealthier class has better living houses with good number of rooms, whereas the less wealthy class households maintain poor living houses with one or two living rooms.

The section 4.2 presents the wealth class-specific housing scenario in the three study sites. This section examines the housing condition and housing materials including -the materials of house roof, exterior walls, house floor, number of living rooms, homestead land occupancy, toilet sharing etc. to know the true scenario of poverty condition of the three study sites. Section 4.3 below examines the key livelihood choices of different wealth-class people residing in the three study sites. The study also examines the livelihood diversification opportunities for both rich and poor households. Finally, section 4.4 explores some basic features of poverty condition of three study sites.

4.2 Housing condition, homestead land occupancy and sharing scenario in Baro Aria

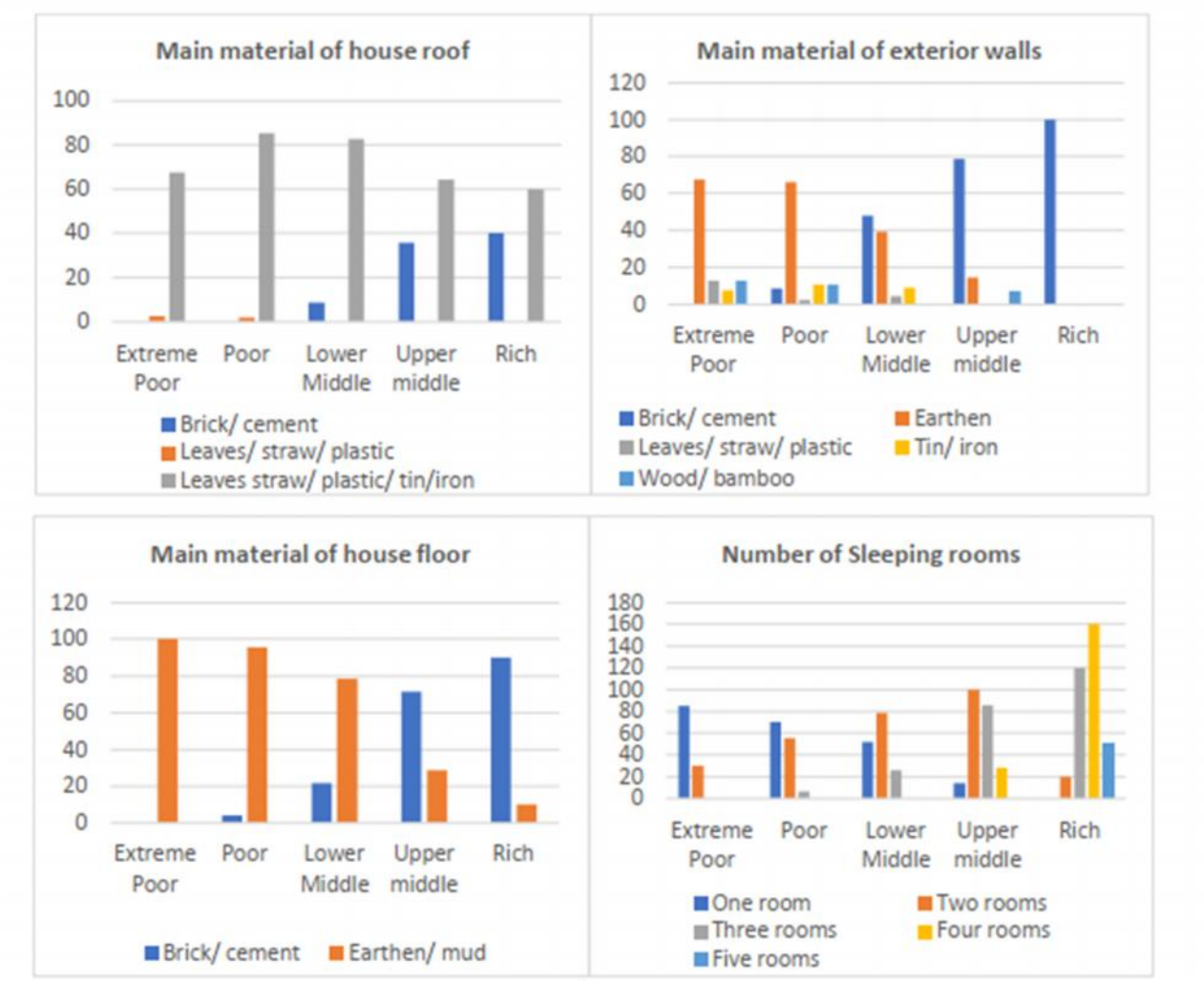


Figure 4.1: Housing material in Baro Aria

The housing condition often tells the actual socioeconomic status of a household. The people of coastal Bangladesh maintain a common belief that housing condition is a part of status quo of a household. Figure 4.1 portraits the housing condition of the households of different wealth class in Baro Aria. As it shows, most concrete houses belong to rich and upper middle class, and the house roof, exterior walls, house floors are made of bricks and cement. Moreover, the wealthier class households have more living rooms. The number of living rooms is also another indicator of economic condition of a household. Many wealthier households in Baro Aria have more than two living rooms.

The condition of less wealthy class in Baro Aria is quite different. Most of the poor and extreme poor of the villagers live in clay houses, where the house roof is made of straw or locally available leaves named *Golpata*. Some uses corrugated plastic sheets or corrugated tin to cover their houses. The exterior walls and house floors of these wealth class is made of clay. The reason behind this structure and material is obviously poverty, and uncertainty of hazard condition. As delineated by Chapter three, the long-term breaching has engulfed a considerable part of homestead areas and agricultural field. Many concrete houses and homestead of rich households are engulfed by Bhadra river. Therefore, the less wealthy class fears to take loan for the purpose of constructing better houses. Only a very few of them manage loan or save money and build concrete houses. The condition of lower middle class is in between.

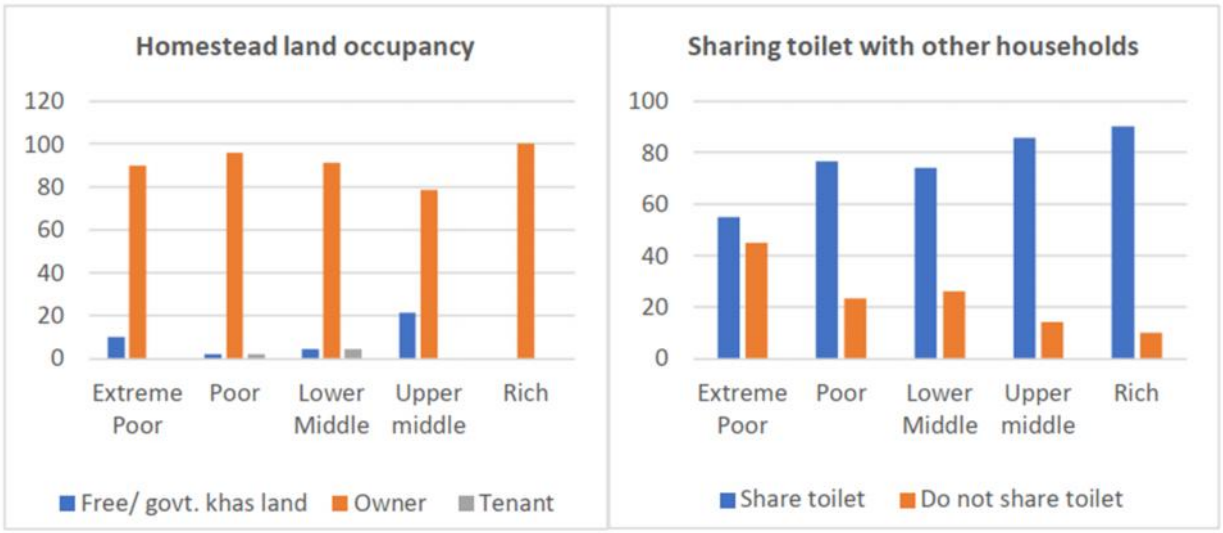


Figure 4.2: Homestead land occupancy and toilet sharing scenario in Baro Aria

Figure 4.2 presents the homestead land occupancy status and toilet sharing scenario among the inhabitants of Baro Aria. It shows that, most of the respondents are living in their own homestead land, which they inherited or bought from others. However, there are some poor, extreme poor, lower and even upper middle-class households who are living in government *khas land*. The reason behind this is breaching, which engulfed the homestead of many of these household and left almost no choice to live in other areas. Moreover, the toilet sharing scenario tells another story of socioeconomic status and hygiene condition. As the data depicts, sharing toilet is a common scenario across the households in Baro Aria. Very few households among the participants do not

share toilet with other. Figure shows, more than eighty percent rich and upper middle households share toilet with other household, which is relatively high from the less wealthy class.

4.2.1 Mirroring poverty through ownership and household characteristics: Baro Aria

Table 4.1: Key household characteristics of the respondents in Baro Aria

	Extreme Poor n=40	Poor n=47	Lower Middle n=23	Upper middle n=14	Rich n=10
Homestead land occupancy					
Free/ govt. khas land	10.00	2.13	4.35	21.43	0.00
Owner	90.00	95.74	91.30	78.57	100.00
Tenant	0.00	2.13	4.35	0.00	0.00
Main material of house roof					
Brick/ cement	0.00	0.00	8.70	35.71	40.00
Leaves/ straw/ plastic	2.50	2.13	0.00	0.00	0.00
Leaves straw/ plastic/ tin/iron	67.50	85.11	82.61	64.29	60.00
Main material of exterior walls					
Brick/ cement	0.00	8.51	47.83	78.57	100.00
Earthen	67.50	65.96	39.13	14.29	0.00
Leaves/ straw/ plastic	12.50	2.13	4.35	0.00	0.00
Tin/ iron	7.50	10.64	8.70	0.00	0.00
Wood/ bamboo	12.50	10.64	0.00	7.14	0.00
Main material of house floor					
Brick/ cement	0.00	4.26	21.74	71.43	90.00
Earthen/ mud	100.00	95.74	78.26	28.57	10.00
Number of sleeping rooms					
One room	85.00	70.21	52.17	14.29	0.00
Two rooms	30.00	55.32	78.26	100.00	20.00
Three rooms	0.00	6.38	26.09	85.71	120.00
Four rooms	0.00	0.00	0.00	28.57	160.00
Five rooms	0.00	0.00	0.00	0.00	50.00
Sharing toilet with other HHs					
Share toilet	55.00	76.60	73.91	85.71	90.00
Do not share toilet	45.00	23.40	26.09	14.29	10.00

4.3 Housing condition, homestead land occupancy and sharing scenario in Chandgarh

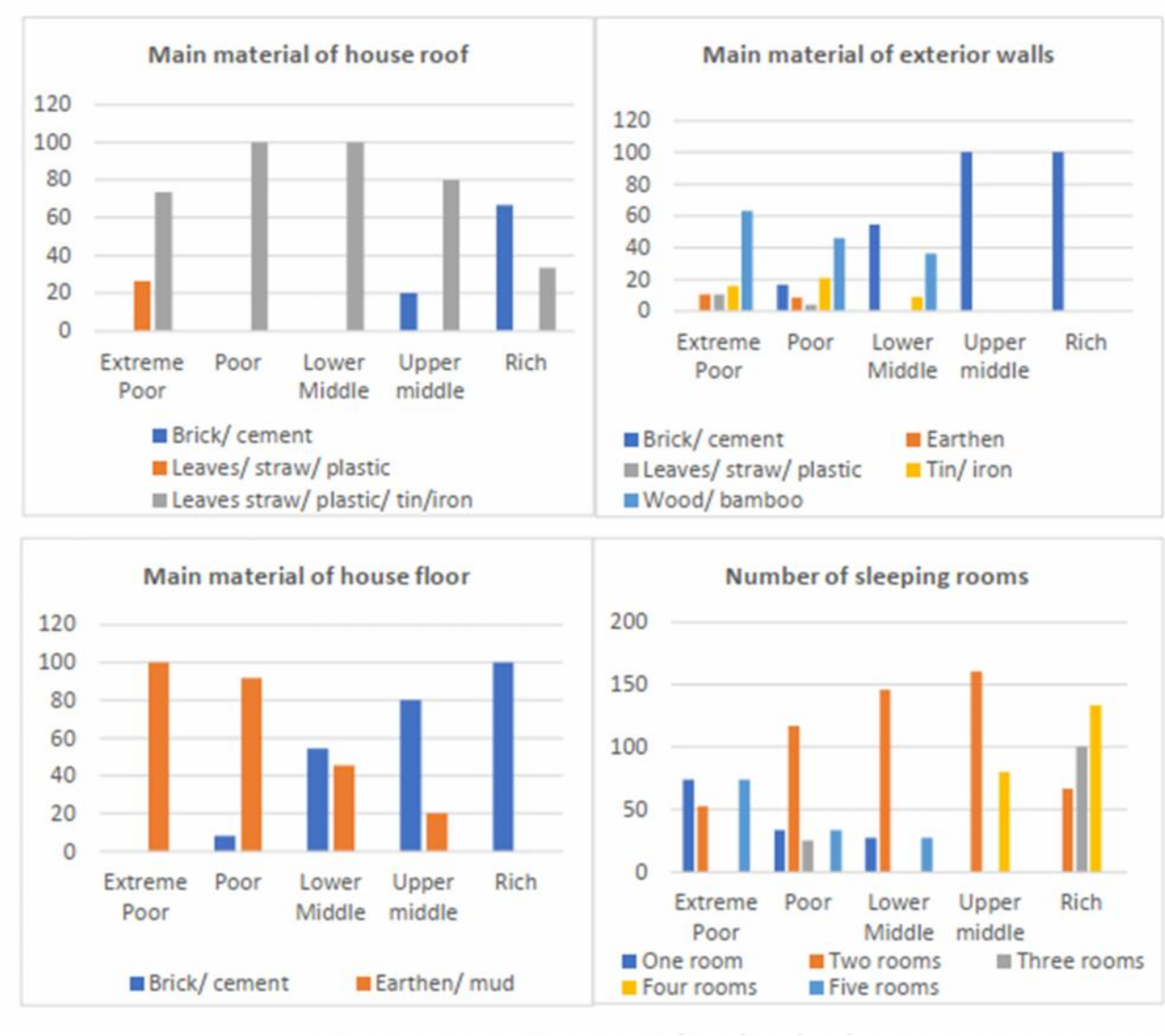


Figure 4.3: Housing material in Chandgarh

The housing condition in figure 4.3 presents the socioeconomic status of different wealth class in Chandgarh. Many families of Chandgarh are severely affected by breaching and live on partially damaged earthen embankment. Families that were uprooted from their homestead land has built temporary houses on the embankment and started living. This is not the condition of the whole village. Wealthier households manage to live far from risky areas; some of them permanently migrated to nearby Khulna city. Less wealthy households are compelled to live in the risky zone, as they have almost no other viable choices. As figure shows, the houses of nearly seventy percent of

rich and only one fifth of upper middle households are concrete houses. The house roof, exterior walls, house floors are made of bricks and cement. In addition, it is considered that number of living rooms are also another indicator of economic condition of a household. The wealthier households in rural Bangladesh usually arrange more living rooms. A considerable portion of rich, upper middle and lower middle class in Chandgarh have two and more than two rooms. Nearly two-third of the respondents from rich and upper middle-class households has four living rooms.

The housing condition poor, extreme poor and even lower middle class is almost similar. Most of the poor and extreme poor of the village live in clay houses, where the house roof is made of straw or Golpata. Many of them use corrugated plastic sheets for house roof. The exterior walls of these families are made of clay or straw with earthen floor. The story behind such housing material structure lies in their poverty, and uncertainty of hazard condition. The long-term breaching record and frequency of breaching at present threaten residents, and people act accordingly. Breaching has engulfed the major part of homestead areas and agricultural field. Therefore, the less wealthy class is reluctant to make their destroyed houses again or try to recover the homestead land frequently visited by saline water.

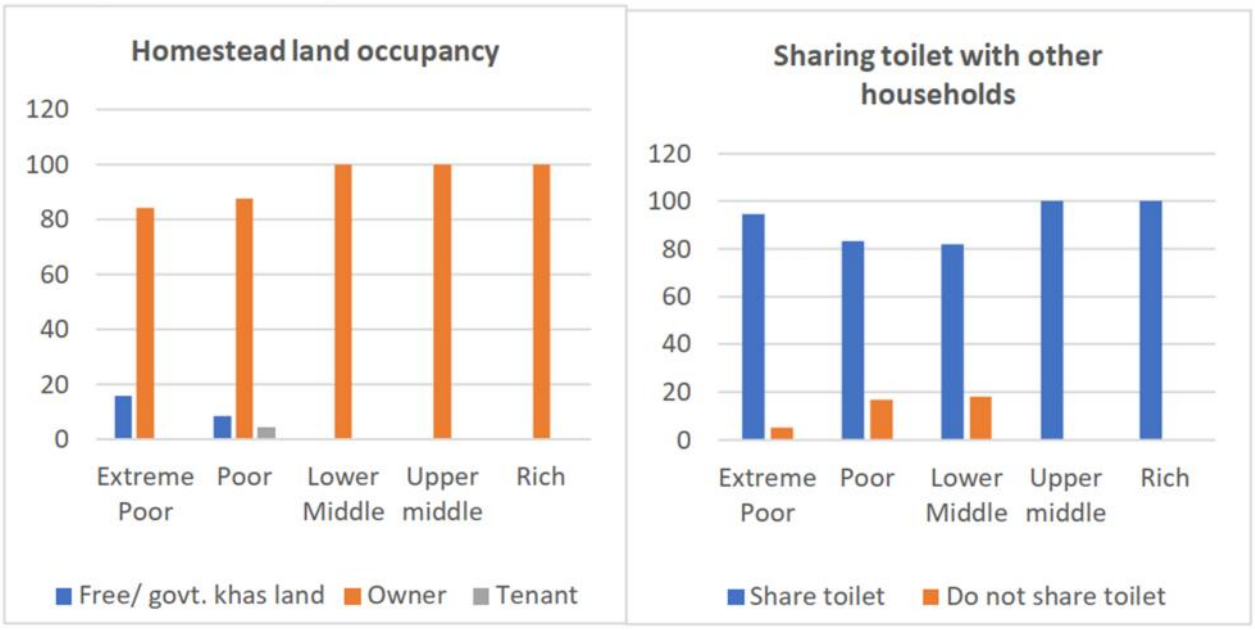


Figure 4.4: Homestead land occupancy and toilet sharing scenario in Chandgarh

Figure 4.4 presents the homestead land occupancy status and toilet sharing scenario among the respondents of Chandgarh. As figure shows, most of the respondents are living in their own homestead land [need to recheck data], which they inherited or bought from others. There are poor, extreme poor, lower and even upper middle wealth class households who are living in government *khas* land, because breaching engulfed the homestead of many of these poor households. In addition, the toilet sharing scenario tells of socioeconomic status and hygiene condition of the residents. The figure tells that sharing toilet is a common scenario across the households in Chandgarh. There are few households among the participants who do not share toilet with other families.

4.3.1 Mirroring poverty through ownership and household characteristics: Chandgarh

Table 4.2: Key household characteristics of the respondents in Chandgarh

	Extreme Poor n=19	Poor n=24	Lower Middle n=11	Upper middle n=5	Rich n=3
Homestead land occupancy					
Free/ govt. khas land	15.79	8.33	0.00	0.00	0.00
Owner	84.21	87.50	100.00	100.00	100.00
Tenant	0.00	4.17	0.00	0.00	0.00
Main material of house roof					
Brick/ cement	0.00	0.00	0.00	20.00	66.67
Leaves/ straw/ plastic	26.32	0.00	0.00	0.00	0.00
Leaves straw/ plastic/ tin/iron	73.68	100	100	80	33.33
Main material of exterior walls					
Brick/ cement	0.00	16.67	54.55	100	100
Earthen	10.53	8.33	0.00	0.00	0.00
Leaves/ straw/ plastic	10.53	4.17	0.00	0.00	0.00
Tin/ iron	15.79	20.83	9.09	0.00	0.00
Wood/ bamboo	63.16	45.83	36.36	0.00	0.00
Main material of house floor					
Brick/ cement	0.00	8.33	54.55	80	100
Earthen/ mud	100.00	91.67	45.45	20.00	0.00
Number of sleeping rooms					
One room	73.68	33.33	27.27	0.00	0.00
Two rooms	52.63	116.67	145.45	160	66.67
Three rooms	0.00	25.00	0.00	0.00	100
Four rooms	0.00	0.00	0.00	80	133.33
Five rooms	73.68	33.33	27.27	0.00	0.00
Sharing toilet with other HHs					
Share toilet	94.74	83.33	81.82	100	100
Do not share toilet	5.26	16.67	18.18	0.00	0.00

4.4 Housing condition, homestead land occupancy and sharing scenario in Gajendrapur

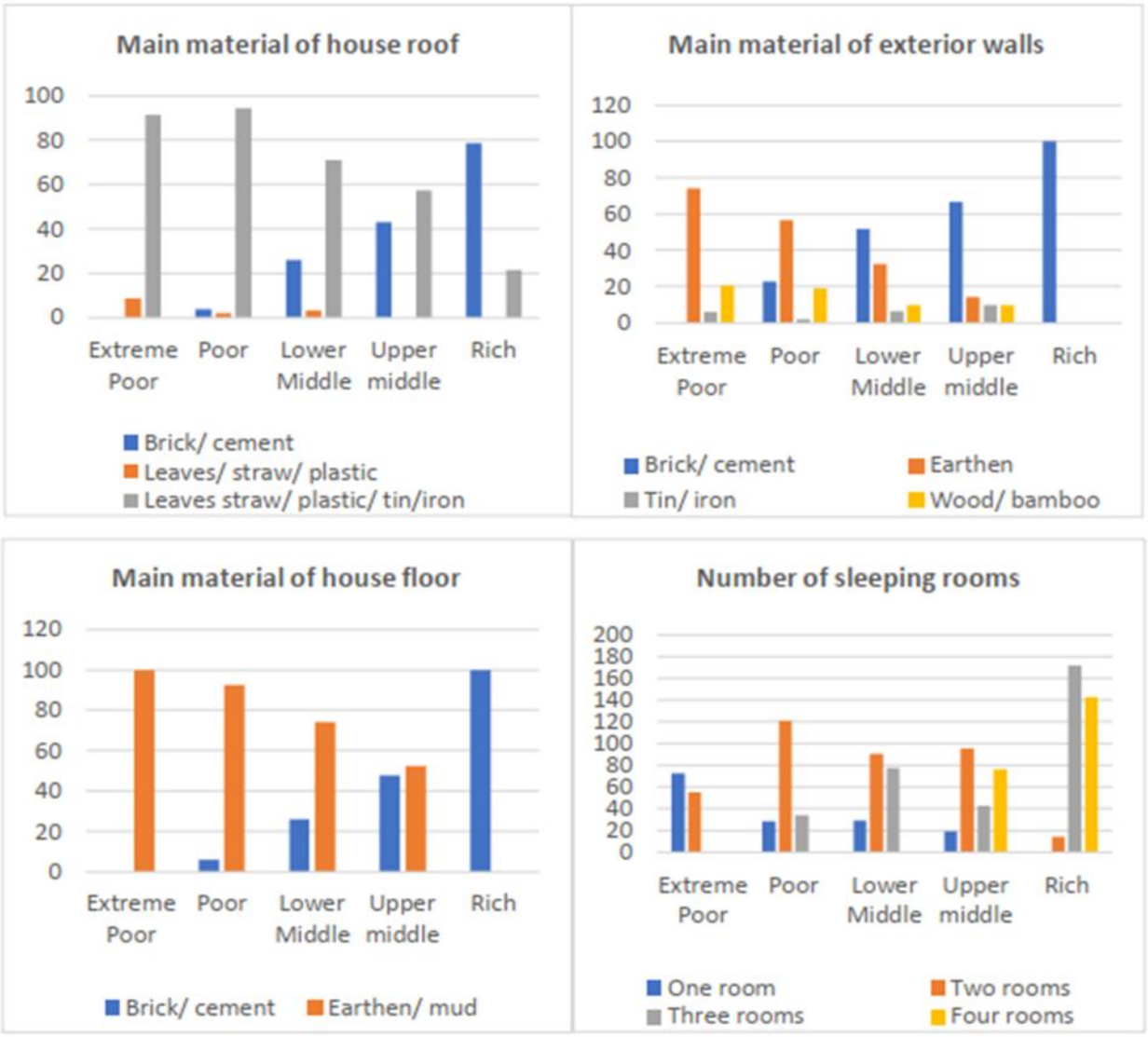


Figure 4.5: Housing conditions and housing material in Gajendrapur

Unlike the earlier two villages, the housing condition portraits the better socioeconomic features of different wealth class in Gajendrapur. As figure 4.5 presents, considerable number of the rich, upper and lower middle wealth class families live in concrete houses. The exterior walls, house floor, roof is of concrete. Many wealthier class houses are semi-concrete, with a combination of concrete floor, walls with *Golpata* or corrugated tin roof. Some wealthier families also live in clay houses, as the figure depicts, where the house roof is made of straw or *Golpata*. Both practices are

prevalent in wealthier classes. Furthermore, the use of wood in the construction of houses is conspicuously different than earlier villages. The good number of living rooms is also another indicator of better economic condition of households. The wealthier class households have more living rooms. Many wealthier class households in Gajendrapur have more than two living rooms. Most of the households are engaged with farming activities and use their homestead lands to produce vegetables.

The condition of less wealthy class in Gajendrapur is comparatively better than the earlier villages. Most of the poor and extreme poor of the village live in clay houses, where the house roof is made of straw or *Golpata*. Some uses corrugated plastic sheets or corrugated tin for their house roofs. The exterior walls and house floors of these wealth class is made of clay, wood, bamboo or corrugated tin. The earthen house floors are common in the houses of poor and extreme poor classes. Most of the household of this category have one living room, there are families among this wealth class who have two living rooms.

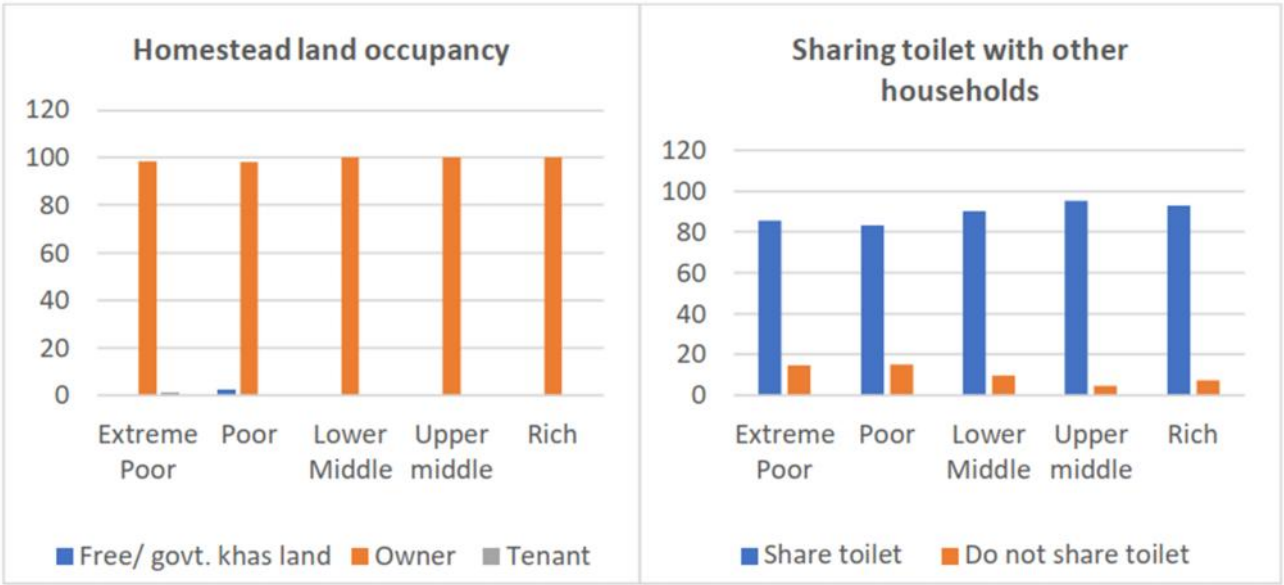


Figure 4.6: Homestead land occupancy and toilet sharing scenario in Gajendrapur

The homestead land occupancy status and the condition of toilet sharing scenario among the inhabitants of Gajendrapur are present in figure 4.6. it shows that, both rich and poor households are living in their own homestead land, which they inherited or bought from others. The

subsistence farming in last 10-15 years has changed the poverty scenario of this village. Very few poor households live in government *khas land*. Moreover, the toilet sharing scenario tells another story of socioeconomic status and hygiene condition. As the data depicts, toilet sharing is a very common scenario across the households in Gajendrapur. All wealth class households share their toilet with other families. Very few households among all wealth class do not share toilet with other.

4.4.1 Mirroring poverty through ownership and household characteristics: Gajendrapur

Table 4.3: Key household characteristics of the respondents in Gajendrapur

	Extreme Poor n=69	Poor n=53	Lower Middle n=31	Upper middle n=21	Rich n=14
Homestead land occupancy					
Free/ govt. *khas* land	0.00	1.89	0.00	0.00	0.00
Owner	98.55	98.11	100.00	100.00	100.00
Tenant	1.45	0.00	0.00	0.00	0.00
Main material of house roof					
Brick/ cement	0.00	3.77	25.81	42.86	78.57
Leaves/ straw/ plastic	8.70	1.89	3.23	0.00	0.00
Leaves straw/ plastic/ tin/iron	91.30	94.34	70.97	57.14	21.43
Main material of exterior walls					
Brick/ cement	0.00	22.64	51.61	66.67	100.00
Earthen	73.91	56.60	32.26	14.29	0.00
Tin/ iron	5.80	1.89	6.45	9.52	0.00
Wood/ bamboo	20.29	18.87	9.68	9.52	0.00
Main material of house floor					
Brick/ cement	0.00	5.66	25.81	47.62	100.00
Earthen/ mud	100.00	92.45	74.19	52.38	0.00
Number of sleeping rooms					
One room	72.46	28.30	29.03	19.05	0.00
Two rooms	55.07	120.75	90.32	95.24	14.29
Three rooms	0.00	33.96	77.42	42.86	171.43
Four rooms	0.00	0.00	0.00	76.19	142.86
Sharing toilet with other HHs					
Share toilet	85.51	83.02	90.32	95.24	92.86
Do not share toilet	14.49	15.09	9.68	4.76	7.14

4.5 Summary

This chapter provides detailed account of the socioeconomic condition and livelihoods of the three study sites of coastal Bangladesh. The housing condition examined in this chapter uncovers the socioeconomic picture of household of various wealth class. Based on gathered information chapter

provides the detailed overview of following issues- the materials of house roof, exterior walls, house floor, number of living rooms, homestead land occupancy, toilet sharing etc. to know the actual scenario of poverty. This chapter found that people in high risk areas are less motivated to invest more in housing. Both hazard and poverty are the two major reasons for poor housing condition and structure. In the areas where risk is less, people are interested in the improvement of houses. This chapter also examines the livelihood diversification opportunities for both rich and poor households. It concludes with an overall account of poverty condition of three study sites.

Chapter Five: The drivers of poverty and underlying influences

5.1 Introduction

Based on poverty literature and observed facts, the drivers of poverty have been explored in this chapter. The drivers of poverty, along with water related drivers, receive special attention as they have a combined influence in the choice of livelihood strategies in rural areas. Significant alteration among these drivers may create a greater impact on livelihood choices. This chapter also analyzes how these water-related drivers are creating poverty-trap for the poor people of selected villages of polder 29. Special focus will also be on water related drivers and the way they create significant influences on the livelihood choices.

The section 5.2 treats poverty through its multidimensional nature, where a range of drivers play differential role and produce poverty across households. Section 5.3 presents the wealth class-specific employment scenario, their partially employment and precarious jobs and their relationship with poverty. The following section 5.4 deals with the accounts of the access to agriculture, food and water. Section 5.5 concentrates on socioeconomic inequality, labor market and local economy. The section 5.6 explores the intra household vulnerability. The following section 5.7 investigates the hazard and environmental condition, and the section 5.8 explores the government and basic social support, which usually help people in lifting out of poverty.

5.2 Measuring poverty through multidimensional way

This section presents an additional understanding of poverty in terms of the measurement and analysis developed by Oxford Poverty and Human Development Initiative (OPHI) and United Nations Development Program (UNDP) jointly for calculating Human Development Index. The calculation of Multidimensional Poverty Index (MPI) was initiated in 2010 and the Human Development Report has been published using this measurement since then. This section tries to

see, in terms of HDI measurement scale, the condition of rich and poor, for a better understanding of water-poverty relations in water-stressed and water-managed villages.

Table 5.1: MPI Indicators and their connection with field data 1

What MPI suggests	**What data shows**
1. Years of **schooling**: deprived if no household member has completed six years of schooling	Both water-stressed and less stressed villages o Category is fulfilled by kids, most of the cases, and by parents also in few cases o Stipend has changed the scenario, awareness also
2. school attendance: deprived if any school-aged child is not attending school up to class 8	Water-stressed villages o Large number of drop-outs, usually starts after primary schooling o Attendance of girls are remarkably low Water-Secured village o Attendance is satisfactory, as guardians are willing o Less drop-outs, attendance of girls are high

Education is considered the key elevator which helps the members of poor household lift out of poverty. The collected information shows that the 'years of schooling' criteria is broadly fulfilled by the school going children in most of the households, and there are very few cases where the criteria is fulfilled by adults or parents. In most cases the parents are little or have no education. This is particularly true in both water-stressed and less water-stressed (or water managed) villages. The villages are predominantly characterized by illiteracy for long and the situation is changing gradually. The change is not homogenous to both less and water-stressed villages. The change is remarkably slow in water-stressed villages and comparatively better or satisfactory in less water-stressed villages. Like the impacts, the reasons are also heterogeneous. Situation is changing at a slower pace in water-stressed villages, and the main reason is the introduction of school stipend by government. In the less water-stressed villages, the situation is improving in a comparatively better pace, and the key reason includes parents' awareness regarding the future of their children, and the liberty of children from imposed subsistence or income generating options by their parents.

In the water-stressed villages, people tend to involve their school-aged children to various income generating activities rather than sending them to schools. Parents see no benefit if sending them to schools except creating extra burden of education expenses for the families. Parents see only immediate benefits by engaging themselves to various income generating activities that are available within the areas (like collecting shrimp larvae, working in own fields, helping parents by doing household chores when they are at work etc.). The school attendance is normally low and lower in cases of girls. The girls engage in household chores as part of helping their mothers while they are in the work. The early marriage of girl children is notably high in stressed villages. The scenario is opposite in less water-stressed (or water managed) villages. The well managed drinking and irrigation water security liberate them to focus on areas other than subsistence farming. They endorse the schooling for their kids, help them to pursue college education. Even the poor families there often tend to unbowed in the question of education for their children. Consequentially, the rate of school dropouts is very low, early marriage is very rare. The attendance is satisfactory for both boys and girls. Girls are likely to attend college like boys after successful completion of high school education.

Table 5.2: MPI Indicators and their connection with field data 2

What MPI suggests	What data shows
3. Child mortality: deprived if any child has died in the family in past 5 years	Qualitative data available/no official record
4. Nutrition: deprived if any adult or child, for whom there is nutritional information, is stunted	Qualitative data available/no official record

Both child mortality and nutritional status indicates the health condition of a community or area. On the one hand, the death of a child below five years of age indicates a serious health care

inadequacy and support. On the other hand, the nutritional status of a household is difficult to measure and indicates an overall healthy arrangement of a family or household.

Child mortality in both water-stressed and less water-stressed villages is not reported in last five years. This fact fills the third criteria of MPI, and at the same time, provides inadequate data on nutritional status of the households surveyed. The objective of this research was not to collect wider input of quantitative data on the nutritional measurement information from households and therefore the study lacks such information. The qualitative data is not adequate enough to fulfill this field of wider measurement. It is very usual that the households facing acute poverty than others are often fail to fulfill the basic standards of nutritional criteria.

Table 5.3: MPI Indicators and their connection with field data 3

What MPI suggests	What data shows
5. Electricity: deprived if the household has no electricity	**Baro Aria**: 67.74% HHs are poor (coverage: 32.26% HH) **Chandgarh**: 44.03% HHs are poor (coverage: 55.97% HH) **Gajendrapur**: 66.49% HHs are poor (coverage: 33.51% HH)
6. Sanitation: deprived if the household's sanitation facility is not improved (according to MDG guidelines), or it is improved but shared with other HHs	**BaroAria**: 71.64% HHs are poor **Chandgarh**: 88.71% HHs are poor **Gajendrapur**: 87.23% HHs are poor
7. Drinking water: deprived if the household does not have access to safe drinking water (according to MDG guidelines) or safe drinking water is more than a 30-minute walk from home roundtrip	Water-stressed village **BaroAria**: 100% HHs are poor/deprived **Chandgarh**: 100% HHs are poor /deprived Water-managed village **Gajendrapur**: 100% HHs are benefited

As MPI considers, the power source of a household mentions the opportunities for the improved living standard. There is more chance of improvement if a household enjoys an improved source of power. If, for example, a household remains under electricity coverage, it can ensure services that require electric supply. The households are facing scarcity of electricity in the study villages. For water-stressed villages, nearly half the households of Chandgarh, and more than two thirds of the villages of Baro Aria are poor, as they are beyond the electricity coverage. The proportion is worse in less water-stressed village, where only one third of the households are under electricity coverage. Among these three villages the coverage is partly disrupted in Chandgarh because of breaching problem. The households that are deprived from electricity coverage depend on kerosene oil as their lighting source; leaves, straws, wood, and dung as their cooking fuel source; hand or peddle-driven technology as their irrigation source. They cannot afford or depend on any type of electric technologies as required in everyday lives. This inability forces them to live in poor and substandard living.

The quality of sanitation falls in basic health issue in any type of measurement of standard of living. In multidimensional poverty index, both the questions were raised-whether the sanitation is standard and whether it is shared with other households or not. Both are measured to identify the living standard in terms of sanitation services. If condition of sanitation is not standard enough, it may cause various health problems. Toilet sharing is a very common scenario in study villages, and the less water-stressed villages are no longer different from the water-stressed village. Both the worst stressed Chandgarh and least stressed Gajendrapur are in similar position, where nearly ninety percent households share their toilets with other families. The scenario is not different to different wealth classes (discussed in chapter four), the sharing is practiced highly across the classes. There are very few extreme poor and wealthier families who not share own toilet with other families.

Drinking water is another major indicator of standard of living. The inadequate supply of fresh edible drinking water may indicate various health issues in communities. The tube-well is unsuccessful and the sources of edible fresh drinking water are very far from water-stressed

villages. Water vendors collect water from those water sources and sell to the stressed villages, though all families do not tend to buy the vended water. The rich and upper middle and some lower middle families of Chandgarh and Baro Aria purchase water from the water vendors regularly. There are families, who buy water only for kids and often for pregnant women, rest of the family members drink locally available unsafe water. Water vendors do not collect and sell water in rainy seasons in those villages, as the road communication is not well enough to do that and as the villagers collect water through rainwater harvesting and store for longer use. The wealthier households use large 10000-20000-liter barrels to store rainwater and use for rest of the months of a year, whereas the poor households store water in small mud pitchers and plastic bottles which runs out within few days. The poor often fail to afford such barrels with larger capacity or to purification technologies to ensure fresh drinking water in both Chandgarh and Baro Aria. Tube-well is successful in a very small part of large Gajendrapur village. The community people has successfully managed and distributed their drinking water throughout the villagers.

Table 5.4: MPI Indicators and their connection with field data 4

What MPI suggests	What data shows
8. Housing: deprived if the household has a dirt, sand or dung floor	Baro Aria: 80.60% HHs are poor Chandgarh: 75.81% HHs are poor Gajendrapur: 80.85% HHs are poor -these HHs have earthen floor
9. Cooking fuel: deprived if the household cooks with dung, wood or charcoal	Baro Aria: 98.51% HHs are poor/deprived Chandgarh: 96.77% HHs are poor /deprived Gajendrapur: 100% HHs are poor /deprived
10. Assets ownership: deprived if the household does not own more than one of: radio, TV, telephone, bike, motorbike or refrigerator and does not own a car or truck	This calculation is better understood in PCA

In rural Bangladesh, like many other parts of the world, the housing structure and housing condition often portraits the socioeconomic status of a household, and also the scenario of poverty. Houses

constructed with clay/mud are predominant, which is referred as *kutcha bari* in all the villages studied. Many rich families have improved dwellings with concrete structure. The wealthier families in stressed villages also have concrete houses. Corrugated tin is a common material for houses with minimum standard of living. Most of the families, even some extreme poor households also, try to use corrugated tin in making their house roofs because the traditional material for preparing house roof usually straw and *golpata*[4] are not available like previous time, and therefore people try to use tin as a supplement material of house roof. Data shows (elaborated in chapter four) that the dwelling houses of more than eighty percent households of Baro Aria and Gajendrapur and more than three-fourth of houses are made with earthen floor. The dwellers of all these households could be termed deprived in accordance with the standards of multidimensional poverty index measurement.

Fuel material is also an important indicator of living standard in any household or community. If the fuel materials are not standard enough it may invite serious health hazards including various respiratory complications. It is observed that nearly all of the households of all three villages use substandard raw material as their cooking fuel including fuel wood, cow dung, straw, leaves etc. Such materials may cause health hazard for pregnant women, girls and children of different age (Biswas & Lucas, 1997; Agarwal, 1987; Briscoe, 1979).

The asset allocation is one of the concerns for this study, and therefore, it applied to a range of questions related to assets so that they are recorded carefully to produce clear statements regarding the asset condition and asset poverty scenario of each household. Based on the asset recorded in household questionnaire survey, the present study plotted all the studied households to five wealth classes with the help of principal component analysis (detailed method are discussed in chapter 3 and analysis are made in chapter 4). The five wealth classes are: rich, upper-middle, lower-middle, poor and extreme poor. The livelihoods of all five classes have been recorded with special attention to the trajectories of change of those livelihoods. The agriculture-based livelihood

[4] *Golpata* is long leaves of a mangrove palm (Nipa palm/ Nypa palm) which grows abundantly in Sundarban (the largest mangrove forest in the world) and coastal people use that leaves to cover the roof of their houses. The leaves has a huge popularity among rich and poor residents.

was the key concentration for this study, where it is observed that how the agriculture-based livelihood has been changing with the course of major environmental change in the area. The asset profile is largely influenced by the key livelihood options of households, with the amelioration of traditional agriculture-based livelihood, households made significant advancement in terms of asset accumulation and other forms of improvement as part of better standards of living.

5.3 Livelihoods, employments opportunities and precariousness

A. Unemployment, partially employment, precarious jobs

The local farmers and agricultural laborers in the water-stressed villages face challenges of lack of employment opportunities in several times of year. After cultivation period, most of them face dearth of employment opportunities. In the post-harvesting period, they are to face the same challenges. To cope with the working opportunity shortage, they often leave their villages and go to distant places for work. Many of them seasonally migrate to urban centers and do various manual odd jobs there. Some families also seasonally migrate to work in the brickfields. The households fail to maintain savings, most of their earnings are expended for their subsistence.

The lack of employment opportunities has been creating number of challenges for the members of poor and extreme poor households. The poor people often fail to ensure the family consumption if they are unable to guarantee the livelihood opportunities. The situation is almost similar for both water-stressed villages. Failure to ensure employment opportunity enhances the chances of intergenerational poverty.

It is important to raise income of the poor households to help them get out of poverty. For poverty reduction, employment generation is badly needed and the continuation of existing livelihood opportunities.

B. Little or no access to livelihoods or decent jobs

Ownership of land is often considered as a defining criterion of poor and non-poor in the villages of South Asia. But this is not always the indicator, as the study villages bear the perfect examples for

that. The landownership in Chandgarh, for example, does not necessarily mean that they are in better position in wealth indicator. Rather, there are people who have agricultural land but cannot cultivate, as saline river water visits recurrently their fields when tide is high. Another reason is salinity. Both problems are exacerbated by recurrent embankment breaching in both Baro Aria and Chandgarh village.

Because of asset and income poverty, a section of people of Baro Aria and Gajendrapur do not have access to their traditionally agriculture-based livelihoods. They do not have required capital, cannot manage any guarantor to get loan, and therefore they try to leased in some land and invest there. To cope with the situation and for family maintenance many poor households choose various non-farm jobs throughout a year. Many engage agricultural jobs for 3-4 months a year and are engaged in nonfarm activities for rest of the year.

Nonfarm jobs require additional knowledge and skills, which the members of poor families often fail to ensure. It is observed that the rich families are able to afford better schooling for the children and make competent for decent jobs (like teaching in local schools, have some medical orientation to become local doctors, working as development workers in local NGOs). Rich families often send their children to nearby city areas after getting primary education or high school education from village. There are better job opportunities in the city areas than villages.

Even the people [of water-stressed villages] suffer from lack of information, and are often guided by misinformation at times. Sometimes, lack of information push them toward devastating future. Students, getting no future hope or betterment, often lose their motivation to carry on their studies. Consequently, school dropouts rise, parents become reluctant to support their children's studies. Parents often see benefits in recruiting their children in locally available income generating activities (IGAs) from early childhood.

> *"I have completed my graduation from Govt. Brajamahan College (a renowned college in the territory), and returned to village, because I have heard from many of my friends and familiar ones that candidates who have*

> *relatives in high position, or have money to invest [as bribing] are able to get a job. I have neither relative nor money, and therefore I did not try for a job. I have returned village after my degree is completed*" -A graduate student in Chandgarh, working as day laborer

The scenario described so far is opposite in Gajendrapur, the villagers send their children to schools and support them to continue. Like their kids, the parents also feel competition?? with their neighboring children. This competition is about doing better results and receiving higher degrees.

> *"Education is the topmost priority for our children. We try our best for the education of our children. The situation is not here like this all the time. After we have managed to draw three or more crops from same land in a year, parents have become serious about educating their children". -A farmer, interviewee, Gajendrapur*

Beside the employed members of households, the rest of the family members are just consumers or jobless consumers. What are the reasons for those cases? This can include the age barrier [underaged child, overaged], girls are not allowed to go for work to maintain their chastity or for security reasons, and parents usually do not permit their children to work outside.

5.4 Access to agriculture, food, and water

C. Food and agricultural issues

Both rich and middle farmers practice agriculture within and nearby villages. The rich farmers, having handsome capital, invest in farming and practice in their own and leased in lands in own and neighboring areas. Among the less wealthy category, people who have capacity to pay the landowner are able to get land on lease. It is observed that most of the households of water-stressed villages fail to share fair amount of nutritious food, but the situation is completely different in water-managed village. Sufficient production of crops and vegetables let people go get more

food for their families[5]. Sufficient amount of vegetables is grown within each homestead in water-managed villages, whereas the nearby local market of water-stressed village lacks the provision of sufficient amount of vegetables. The lack of provision may indicate serious nutritional imbalance in the water-stressed villages.

D. Inadequate access to clean water and nutritious food

These are the significant indicators of poverty measurement. People who fail to ensure fresh food and clean water for them face a number of challenges.

Water poverty occurs when a household or a community do not have accessibility, availability, and acceptable level of quality water. This water may be for drinking, household use or water for agriculture. When a community or household fails to ensure acceptable level of quality water, they are considered as water poor. In accordance with this definition, the people of two water-stressed villages can be considered water poor, as they lack sufficient amount of drinking water, and water for household use and agriculture throughout a year. Water is a major concern for the water-stressed Chandgarh and Baro Aria as discussed in section 5.2. The people of Gajendrapur have managed the situation[6]. The water poverty creates various challenges for the poor and insolvent families struggling for long to lift out of poverty. They may fail to produce agricultural items, and insufficient or lack of quality drinking water may create various health problems etc.

Food poverty is associated with both poverty and the consumption of nutritious/healthy food (Dowler and Connor, 2012; Molcho et. al. 2007; Lang and Caraher, 1998). Such poverty may be created if a household has inability to buy food, or to afford food required for healthy diet, or if the household members suffer from lack of required food. This involves both quality and quantity of food required for healthy life. The study findings suggest that the wealthier and solvent families in water-stressed villages have capacity to ensure sufficient amount of food for their families, where the poor and extreme poor families often fail to do such. The wealthier families do not face any type of food poverty throughout a year, whereas the poor families are to face this in several times,

[5] This has been discussed more in chapter four and chapter six.
[6] For details please see chapter Six

particularly in the time when the working opportunities are less. Food poverty and associated nutritional deficit create a number of health challenges for the members of the poor households in the water-stressed villages. The poor households of Gajendrapur seldom face such challenges as the village produces sufficient number of agricultural items throughout a year.

5.5 Socioeconomic inequality, labor market, and local economy

E. Socioeconomic inequality and discrimination

It is not very unusual that social inequality will rise if resources of a society are distributed unevenly, or the allocation system is arranged in a way which deprives a segment of population of their basic rights (Scheffer et. al. 2017; Yifei, 2011; Naidoo, 2004). Such situation creates a very unequal distribution of population and arrays them to various socioeconomic strata -i.e. array population under different categories or wealth classes. In such contexts the access to resources and social goods are controlled by power, status group, prestige, race-religion or ethnic identity, gender identity, age and various wealth categories. Inequality creates a possibility for less privileged individual or group to be deprive of their social rights including the source of income, education, health care, political representation, participation, and freedom of speech (Wade 2014).

Social inequality can be observed in every society, but it is necessary to examine how the cultural affairs or discourses define the less-privileged. It is important, for example, to see whether the poor are considered 'deserving' or 'underserving' (Walker 2015) within a society.

The most common type of inequality includes income disparity, social class, health care, and gender inequality. It is also often observed five specific types (Scott 2013) of inequality that are observed in many communities. Social inequality has a close connection with economic inequality: the unequal distribution of wealth and income. It is hardly possible to explore social inequality without proper investigation and interpretation of economic inequality. The present , therefore, has a clear investigation on economic profiles and wealth distribution for a clear understanding of socioeconomic context of the study areas. Such understanding help to capture the nature of their livelihood choices and the reasons they choose various livelihoods to meet their necessities. This also help us to understand why the agriculture-based livelihoods are so fragile in the face of various

waterborne challenge, and why poor and extreme poor feel the need to search for livelihood options other than their traditional agriculture-based options.

Table 5.5: Inequality and evidences from study areas

Type of social inequality	Associated with	Evidences from Study areas
Income and wealth inequality	On the basis of what a person can earn daily	The wealthier families in three villages manage to secure income through livelihood diversification. Most of the poor and extreme poor households of water-stressed villages are engaged with subsistence farming. However, the poor of less water-stressed village is comparatively the earlier two villages.
Treatment and responsibility Inequality	Ability to receive privilege than others	Some individuals have better access to health care and receive better professional care than others.
Political Inequality	Ability to access to resources related to government	Individuals with political connection get benefits of social and political benefits. In case of relief distribution, for example, those people get benefits first.
Life inequality	Brought about by inequality of opportunities which, if any, improve the life quality of a person.	The people consider that either money or education can improve the living condition. The poor and extreme poor lack both categories. They cannot ensure the higher education for their children. Most of their children drop out from primary and secondary schools. Very few of them reach to local college.
Membership inequality	On the basis of number of members in a family or nation	The voice of the poor remains unconsidered. Even their participation in community groups cannot represent meaningfully. The poor member in local water management group, for example, often cannot create impact on community decision.

F. Poor labor market (low payment)

In addition, the local economy does not offer viable compensation to the workers who finally get chance to work within own area and nearby villages. The payment system is not standard enough to maintain their families. The payment is variegated in different seasons within a year: the regular cropping season offers better compensation then the rest of the year.

> *"Working opportunities are unavailable throughout a year. That are available in cultivation and harvesting periods, the rest of the time one can observe that a large number of workers are searching jobs. Many of them*

> *seasonally migrate to distant villages, even cities. There is wage discrepancy. During cultivation and harvesting, we get better compensation, but the labor price goes down rest of the time. We cannot maintain our families properly with that limited job opportunities and decreased wage".* -A male day laborer, male FGD participant, Baro Aria.

Moreover, there is wage discrimination between male and female, as there is a common belief that women are less capable to do jobs that requires physical effort (Fall and Vézina, 2013; Scott and Joshi, 2009; Casey and Alach, 2004). Communities consider that as women have less physical strengths than men, they must work less and therefore they should be paid less. There were times when the demand of female workers rose, not because of women empowerment but because of their lesser compensation money. The time when the crop-fields are needed to be taken care with hoes, the farm owners consider that this service can be taken from female workers with less payment.

> *"We are paid less. This is the scenario for this and all nearby villages. In cultivation and harvesting period, male day laborers are paid BDT 200 taka in a day, whereas the female labors are paid 160. In other period, the working opportunities become less available. There are plenty of workers, but the work availability becomes less. As a result, the wage goes down. The male day laborers are paid 120 and female are paid 80. We do the same work, but the system always deprives the women".* - a female day laborer, female FGD participant, Chandgarh

G. Local trade and economy, market conditions

The local labor market is not well organized and therefore, it fails to provide employment for the vast number of surplus laborers. The laborers, therefore, choose seasonal migration strategy in search of living and family maintenance. The local working opportunity includes jobs in agriculture and aquaculture sectors, which are not enough for family maintenance for most of the poor households. In addition, the local economy does not offer handsome compensation (as stated in

previous section) to the workers who finally get chance to work within own area and nearby villages.

There is gender segregation of works as well. The gender role in agriculture is delineated on the basis of job nature and type of physical effort it demands. Farmers consider the jobs that require many physical efforts like plowing, managing cows, leveling seeding, sowing seedlings are the jobs for male; whereas the jobs that require less physical effort like caring seedlings, applying hoes and weeding out unnecessary plants are jobs for female workers. The female workers are also observed in working together with male workers in the time of plowing, sowing, and harvesting. Most of the cases, the gender roles for women limit them to stay and work within family boundaries, as poverty compel them to work outside their households.

In case of subsistence farming, using family labor is very common in the study villages. Almost all eligible members, including children and aged, are seen working in the crop fields. Family labor reduces both labor and production cost. The families draw greater benefit in this case. However, such benefits are not homogenous, as the amount of production varies in water-stressed and water-managed villages due to waterborne challenges.

The market system and its mechanisms have not been fully developed in the study villages. Most of the exchanges are made within villages can be categorized as petty trade. The trade is limited into locally produced daily necessary items like vegetables, fishes and the likes. The people of Chandgarh cannot grow vegetables; people can produce vegetable in Baro Aria, and mostly for their own consumption. At times, the people of two water-stressed villages are engaged into petty business like buying locally produced vegetables (from nearby less water-stressed areas) and selling and taking them into nearby Khulna city for better price. The people of Gajendrapur, can practice agriculture throughout the year. They produce vegetables in both their homestead and crop fields. Most of them usually draw 2-3 crops per year. Large producers generally manage better transport, like large trucks and pick-up vans, to send the village products to Dhaka, the capital city of Bangladesh. In comparison, the people of Gajendrapur are in better position in terms of local

production and marketing. The poor are often left with little choice to get the real share of their product as they are not the direct transporter of their products.

5.6 Household vulnerability

H. Poor, little or no education

Education is one of the leading drivers which help individuals and households lift out of poverty. In some families, he younger members, specially the children, often play the vital role here and improve their living condition and family status through studying and getting decent jobs. The jobs liberate them to get out from various malfunctions caused by poverty including poor standards of living. Education helps families not only by increasing household income, rather the living standards, and the possibilities to ensure better schooling and training skill to later generations etc. If any member of a household has basic formal education, as depicted by the multidimensional poverty index in 5.2, there is a chance for improvement in later stage and a hope of lifting out of poverty. The school enrollment means nothing if a child does not continue study and move toward higher education. Large number of dropouts in less educated communities of two water-stressed villages cannot play significant role in improving standard of living through education. The water-managed village has become successful both in school enrollment and continuation through past few years. The school attendance may indicate the continuation of schooling or active engagement to academic process. Poor attendance rate often turns into detachment from schooling process that leads dropouts from schools finally. This issue is discussed in detail in section 5.2 in this chapter.

I. Household debt, national debt

A growing literature has been trying to link poverty with household and national debt (Aluko Arowolo, 2010; Sachs, 2004; Poku, 2002; Sachs, 2002; Kemal, 2001; Peters, 2000). It is argued that poor people often fail to come out of poverty because the household debt works as trap where the poor people cannot get out of it. To get remedy from it, the households need a powerful economic support which household members fail to ensure in most cases. As a result, poor households continue to sink in poverty and poor living conditions over the years.

In water-stressed Chandgarh, people move seasonally to Khulna city in search of work in various non-farm sectors. Many of them work in the brickfields. When these people come back to the village in cultivation and harvesting period, they take loan from brick field owners so that they can maintain their family in the next few months with a commitment that they will go back to the brickfield and work again to repay the loan.

> *"My husband took loan from a brick-field manager when we migrated there in search for work. The loan was taken for few months. We spent all the money there as the living cost is high in Khulna city. He took a loan again at the time of returning home, with a commitment that he would work in the brickfield again when the work opportunity would be less in village. We often would stay in debt. We would need to search for new debt source immediate after we managed to reimburse a debt".* -A female worker, FGD participant, Chandgarh

The poor and extreme poor households, thus, engage in such debt trap, and cannot fight it out for years. Debt does not help poor people to lift out of poverty, rather sometimes it increases poverty condition (Dent and Peters, 2019; Pressman and Scott, 2010; Carr, 2005; Soludo, 2003; Basu and Farmer 2000). They consider the debt-trap will continue and this is one of the key reasons for their lingering poverty. No debt options and endeavors that are available in the study villages have the reputation to help poor to improve their livelihoods or assist them to lift out of poverty.

J. Lack of resources/ poor management of resources

Poverty is a many-headed evil. The poor often fail to manage natural resources properly just because of their inaction and lack of sufficient knowledge on resource management. Lack of resource hinders poor to invest and improve their living condition. Even the poor cannot invest on the education of their children properly (Kiernan and Mensah, 2011; Lacour and Tissington, 2011; Van der Berg, 2008; Nolan and Whelan, 1996). Lack of resources compels them to enter into the vicious cycle of poverty and continue the poverty condition over generations.

K. Lack of financial means to improve the living conditions

Poor resource base, along with water-related hazard, arguably, is one of the key reasons of poverty. If less wealthy households have the capacity to invest more, or have sufficient financial means to invest and improve their living condition, the overall situation can be changed in a significant way.

> *"All of us sitting here, are very poor and we live on hand to mouth. Our families depend on everyday income of the earning members. If there is no work opportunity, and if we are to stay without work for one week, all the family members will have to starve. We have no choice other than work. We have no savings, we have almost no support". -a female FGD participant, Chandgarh*

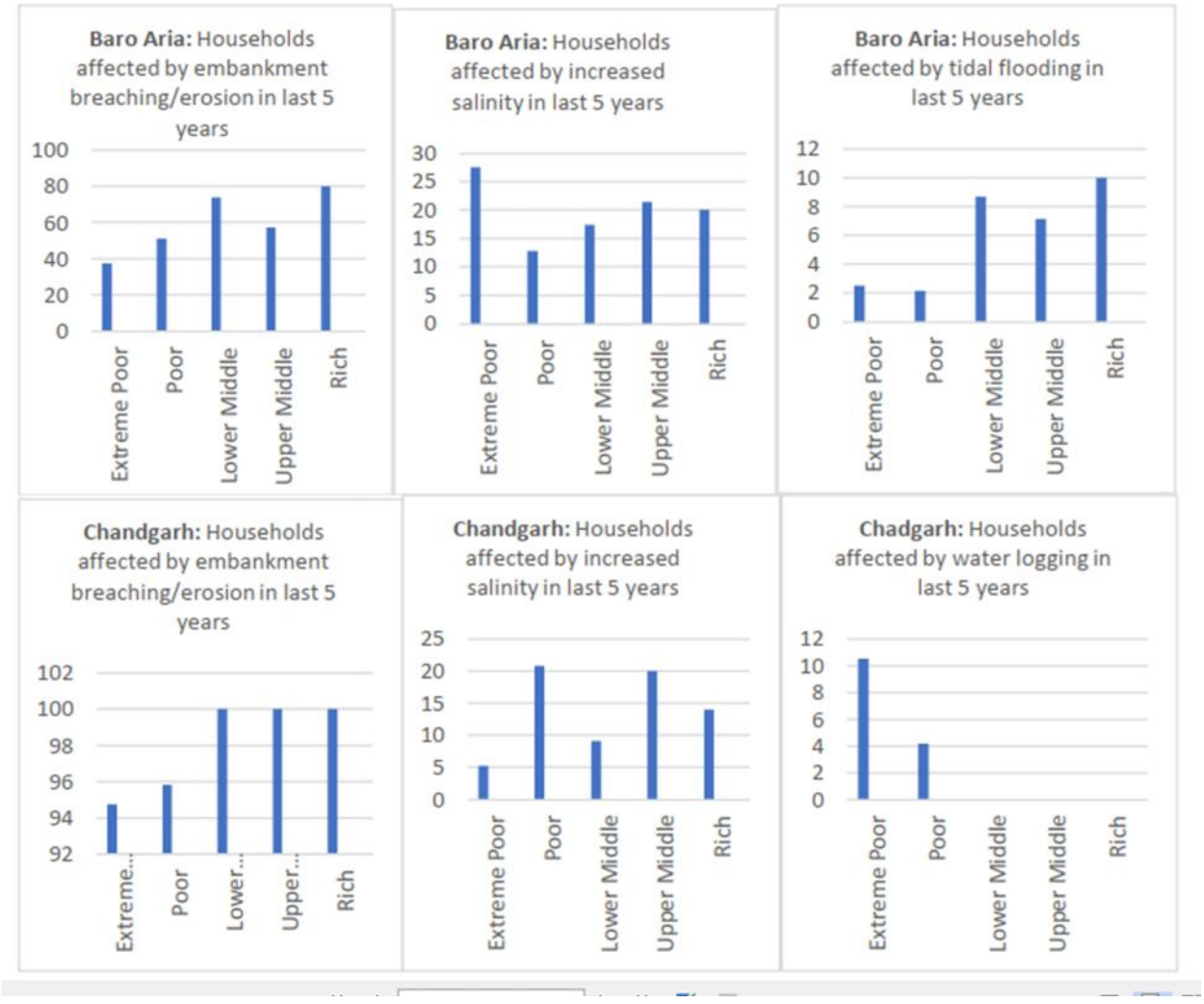
The situation is not the same at Gajendrapur. There are poor and extreme poor families, but they do not face such starvation like the water-stressed villages. The members of poor families in Gajendrapur have working opportunities throughout a year within their own villages.

5.7 Hazard and environmental condition

L. Climatic factors/ extreme weather/ vulnerability and natural disasters

Most of the villagers in Chandgarh and Baro Aria depend on the subsistence agriculture and few of them are engaged in saline water-based aquaculture. People with poor economic profile lack agricultural land, in both villages, work as day laborers for their family maintenance. As figure 2 depicts, the people of different wealth classes experience the waterborne challenges differently. People of Baro Aria and Chandgarh face high risk and exposure of waterborne challenges including embankment erosion, tidal flooding, saline water intrusion, soil salinity and limited waterlogging. These drivers severely affect their traditional agricultural production. Therefore, very limited agricultural production forces subsistence farmers to search for new livelihood options for their family maintenance. Table-2 depicts that the same problems of embankment breaching affect

different wealth class differently; the rich considered themselves the most affected as they either lost their cultivable lands or the production was declined considerably, whereas the poor and extreme poor experienced the problem differently as they faced gradually diminishing opportunities for casual labor in agriculture. The rich households perceive salinity as a minor problem which is responsible for low agricultural production whereas the poor and extreme poor see it as a major problem as they cannot practice garden in their homestead. Likewise, poor and extreme poor in Chandgarh regard breaching a less serious problem as they lost everything long ago and residing on partially eroded embankment, whereas the rich household consider this as a major threat to their homestead and agricultural fields.



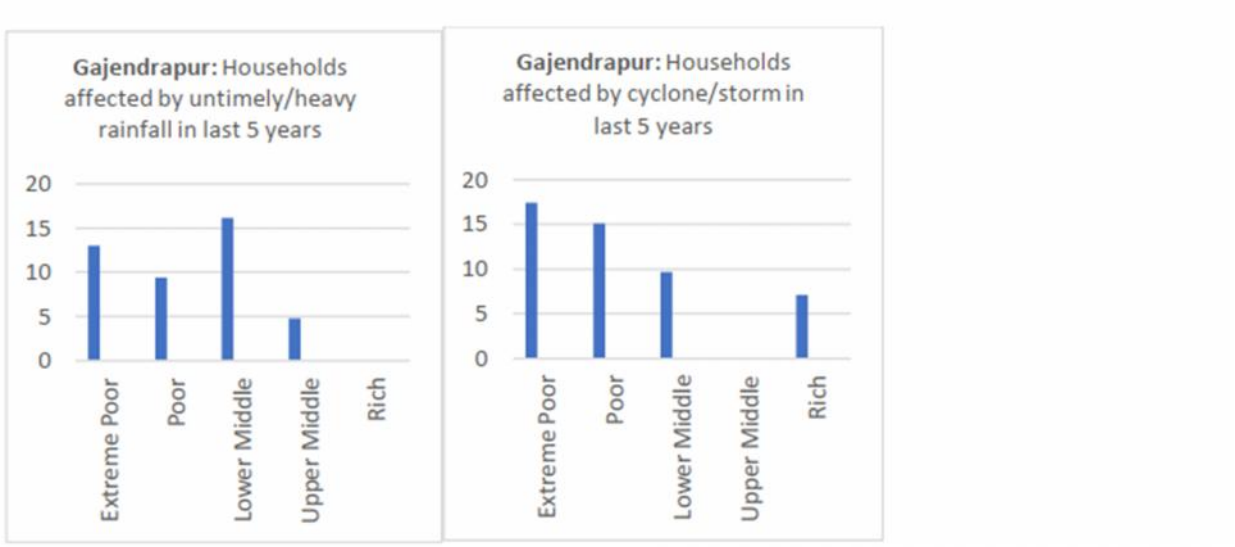


Figure 5.1: Major water-borne challenges experienced by the inhabitants of the studied villages

The breaching problem started a decade and a half ago, has reversed the situation. Because of breaching, significant part of the village is already eroded, salinity increased, soil quality is deteriorating gradually, and vegetation along with a good number of trees are decreasing. Many people, who were traditionally engaged with agriculture, are shifting their occupation. Many rich families, with large land stakes and are dependent on crop-farming, migrated to nearby villages and cities. The adult members of poor households are now working as agricultural day laborers and many other nonfarm activities within nearby villages or Khulna city. Seasonal migration is evident, when there is dearth of work opportunities. The migrant workers usually engage in odd jobs available in the cities and come back village when work is available.

The villagers also face drinking water problem as tube-well is unsuccessful in the village and nearby areas, the water in the nearest deep-water table is brackish and inedible. The villagers, therefore, depend on water vendors for fresh water in dry season and on rain water in the rainy season. Poor families are to pay significant part of their income to buy fresh water for drinking purpose. There are poor families who do not buy water and take unhealthy source without proper treatment. Members of these families often face health problems, are to pay medical bills, and thus a significant portion of their income runs out which push the already insolvent families to further vulnerability.

5.8 Government and the basic social support

O. Lack of necessary infrastructure

Government and local effort to remake the embankment often turns into futile by further breaching and tidal flooding. The breaching affects the communication in a negative way.

Like other rural communities, the infrastructure of study villages includes roads, bridges, wells, and cables (for electricity, cellphones and internet). These are necessary for keeping a community functional and to be connected with the mainstreaming development. Without these support systems, community becomes disoriented, feel themselves isolated and detached from mainstream development effort of government. Living "off the grid" (their inability to go to school, college, work, or market to buy and sell products) often promote people to fall in poverty and maintain the abject condition over generations. When individuals try to reach distant places for these services, they are to pay extra time and money -which in turn, push those families further into economic vulnerability.

The road and transport communication is not good enough and therefore, the district level administration cannot communicate with the community properly. Although the concrete pitch road has been constructed by local government years ago, those were not maintained properly by concerned authorities. Roads were damaged in some parts on the way to reach the community. One of the major reasons of partially or fully destruction of road lies in the common problem like erosion and flooding. Although sufficient trees were needed to be planted on both sides of concrete pitch road, which was not maintained everywhere properly. In places, illegal piped-drains were made under the main road to draw river water in the agricultural fields for practicing aquaculture. The practice is so frequent in some parts and therefore the roads and embankment have become vulnerable. Local government and community people often repair the embankment, which again become damaged by next breaching and tidal flooding. The number of bridges is not sufficient for the area. People in the locality mentioned that they are always in anxiety in the rainy or cyclonic season not due to flood or cyclone hits but about the damages or destructions of

embankments/polders. They urged to the authority for proper and timely maintenance and repairment or reconstruction of those faulty or poorly maintained embankments (*beri bandth*).

The drinking water infrastructure is another important issue to be discussed, as this water related driver also have significant role in the everyday lives of the poor inhabitants. The scenario of drinking water in water-stressed areas is a point of disappointment for the community. The tube-well is unsuccessful in both water-stressed Chandgarh and Baro Aria. Though the local people tried their best to install both shallow and deep tube wells but found that the ground water is full of iron, brackish and not drinkable. The people draw water from long distance. Significant part of each single day is to invest to draw a single pitcher of water. Local water vending system has been developed, which supports a very small part of the demand of the local drinking water. In addition, only the solvent families buy water from vendors, not poor households. The water vendors cannot draw and sell water in rainy season, as the roads are not well enough in that time.

The drinking water problem is well managed by the people of less water-stressed village Gajendrapur. The villagers have managed to install an electricity driven deep tube well, a large water tank and a piped drinking water supply for the households within the village. The drinking water is no longer a problem for the villagers and these permit village women plenty of time to invest in their households and agriculture fields. Most of the vegetable and crop farming are managed by households using both family labor and hired labors.

The villages are under electricity coverage, but all residents of the villages do not have access to electricity service. Many families residing on embankment in Chandgarh remain out of electricity facility. The people residing in broken part of Baro Aria are deprived of electricity. The households residing in both areas are deprived of services powered by electricity.

P. Limited capacity of the government

Both the chapters 1 and 2 have portrayed the remoteness of the study villages. Due to remoteness the villagers often cannot reach out to the services offered by government in the nearest urban centers (usually the Upazila sadars). Most of the government services like better healthcare, schooling, legal and other social support are available in urban centers. As it is not offered in local level, the local people often are not willing or able to reach the urban centers to receive the benefits of those services. Government services are not available in remote areas always, and therefore the people residing there remain deprived of the state services.

> *"Local government should offer essential services based on the needs of peoples in local remote areas. If government can do it, the root level served, political acceptance of government will increase".* -A KII participant in Baro Aria

Most often, these matters are influenced by economic capability, required arrangement and political will of the government. But these are not enough, attentions are required for curbing corruption, local power practice, nepotism, widespread inequality and lack of participation. This study has found no evidence in line with these, except some opinions of very few participants. The awareness and participation of the villagers are too poor to get the welfare of the benefits offered by the government bodies along with the various non-government, profit and non-profit organizations.

Q. Social services and safety nets

Social services, including widespread public works and services, are usually offered and supported by government, local and or international non-government organizations, and other profit or non-profit agencies. The goal of social services to create to build capacity with stronger communities, and promote equal opportunities. The service includes the promotion of health care, education, food aid and agriculture subsidies, police and legal support, fire service, training and employment, subsidized housing, adoption, community management, policy research and lobbying (Hills & Mullett 2000).

Both the health care and education services are available, though not sufficient enough, within and nearby areas. The health care services of the government to the study villages are not sufficient to meet the requirements of local poor and extreme poor populations. The nearest hospitals are almost 14.5 kilometers far from the water-stressed areas. The community clinics are claimed to have a good functionality by local government, but those are not enough to support the densely populated villages (in terms of patient-doctor ratio and functionality). Though the community clinics are claimed to offer equality and access, very few villagers are interested to go there to get service. Most of the maternity and child delivery related issues are managed locally. The villagers seek hospital support in the cases of complex cases like complexity in delivery, critical cases of surgery, etc. The educational institutions often fail to attract students to pursue higher studies. Though there are schools and colleges in the locality, the literacy rate is not improving and being affected by dropouts, lacking family support etc. (described in chapter four).

Government has a number of safety-net programmes; however, these are not for poverty alleviation but mainly to provide support to the affected people in hazardous areas. The most common social safety-net programmes of the government of Bangladesh include Employment Generation Program for the Poorest (EGPP), Vulnerable Group Development (VGD), Vulnerable Group Feeding (VGF), Old Age Allowance, Allowance for Widow and Destitute Women. Although the safety net programmes are creating notable changes in many parts of the country, the programmes are not sufficient to reduce poverty in the study villages because of its low coverage, weak selection process, unaccountability in the selection process, lack of clear guidelines.

R. Overpopulation

Overpopulation is depicted as one of the major reasons of poverty, but there is a significant transformation of other dimensions of population. It is evident that vast number of people has migrated since embankment breaching started. Number of villages (for example Jaliakhali) disappeared, and the population displaced, started working for their living again in distant villages. Some of them migrated to urban poor settlements as workers. Many rich families migrated to urban centers leasing out their agricultural lands to other sharecroppers. The rest of the

households, who did not move elsewhere, started staying in the government *khas* land[7], on partially broken embankments, in the homestead land permitted by relatives or neighbors whose homestead land have not eroded yet.

Along with internal migration feature, there has occurred a notable change in the family structure. The traditional extended families have been going through a gradual change. The family members that were traditionally been supported by extended family become responsible about maintaining their own costs. The newly created nuclear families been created once the adult children got married and form new families. Breaking down of extended families influences the break-down of their family property. The large lands then turn into smaller pieces eventually produce insufficient crop to support a family throughout the year. The members of nuclear family thus are unable to practice subsistence farming and finally the shortage turns into poverty.

The poverty created in the gradual loss of key livelihood items leads the household to poverty in the long run. The households, thus, maintain poverty as an intergenerational legacy. As they lack resources, capital, and various inputs, they remain in undernourished situation and bear this brunt over the generations. Long-term food shortage or hunger creates intergenerational poverty and protracted crisis. The general strategy to address such situation is providing food aid and associated reliefs to affected areas. The food aid and relief strategy are often criticized as they may propel dependency of the recipient countries in the long run. There are examples that the recipient countries fall into long-term debt traps, which is often considered as the key barrier of many developing countries for not being able to get rid of poverty. Many developing countries fail to repay their loans as the successive governments do not take the responsibility and willing to fill-up their regime period successfully.

5.9 Summary

This chapter provides detailed account of the poverty through the calculation of multidimensional poverty index where poverty is seen in terms of three broad dimensions and ten specific indicators. All these indicators are capable enough to present true nature of poverty among different wealth

[7] *Khas* land is government owned (and usually unused) land.

classes in the studied villages. The wealth class-specific employment scenario tells the type of jobs people do in terms of their socioeconomic capability. It shows that rich people have much capability to do descent jobs, whereas poor engage in precarious jobs. The small households are traditionally engaged in agriculture-based activities. As the agricultural practices are declining in water-stressed villages, the poor are losing the opportunities and are compelled to choose various nonfarm jobs. Many families migrate seasonally in search of jobs and often engaged in debt trap -which increases their vulnerability. The following chapter investigates the hazard and environmental condition which poses threat to the people who are engaged in agricultural practices. The final section explores the government and basic social support, which usually help people in lifting out of poverty, but the insufficient coverage plays minimal role in poverty alleviation across the study villages.

Chapter Six: Major livelihoods, agricultural features and uncertainties

6.1 Introduction

The present chapter explores the major livelihood options of the residents of the selected villages. It also presents a brief explanation about why the poor and extreme poor households of water-stressed villages choose various fragile livelihood choices. It is the reality that a small amount of agricultural land cannot ensure the livelihood security of a family if that land is affected by breaching like disasters. Due to waterborne challenges, like breaching and tidal flooding, the people of water-stressed villages cannot produce crops throughout a year. This chapter also contains one of the significant statistical outputs which are directly connected to the objectives and outcome of this research.

Section 6.2 explores the wealth distribution, educational features, and the critical livelihood options for people with different economic backgrounds. The wealth distribution tells the economic base of people who are considered as one of the vital reasons for poverty. The people of the weaker economic base cannot choose a stable livelihood option because, durable livelihood options always demand strong, financial background -which only affluent households can ensure. Section 6.3 captures the crop production scenario in the selected villages throughout a year. Such an account tells us the reason why poor people do not get agricultural job opportunities all the time in stressed villages. These people finally choose seasonal outmigration for their family maintenance. This section also explores why people of poor and extreme poor category in the water-managed village find year-round agriculture-related jobs. Irrigation water management and the absence of breaching like risks permit the people of Gajendrapur to practice agriculture all the time. Finally, section 6.4 expounds on the statistical association among different variables. This section presents the statistical reality in line with the claims which are made in this research work.

6.2 Wealth distribution, educational and key livelihood options

This section explores the wealth distribution features among the residents of water-stressed and water managed villages. It also presents an idea about the mean agricultural and homestead lands of people of different wealth classes, their educational attainment, and their primary income sources in the last one year. These data present the background of their livelihood and wellbeing features across the selected villages. Data also indicates that the meager amount of land the poor and low-income family holds (there are landless households too) is one of the fundamental reasons for poverty.

Table 6.1: Differential livelihood strategies followed by heterogeneous wealth classes in Baro Aria after the water driven transformation

		Rich n=10	Upper middle n=14	Lower Middle n=23	Poor n=47	Extreme Poor n=40
Percentage of Wealth Class		7.46	10.45	17.16	35.07	29.85
Mean agricultural land (decimals)		495	330	165	15.25	5.25
Mean homestead land (decimals)		130	62.15	29.25	7.15	2.15
Mean pond area (decimals)		40.25	28.21	22.15	4.25	1.05
Education (High School Certificate/above)		43.15	25.12	20.5	13.3	3.15
Income from different sources within last one year	Agriculture	50.00	57.14	34.78	57.45	37.50
	Aquaculture/pond	60.00	35.71	39.13	38.30	37.50
	Business	50.00	50.00	43.48	23.40	12.50
	Casual labor	0.00	0.00	21.74	61.70	80.00
	Livestock/Poultry	50.00	35.71	13.04	25.53	25.00
	Property rent	60.00	57.14	39.13	6.38	12.50

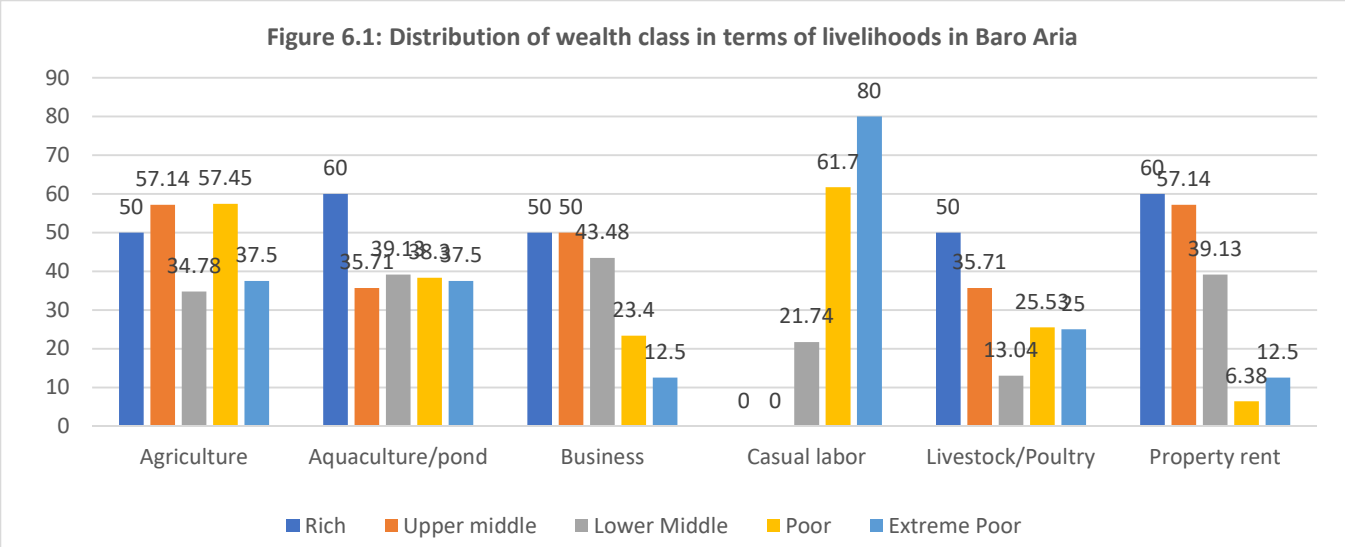


Figure 6.1: Distribution of wealth class in terms of livelihoods in Baro Aria

Figure 4.7 illustrates that most of the wealthy and upper-middle wealth class households of Baro Aria practice agriculture and aquaculture. Many of them use their lands to produce more than one crop. Both classes are in a better position to invest more in their lands. It is also evident that the rich are more interested in saline water aquaculture than any other class, as this practice is more profitable. In comparison, upper-middle-class households are more interested in agriculture as this practice is of less risk. All these households practice agriculture and aquaculture both for subsistence and for sale. A considerable number of families are engaged in extensive and medium businesses. It can also be observed that all the wealthy, upper, and lower middle class are not interested in investing more in their lands instead of many of them practicing property renting. Many wealthy and upper-middle wealth class households have their livestock and poultry farm, and they practice these primarily for sale. Some members of lower-middle wealth class households also work as casual or day laborers.

The poor and extremely poor in Baro Aria usually work as agricultural laborers in their own and nearby villages. Some poor households own a limited amount of farmland and aquatic bodies like ponds within their homestead area. Still, such production is for subsistence only—working as casual labor is the key livelihood option for both poor and extreme poor households. Working opportunities are not available in villages throughout a year; therefore, the laborers are to seek

other farm and non-farm activities for their family maintenance. Some poor households also own livestock and poultry; most of the cases, they are small in numbers and are reared for subsistence only. There are cases when the poor and extreme poor households are compelled to lease out their small amount of land to the rich and powerful farmers.

Table 6.2: Differential livelihood strategies followed by heterogeneous wealth classes in Chandgarh after the water driven transformation

		Rich n=3	Upper middle n=5	Lower Middle n=11	Poor n=24	Extreme Poor n=19
Percentage of Wealth Class		4.84	8.06	17.74	38.71	30.65
Mean agricultural land (decimals)		1299.7	720.2	239.4	190.5	42.8
Mean homestead land (decimals)		104.25	43.30	22.25	7.15	2.15
Mean pond area (decimals)		41.40	34.25	12.50	7.40	2.60
Education (High School Certificate/above)		43.50	38.50	33.60	11.25	3.50
Income from different sources within last one year	Agriculture	100.00	100.00	63.64	33.33	42.11
	Aquaculture/pond	66.67	60.00	54.55	25.00	5.26
	Business	0.00	0.00	18.18	8.33	10.53
	Casual labor	0.00	0.00	45.45	54.17	94.74
	Livestock/Poultry	0.00	0.00	9.09	8.33	0.00
	Property rent	33.33	0.00	0.00	8.33	0.00

Figure 6.2: Distribution of wealth class in terms of livelihoods in Chandgarh

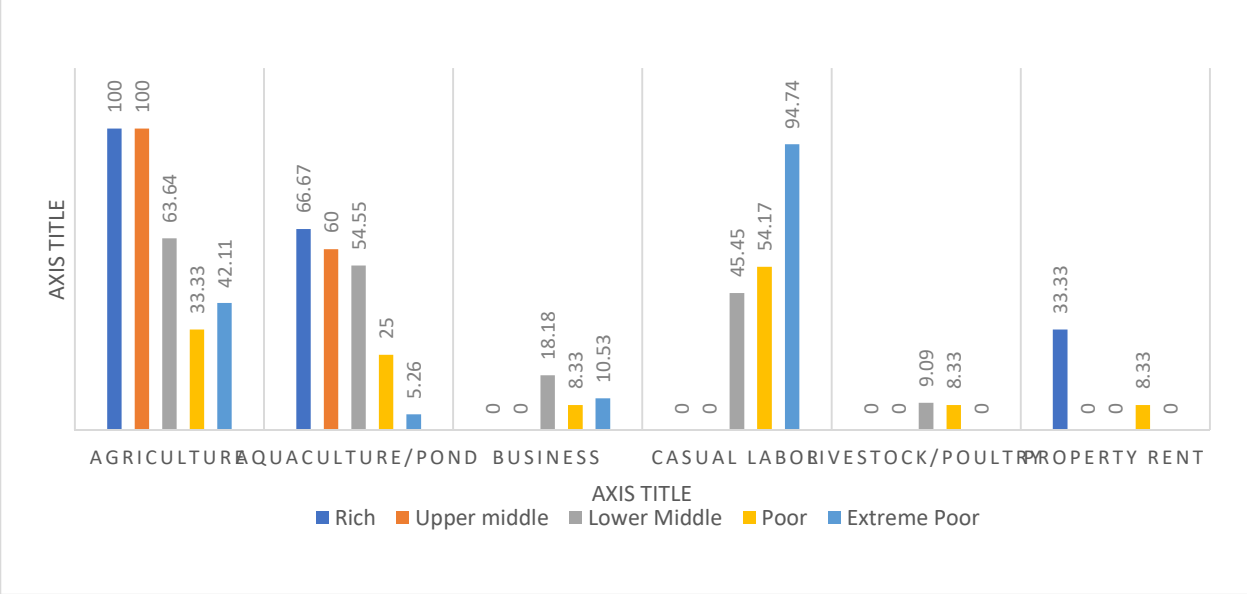


Figure 6.2: Distribution of wealth class in terms of livelihoods in Chandgarh

Figure 6.2 demonstrates livelihood scenario in terms of wealth class in Chandgarh. As the figure presents, most of the wealthy and upper-middle wealth class of Chandgarh practice agriculture and aquaculture use their lands on their own. The village is severely affected by salinity and embankment breaching, which hinder the farmers from practicing agriculture effectively. Because of the frequency of breaching and severity of salinity, the wealthier households are also less interested in livelihood diversification like livestock and poultry farming, doing business, etc. Some affluent families left to the nearby city, leasing out their remaining agricultural land to others. Because of breaching and salinity, much of the farming fields are arid and does not attract farmers to be leased. Many affluent and upper-middle households leased in lands in remote villages, invest agricultural inputs, employ casual laborers and thus engage in crop production. Both fresh (pond) and saline aquaculture (*gher*) are available in Chandgarh, and wealthier households usually engage in saline water aquaculture.

The poor and extremely poor households are in the worst position in Chandgarh village. Many households lost their homestead since the breaching started, the poor and extreme poor families live on a partially damaged embankment. The homestead lands are frequently visited by river water

when the tide is high, and therefore, people cannot live within the areas tidewater reaches. The families cannot produce any vegetables in their homestead. Casual labor is the key livelihood option for poor households, and they have a minimal opportunity to diversify their livelihoods. Most of these households have less or no capital to invest, less or property to be rented. Very few households are engaged in petty business -like buying agriculture products from nearby villages and selling in a small rural market, or small livestock and poultry -for subsistence. The real danger arises when the demand for causal laborers declines.

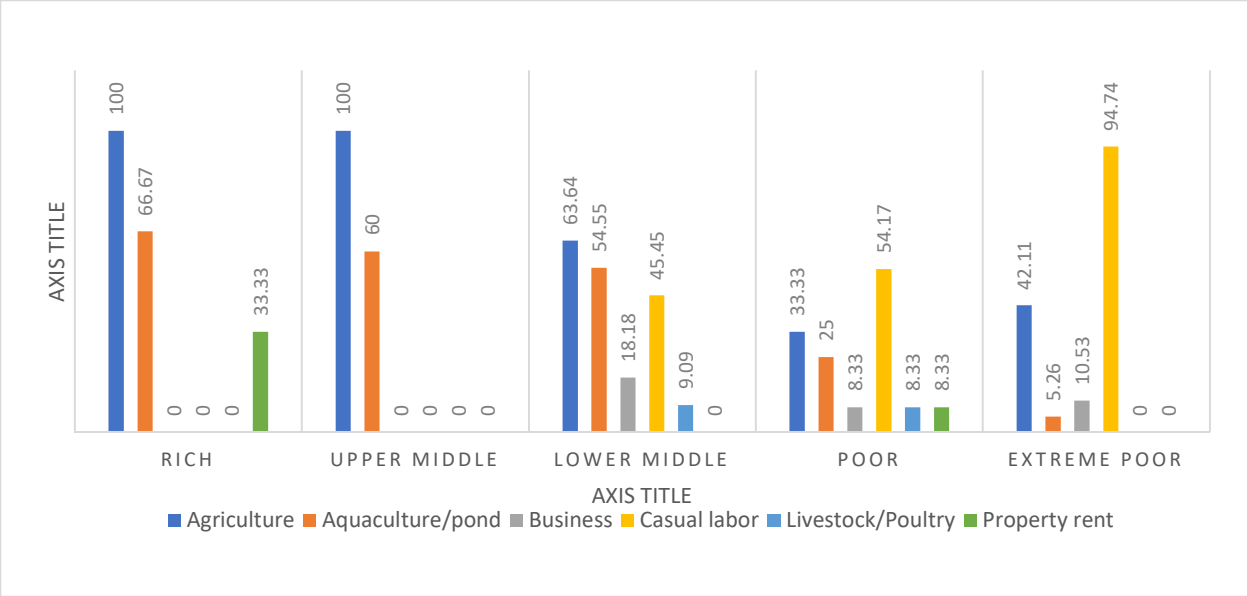


Figure 6.3: Wealth class specific of livelihood choices in Chandgarh

Table 6.3: Differential livelihood strategies followed by heterogeneous wealth classes in Gajendrapur after the successful transformation water sources

		Rich n=14	Upper middle n=21	Lower Middle n=31	Poor n=53	Extreme Poor n=69
Percentage of Wealth Class		7.45	11.17	16.49	28.19	36.70
Mean agricultural land (decimals)		753.5	531.2	426.3	103.5	29.5
Mean homestead land (decimals)		145.6	125.5	85.6	29.5	12.6
Mean pond area (decimals)		43.5	28.6	22.6	15.2	2.05
Education (High School Certificate/above)		45.8	29.6	21.5	15.6	3.8
Income from different sources within last one year	Agriculture	50.00	52.38	77.42	83.02	57.97
	Aquaculture/pond	0.00	19.05	9.68	18.87	7.25

Business	35.71	28.57	32.26	22.64	11.59
Casual labor	0.00	0.00	32.26	54.72	71.01
Livestock/Poultry	50.00	61.90	67.74	58.49	60.87
Property rent	64.29	61.90	25.81	13.21	5.80

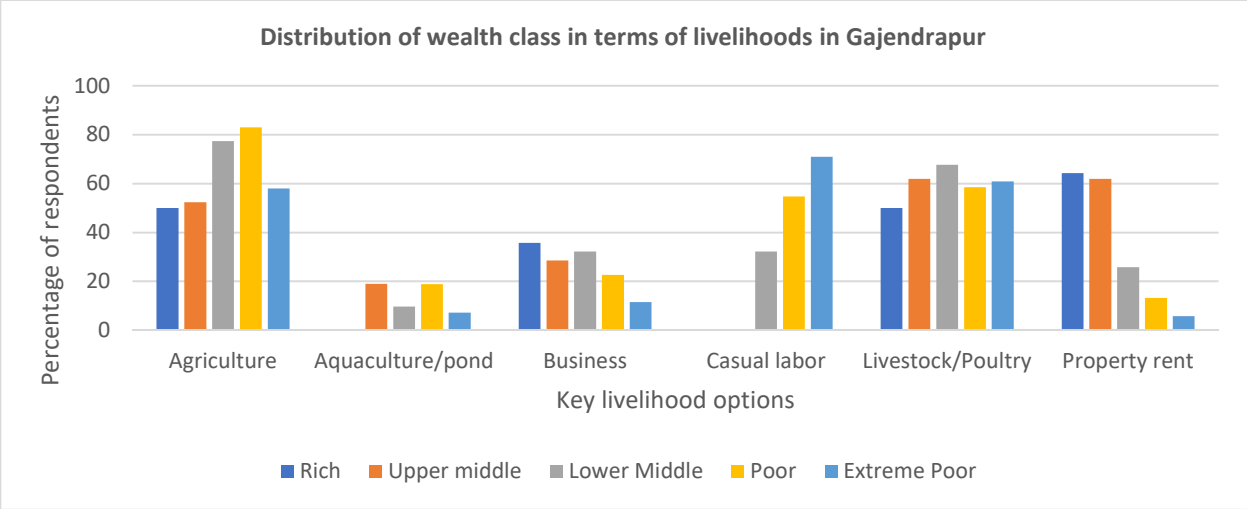


Figure 6.4: Distribution of wealth class in terms of livelihoods in Gajendrapur

Figure 6.3 portraits key livelihood options followed by different wealth class in Gajendrapur. Unlike the earlier two villages, the different wealth class households are more engaged in agriculture, livestock and poultry farming, property rent, and casual labor. The families are less engaged in aquaculture, and there are no saline water aquaculture practices in the village. The study shows that the people of wealthier classes are less involved in agriculture and livestock or poultry farming directly, instead the people of lower-middle, poor, and extreme poor households are more engaged in agricultural practices. The affluent and upper-middle wealth class households diversify their livelihoods like -engaged in agricultural practices, freshwater aquaculture, livestock and or poultry farming and property rent.

The poor households in Gajendrapur are more engaged in agriculture in their lands and others. The better production and subsistence farming scenario in the last couple of years has changed the lot of the residents of Gajendrapur. As the figure depicts, the engagement of poor and extreme poor to agricultural and farming activities are relatively higher. These households can diversify their

livelihood opportunities in different ways like- engagement in livestock and poultry farming, working as casual labor, doing some local small business, or limited scale freshwater aquaculture in their ponds. Very few poor and extreme poor households also lease out their agriculture lands to large farmers.

6.3 Year-round agriculture opportunities and seasonal outmigration

The poor and extreme poor households of water-stressed Chandgarh and Baro Aria cannot pursue traditional agricultural practices due to lack of agricultural land, or command over the land (as they do not own sufficient amount of land or capital). Frequent water-borne disasters like breaching and tidal flooding do not permit people to produce crops throughout a year. In Baro Aria, some landless farmers have managed to collect loans and started share-cropping. Still, many others often fail to do so, as the loan providers often scrutinize the base assets of the loan seekers for their security, which poor often fail to ensure. In both villages, the rich and upper-middle-class have agricultural lands and or have the ability to manage money or land from other areas for share-cropping. This is one of the key reasons for poor households to leave traditional agricultural livelihoods, though many of those work in agricultural fields in nearby and far villages as day-laborers.

The people of water-managed Gajendrapur are an advantaged position. People can practice freshwater agriculture

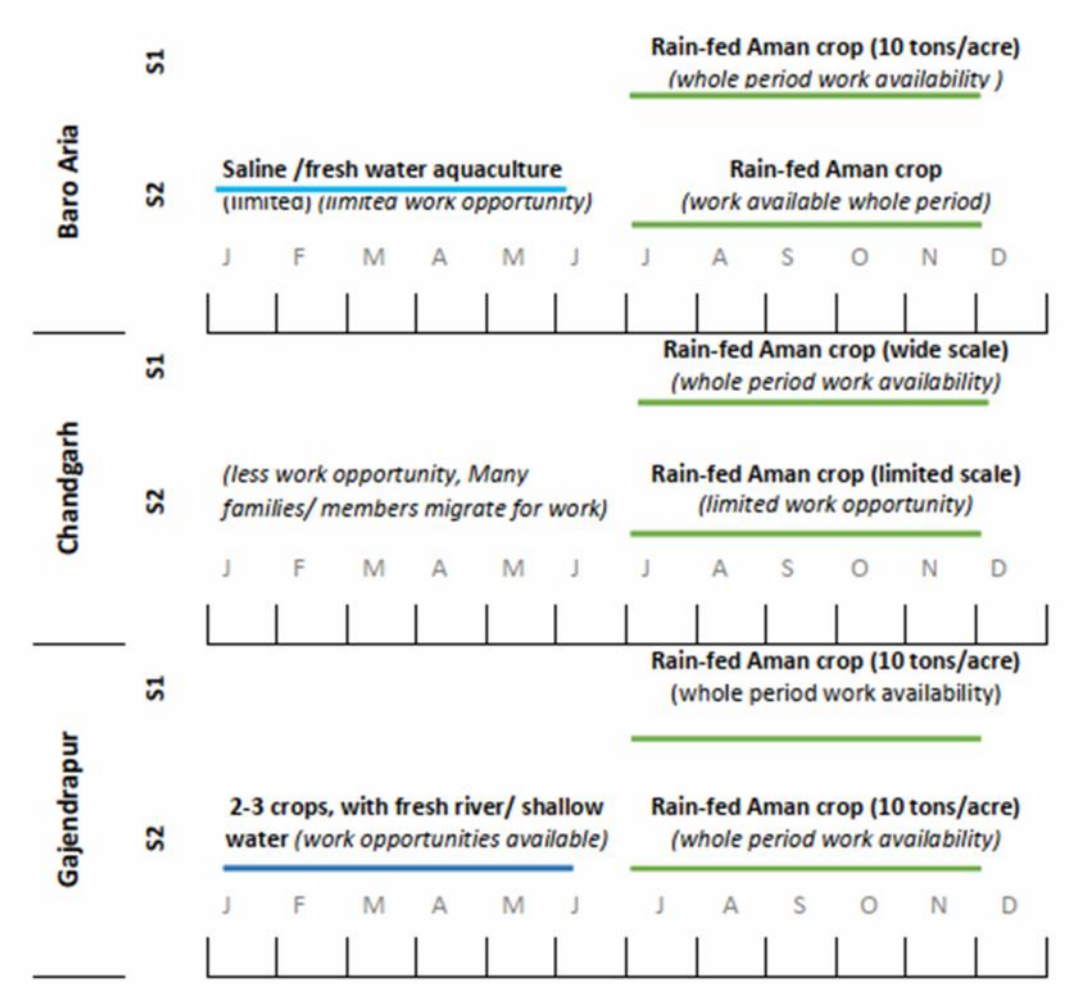


Figure 6.5: Changing farming system and agriculture-based livelihood opportunities in study areas throughout a year (In different situations, where S1 denotes traditionally practiced farming/ pre-erosion period, and S2 represents present farming practice).

It is observed in water-stressed villages that the seasonal outmigration is a dominant adaptation strategy in the areas where both agricultural practices and production are low. People choose to migrate seasonally to maintain their families, though they are not lucrative enough. Such matters also have some gender dimensions, as disasters affect males and females very differently. When the water-borne vulnerability is high, women suffer most (Nasreen, 2007, 2009). It is also because women have to take the critical responsibility of managing drinking water as it is their socially assigned gender roles (Nasreen, 1995). The tendency to seasonal migration is significantly less among female-headed households (elaborated in chapter eight), whereas the trend is high among male-headed families (Mersha & Van Laerhoven, 2016). This study also found that female headed households are not willing to migrate seasonally, as they feel insecure in such cases.

6.4 Statistical associations and interpretation of results

This section explores the critical associations among the variables that are most important for this study. These associations expose the statistical reality behind the livelihood choices of people and their search for alternative livelihood options. The first association explores the connection between waterborne challenges and total number of crops produced yearly by families. The second association explains the linkage between embankment breaching (in last five years) and number of crops produced by people in different villages. The third association expounds the connection between waterborne challenges and current welfare status of the people. And next, the fourth association presents the correlation with embankment breaching and the number of lands left fallow. Each correlation is shown below as unique features and their possible explanations.

Table 6.4: Major statistical associations (correlation pairs)

	Correlation pairs	Correlation Coefficient	P-value	Remarks
1	Correlation with waterborne challenges and the number of crops produced yearly	-.213	.000	significant
2	Correlation with embankment breaching (in last five years) and number of crops produced by people in different villages	-.102	.046	significant
3	Correlation with waterborne challenges and current welfare status of the people	.241	.000	significant
4	Correlation with embankment breaching and number of lands left fallow	.087	.089	significant

Table 6.5: Correlation between waterborne challenges and the number of crops produced by farmers

Correlations

		waterborne challenge	number of crops produced (yearly)
waterborne challenge	Pearson Correlation	1	-.213**
	Sig. (2-tailed)		.000
	N	384	383
number of crops produced	Pearson Correlation	-.213**	1

(yearly)	Sig. (2-tailed)	.000	
	N	383	383

**. Correlation is significant at the 0.01 level (2-tailed).

- The correlation coefficient is -2.13, and there is a significant negative correlation between the two variables. This means that the waterborne challenge has a negative impact on the number of crops drawn by the people in different villages.
- People produce less crops (usually 1 crop each year) in the villages where waterborne challenges are high (waterborne challenges affect them within past 5-10 years, and people draw more crops (usually 2-3 crops from each parcel of land) where water borne challenges are low (does not affect the villages in past 5-10 years).

Table 6.6: Correlation between breaching record in last five years and number of crops produced annually by the people of different villages

Correlations

		breaching_held	number of crops produced (yearly)
breaching_held	Pearson Correlation	1	-.102*
	Sig. (2-tailed)		.046
	N	384	383
number of crops produced (yearly)	Pearson Correlation	-.102*	1
	Sig. (2-tailed)	.046	
	N	383	383

*. Correlation is significant at the 0.05 level (2-tailed).

Analyzing major statements-

- The correlation coefficient is -.102 and there is significant negative correlation between the two variables. This means that the embankment breaching that occurred in last five years has a negative impact on the number of crops produced by the people in different villages.
- The people of water managed village produces 2 to 3 crops annually, whereas the people of water managed villages produce 1 to 2 crops annually. Agricultural fields which prone to be affected by breaching or tidal water intrusion are used to produce one crop annually (some fields are left uncultivated).

Table 6.7: Correlation between waterborne challenges and the welfare status of the people in water stressed and water managed villages

Correlations

		waterborne challenge	welfare_status
waterborne challenge	Pearson Correlation	1	.241**
	Sig. (2-tailed)		.000
	N	384	384
welfare_status	Pearson Correlation	.241**	1
	Sig. (2-tailed)	.000	
	N	384	384

**. Correlation is significant at the 0.01 level (2-tailed).

- The correlation coefficient is .241, and there is a significant positive correlation between the two variables. This means that the water-borne challenges and the welfare status of the people in different villages are positively correlated.
- This correlation tries to figure out if there any connection between the waterborne challenges and their current welfare status of the residents of selected villages. The result shows there is a strong connection. The people of water managed village are in a better condition than the water-stressed villages.

Table 6.8: Correlation between breaching record in the last five years and the number of annual fallow land pieces in different villages

Correlations

		breaching_held	parcel of land left fallow yearly
breaching_held	Pearson Correlation	1	.087
	Sig. (2-tailed)		.089
	N	384	384
parcel of land left fallow yearly	Pearson Correlation	.087	1
	Sig. (2-tailed)	.089	
	N	384	384

- The correlation coefficient is .087, and there is a significant positive correlation between the two variables. This means that the embankment breaching and parcel of land left fallow each year are positively correlated.
- The fallow land is not whole fallow land at all. It is considered that land can produce at least three crops per year (which is ideal cases in Gajendrapur). But such land is employed for producing single crops annually in water-stressed villages. This study considers that when a piece of land produces only one crop, that land is deemed to be fallow for the next two crop seasons.

Revised diagram (prepared on the basis of the observed results)

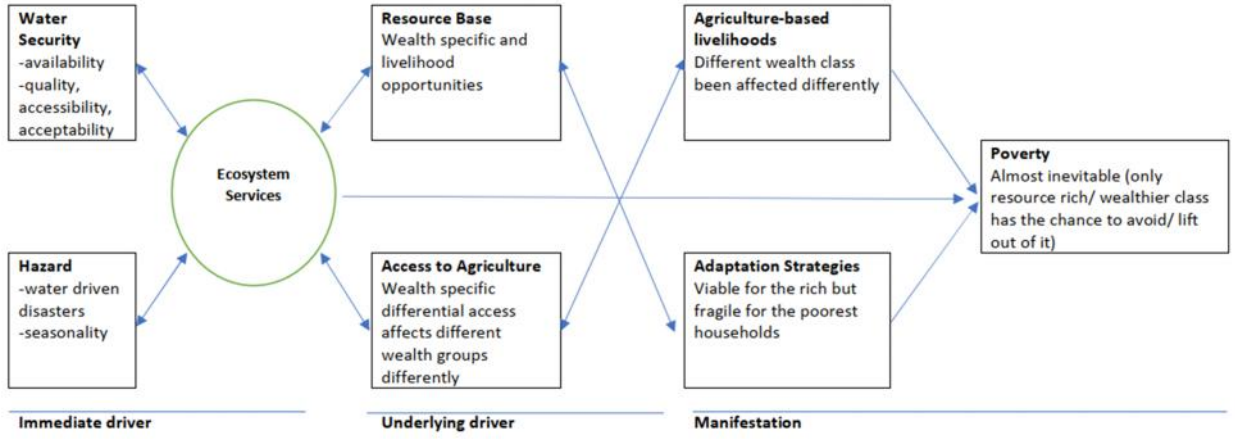


Figure 6.6: Revised diagram (prepared on the basis of the observed results)

6.5 Summary

This chapter captures the wealth account of the study participants and their livelihood choices. Waterborne challenges make agriculture-based livelihood choices more fragile in some villages, and water managed villages ensure the possibility of agriculture production in the other. This chapter also presents a brief account of the agriculture-based work possibility in different villages. Such an account conveys the reason about why the poor and extreme poor cannot follow their traditional agriculture-based livelihoods and choose to unstable jobs or seasonally migrate to remote villages and cities for their income and essential family maintenance. Most of these seasonal outmigrant workers cannot save anything, but they are compelled to follow such unstable employment

opportunities to maintain their family expenditure. Another central area this chapter covers is the salient statistical associations among the studied variables. Such correlation reveals the base of the claims which are made in this research work.

Chapter Seven: Existing adaptation strategies, opportunities and constraints

7.1 Introduction

Based on water-poverty literature and observed reality, the existing adaptation strategies, opportunities and challenges have been explored in this chapter explains adaptation strategies are heterogeneous in nature but are taken aiming similar goals- economic betterment and subsistence. The adaptation strategies usually adopted by wealthier class are quite different from strategies that are taken by poor households. The strategies that are taken by poor households are unstable and fragile in nature, whereas the wealthier households choose more stable options. The stable options ensure rich households' economic betterment and stability whereas the fragile options led poor to further impoverishment.

The section 7.2 explores the adaptation strategies those are taken by the poor and wealthier households. The 7.2.1 focuses on economic opportunities and barriers; 7.2.2 expounds the social and political features which hinder poor to get adaptation opportunities and helps rich households to receive those. The 7.2.3 concentrates on ecology and environmental opportunities and constraints; next section concentrates on institutional opportunities and challenges. Next two sections focus on knowledge and infrastructure related features and also the access to poor and other wealth classes to those opportunities. The market opportunity and challenges have been discussed in 7.2.7. The 7.2.8 discusses on gender-based opportunities and challenges and also explores why male members enjoy more sociopolitical and economic benefits than females.

7.2 Adaptation Strategies, shifting livelihoods and aftermath

Pursuing traditional farm and non-farm activities and livelihood diversification is not often the case for all wealth class simultaneously. The livelihoods strategies and decisions, that are shifted from traditional agriculture, often are made on the basis of the wealth class background and capacity. As the most households interviewed were the owner of both homestead and agricultural lands prior to

the frequent breaching started, they are almost pauper now and therefore they follow any available activities in nearby or far areas.

> "We had 1.5 acres of land once, and now we have nothing, both of our agricultural and homestead land have been eroded. Nearly 3 decimal agricultural land still remains in the brink of the river, which is not cultivable. The breaching has made us pauper, and now we work as day laborers for subsistence. There is seasonal and gender-based payment imbalance. In cultivation and harvesting periods, the labor demand is high and men are paid BDT 300 for a day, whereas women are paid BDT 150. Rest of the time the wage is low, as the demand is low. This time men are paid BDT 200 whereas women are paid BDT 100 per day." -A woman day laborer, Chandgarh

Site	Livelihood options	Rich	Upper Middle	Lower Middle	Poor	Extreme Poor
Chandgarh	Agriculture in own/leased land					
	Aquaculture in own/leased land					
	Homestead gardening					
	Fishing in rivers / canals					
	Livestock /poultry raring					
	Casual labor					
	Small-scale business					
	Part-time job					
	Land/property rent					
Baro Aria	Agriculture in own/leased land					
	Aquaculture in own/leased land					
	Homestead gardening					
	Fishing in rivers / canals					
	Livestock /poultry raring					
	Casual labor					
	Small-scale business					
	Part-time job					
	Land/property rent					
Gajendrapur	Agriculture in own/leased land					
	Aquaculture in own/leased land					
	Homestead gardening					
	Fishing in rivers / canals					
	Livestock /poultry raring					
	Casual labor					
	Small-scale business					
	Part-time job					
	Land/property rent					

Legends

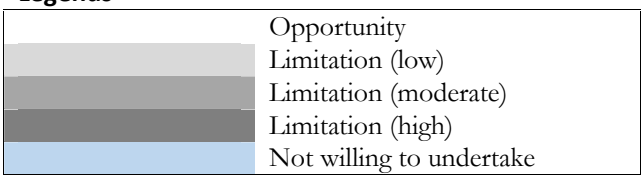


Figure 7.0.1: Opportunities and Barriers in livelihood options

Adapted from Hoque et al 2016

The households consider combined strategies as the 'best fit' for their subsistence and survival (citation needed). The household members, both women and men, follow a number of strategies for their subsistence. After cultivation and harvesting period is over, many families move to city areas to work in the brickfields, as they receive advanced loan from the owners of the brickfields, and therefore they are paid low in comparison to usual wage. However, the poverty forces people of lower wealth class to engage such jobs, gender disparity is evident (Nasreen, 2010), in such cases though the working environment in the brickfields is not satisfactory.

> "I do not like to work in the brickfield, and I believe most women of our village are also unwilling to, because teasing and other harassments are common there. However, we are to go with our husbands, because they are to stay there for longer periods, we also feel unsafe with kids in our village."
> -Working woman, Baro Aria

7.2.1 Economic

The economic base of households is the key determinant of any livelihood challenges and adaptations in rural Bangladesh. The economic base is often identified by the amount of land a household owns, the amount of money or other forms of asset they save etc. The livelihood adaptation options, therefore are dependent on the both. Rich households in water-stressed villages have large amount of lands and handsome capital for investment in both agriculture and aquaculture which permit them to manage better income and any impact caused by breaching and salinity could be compensated by their economic base. In addition, those household are engaged in various livelihood diversification activities which may ensure high income. In Chandgarh, many rich

households have migrated to nearby urban centers leasing out their family lands to sharecroppers and engaged in urban business. The situation is same for some families of Baro Aria also. Some rich families in both villages have leased out their lands to sharecroppers and engaged themselves in other high-return jobs. The rich households, as the chapter five and seven depict, engage in various high returning non-farm activities including.

The upper-middle class of the both villages are still trying to agriculture activities in the lands within and far villages. They are also engaged in various petty business as part of the livelihood diversification. There still has homestead vegetable gardening in Baro Aria, and many upper middle and the households who have their own homestead lands are trying to cultivate seasonal vegetables there and mostly for subsistence. In Chandgarh, such practice is impossible in highly affected zone, some people are a bit far from that zone and can practice vegetable production in their homestead. Households with better economic base, thus, are able to make better income in comparison to poor households.

People with lower economic status, namely – lower-middle, poor and extreme poor in water-stressed villages often struggle for their subsistence. These traditionally farm-dependent households face greater challenge due to the diminishing agricultural practices. The lower-middle households are engaged in limited scale of livelihood diversification as they do not pose enough land to depend only on one activity. Therefore, as a way of livelihood diversification, these households engage in petty economic activity like glossary, collecting shrimp-larvae or buy and sale them elsewhere or doing some small business. The practice of livelihood diversification is a smaller scale can also be found among the poor and extreme poor households as well. For the sake of subsistence or family maintenance, both poor and extreme poor households often grab any type of opportunity that may generate some income. As noted earlier, these households are worst affected by the water-borne problems and associated livelihood threatening situations. They suffer from capital, or asset deprivation. In Baro Aria, most of the poor and extreme poor households cannot grow crop for want of land, cannot excavate pond to cultivate fish for subsistence because of the same reason. With little or no agricultural output these households often engage in small scale

farming with the help of others and wage laboring. At the end, it is their physical labor which saves these households from starvation.

The situation is opposite in the villages facing less or no water stress. The wealthier households invest more in agriculture throughout a year and the same practice is also followed by the lower middle and poor households also. The poor and extreme poor households of Gajendrapur enjoying better livelihood opportunities and living conditions than the stated water-stressed villages. The agricultural laborers get perennial working opportunity within and nearby villages.

Although it is argued that the ownership of agricultural land and the ownership of assets play the significant role as key factors in determining the socioeconomic status of a household and its adaptation capacity these are not the sole factors. Both the location and special distribution of households also play greater role in the above spheres. The close proximity to nearest saline water body and the recurrent visits of saline flood water compels the households of Chandgarh to search for other livelihood options than agriculture. There are evidences that the wealthier farmers, amid water-borne challenges in their own villages, are able to practice agriculture farming in far villages as they have more pieces of land, have capital buy or lease in lands in those areas.

7.2.2 Social and political

The social inequality and inequality generate a number of challenges in human communities, and the powerless poor become always of its victims. The social inequality is often rooted with the economic power stated in 8.3.1, and creates influences on people with less economic power. The unequal distribution of resource ownership and widening poverty gap may create long-term or persistence inequality which create obstacles of weaker groups to undertake poor households to take their expected strategies of livelihoods and change towards development, and simultaneously, enables wealthier households to follow their preferred strategies and trajectories. This is what actually happening in water-stressed Chandgarh and Baro Aria. Narrations from residents of both villages depicts that the opportunities for poor are shrinking, generates opportunities for the

wealthier, poverty gap is widening. What is more important to note in terms of social inequality is that, the wealthier households have a

The influence of social inequality has a close kinship with power and dominance. Imbalance in political and other types of power always creates influence on powerless individuals and communities. The

> "One common conflict arises at the time when a new pocket embankment is going to be constructed by villagers to protect both homestead and crop-fields. Almost no one wants to lose his cropland. agrees or allow others to build embankment on his crop land, as this endeavor will lose his land permanently, there is no such thing like judgmental compensation for the landowners who have lost their lands". -A villager, Chandgarh

The social inequality, in contrast, is considered tolerable in Gajendrapur in the eyes of the residents. Both the socioeconomic condition of both rich and poor are improving gradually. The wealthier and poorer households are following their preferred livelihood strategies. The poor and extreme poor households are in weaker position but the changing /ameliorating agricultural practices enables them to follow their traditional agricultural practices throughout year. They are not to face the shortage of agricultural working opportunities, no threat to leave their traditional livelihood like water-stressed villages. These households can ensure the education for their children, not are compelled their kids to leave schools and concentrate on income generating activities.

> "The people who own more money than others try to get more land, either buying or leasing in, to cultivate more land. Its is more profitable here. We do not practice saline water aquaculture. I have a small plot of land and we produce seasonal vegetables there one after another -throughout a year. In every household in this village, you can see, people practice homestead gardening and growing vegetables or crops in their crop fields even. There are agriculture opportunities for the wealthier, and working opportunities for the people

> searching working opportunities. You will find them busy year-round". -A villager, Gajendrapur

> "There are some households who are wealthier than others, but we do not face any problem/conflict here. The poor have substantial working opportunities, the food is fresh as people grows it within villages, we have fresh water to drink as we have managed it recently. As you can see, the poor people are also gradually improving. Yes, there are some dominations of wealthier individuals seen in community meetings, but this is natural in every village". -A school teacher, Gajendrapur

The political influence, from different corner, should be noted as well. The local political representatives are supported financially and politically by the wealthier farmers in rural villages which enables rich people to feel more empowered. This political empowerment of wealthier households helps them to create further social inequality within villages. They can grab more land, manage more money to invest and thus become much wealthier. The poor, on the other hand, remain politically less empowered, fail to manage land and money, rather often lose their control over their own small pieces of land. This polarization widens the poverty gap and creates socioeconomic inequality.

There are other reasons for why conflict is less in Gajendrapur. The grassroot organizations like Paani Committee and various cooperatives for savings purposes, have been developed in the village which permits interactions among villagers. Such interactions reduce the possible conflicts of interest through discussions, mutual consideration publicly. Any possible conflicts are reduced openly, with opinion from various corners.

7.2.3 Ecology and Environmental

Ecology concentrates on the study of the interactions among the organisms, including biotic and abiotic components, and their environment. It further incorporates the concepts of biodiversity, distribution, biomass and the populations of organisms.

Primarily, water and soil availability make the agricultural production possible. The amount of agriculture often plays a significant role. The production can be negatively affected if the irrigation is saline or if the soil is saline because of its exposure or its proximity to nearest saline water bodies. In many reasons of rural Bangladesh, the fresh soils turn into saline one because of recurrent visits of river water through breaching or overflowing. Once soil turns into saline, it loses its natural fertility to produce as much flourishing way as it was earlier.

The availability of fresh water for irrigation in Chandgarh is solely dependent on raining. There is no other source of fresh water. soil is saline because of recurrent breaching of embankment. The underground water is brackish and saline which is not compatible for irrigation. It is said that significant amount of rainfall reduces the soil salinity and make ground for agriculture, but this is not the case for Chandgarh. Long term exposure to saline water of the nearby Bhadra river has made the soil saline, which reduces the agriculture productivity in a greater scale (these are elaborated in chapter six). There is limited agricultural possibility in other than the broken part of Chandgarh.

> “Indeed, the erosion has destroyed our area, only a small part of this villages is remaining now. The soil of this village was the best, almost all types of seasonal fruits and vegetables are grown by the villagers, the yielded crops were enough for us, but breaching destroyed us all. People turns into beggars from solvent ones. We offered job once, now we are the job seeker”. -A pauper farmer, now working as agriculture laborer in Chandgarh

The condition is not much different in Baro Aria also. The difference is that the ground water is not as much brackish and saline as Chandgarh. The farmers can depend on both rainwater for the rainy season and ground water for the rest of the time. The wealthier farmers produce more than one crop which the poor farmers rarely follow. Irrigation and other agriculture inputs are higher than the outputs, -this simple truth hinders small farmers from practicing second crop. Additionally, as the river water intrusion is not recurrent as Chandgarh, the soil is less saline. In addition to soil and water related challenges, the respondents from both villages mentioned the challenges heat stress, heavy rainfall for the shorter period, late onset of monsoon, pest attacks as the main reasons of productivity decline. With the increasing salinity, the trees and bushes are decreasing, declining livestock raring and with this there creating acute shortage of homestead gardening and fuel for cooking.

Evidences from Gajendrapur shows that, the people successfully managed their irrigation water problems (explained in chapter six and seven), continuing the agriculture practices. The coordinated effort of water management let the farmers to practice agriculture throughout year. The farming practices have solely been ameliorating the socioeconomic condition of the villagers for the last ten to twelve years. The water management committee follow a simple guideline, just to trap the fresh water in nearby canal, keep the gate locked, and use that water to irrigate their agricultural fields throughout year. The perennial practices of paddy and vegetables lays the keys for development. Availability of fodder permits villagers to rare livestock and raring of poultry, ducks etc. which help them to generate additional income for the households. The welfare of the economic development has been transferring to other socioeconomic spheres, like- this growing solvency let them to get full schooling for their children, do some extra economic activity as part of their livelihood diversification etc.

7.2.4 Institutional

The institutional arrangement matters for a community -whether there are substantial effort towards equality, whether there is windows for the poor to lift out of poverty. It is important for poor households to have the opportunity for substantial livelihood diversification, needs to have

proper and calculated steps to help poor for take-off condition. Institutional arrangements have the responsibility to create windows for the sake of the weaker, poor and vulnerable destitute.

In the water-stressed villages the most institutional support made so far is relief distribution and rehabilitation program. The institutional arrangement often support infrastructural development like building and repairing embankment in water-stressed villages. The villagers, however, experiences the institutional support comes with sluggishly, therefore they found the local support to this context is most important. In Chandgarh, the union parishad chairman often helps in his own to rebuild and repair embankment. Local people support this rebuilding and repairing embankment during or on the eve of emergencies. The union parishad receive assistance from government and non-government organizations, but that is limited enough to protect the entire embankment for long.

For Baro Aria, community is the first responder to embankment breaching. The local government has build the embankment, with concrete pitch cover, but the road has been threatening by erosion. When people predict further breaching, start working together to make pocket embankment targeting weaker points and possible points of breaching of existing embankment.

Gajendrapur is in safe zone from direct breaching like earlier water-stressed villages, and the people have faced less problem of natural disasters. Local people mentioned cyclone as the key hazard for them, though that disaster has not visited their village in last couple of years.

7.2.5 Knowledge

People of water-stressed villages lack required information about science of tidal flooding, optimum level of temperature-moisture and salinity, management of topsoil quality, soil preparation, efficient tequnies of pest control without apply toxic medicines, applying natural fertilizers and less use of chemical fertilizers, level of soil salinity and saline tolerant varieties of crops, appropriate techniques of crop fields and aquatic body management, storage of food. Most of the cases, farmers use their traditional knowledge in all of above-mentioned contexts. Because of the absence

of modern scientific techniques to deal with hazards and agricultural practices, the negative impacts can often not be ignored and the farmers receive reduced crop production consequentially. Many farmers try to learn on trial and error basis which led them to waste of money and time.

In the water-stressed villages, wealthier farmers often try to avoid farming in most risky zones and invest more for more agricultural production, but small farmers often do not have the idea or capacity to follow modern concepts of agricultural practice. As some farmers, who do not have land in other than risky zone, try to cope with and try to practice crop in the area affected by salinity. They do not get their expected outcome, as they lack sufficient knowledge about level of salinity, toleration level for crops, saline tolerant crop varieties, techniques to improve soil quality, appropriate pesticides and fertilizers etc.

Initially, the people of Gajendrapur often failed to produce desired amount of crops just because of their lack of sufficient knowledge on farming. Farmers used to apply their traditional knowledge and practice agriculture with a goal of subsistence farming. Later, with the irrigation system management they have managed to produce more, now they receive updated information from many NGOs working there. Farmers cultivate paddy in the rainy season, many of them produce second crop after harvesting the first one. Other farmers produce vegetables after drawing the first crop. They produce more crops and vegetables, use better transport and send to capital city. They are well connected with national market, and become benefitted of it. Their knowledge and engagement have created the difference.

7.2.6 Infrastructure

Infrastructural support includes the construction of bridges, culverts, roads, embankments, electricity grids etc. which plays a crucial role in the communication of communities in enhancing their livelihood opportunities. If road and bridge communication is well-developed, for example, an poor individual may take rickshaw or van pulling as a livelihood option, local producers can be able to use transport to get better market price, inhabitants may communicate city centers for better legal or medical support or any other type of emergency service.

For the people of Chandgarh and Baro Aria, the communication to nearest urban centers often hindered by damage in some points of connecting concrete road to Khulna city. Because of road connection problem, the villagers of water-stressed villages often deprived of medical care if any critical case arise. The villagers of both villages depend on drinking water of far villages. Water vendors collect water from water source of far village and sale in drums in the study villages, but this vending system become seriously disrupted when roads are difficult to use, particularly in rainy season. The people cannot market their agricultural products what they able to produce in their own. A significant part of Chandgarh and Baro Aria do not have electricity coverage. Therefore, residents of those areas are deprived of the services provided by electric power supply. In the time of serious tidal surge and embankment breaching, most of the families, except wealthier households having concrete houses, are to take shelter on partially broken embankment.

The people of Gajendrapur are blessed with infrastructure development within and nearby areas. Though there are some old and decaying bridges and roads, the overall condition is better than earlier water-stressed villages. The producers and middle-men can use better transport services to draw and transport goods to far areas. Residents can communicate better with schools, colleges, nearby markets and Khulna city than the water-stressed villages. They elect local representatives who may hear and support them better, which is another reason for their development story -as they think. The condition of nearest embankment is good enough to protect its people from breaching or overflowing river water. The villages have no notable natural disaster to mention in the last ten years.

7.2.7 Market

Close proximity, access and good communication facilities to local market inspires local people to be involved in various non-farm activities to maintain their families as well as choose their livelihoods. Nearest market hub to two water-stressed villages is not well developed and are facing number of challenges including communication problem, presence of local participants only, not enough locally produced products to sale elsewhere, less agricultural products produced locally,

less participants in the market, lack of intermittent power and water supply, far from nearby city center, underdeveloped local business exertions etc. Such lacks often fail to attract good number of buyers and sellers as a precondition of better exchange market. It can easily be observed that the number of people engaged in business is remarkably low, and are limited in middle- and low-income population who are mainly do this for their subsistence only. Taking business as a profession with a goal to do better or make more profit has not become developed in the water-stressed villages, and therefore the rich people are seldom engaged such business as they consider this is not much profitable.

The business opportunities in water secured Gajendrapur villages is comparatively. The nearby market is comparatively developed with regular exchange and large number of inner and outer participants. Better communication system to Khulna city is another key characteristic why market get better exposed here. The number/proportion of population engaged in business is greater than water-stressed villages. Large number middlemen created there for making profit on locally produced agricultural products. Most of the businessmen belong to upper middle and lower middle wealth class category. The poor and extreme poor have neither capital nor relevant support to start new business or play role as a middleman. The significant portion of rich people in Gajendrapur are engaged in business including. The reason behind is that, business environment has been created within villages which attracts people to invest their capital and make profit.

It is very common that individuals are interested in renting out their land and engaging in various higher return activities if there exists good land and better labor market (Barrett et al., 2001). The demand of land is high in Gajendrapur, and both the price of land and rent is going higher day by day with the increasing practices and boosting agricultural production. With growing agricultural business, the demand for labor is notably raising, which permits poor and extreme poor households within and nearby areas to invest their labor. The opposite is evident in water-stressed villages, where the demand of labor is very much time specific and creating a gap in employment opportunities of local poor wage laborers in the rest of a year. This want of employment creates pressure on the traditional farm-based wage laborers to choose various non-farm activities.

7.2.8 Gender

Opportunities, barriers and limitations of different water-stressed villages and water secured one is depicted in the above discussion, it is also discussed about some opportunities enjoyed and barriers faced by the people of different wealth classes. Beyond inter villages disparity and livelihood opportunities, and differential livelihood opportunities and choices among various wealth class, it is important to understand the intra-household disparity. The gender roles often narrate some of the key features. Most of the adult of water-stressed villages are housewives. Housewives other than rich and upper middle-class households work in the field to add some in their family income. They work in their fields, as part of their subsistence income and family maintenances. Men are the key income earners of any male-headed households, but they often fail to support their families better single handedly, with their own income. Therefore, the women work to support it.

In both Chandgarh and Baro Aria, women engage in post-larva shrimp collection from Bhadra river, although this collection is limited for few months. Government has a strict rule for the collection, though there are some violations are also observed, it is often because of their poverty, sometimes greediness. Working as a wage laborer is a very common practice for the women in both villages. The payment system is discriminatory, as the chapter eight depicts, they are less paid than their male counterparts. It is considered that, in cases of payment, women are physically less capable than men, and can therefore produce less than men in the same period of time.

Women in Gajendrapur face a bit more liberty than those earlier villages. Most of women from less wealthier class work within their own villages, or the crop fields of their fellow villagers. Women are also engaged in subsistence farming in addition to their household responsibilities. As mentioned earlier, the number of livestock and poultry raring is high in Gajendrapur, and women are the key manager in this matter. There are women who do not work in the fields, rather take care of kids, poultry farm within own courtyard and engage in household activities. The proportion of housewives do not work outside is high in Gajendrapur.

The sign of future development of the role and position is not same in all study villages. The women and girls of water-stressed villages are facing uncertain future, as the educational scenario is very much disappointing. Large number of school dropouts, early marriage for girls, involving children in income generating activities and lack of support to children to continue or better schooling is a very everyday scenario in Chandgarh and Baro Aria. This scenario is opposite in Gajendrapur, where most of the families are promoting their children to receive both primary and secondary schooling. Many of them are moving for tertiary education as the chapter five analyses.

7.3 Summary

This chapter focuses on the existing adaptation strategies, opportunities and challenges in the selected villages. It explores that the adaptation strategies have been undergoing through a rapid change in last ten years. The poor and extreme poor households have returned from their long-term agricultural dependency and repeatedly focusing on non-farm options. But these new non-farm options are very fragile and are not available all the time. Sociopolitical and market system works in favor of the people who have money, the poor become deprived. The poor receive less institutional support than the rich households.

Chapter Eight: Gendered approach in understanding adaptation barriers and differential impacts

8.1 Introduction

In response to various waterborne challenges, the term adaptation has become popular in contemporary discourse. Adaptation means building adaptive capacity and implementing adaptation decisions (Adger et. al. 2005). The term is also important in various other types of disruptive climatic events (Adger 2007) that are frequent in many parts of the world. Adaptation indicates the process of adjustment to the real or predicted change in the climate as well as its effects (IPCC 2014b). The term is closely connected with the concept adaptative capacity. The adaptive capacity refers to 'the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences' (IPCC 2014b; cited in Mersha and Laerhoven 2016).

In recent years, the discussion of adaptation has reached its advanced stage where adaptation barriers are receiving more attention (Biesbroek et a. 2013), which indicates some particular factors 'that make it harder to plan and implement adaptation action' (IPCC 2014b). The adaptation barriers may deter households from taking effective adaptation strategies (Bryan et al 2013) to cope with the challenges emerge from various waterborne disasters. These barriers may include age, educational level, wealth of a household head, access to credit and extension services, gender etc. (Deressa et al 2009).

Water security is conceived as "the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies" (Grey and Sadoff 2007). Water insecurity can, therefore, be occured if the availability of water is above than required, and threatens (like flood or

coastal surge) the nearby residents of waterbodies, their lives and livelihood strategies, overall environment and economies. Adaptation to such waterborne challenges are one of the major concerns of contemporary climate change discourse.

This paper attempts to examine the various types of barriers, caused by waterborne challenges, that often affect the choices of the people those are associated with farming activities. The particular focus is to examine how those barriers affect male and female headed households differently and how do they perceive and face those barriers. This paper has also captured the key perceptions and develop an inclusive framework that will offer advocates, policymakers and development partners a new understanding to the ongoing debate.

High profile disasters are very common to different parts of Bangladesh, which affect both rural and urban parts. Nearly one third of the land is flooded every summer. In 1998 flood, nearly half of the land was under water. The experience of flood for women is very much different from that of men. The frequent disasters in Bangladesh create poverty and vulnerability and affect women disproportionately (Cannon 2002). The increasing disasters affect the ability of women to resist, cope with and recover. One of the key reasons for this is the economic inequality (Cannon 2002) and differential economic freedom men and women enjoy. Other non-economic factors (like social or cultural) have significant role there. There are specific gendered factors in the country that are needed to address in order to reduce the vulnerability of women (Hossain et. al. 2017, Ahmed et. al. 2017, Shmuck 2002, Michaud 2000, Enarson and Morrow 1997, Khandkar 1996).

There is a clear indication of lack of attention in the literature to social and cultural barriers to adaptation in the fourth assessment report of the IPCC (Adger et. al. 2007). The salient focus of recent research is not only on socioeconomic and cultural barriers but on political, cognitive and institutional barriers faced by people and organizations (Adger et al 2009, Biesbroek et al. 2013). A total of eight types of adaptation barriers were listed in the IPCC fifth assessment report, which include: social and cultural, economic, financial, physical, biological, governance and institutional,

human resource, and barriers related to knowledge, awareness and technology, respectively (IPCC 2014a).

A good deal of scholarly work and research has been reviewed before conducting this research, special focus was given to the barriers as well as gendered barriers to the adaptation process of the households that are facing various long or shorter-term disasters. It has been observed that the barriers create a negative force that impede the ability of people (Biesbroek et al. 2013) to adapt with the challenging condition. It is very clear that there is very notable dearth in the literature regarding the differential impacts of combined barriers on male and female headed households. This study takes a gendered perspective to explore the differential impacts on and adaptation measures of male and female headed households, where sociocultural barriers have received a notable attention. Our conviction is that the gender lenses have assisted us to dig out the gendered connection between differential impacts on male and female headed households.

8.2 Conceptual framework: the relevance of sustainable livelihood approach

The sustainable livelihood approach (SLA) captures the impact of waterborne disasters on the livelihood strategies of people and it also identifies the factors that may shape their adaptation choices and decisions (Below et. al 2014). The SLA address five capital assets, activities and access that determine the living of individuals or households (Ellis 2000). Since livelihood is in the heart of adaptation process, this study conducted a careful revision on sustainable livelihood approach in developing a comprehensive framework.

A livelihood does not necessarily mean the generation of income only, rather include the getting and retaining the access to resources and opportunities (Scoones, 1998), it also includes the capability of household to deal with risk, maintaining social networks and institutions. Households often try to combine a number of resources to create their own livelihood strategies which let them survive and improve wellbeing opportunity. Access to these resources are determined by the nature of social relations, institutions and organizations (Ellis 2000), the connectivity that may define a household's chance to receive help in emergencies.

Both the resources and mediating factors are considered important in sustainable livelihood framework, where the latter has received very less attention in contemporary literature (de Hann and Zoomers) than the former. The mediating process, in SLA, plays a central role in determining livelihoods through creating influence on livelihood strategies, decision making process, access and interaction among various types of capital (Ellis 2000, Scoones 1998). Gender has an influential direct and indirect role in this mediating process (Lowndes and Roberts 2013). This is possibly one of the major reasons for the lack of gender in livelihood discussions; therefore, it is urgent to incorporate gender in sustainable livelihood framework (Krishna 2012). Gender inclusion is important, therefore, to the mediating process. Present study, in this context, addresses the gender gap and calls for deeper understanding on the way gender is important livelihood literature.

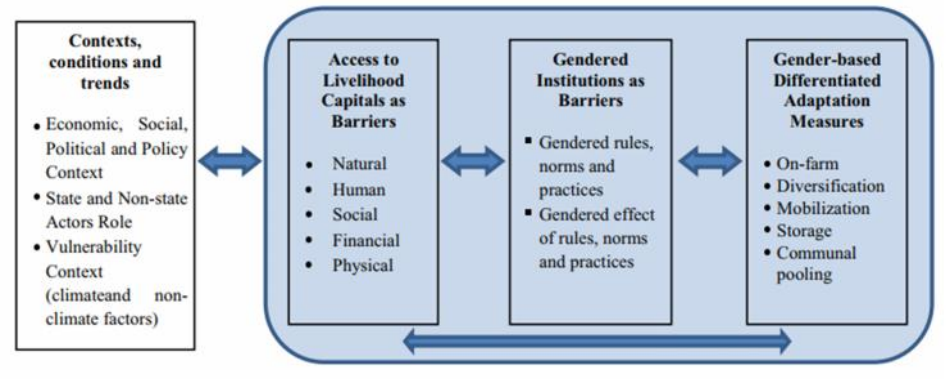


Figure 8.1 conceptual framework, adopted from Scoones (1998)

In this regard, it is very relevant to concentrate on gendered institutions. The term is used to explain the way gender relations and the construction of femininity and masculinity are entrenched in daily institutional processes and practices (Mersha and Laerhoven 2016, Lowndes and Roberts 2013, Acker 1992). There are number of dimensions through which gendered institutions can be considered. This may include gendered rules, gendered effects of rules (Lowndes and Roberts 2013) on which this study focuses. Gendered rules are considered as norms, rules and practices that may have significant effect on actions, behavior and relations of men and women; whereas gendered effects indicate the condition where the impact of institutions are different in terms of gender.

Gendered institutions were considered the barriers to adaptation strategies and this is accepted as the first core component of the framework. The framework has a focus on both formal and informal institutions, which also considers social, cultural and governance barriers (IPCC 2014a). Individual, household and communities are also considered (Behrman et. al. 2014), whereas, as a unit of analysis, household experiences are given greater importance during analysis.

Gendered institution, as second core component, is considered here as a barrier which may produce differential impacts on male and female headed households and their access to different capitals. Natural capital indicates natural resources like land and forest resources, human capital considers the knowledge and their access to the trainings, social capital comprises their social networks and connectivity, physical capital comprises of access to road network and their access to information technology like television or internet, and financial capital encompasses farming and non-farming activities that may generate income.

Adaptation measure, the third core component, combines the range of activities and choices which households choose to achieve their goals. Both farm and off-farm activities, storage, mobility, and various other livelihood diversification options were taken into consideration while analyzing adaptation measures. The framework is also using context, traditions and trends as the SLF portraits. The condition is presented here as the vulnerability context which encompasses climate and non-climate induced factors, state and non-state actors as well as other socioeconomic, political or policy responses.

8.3 The country context: Gender in Bangladesh

Bangladesh is situated in the southern part of South Asia. Large numbers of her rivers are crossing the country and ended with the Bay of Bengal. Historically the country has been experiencing waterborne challenges like flood, riverbank erosion, salinity problem and many other climate induced disasters like cyclone, flash flood, embankment breaching, flood, surge or overflow of river water, saline water intrusion and gradual alteration of soil quality (Choudhury et. al., 2019; Sarker et. al., 2019; Haque and Jahan, 2015; Juran and Trivedi, 2015). Major part of the country is affected

by different disasters almost every year (Cannon 2002). The country is occasionally visited by disasters like flood, cyclone, lightning and earthquake. A total of 15 districts with 15 million people were terribly affected by 2017 flash flood [Ahmed, et al. 2017, Kamal et. al. 2018] and affected almost mature crop that were yet to harvest. Another vulnerable area for disaster is the southern coastal zone, which is visited by coastal surge, cyclone like disaster more frequently than any other parts of the country. More than two-thirds of the entire population of Bangladesh directly depends on rain-fed agriculture, and the production becomes seriously affected by lack of or untimely rainfall. The rural farmers become severely affected when agriculture production is disrupted by disasters events. Rural poor households repeatedly get involved in debt crisis (Islam 2011) to cope with the post-disaster effects and further fall into vulnerability.

Historically, the water policies formulated by the government have a significant influence on the lives and livelihoods of the people of lowlands including coastal zone in Bangladesh. The policy is directly and indirectly responsible the chronic water insecurity and waterborne hazards in many parts of coastal zone. The chronic water insecurity has a significant impact on the livelihoods, health, and various other social and human capitals of coastal people. It interrupts their century-old engagement with land and land-based agricultural livelihoods, their livestock raring and poultry farming practices both for consumption and selling.

With support from World Bank a total of 139 polders were constructed in the coastal belts, consists of 19 districts, of Southern Bangladesh. The polders[8] were working well initially but recorded diminishing performance in later period due to lack of surveillance and associated maintenance works. It is thus, the government policy with clear focus / aiming to provide permanent protection of coastal people from leave people in water insecure condition for decades. Number of year-round hazards often added with disruptive events like overflow of river water, frequent embankment breaching. This portrait the institutional failure to ensure water infrastructure which can be considered as the key reasons for augmentation of long-term water crisis and associated water insecurity to many communities across the coastal zone.

[8]Earthen embankment to protect enclosed deltas.

The selected villages of Polder 29, reflect the unique characteristics of the water insecure communities, where the people of one selected village has successfully managed their waterborne problems. Present study tries to see gendered-impact of how the people from water-insecure villages are experiencing waterborne challenges that are completely different from the experience in water secured village.

The waterborne challenges caused by the embankment breaching, flood, surge or overflow of river water, saline water intrusion and gradual alteration of soil quality. These events are very much frequent in many parts of coastal Bangladesh. The key livelihoods, agriculture and agriculture-based jobs, are frequently threatened by these disruptive events. As these events are frequent, the poverty of coastal population cannot be alleviated through pumps that are applicable to other parts of the country. Disasters affect different socioeconomic groups differently and disproportionately in to the groups that are differentiated in terms of gender (Enarson and Pease, 2016; Bradshaw, 2013; Hines, 2007).

Male dominance is very common in existing cultural setting, though the influence is not the same in urban and rural areas. The rural poor women headed households can be marked as poorest among the poor. The female headed households face disparity in terms of opportunities like livelihood choices, involving in public works, income and wage, gendered norms and voice, control over productive assets like land and capital. Disparities faced by female headed households are very common in rural setting (Mersha and Laerthoven 2016; Alebachew 2011; MoWa 2006). In rural setting of Bangladesh, female heads are widows, divorced or separated women and are usually considered vulnerable as these families do not have elderly male members. They often face problems in terms of opportunities that are provided for the destitute like public works, or other support provided by development partners. In rural south, only few households can be found in each village those are female headed and they always remain in awkward position in terms of progress and the development of capitals that are the key indicators of sustainable livelihood framework. Though equality is ensured in the constitution of Bangladesh, and uttered in various

programs of relevant ministries, the gendered norms are strict in manner and prevalent in rural settings of coastal zone.

8.4 Methods

This study was conducted on the basis of qualitative methods which combines focus group discussions, key informant interview, semi-structured in-depth interview techniques with a central aim to investigate the impact of waterborne challenges to the adaptation strategies adopted by male and female headed households. In terms of livelihood and family maintenance, the male and female headed households adopt various types of adaptation strategies which are not of similar strength. Some strategies are more vulnerable than others. Considering the waterborne challenge in coastal zone, this study applied a purposive sampling technique to select female and male headed households from two villages of southwest Bangladesh.

Participants for case studies and focus group discussions were selected with the help of development workers and associated NGOs who have been working within and nearby villages for long time, and with consultation from elected village representatives. Purposive sampling was used in the selection process. The socioeconomic backgrounds of the selected male and female headed households are almost similar and fall into lower-middle and poor wealth class. While selecting sample, emphasis was given to keep the control variables like occupation, power source, some indicators of socioeconomic backdrop as constant as possible.

The field research was conducted in four consecutive periods, within May 2017 to September 2018, and a range of qualitative techniques were applied to gather information from female and male household heads and various local participants. Before each discussion or interview, the consents were taken from and information were collected whether each participants understands the discussing issues or not. The discussions and interviews were conducted with local language with the help of local participants, so that the participants may feel easy and confident. A good number of informal discussions with elderly, school and college teachers, development workers, religious

priests have helped this research in terms of validation and gathering additional information regarding the investigated concepts.

The semi-structured questionnaire interviews have covered the areas like socioeconomic (and poverty) profile, basic livelihood strategies, type and impacts of waterborne challenges, adaptation strategies, experience with gendered institutions and how they influence adaptation strategies. Focus groups were composed of 9 to 12 participants and discussions held with -male group only, female group only and mixed group. A total of 8 focus group discussions, 16 interviews, 6 case studies were conducted. The participants were in the age group of 35 to 65 years, considering the local context of taking family responsibility. Informal discussions with male were carried out while they were gossiping and passing evening leisure time in local tea shops and in front of grocery, while they were waiting for the boat to cross Bhadra river, working in their fields, and informal gatherings near local *haat* (local market, opens only two days a week). Informal discussions with female are carried out in local water collection points, gatherings near school, informal gathering and gossiping in yard. Other discussions and interviews were conducted formally. A team of three researchers conducted the discussions; interviews and cases studies were conducted individually. All discussions and interviews are reproduced in narrative analysis form, which "permits a holistic approach to discourse that preserves context and particularity" (Smith 2000). All discussions and interviews were audio recorded. The records were transcribed and coded within shorter time so that the discussions can be recalled and produced more correctly. The salient features and information are presented in tables so that those can be easier to understand and compare the differences.

8.5 Result

The findings of this research highlight the broader issue of gender and water security, where gender is considered as one of the key determinants of water insecurity. The water insecurity often shapes the emotional geography of women and offer them a different [subordinate] position than other members within community.

Water insecurity interrupts women from practicing homestead gardening and livestock and poultry rearing. In rural area, women often manage their greater part of their cooking, through depending on the herbs/ wild vegetables/ own reaped vegetables, as they play the key role in cooking and food preparation for all members of a household. Women, almost single handedly, manage the livestock and poultry which provide additional nutritional support to the household, as they are reared primarily for household consumption. Families, especially women, provide support in educating their children with their little income from selling of livestock, poultry, dung-made fuel sticks, eggs etc. But this opportunity is seriously interrupted by long-term waterborne challenges.

Men are more responsible in creating a secure income for family maintenance. Most of the adult men in both villages are traditionally engaged with agriculture. The decade-old relationship of households to land has been shifting dramatically in recent years. Water-borne shocks leave many villages in coastal zone vulnerable to agricultural practices. Frequent embankment breaching, overflowing high tidal water let saline water enter into village and alter the soil quality of the agriculture fields. Consequently, the agriculture production is gradually declining, leaving many families reluctant to further investment in agriculture, and are been forced them to search alternative livelihood options. Male members are often engaged in various non-farm activities. For search of those activities, they often move to nearby or far villages, or even to cities. Men are considered capable of doing jobs that require more physical effort like construction and repairing activities. Women are usually responsible for jobs that require less physical effort like household management, childcare, collecting herbs, cooking and food preparation, small scale food collection activities, helping and overseeing educational improvements of children etc. Community people in both water-secure and water-insecure villages are rarely educated, but the change starts with their children, which is considered satisfactory in water secured village and frustrating in water insecure community.

Table 8.1: Adaptation strategies of male and female headed households

Capital / resource	Female-headed households (n=10)	Male-headed households (n=10)
Agriculture-based livelihood adaptation strategies		
Mixed crop	-	10
Planting large trees for sale	4	6
Conservation of soil	2	8
Livelihood diversification		
Drawing shrimp larvae	4	-
Selling labor / work as casual labor	6	10
Small business	1	9
Be involved in public work	5	8
Rickshaw/van pulling	-	4
Weaving/ handicraft	4	-
Mobility		
Temporary migration to far villages	-	10
Migration to cities	-	10
International migration	-	1
Storage		
Grain storage (for selling, when price peaks)	-	7
Seeds storage	1	6
Support from community/ relatives		
Monetary support from relatives	6	9
Monetary support from neighbors	5	8
Sending children to the relative, in crisis period	2	4
Drawing remittances	-	1

Source: Field data, 2018

The gender division of labor (GDL) remained strict in the studied communities which has been undergoing a change. The role of women has been changed dramatically in the last few decades. Working outdoor for women had been considered as slander to own household status for women, but the scenario has been changed a lot. The strict norms have been transforming into fluid ones when there is in need (Billson and Mancini 2007). Women in most households of water-stressed villages work outdoor, not as a part of awareness or education, rather this is because of poverty and want. They work, as they can support their families, can ensure basic education for their children. Working men often fail to fulfill all demands of their families alone, leaving women to take additional responsibilities to work and income to support own families.

The collection and management of household drinking water is the sole responsibility of women in the community, such practices are very common in other parts of South Asia [citation needed] and Sub Saharan Africa [citation needed]. Such gendered division of labor has far reaching implications and impacts on physical and mental health of women.

8.5.1 Vulnerability context: Community perception of water insecurity and poverty

The respondents maintain different perceptions pertaining to water-borne vulnerabilities and their impacts on livelihoods. The education level of respondents, their orientation with water-borne hazard and disasters, traditional concepts lays the foundation of their perception. Their perception and understanding influences their adaptation strategies and decision (whether they take any adaptation strategies or not or the type of strategies they undertake). It is found that the participants have differential idea about the water-borne disasters, as most of them are unpredictable and sudden onset event (like embankment breaching or overflowing of river water when there is high tide), and they have a comparatively clear understanding about slow onset water-borne problems like salinity impacts. On the basis of these experience and understanding households predict the amount of crop output, likelihood of changing weather. In the same time, the farmers have little understanding on rainfall variability, seasonal variability, temperature fluctuation within local area.

8.5.2 Differential adaptation measures adopted by households

Substantial differences in gender-based adaptation choices and options are evident in both study sites. Choosing a particular type of adaptation measure (eg. agriculture based only) has been very common among the households in the areas like the particular decisions in the cropping field, their time and diversification options, practicing either cash or food crop, the decision of whether second crop (usually Kharif) will be practiced or not, method of cultivation and irrigation to be chosen, soil preparation -all these were regarded as important adaptation measure and these decisions are usually taken by male members where women sometimes play a minimal supporting role.

Most of the families are lower-middle, poor and extreme poor and they are to depend on both farm and various non-farm activities,

> *"My father and grandfather were farmers. We continue this farming tradition following my great grandfather. We are the sons of this land. But the situation has been reached such a destiny that we have to die in hunger if we do not do anything other than agriculture labor. The villagers have lost their lands, many of them have already moved to far villages and urban centers".* (a village leader, case study participant in Baro Aria)

> *"We had our own homestead land and some agriculture land also, but it has been more than 10 years we have lost everything. You can see only the small remaining part of this village. The major part of it is already engulfed by [Bhadra] river. I love to do agricultural jobs, but we do not have the option to follow it throughout a year".* (a male agriculture labor and informal discussant from Chandgarh)

The story is identical for nearly most of the household heads, who are poor and extreme poor. This is the story of male, who are traditionally associated with farming activities. The historical alteration of farming activities has created a far-reaching impact on female members in a different way. Traditionally, the female members were not used to go to the fields, but today this is the practice in most of the lower middle, poor and extreme poor households. The subsistence farming is often associated with efforts from male and female. The story does not end here; the crop produced in the small slice of land often fails to support those families throughout a year. Therefore, male members engage themselves in various nonfarm activities where female members are to engage themselves in various income generating activities to support their family.

Table 8.2: Household asset profiles in terms of five distinct capitals

Capital / resource	Female-headed households (n=10)	Male-headed households (n=10)
Social capital (participation/social networks)		
Samitee (association for microcredit, for women)	All households	All households (through female members within family)
Peasant committee	None	All households
Poultry *Samitee*	3 households	All households
Having strong relation/network that may help in crisis	3 households	9 households
Labor exchange system	2 households	All households

Human capital		
Literacy	3 households	7 households
Farming knowledge and ability	2 households	All households
Training/ skill training	None	All households
Natural capital		
Access to agricultural land (own farming)	3 households	All households
Access to sharecropping	None	9 households
Access to forest resources	None	3 households
Financial capital		
Income from farm (own farm) either by own farming or mortgaged out	All households	All households
Income from (including casual labor)	All households	8 households
Income from non-farm activities	5 households	All households
Physical capital		
Access to road communication	All households	All households
Access to technology (mobile phone, tv, radio)	6 households	All households
Access to farming tools (plough/tractor/oxen)	None	All households
Access to public vehicle, communicating growth center/health center/law enforcing authority	3 (others are reluctant)	All households

Source: Field data, 2018

8.5.2.1 Livelihood Diversification

Engaging in various non-farm activities is the dominant adaptation measure for both male and female headed households. In doing so, they choose various types of jobs as part of their livelihood diversification. The households having weaker economic background are compelled to engage such measures for their subsistence and survival. Other than cultivation and harvesting season, male household heads and adult male engage themselves in non-farm work like rickshaw and van pulling with passenger and goods, hairdressing, engaging in petty business like grocery shop, selling vegetables in local regular *haat*[9], frying shop, chicken and meat shop, fuel wood shop, locally available charcoal, green coconut vending, fish vending, vegetable vending, and also working as a day laborer. Very few men work as water vendors, those who manage to buy a van to draw water from safe water source, the nearest one is about four kilometers far from own village, and sell them to the villages where there is no safe drinking water source. These tasks are traditionally thought as of male, so social norms have been formed in the same way.

The role of women is not of much distinct than men. Female heads and female members of male headed family choose various types of jobs including working in the agricultural fields as sowing

[9] Local bazar, where people gather once or twice a week to buy and sell items

seedlings, getting weeds out, managing wild vegetables or herbs for cooking unless it were bought by male members from local market, cooking and food management, childcare, overseeing educational improvements for children, preparing dung sticks, selling vegetables, eggs or poultry produced domestically, rearing livestock and poultry. Other than this, the adult female members take part in outdoor activities as day laborers. Engaging in various types of jobs that were traditionally considered as jobs that are physical demanding and therefore of males. Such job includes excavating and transferring vast amounts of mass, working in the brickfield and construction sites and taking the same load as male counterparts. Some carpentry works, and weaving *aton*/*guna* (indigenous tools to catch fish) and *madur*/ *pele mat*[10] were also chosen by few men in male headed households, some women in female headed households mentioned that they do small scale sewing *nakshikhatha*[11] to sell locally.

Significant evidence of mobility or migration are noted from both male and female headed households. Both female and male headed households choose internal and international migrations as adaptation strategy. It is also found that comparatively the male heads are more mobile than the female heads and they consider taking less household responsibilities. The male heads work as the key financial contributor to their families and usually depend on their temporary working. They migrate frequently to far-off villages and even in nearby Khulna city when agricultural work opportunity is less, or severely affected by saline and river water or the in the times of bad harvest. The female heads also move to distant villages and cities in search of work but less often. One of the key reasons of their less mobility lies in the gendered culture of public-private spheres. Women are responsible to perform domestic cores, looking after children and elderly, livestock-poultry and other belongings. Less opportunities for alternative employment for women also restrict female heads to earn a living moving elsewhere. Migration for both cases is heavily dependent on age and need. Young men in the male headed households often try to move out of country for economic sustenance and better future. However, due to huge cost involved, only few in the study villages reported to migrate internationally.

[10] Mat, prepared by local people using indigenous materials and techniques
[11] Embroidered local quilt

Before the emergence of waterborne challenges, there was a business of storing grains in the harvesting period and sell them when the price of grain reaches its peak. This business was popular among the rich and middle-class households, and also those who secure loan to invest in this business. There is no evidence of this business at present, because surplus grain is not available even after harvesting period. This practice survives in its minimal level and visible only in few solvent male-headed households. The female headed households cannot afford such opportunities due to lack of capital and associated willingness. Most families of lower middle, poor and extreme poor class could not produce any surplus grain in the last five years.

Like many common disasters in coastal zone, the poor households expect support from their friends, relatives and neighbors. The social networks often help people to survive in during and post disaster situation as both male and female headed households reported. This study also recorded that the male headed households have stronger social network and can manage better support than female headed households. Female headed households often are forced to take loan when they fail to manage necessary financial support in post disaster periods. Both type of households mentioned, along with financial support, they seek additional support including food for family members, accommodation, sending children to secure places or in the home of relatives and neighbors.

8.6 Adaptation opportunities and barriers

There are clear evidences that gendered institutions have a significant influence on the adaptation opportunities to the study villages. These institutions have both direct and indirect influences that play a powerful barrier to their adaptation decisions. In the one hand, gendered culture –specially gendered norms, rules and regulations, and practice generate unique barriers to the adaptation choices and decisions to the community people which create significant direct barriers to the adaptation options.

On the other hand, gendered barriers to access to the various opportunities may limit scope for development of community. Such barrier, for example, may include financial deterrent which may

have a powerful influence on the access to the various services that are related to it. Lack of human capital and resources, i.e. lack of skill or knowledge or awareness, also create barrier to the adaptation options. Not having access to technology (IPCC 2014a) also indicates lack of awareness and choosing viable adaptation options. The resulting barriers delineates the unique weakness to the community to choose and adopt better adaptation measures and strategies.

The subsequent sections of the present research will illustrate- firstly, the effect of gendered norms, rules and regulations, and practice and the way of affecting them; secondly, the way differential access to different livelihood capitals may create additional barriers and propel community people to choose weaker or stronger adaptation strategies that may increase their vulnerability.

8.6.1 Barriers created by gendered institutions

Gendered norms, rules, practices and restrictions: Gender division of labor is evident in the study communities. The norms are strong and therefore the gender roles are historically fixed, where men often engage in physically demanding job like farming activities (Aregu et. al., 2018; Petesch et. al., 2018) and therefore they grow sufficient knowledge and skills on that, whereas women are engaged in less physical demanding jobs and are engages in like household chores, and taking care of children, elderly and household belongings. It is considered that only men can perform better in any type of farming tasks, practices and decisions, and it is the domain or duty of women to become engaged in subsistence farming activities. The farming practice of women are traditionally restricted within own *vita*[12] (homestead land). And women are traditionally associated with homestead gardening, they sow, nurture seedlings, take care of garden in every respect, where men usually engage if there is needed to apply fertilizer, pesticides, constructing *macha*[13] for rolling plants.

But in case of outdoor activities, men are considered the sole contributors, due to their visibilities in farming activities, e.g. planting and harvesting. In general, there is an invisible taboo against women

[12] *Vita* is a raised homestead land, usually raised above from the level of usual agricultural fields
[13] Raised platform, usually made of bamboo

which prohibits them to cultivate the agricultural fields, even if women are the owner of that piece of land. There also exists the idea of 'family honor' with the type of work of women.

> *"In our culture, women are seen as soft, ideal minded, and cordial to the family members. They are not for hard work like farming. They should maintain the family honor through honoring the opinions of the elderly, the village heads and relatives. They shall not go outside without the consent of the husband and elders. Going outside home for work is the work of men, not of women. They do not need any permission, because our society is guided and regulated by the elders who are male".* (A male interviewee, in Baro Aria)

> "*Women can do most of the agricultural work except ploughing, because most of the tilling work is done here by power tiller usually operated by male. In the cultivation time, you can see women are engaged in sowing seedlings, nurturing, weeding with weeding tools, applying fertilizers, winnowing, even harvesting crops. It is no longer the domain of men only, women are better for farming."* (A female IDI, Chandgarh)

These narratives can illustrate a present scenario of the traditional domain of patriarchy and the present involvement of women in farming activities. The former narrative portraits the gender roles of males and females within communities and the gendered restrictions that were set by patriarchy historically. The intrahousehold discrimination, which are embedded in gender roles and responsibilities, may enhance poverty (Morrison et. al., 2007; Kabeer and Mahmud, 2004; Clancy et. al., 2003). The latter narrative depicts the present scenario of the way women engage in agriculture activities. This does not necessarily mean that the conception of patriarchy has become weak, rather male defines and treat these working women differently. Women who work outdoor, including farming and other areas as casual labor, are treated negatively. They are not considered ideal, in the eyes of others. They are referred as bad examples, and as 'prey' to poverty. Such patriarchal norms and regulations often play as a powerful barrier for women within community.

8.6.2 Gendered rules norms, and practices

The participants of focus group discussions, interviews and case studies and informal discussions reported that the community adaptation measures are usually inspired by various types of aid and extension services available to them. Extension services, though are smaller scale due to water-borne challenge areas, are offered by government and various non-government organizations working in and nearby areas for long time. The aid services are primarily offered by government and community groups. Both measures help the communities most and enable them to choose better options. However, there are also gendered discrepancy in such opportunities. It was reported that the men have better network and therefore the personnel associated with extension services contact them directly which empower them in terms of knowledge, skill and connectivity. Women often remain in dark about the activity updates, skill training, and knowledge sharing activities offered by the extension services. Different opinions are received from male participants, which portraits the support of extension services positively. Women and girls are advised to involve in training sessions on family planning issue, basic healthcare, water use, sanitation and hygiene, reproductive issues. This is also gender biasness, as participants consider. The participants consider that both women and men should be involved in all trainings. Nevertheless, there are similarities in the experiences of women and men with regard to water-borne challenges and the way the households with different socioeconomic background face differently.

8.6.3 Gender and share of agricultural land

Gendered culture has a significant influence on the sharing of inherited lands to the male and female members in studied communities. It was observed that the male possess the lion share of farming land and other household assets. The cultural setting does not offer equal rights and equal share for both male and female. The laws of inheritance of the dominant religions (Islam and Hindu) does not ensure equal opportunities for women and men and their successors.

8.6.3.1 Share-cropping

It cannot be said that the community women are reluctant to involve in tilling, and feel shy to be involved in it -rather, the cultural norms prohibit them to become involved themselves to such activities. The key reason lies in the influence of patriarchy, which treat the involvement of women in such 'outdoor' activities negatively. In response to a 'Why' question many of them responded like if we do so, 'what others think of me'? Considering this reality, as women do not directly engage in tilling their own land and face problems manage farming activities in their own, the female headed households often choose share cropping, or lease out their lands. There is almost no doubt about the sharing amount, as this matter is mutually agreed.

> *"I choose share-cropping, and have given my agricultural land to my step brother. I trust him and like to receive whatever the amount of crop he offers. I have no other way; there is almost no female headed household in this village who cultivate their land on their own. They are to depend on others. This is the jobs of Male".* (Female Household Head, Baro Aria).

The story is quite different for Chandgarh, most of the poor villagers do not have own any farmland. The subsequent embankment breaching engulfed more than two thirds of the entire village. Many families lost their homestead lands, and many remaining families cannot use their homestead lands for vegetation purposes. The saline water intrusion alters the quality of the topsoil, and therefore the vegetation becomes impossible. Share cropping opportunity is therefore limited, and most families have nothing to sell their labor, as a viable adaptation strategy.

The female headed households often agree with disproportionate sharing agreement like- if the female headed landowner bear/invest seedling and fertilizer cost along with sharing land, she will receive one-third of the produced yield/crop; if she shares her farmland only, she will receive only one-fourth.

8.6.3.2 Inequality in labor compensation

In Chandgarh, most adult members of households with weaker socioeconomic background work as causal labor. A significant inequality is evident in the payment system. The payment system was developed by the solvent village leaders and payers, where the working women has less or no bargaining power to deal with this unequal distribution of wage. The participants reported that, even if a woman can produce similar types of job within a given period, they are paid less than the male counterparts. Most of the cases, the wage is decided in terms of work availability, labor demand and the number of available workers.

The working men are more mobile and have sufficient freedom to do so, if they do not agree with the payment system. They can move elsewhere, even in cities, in quest for better paying jobs, but women have less mobility as they have less freedom and courage to take steps. Showing much freedom may create family anxiety, arise negative relationship, even family break-up. Most cases, women keep their families in the topmost priority and follow what the family head decides.

8.6.3.3 Microcredit -as a glimpse of light

It is often argued that the opportunity microcredit create is very important for poverty alleviation. Majority of the participants do not consider microcredit as an effective or viable adaptation strategy. The discrepancy here has been created differently. The study participants, especially women are not much interested to get involved in the program. One reason is that, they believe, this program may offer better opportunity to the poor women, but actually the system is in the control of household head -who are men. There are many examples they cite where, after taking loans, women are to handover the loan money to their husbands and the money is used for other purposes such as men's businesses or as dowry for daughters' wedding. As a result, women fail to repay or reimburse the loan leading to extreme poverty and pauperization. Their husbands do not support much in the time of reimbursement.

8.6.3.4 Gender in safety net programs

Safety net programs are very popular techniques to address problems that are directly connected to poverty. These are very common in least developed and developing countries. Among a good number of safety net programs, the Employment Generation Programme for the Poorest (EGPP) is often chosen and applied safety net programme in the study areas. EGPP is offered by the government of Bangladesh with the support of World Bank. The beneficiaries for this programme are selected from vulnerable categories through a priority list. The participants receive food or money in return to the work they perform in public works offered by government and its partners/ associated organizations or agencies. Employment or works usually include repairing partially damaged embankment, eroded road network, canal excavation, maintenance of public infrastructure, road-side tree plantation, watering and nurturing seedlings etc. However, the selection process of beneficiaries often becomes questionable, and some of the respondents accuse of politicization and nepotism in the process. The 'own people' of elected representative[14] often get selected, depriving the 'real poor'. The process is gender unfriendly as well; more male got the opportunity than the female.

The support from EGPP is minimal as reported, and it is untimely as well. Usually the EGPP is offered at a time when there is shrinking working opportunities and the poorest daily laborerers and wage earners may be benefitted with this programme. But in practice the working opportunity offered two to three months later than the expected time period, and working opportunity started appearing by that time. As women can be less involved with this opportunity, the poorest female headed households often fail to draw the benefits it offers. Therefore, this can no longer be considered as the powerful adaptation for women and for female headed households within community.

8.6.3.5 Capitals as barriers to adaptation

Among the five types of capital stated earlier, only three of them can be stated as tangible. They are physical, natural and financial capitals. Physical resources include the public infrastructure like

[14] Chairman or Members of the Union Parishad-the lowest tier of Local Government

buildings roads, bridges, and such other physical communication networks, and public transports. Both study villages have better communication roads but communication is disrupted heavily in cases of flooding caused by overflow of river water and in case of embankment breaching. Respondents maintain that in cases of such waterborne problems, female headed households face more challenge than male headed households. Men have better knowledge and information about weather condition and forecasts, communication issues, market information etc. than female headed households, and therefore the former have greater chance to survive than the latter.

The farming practices remains in the domain of men, as they own the farming tools (the tilling machine, power-tiller or traditional plough and oxen, weeding tools, spray machines) they have better control over farming.

Natural asset include farmland, grazing land, forest land and forest resources etc. Most of these resources are owned by government and people have little control over them. The ownership of farmland and gazing areas lies in various communities, but ultimately it is government who poses the ultimate ownership and control over these. The discrepancy can be observed only when the landownership is designed within households. It is observed that the female members of households usually receive unequal share, usually very smaller portion of land and male receive the larger part. The female headed households, thus, have chance to less inherited land, unless their husbands possess or inherit sufficient amount of land. Female headed households with less amount of land are to face greater difficulty and have less chance to survive in case of emergency.

Households can be benefitted from grazing lands only if they own livestock. As Chandgarh is suffering long from salinity and breaching problem, people usually cannot rear livestock because lands are not suitable enough for grazing. The people of Baro Aria are benefitted as frequency of breaching is less there. Both male and female headed households possess livestock. However, female headed households own lesser number of livestock and poultry than men. Women are also less in running large business involving poultry and livestock.

Financial capital may include the income from agricultural farm and laboring activities. The female headed households, in both cases, get a very unequal share in comparison to male headed households. This study also observed that the former one has less bargaining power, and agreeing with familiar ones, or the man who proposes first, try to keep the agreement as part of keeping good understanding with them. The female headed households consider themselves as vulnerable and also maintain that any type of confrontation in socioeconomic matter may create further vulnerability for them. [show link with table]. In terms of their income from causal laboring activities, women also receive disproportionate amount compare to their male counterpart. In support, it was frequent argued by the men participants that women are physically less capable than men, they can produce less within a given time, even they become sick more frequent than men etc. At times, the demand of female labor arises, in the middle of cultivation and harvesting period. This is because of the lower wages and the availability of vast number of poor female workers across the villages. Income from non-farm work like public works is available in a very limited scale and covers a very smaller section of the poor. The female headed households receive very small opportunity in those works. Income from homestead livestock is another non-farm income area, and it is observed that due to salinity problem and lack sufficient grazing land, the people of Chandgarh raise limited number of livestock and poultry. The households of Baro Aria rear livestock and poultry but the number of raised animals is disproportionate for female headed households and male headed ones, women possess less than men. The male headed households in the villages of Baro Aria have more poultry farms primarily for sale only.

The other two types of resources- namely human and social capital, can be portrayed as intangible resources through which community people can be benefitted greatly in the time of normalcy and crisis. These two capitals have a powerful influence on the adaptation measures for the community people.

Lack of human capital, their knowledge on farming practices, sowing time, weather forecasts and prediction, training on farming practices, sufficient skill -often play as a powerful barrier to the adaptation strategies of female headed households. The male headed households receive almost all

types of information and, therefore, receive 'true' benefits of farming. Whereas gendered regulating norms often deter women to occupy sufficient human capital on farming knowledge and practice as per knowledge and information. Female headed households farming are few and run with the support of adult son or relative such as brother. Others practice sharecropping and receive small benefits from their own farmland. In this condition the ownership cannot be a powerful or viable technique for adaptation.

Social capital is another intangible resource and composed of social relations, kinship, social bondage and networks through shared activities. Connectivity helps people and their families to exist in meaningful and enjoyable environment. People can get benefit of it during normalcy and in crisis. Social capital help people and their families to survive when a they need support during their most critical time. The social connectivity helps individuals and families to survive and perform better even in hard time.

8.7 Discussions and concluding note

The adaptation strategies to waterborne challenges vary in time and space. The adaptation strategies are dynamic and complex process. Though different factors play crucial role and influence the adaptation process and strategies taken by communities in general, homogeneity may play a significant role in this process. However, households that are heterogeneous in nature face the waterborne challenges differently and take context specific adaptation strategies. Households that have gender-based differences (headed by female or male) experience differential rules or regulation or freedom, and access to resources. The sense of empowerment or vulnerability associated with household identity creates the significant differences in their ability to pursue better adaptation strategies. It is certainly evident that gender-based differences shape the adaptation process and possibilities for men and women in a very different way. The present study reaffirms that findings. It is also evident that the male headed households have more diversification opportunities than female headed households (Mersha and Laerhoven 2016) and this study also confirms this claim. Present study also observes that the male headed households in both farm and nonfarm sector, have more chance and freedom to move anywhere, have better human and social

capital, greater chance to succeed in farming activities, better storage capacity, have better seasonal and temporary migration opportunity, almost no problem to raise voice, more opportunity to be involved in government offered public works or various programs offered by other than government agencies.

Gendered culture -institutions, norms, rules, practices, mores, and sanctions- have greater influence (as pressure) on female headed households which often deter them to take part in farming activities like plowing, managing farming materials, apply pesticides and fertilizers etc. The gendered norms often appear them in the form of 'taboo' for community female workers. These barriers have significant and differential impacts on the adaptation strategies adopted by female and male household heads. The female headed households often in the passive role, and try to alter themselves in line of patriarchal norms, rules and regulations.

The condition of five capitals also has a differential possession and impact in female and male headed households. The male headed households often have a stronger human capital, farming knowledge and information, necessary skills and trainings. The female headed households lack such opportunities, because training and service providers consider the farming knowledge and skill should be provided to the male, as farming is the job for male. the male heads perform better in maintaining social networks which enable them to receive better support for choosing better adaptation strategies and survival during emergencies, whereas the women heads maintaining networks among close kin and relatives and therefore have less chance to choose better adaptation strategies. The social capital, therefore, have differential role to serve male and female heads.

In terms of financial capital, women have less chance to livelihood diversification than the male heads. Restrictive norms often deter female heads to engage hard farm work like plowing. Though some of them have land but are compelled to engage in discriminatory sharecropping relations, as they have less bargaining power and try to stay in harmony rather than bargaining may deteriorate social relation, and therefore they prefer to defer financial benefits and stay in harmony. They cannot start a new business, as they lack such capital or willingness to do so. Their mobility for

better work opportunities are also very limited, which leave them less chance to adopt more viable adaptation strategies.

The findings of this study have a clear implication to the long-cherished discussion on the effective adaptation strategies while facing waterborne challenges like flood, breaching and salinity problems. The previous studies successfully show the connection between the adaptation strategies that have connection with both climatic and non-climatic factors (Biesbroek et al 2013, Adger et al 2009). This study tries to deeply understand how those adaptation strategies can be less effective through gender leans. It should be noteworthy that if the possible drawbacks are considered with greater care, the gendered adaptation disparity can be mediated in a more effective manner. It should be noted that, this study suggests that using livelihood capitals in the discussion of adaptation strategies can have a far more positive implication as these capitals broadly lays the foundation of human livelihood and survival strategies. Along with the capitals, the possible shocks are also taken into consideration in sustainable livelihood framework; it is now time to address the possible drawbacks. With the application of sustainable livelihood framework, present study aimed to see how these capitals works in the time of shocks like waterborne challenges, and how these capitals should be used as a means of survival strategies. It also provides empirical evidences and addresses the way gender should be considered in a more meaningful way in terms of livelihood adaptation strategies. It also explicates the ingredients of gendered culture and the way they create powerful barrier to the adaptation strategies of women, and how the same culture offers more freedom to the intra community males. The present study argues that the livelihood adaptation strategies, as offered by various frameworks like SLA, can have impressive implication if those include gender sensitive results as this study offers. That policy revision may remove the gendered restriction and barriers of effective adaptation strategies and also offer a broader meaning and arena with greater freedom to the community people -irrespective of race, gender and ethnicity.

Due to serious alteration in climatic scenario and factors, our planet is undergoing a tremendous global environmental change. Climatic shocks are altering geographical location in greater speed than ever before. The emerging interest concentrates on how communities can find effective

adaptation strategies those may offer benefits for community. In doing so, effective policies should enrich themselves by eliminating discriminatory ingredients and trying to the more polishing. This research offers new findings that can focus new insights to the rich discussion of adaptation strategies. There exists a broader understanding on the negative impacts of barriers which influence the adaptation strategies (Bies-broek et al. 2013) but this research shows the way the negative impact of barriers affects male and female heads differently. Through addressing these realities, it will be possible for policy makers to design effective and durable adaptation strategies than can offer better opportunities to community people. Effective policy should address the differential negative effects of barrier so that some section may not be affected in a very different way than other.

The study presents empirical evidences to account how the barriers of adaptation strategies may have gendered impacts. Government, development partners and policy makers may be benefitted with the findings and suggestions this research is pursuing. If the associated stakeholders design the policies in a more inclusive and comprehensive manner, those can offer better adaptation solutions to the community members those are facing various waterborne challenges. It will be serious mistake if policies fail to address these issues in a more inclusive manner, which may lead further discrepancy among different agents, in terms of race, gender or ethnicity. Policy drawbacks may lead the most vulnerable, disadvantaged and weaker section of communities to further vulnerability.

Chapter Nine: Conclusions

9.1 Introduction

The coastal rural livelihoods in southern Bangladesh are primarily agriculture-based. Households with various socioeconomic background practice agriculture in order to ensure goods and services, specially the production of food and fiber to meet family needs and is largely dependent on water availability. For irrigating agricultural fields, fresh water is the prerequisite. A number of other drivers also play crucial role in agricultural production, which include natural or bio-physical, economic or financial, institutional, technological, and physiological. As local agriculture-based livelihood often shifts or gets affected by a factor or combination of factors, it is crucial to have an understanding of the pathways of influence of these drivers.

Agriculture in many parts of South Asia can be directly influenced by seasonality and rainfall variability. This matter is true for the study population and nearby villages. The over-dependent rain-fed agriculture-based rural livelihoods can be badly affected if there is water shortage or the irrigated water quality is not suitable (saline, for example) enough to produce crops. Saline water-bodies in near-to agricultural fields may also adversely affect the growth and production of crops. These statements were evident in water-stressed villages, leaving people in vulnerable condition over time.

The study households fall in various categories. Rich farmers invest on own land and water for producing more crops, where the off-farm day laborers often do not have this opportunity. Agricultural fields that are managed by wealthy farmers and are not rainwater dependent only, use shallow-pumps to draw groundwater for irrigation, have better chance in boosting agricultural productions. In such cases, the technology allows them to produce and draw more than one crop in a year. Such production also needs the quality ground water and accessibility to ground water table.

The sharecroppers often try to invest in water for better crop production. Farmers who do not have the capacity to afford such technology or to pay the provider are compelled to limit their production in rainy season only. All of these factors largely affect agricultural production and rural agriculture dependent livelihoods. The households with limited or no resources may receive the worst shock from water-borne problems.

The existing water-livelihood connections becomes worsen if the situation is further exacerbated by water-related hazards and challenges. As the present study shows, both have a dramatic impact on the agricultural fields, and the soil fertility been reducing suddenly or in the long run.

9.2 Revisiting conceptual framework

Water insecurity is the key challenge for the villagers for their life and livelihoods. Managing fresh irrigation water is one of the major challenges in the study villages. The water itself has become a problem for the villagers. Both fresh drinking and irrigation water inevitability poses a significant challenge for their life and livelihoods as the livelihoods of the participants are agriculture dependent. The irrigation water source is twofold -rainwater and river water. Agriculture fields that are solely dependent on rainwater are often affected by seasonality or untimed rainfall. The ground water table is not suitable enough to irrigate their fields, in some areas the water is not edible or too brackish. Some of the farmers depend on river water, which is saline and not suitable for agricultural production. Sufficient amount of rainfall reduces the saline level of river-water and that time the farmers can use that water to irrigate their fields, but for limited time. After the time, the saline level goes up which harm the agricultural production. Both the fresh irrigation water inevitability and the water quality

Another threat poses by river is the embankment breaching and saline water intrusion to the agricultural fields. The villages experienced eight major breaching in last fifteen years. Each time few nearby villages get inundated. The frequent cases of saline water intrusion gradual alter the soil quality and make it less productive for crop production. The saline water not only causes harm to

crop fields, the homestead gardening of the villagers was seriously affected. The water insecurity thus, poses the vital threat for the livelihoods of villagers.

Most of the hazards that the villagers facing currently are waterborne. The key concerns of the villagers include the salinity and riverbank erosion which force many families to migrate elsewhere in last fifteen years.

As mentioned early, two water insecure villages have experienced nearly eight times of major riverbank erosion in last fifteen years, the villages always remain in further threat of further riverbank erosion. The villagers become alert when the weather condition becomes anomalous, they usually collect and updated themselves regarding current weather reports. Such hazard promotes them to be concerned with their livelihood and household maintenance during emergencies. The hazardous context often impacts their resilience and adaptation strategies during and post event periods.

The poor resource base is considered the key reason of poverty along with the waterborne challenges which are prevailing in the coastal belt. Most of the residents are from poor background. The present study also focuses on this context, the major part of the villagers participated in present study are from poor and extreme poor background. They simultaneously construct the and maintain the vulnerable contexts. The people who are rich and upper-middle class are usually rich because of their strong resource base, and most of the cases those are inherited. It does not necessarily mean that the rich people are not evolving currently. There are evidences which shows, the rich people has been losing (some of them already lost almost everything) managing their threats in advance and afford strategies those are often deserves much pay which poor often fail to afford. The poor people in most cases fail to afford, and therefore have less capability to adopt better strategy or better and viable adaptation measures which push them to further vulnerability. The better strategies help reach households to lift out of vulnerability, which ultimately help them to keep and diversify their livelihoods. On the contrary, the poor do not have the capacity and fall in further vulnerability, which push them and compel often, to change their livelihood, as the agriculture-based livelihood systems are affected due to waterborne challenges.

However, there are some examples of the people among the community who are evolving as rich people recent past. These people are panning very differently. These people usually do not invest more within area, rather their investments are very seasonal and careful, as they measure their area as vulnerable, so they manage the business capital and invest on their children's education, doing something in city area. Whereas the poor and extreme poor households often seasonally migrate to city areas and comeback own villages when work opportunity has been created in rainy seasons.

Thea access to agriculture is heterogeneous to different wealth class. The rice-poor divide can be observed more clearly in this regard. The rich landlords are engaging into agricultural activities directly. On the one hand, the local landlords engage in agricultural activities with engagement of agricultural wage laborers. In this case, the landlords have their necessary inputs. The agricultural outputs are not need to be shared. But this practice is not very frequent in the study villages.

Usually, the local rich landlords choose the second method, to lease out their lands to local sharecroppers. The sharecroppers take the necessary risks and try to grow crops and extract better outputs. The smallholder households usually lack such opportunities. The poor and extreme poor households search for better alternative, as they often fail to afford agricultural lands and also they are unable to take the associated risks.

The poor people do not have the necessary access to agricultural activities. They lack sufficient amount of ingredients. The poor and extreme poor households do not have agricultural land and capital to continue their agriculture-based livelihoods. Many of them have small plots of land, but they are less motivated, because of salinity and riverbank erosion. The gradual alteration of soil quality affect agricultural production very negatively, and therefore the residents are less interested in practicing agriculture. It is; therefore, people of all wealth class are less willing to practice agriculture. The poor and extreme poor households have additional barrier like inaccessibility to

agriculture practices. In combination, these factors propel the vulnerability of the poor to the waterborne challenges.

As mentioned earlier, the agriculture-based livelihoods are undergoing a massive change in recent years. The people with better resource base have connection with agricultural activities in different scale, but the people with poor resource base losing their connection with agriculture-based activities. Though the rich people have chance and usually practice the livelihood diversification, the poor and extreme poor have less or no chance to follow such activities.

Adaptation strategies are needed to cope with waterborne challenges and to maintain the family expenditure. The households take different measures and strategies to cope with waterborne challenges and risks. The said strategies are not homogeneous by nature. They are different and presents the capacities of various households with heterogeneous wealth profiles. The rich households usually take better strategies, as they afford to buy viable and flexible strategies, whereas the poor has minimal choice and often compelled to take strategies whatever they can manage. It was observed that the poor and extreme poor households take strategies that are more fragile, and not viable enough to face waterborne challenges and risks.

The type of strategies adopted by rich households are stronger and more viable. Rich landlords often lease out their agricultural and to various sharecroppers for longer years and thus transfer the waterborne risks. many rich families have migrated to the nearby Khulna city and occasionally come to village to collect money from sharecroppers. Many rich families have sold their cultivable and homestead land and permanently migrated to Khulna, and thus avoided their risks.

The poor people, however, do not have the choice. They cannot move elsewhere with their limited or no resource. The type of strategies adopted by the poor households are weaker and fragile. Poor and extreme poor household members choose to work as seasonal laborers, work in various non-farm activities within and far villages, seasonally migrate to cities and work there for few months

and come back to villages with no savings. The lack of fixed jobs makes these households more vulnerable. They cannot follow their traditional farm-based practices; therefore, they are gradually leaving their agriculture-based livelihoods in recent years.

Poverty, in the end, is observed as an obvious and unavoidable consequence of most of the poor and extreme poor households. Theses households fail to save money for their family maintenance for crisis period, and therefore fall into further vulnerability. The crisis period, caused by various waterborne challenges, compel theses households to fall further into poverty trap. The poor and extreme poor households hardly succeeded to avoid this poverty it, as they do not have any strong mechanism to fight against it.

There were evidences that many rich households have become pauper due to embankment breaching as their cultivable and homestead lands were gradually engulfed by the river. Few pauper families are still staying within area and are living on by hands and mouth. Water insecurity is the sole reason behind their vulnerability, pauperization and poverty.

It is important to note the way resource base are continuing. The households with poor resource base are staying blow from the very beginning, even before breaching started. These families were solely dependent on agricultural activities and various agriculture related seasonal works throughout a year. with the introduction of waterborne challenges, the agricultural practice has been diminishing in a considerable scale which poses threat to the poor and extreme poor households. These agriculture dependent households therefore searching seasonal jobs -range from farm activities in far villages or various nonfarm activities within and remote areas. The people of wealthier classes have been managing to diversify their livelihoods, which the poor households fail to follow. Weaker social networks and poor social capital of poor households fail to show any hope to reduce poverty in future.

9.3 Connecting the findings to address the study objectives

The first objective of this research was to explore the socioeconomic base of the study population and their connection to agriculture-based livelihoods. Doing research in line of that objective explores the socioeconomic conditions of the households which were deeply rooted with agriculture. While very few households were rich and upper-middle class, and rest majority fall in lower-middle and poor category. The livelihood practice of the of the residence is undergoing a notable transformation which started with the embankment breaching and continuing erosion events.

The changing scenario of agriculture-based livelihoods of the poor and extreme poor households is the major concern for this research. It is observed that the livelihood practices of the poor and extreme poor households have changed to nonfarm activities in a greater scale than the wealthier category. households of water-stressed villages with small plots of land are reluctant to invest on their lands, with a fear to get expected production outcome of that investment. The key challenges are there are salinity, tidal water intrusion (when tide is high) and embankment breaching. The households in stressed villages are also suffering from the lack of fresh irrigation water, as the ground water-table cannot offer quality water from farming. Therefore, the lack of fresh irrigation water also playing the vital role in diminishing agriculture practices across the villages in polder 29.

Objective two have a clear focus on poverty, and is to find out the drivers of poverty. The water-related drivers also received a major treatment in this chapter. A range of drivers have been identified in the study villages, which are very familiar reasons of poverty across the countries, behind the gradually lower profiles of the most of the households in the villages. The central focus was on the income sources of the households, whether the main income source is agriculture-based or not, what are the main reasons of nonfarm activities, the reasons behind aquaculture is receiving much importance for some households, the earnings from nonfarm activities and household expenditure, the reasons why most of the households are not following their traditional agriculture-based practices, role of irrigation water in their agriculture practices, nature of waterborne challenges residents are facing, the role of salinity, embankment breaching and the tidal water

intrusion in agriculture practices, which adaptation strategies the people value and why most of the households cannot adopt such strategies. The quest of these questions has successfully revealed a range of factors which have been depicted in chapter six.

In line of treating poverty through its multidimensional nature, the identified drivers tell how the residents are experiencing poverty over the years with major threats by waterborne challenges. The reach households have better adaptation strategies whereas the poor and extreme poor households do not have such. The weaker adaptation strategies do not help them much, rather turning back and push these households to further fall in poverty-trap. The vulnerable households do not find any better avenue to lift out of poverty over time.

The differential adaptation strategies offer differential outputs across the households. The stronger adaptation strategies help wealthier households to avoid major risks and keep them in stable condition. they can manage better income by investing elsewhere and livelihood strategies, they can invest on the education of their children. They transfer their lower production through leasing out their cultivable lands that are in vulnerable to riverbank erosion and tidal water intrusion. Many rich families migrated to nearby cities like khulna and sold out their agriculture and homestead lands, some families stay in city and just leased out their rural land to capable farmers. There are some wealthier households, who stay within villages, practice agriculture through sharecropping, invest their money and time for various other businesses. Livelihood diversification is the popular strategy for the wealthier households. In sum, the power of avoiding the risks keep wealthier households in better position than others.

The strategies of the poor and extreme poor households are very different from the wealthier. Families who have small amount of agriculture land or landless day laborers fall into these categories. The most of them were engaged in agricultural activities over generations with little or no improvement. After the introduction of waterborne challenges, many families who were middle or lower middle wealthier category, lost their agricultural fields and homestead lands. The traditional and resulting poor (newly poor) households are suffering from lack of sufficient

agricultural practices by others. waterborne challenges create adverse impacts not only for the people who have been farmer and sharecropper but also the people who were agriculture laborer and depend on agriculture in a quite different way. The poor and extreme poor households are, therefore, searching alternative livelihood strategies whether they are agricultural or nonfarm. They have less opportunities to diversify their livelihoods, as they neither have sufficient capital to invest in other fields nor have such human capital to lift out of poverty.

9.4 Study implications

Present study clarifies that the waterborne challenges create differential impacts on different wealth groups and also created situations to lifting toward poverty. Different wealth class households do not have similar adaptation capacity to install and therefore adopt different capacity driven adaptation strategies. In combination, these matters created impacts on the livelihoods of different wealth class households where poor face most deterrence toward their traditional agriculture-based livelihoods. This study shows that a more sustainable and equitable approach may help residents to avoid vulnerable conditions caused by waterborne challenges. The sustainable and pro-poor policies may help poor and extreme poor households to lift out of poverty trap and continue their livelihoods. The expected strategies need to ensure their livelihood protection in the face of waterborne challenge.

It is argued that the integrated coastal zone management may achieve better agricultural production and also protect inhabitants from natural disasters without harming ecosystem health or damaging human wellbeing. A comprehensive or inclusive policy may help to ensure such goals. The existing single sector approach is not appropriate enough as there is duplication of roles from various government agencies and have chance for possible contradictions among a number of legal documents. To address the poverty issue, the government passed ‘National Shrimp Policy’ in 2014 but this helps rich households than the poor. Intensive aquaculture practice in coastal zone introduces salinity in many agricultural fields and altered soil quality. Agriculture-aquaculture rotational studies was initially considered lucrative but proved wrong in later years, as the soil quality was gradually declining. The resource poor farmers usually take loan from various agencies

and individuals with high interest to cover the start-up costs, many of them successfully reimburse or repay the money while others indebted (Ahmed and Garnett 2010) and fall in poverty trap.

9.5 Ideas for future research

This research was conducted on coastal communities with a view to explain the differential impacts of waterborne challenges and how the different households face those with their different adaptation strategies in line of their resource base and various other capacities. Another focus of this study was to see how the poor and extreme poor households are perceiving the problems and how do they choose their adaptation strategies, which increase or decrease their vulnerabilities. This study did not focus on rigorous examinations of government institutions and their activities regarding the study problems. Separate studies may explore the interventions from the government agencies and their fruitfulness, which is not the key concern for this study. This study intended to see the way different power dimensions, in the form of their resources and associated socioeconomic status, help households to shape their own adaptation measures and coping strategies.

It is important to protect livelihoods of the vulnerable groups in particular, the people whose livelihood alteration may push them to further vulnerability. In the waterborne villages, this is the actual scenario for the poor and extreme poor households. Livelihood protection in advance keep some groups in better position in the face of waterborne challenges in vulnerable areas like coastal zones. To protect the main livelihoods of the vulnerable communities, it is urgent to take a clear measure of key livelihood options of them. The measurement in advance may help the vulnerable community not to lose their livelihood options. If carefully planned strategies can be implemented in advance, keeping the waterborne challenge in center, the poverty occurrence can be handled in a more meaningful way.

Another important measurement can be the concentration on the construction dams and some other structural interventions. Such interventions may reduce or stop the recurrence of destructions of agricultural possibilities, the key livelihood opportunities of before riverbank erosion

and breaching such intervention also stop the possibility of poverty within the vulnerable communities. Determent of erosion in advance (along with placing in right place) will help communities in advance to protect their livelihoods and continue better agricultural practices.

Adaptive governance may play a role in this regard by takin proactive measurement and actions. For adaptative governance, support is needed from layered institutions (considering complexity and redundancy), institutional diversity (a combination of state, market and community organizations) at different levels, joined by formal and informal social networks. With the installation of diversity and flexibility adaptative governance and related institutions may offer sustainable opportunities and also introduce transformation to an expected state when needed which may introduce better solutions for waterborne challenges.

In this regard, research is required aiming to address better institutional response, sharper policy interventions and administrative reforms which ultimately ensure flexible responses, knowledge and reorganization. Research is needed also on social connectedness and networks, developing linkage with social capital, promote the exchange of knowledge, revive and introduce social norms and rules as well as take necessary actions. The wealthier households, in this research, are capable of investment or managing money for their new business, or investing in agriculture and other fields, but the poor needs to depend on borrowing or taking loan with high interest from others. The poor and extreme poor of both water-stressed villages are reluctant to follow such strategies (managing loans and investing that money). On the contrary, the poor households in water-managed village are willing to follow, as they do not face the risk of waterborne challenge or disasters and hoping to repay the loan with better crop output. In both cases, social networks play a significant role, but very in terms of their risk and vulnerability. The social networks and bondage in water-stressed villages is not as strong as managed village. The water-managed village can ensure better social capital than the water-stressed villages, which looming the future vulnerability of poor households and further falling into poverty-trap. Further research can concentrate on the more balanced approaches to address the poor facing waterborne challenges with a combination of

theoretical diversity and knowledge with a improved understanding of future adaptation strategies of the poor which may ensure equity for the households with heterogeneous background.

References

Abdullah, A. N., Myers, B., Stacey, N., Zander, K. K., & Garnett, S. T. (2017). The impact of the expansion of shrimp aquaculture on livelihoods in coastal Bangladesh. *Environment, Development and Sustainability*, *19*(5), 2093–2114.

Agarwal, B. (1987). Under the cooking pot: The political economy of the domestic fuel crisis in rural South Asia. *IDS Bulletin*, *18*(1), 11-22.

Aluko, F., & Arowolo, D. (2010). Foreign aid, the Third Worlds debt crisis and the implication for economic development: The Nigerian experience. *African Journal of Political Science and International Relations*, *4*(4), 120-127.

Antwi-Agyei, P., Stringer, L. C., & Dougill, A. J. (2014). Livelihood adaptations to climate variability: insights from farming households in Ghana. *Regional Environmental Change*, *14*(4), 1615–1626.

Aregu, L., Choudhury, A., Rajaratnam, S., Locke, C., & McDougall, M. (2018). Gender norms and agricultural innovation: Insights from six villages in Bangladesh.

Assan, J. K. (2014). Livelihood Diversification and Sustainability of Rural Non-Farm Enterprises in Ghana. *Journal of Management and Sustainability*, *4*(4). https://doi.org/10.5539/jms.v4n4p1

Barau, A. A., Afrad, M. S. I., Rahman, M. S., & Rahman, M. A. (2019). Indigenous peoples' livelihood practices in south-eastern Bangladesh and the question of sustainability. *Sustainable Development*.

Basu, S., Mate, K., & Farmer, P. E. (2000). Debt and poverty turn a disease into an epidemic. *Nature*, *407*(6800), 13-13.

Biswas, W. K., & Lucas, N. J. D. (1997). Energy consumption in the domestic sector in a Bangladesh village. *Energy*, *22*(8), 771-776.

Boyce, J. K. (2000). Let them eat risk? Wealth, rights and disaster vulnerability. *Disasters*, *24*(3), 254-261.

Bradshaw, S. (2013). *Gender, development and disasters*. Edward Elgar Publishing.

Briscoe, J. (1979). Energy use and social structure in a Bangladesh village. *Population and development review*, 615-641.

Barrett, C. B., Reardon, T., & Webb, P. (2001). Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food Policy*, *26*(4), 315–331.

Becker, E., & Jahn, T. (2001). Social-ecological research-conceptual framework for a new funding policy: Synopsis of the Report for the German Federal Ministry of Education and Research. *Nature Sciences Sociétés*, *9*(1), 73–77.

Berman, R., Quinn, C., & Paavola, J. (2012). The role of institutions in the transformation of coping capacity to sustainable adaptive capacity. *Environmental Development*, *2*, 86–100.

Blackwood, D. L., & Lynch, R. G. (1994). The measurement of inequality and poverty: A policy maker's guide to the literature. *World Development*, *22*(4), 567–578.

Bryan, E., Deressa, T. T., Gbetibouo, G. A., & Ringler, C. (2009). Adaptation to climate change in Ethiopia and South Africa: options and constraints. *Environmental Science & Policy*, *12*(4), 413–426.

Carney, D. (1998). Sustainable livelihoods. *Sustainable Livelihoods: What Contribution Can We Make*.

Carr, N. (2005). Poverty, debt, and conspicuous consumption: university students tourism experiences. *Tourism Management*, *26*(5), 797-806.

Casey, C., & Alach, P. (2004). 'Just a Temp?' Women, Temporary Employment and Lifestyle. *Work, employment and society*, *18*(3), 459-480.

Chambers, R. (1997). Editorial: Responsible well-being - A personal agenda for development. *World Development*, *25*(11), 1743–1754. https://doi.org/10.1016/S0305-750X(97)10001-8

Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: practical concepts for the 21st century*. Institute of Development Studies (UK).

Chand, R. (2014). *in Punjab Agriculture Emerging Crisis*. *34*(13), 1–10.

Chapagain, P. S., Ghimire, M. L., & Shrestha, S. (2016). Situation of springs, groundwater spring potentiality and gender roles in water management: a study of Melamchiarea, Sindhupalchok, Nepal. *Building*

Knowledge for Climate Resilience in Nepal: Research Briefs. Nepal Academy of Science and Technology, Lalitpur, 87–92.

Christensen, J. H., Hewitson, B., Busuioc, A., Chen, A., Gao, X., Held, I., … Laprise, R. (2007). *Regional climate projections. Climate change, 2007: the physical science basis. Contribution of Working group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*.

Choudhury, M. U. I., Uddin, M. S., & Haque, C. E. (2019). "Nature brings us extreme events, some people cause us prolonged sufferings": the role of good governance in building community resilience to natural disasters in Bangladesh. *Journal of Environmental Planning and Management*, *62*(10), 1761-1781.

Clancy, J. S., Skutsch, M., & Batchelor, S. (2003). The Gender-Energy-Poverty Nexus: Finding the energy to address gender concerns in development. *DFID project CNTR998521*.

Conway, G. R. (1987). The properties of agroecosystems. *Agricultural Systems*, *24*(2), 95–117.

Curry, G. N., Koczberski, G., Lummani, J., Nailina, R., Peter, E., McNally, G., & Kuaimba, O. (2015). A bridge too far? The influence of socio-cultural values on the adaptation responses of smallholders to a devastating pest outbreak in cocoa. *Global Environmental Change*, *35*, 1–11.

De Haan, L., & Zoomers, A. (2005). Exploring the frontier of livelihoods research. *Development and Change*, *36*(1), 27–47.

Dent, M., & Peters, B. (2019). *The crisis of poverty and debt in the third world*. Routledge.

Doberstein, B., & Stager, H. (2013). Towards guidelines for post-disaster vulnerability reduction in informal settlements. *Disasters*, *37*(1), 28-47.

Dowler, E. A., & O'Connor, D. (2012). Rights-based approaches to addressing food poverty and food insecurity in Ireland and UK. *Social science & medicine*, *74*(1), 44-51.

Ellis, F. (2008). The Determinants of Rural Livelihood Diversification in Developing Countries. *Journal of Agricultural Economics*, *51*(2), 289–302. https://doi.org/10.1111/j.1477-9552.2000.tb01229.x

Enarson, E., & Pease, B. (Eds.). (2016). *Men, masculinities and disaster*. Routledge.

Everard, M., Gupta, N., Scott, C. A., Tiwari, P. C., Joshi, B., Kataria, G., & Kumar, S. (2019). Assessing livelihood-ecosystem interdependencies and natural resource governance in Indian villages in the Middle Himalayas. *Regional Environmental Change*, *19*(1), 165–177.

Fall, A., Goulet, L., & Vézina, M. (2013). Comparative study of major depressive symptoms among pregnant women by employment status. *Springerplus*, *2*(1), 201.

FAO. (2016). *FAO in Ethiopia. El Niño Response Plan 2016*. Retrieved from http://www.fao.org/emergencies/resources/documents/%0Aresources-detail/en/c/380012/. %0A

Filmer, D., & Pritchett, L. H. (2001). Estimating wealth effects without expenditure data—or tears: an application to educational enrollments in states of India. *Demography*, *38*(1), 115–132.

Gifford, R. (2011). The dragons of inaction: psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, *66*(4), 290.

Goffner, D., Sinare, H., & Gordon, L. J. (2019). The Great Green Wall for the Sahara and the Sahel Initiative as an opportunity to enhance resilience in Sahelian landscapes and livelihoods. *Regional Environmental Change*, 1–12.

Grey, D., & Sadoff, C. W. (2007). Sink or swim? Water security for growth and development. *Water Policy*, *9*(6), 545–571.

Grothmann, T., & Patt, A. (2005). Adaptive capacity and human cognition: the process of individual adaptation to climate change. *Global Environmental Change*, *15*(3), 199–213.

Haque, A., & Jahan, S. (2015). Impact of flood disasters in Bangladesh: A multi-sector regional analysis. *International journal of disaster risk reduction*, *13*, 266-275.

Hoque, S. F., Quinn, C., & Sallu, S. (2018). Differential livelihood adaptation to social-ecological change in coastal Bangladesh. *Regional Environmental Change*, *18*(2), 451–463.

Hines, R. I. (2007). Natural disasters and gender inequalities: The 2004 tsunami and the case of India. *Race, Gender & Class*, 60-68.

Hunter, L. M., Luna, J. K., & Norton, R. M. (2015). Environmental dimensions of migration. *Annual Review of Sociology*, *41*, 377–397.

Hussain, I., & Hanjra, M. A. (2003). Does irrigation water matter for rural poverty alleviation? Evidence from South and South-East Asia. *Water Policy*, *5*(5–6), 429–442.

Ibem, E. O. (2011). Challenges of disaster vulnerability reduction in Lagos Megacity Area, Nigeria. *Disaster Prevention and Management: An International Journal*.

Islam, M. M., Sallu, S., Hubacek, K., & Paavola, J. (2014). Limits and barriers to adaptation to climate variability and change in Bangladeshi coastal fishing communities. *Marine Policy*, *43*, 208–216.

Ingram, J. C., Franco, G., Rumbaitis-del Rio, C., & Khazai, B. (2006). Post-disaster recovery dilemmas: challenges in balancing short-term and long-term needs for vulnerability reduction. *Environmental science & policy*, *9*(7-8), 607-613.

Jones, L., & Boyd, E. (2011). Exploring social barriers to adaptation: insights from Western Nepal. *Global Environmental Change*, *21*(4), 1262–1274.

Juran, L., & Trivedi, J. (2015). Women, gender norms, and natural disasters in Bangladesh. *Geographical Review*, *105*(4), 601-611.

Kabeer, N., & Mahmud, S. (2004). Globalization, gender and poverty: Bangladeshi women workers in export and local markets. *Journal of international development*, *16*(1), 93-109.

Kemal, A. R. (2001). Debt accumulation and its implications for growth and poverty. *The Pakistan Development Review*, *40*(4), 263-281.

Kiernan, K. E., & Mensah, F. K. (2011). Poverty, family resources and children's early educational attainment: the mediating role of parenting. *British Educational Research Journal*, *37*(2), 317-336.

Kristjanson, P., Mango, N., Krishna, A., Radeny, M., & Johnson, N. (2010). Understanding poverty dynamics in Kenya. *Journal of International Development*, *22*(7), 978–996.

Lacour, M., & Tissington, L. D. (2011). The effects of poverty on academic achievement. *Educational Research and Reviews*, *6*(7), 522-527.

Lang, T., & Caraher, M. (1998). Access to healthy foods: part II. Food poverty and shopping deserts: what are the implications for health promotion policy and practice?. *Health Education Journal*, *57*(3), 202-211.

Martin, S. M., Lorenzen, K., & Bunnefeld, N. (2013). Fishing Farmers: Fishing, Livelihood Diversification and Poverty in Rural Laos. *Human Ecology*, *41*(5), 737–747. https://doi.org/10.1007/s10745-013-9567-y

McEntire, D. A. (2001). Triggering agents, vulnerabilities and disaster reduction: towards a holistic paradigm. *Disaster Prevention and Management: An International Journal*.

Meert, H., Van Huylenbroeck, G., Vernimmen, T., Bourgeois, M., & van Hecke, E. (2005). Farm household survival strategies and diversification on marginal farms. *Journal of Rural Studies*, *21*(1), 81–97. https://doi.org/10.1016/j.jrurstud.2004.08.007

Mellado, M. A., Blanco-Wells, G., Nahuelhual, L., & Saavedra, G. (2019). Livelihood trajectories in the Chilean Patagonian region: an ethnographic approach to coastal and marine socioecological change. *Regional Environmental Change*, *19*(1), 205–217.

Mersha, A. A., & Van Laerhoven, F. (2016). A gender approach to understanding the differentiated impact of barriers to adaptation: responses to climate change in rural Ethiopia. *Regional Environmental Change*, *16*(6), 1701–1713.

Molcho, M., Gabhainn, S. N., Kelly, C., Friel, S., & Kelleher, C. (2007). Food poverty and health among schoolchildren in Ireland: findings from the Health Behaviour in School-aged Children (HBSC) study. *Public health nutrition*, *10*(4), 364-370.

Morrissey, J. W. (2013). Understanding the relationship between environmental change and migration: The development of an effects framework based on the case of northern Ethiopia. *Global Environmental Change*, *23*(6), 1501–1510.

Morrison, A., Raju, D., & Sinha, N. (2007). *Gender equality, poverty and economic growth*. The World Bank.

Naidoo*, R. (2004). Fields and institutional strategy: Bourdieu on the relationship between higher education, inequality and society. *British journal of sociology of education*, *25*(4), 457-471.

Nasreen, M. (1995). Coping with floods: the experience of rural women in Bangladesh. *Unpublished Ph. D Dissertation, Massey University, NewZealand*.

Nasreen, M. (2007). *Social Inclusion: Bangladesh case study* (Vol. 1). UNICEF Regional Office for South Asia.

Nasreen, M. (2009). *Violence against women during flood and post-flood situations in Bangladesh*. ActionAid Bangladesh.

Nasreen, M. (2012; 2019). *Women and Girls: Vulnerable or Resilient?* Institute of Disaster Management and Vulnerability Studies, University of Dhaka

Niehof, A. (2004). The significance of diversification for rural livelihood systems. *Food Policy*, *29*(4), 321–338.

Nolan, B., & Whelan, C. T. (1996). Resources, deprivation, and poverty. *OUP Catalogue*.

Orchard, S. E., Stringer, L. C., & Quinn, C. H. (2016). Mangrove system dynamics in Southeast Asia: linking livelihoods and ecosystem services in Vietnam. *Regional Environmental Change*, *16*(3), 865–879.

Palliyaguru, R., Amaratunga, D., & Baldry, D. (2014). Constructing a holistic approach to disaster risk reduction: the significance of focusing on vulnerability reduction. *Disasters*, *38*(1), 45-61.

Peters, B. (2000). The Third World debt crisis—why a radical approach is essential. *The Round Table*, *89*(354), 195-204.

Petesch, P., Badstue, L. B., & Prain, G. (2018). Gender norms, agency, and innovation in agriculture and natural resource management: The GENNOVATE methodology.

Poku, N. K. (2002). Poverty, debt and Africa's HIV/AIDS crisis. *International Affairs*, *78*(3), 531-546.

Pressman, S., & Scott, R. H. (2010). Consumer debt and poverty measurement. *Focus*, *27*(1), 9-12.

Quinn, C. H., Ziervogel, G., Taylor, A., Takama, T., & Thomalla, F. (2011). Coping with multiple stresses in rural South Africa. *Ecology and Society*, *16*(3).

Rademacher-Schulz, C., Schraven, B., & Mahama, E. S. (2014). Time matters: shifting seasonal migration in Northern Ghana in response to rainfall variability and food insecurity. *Climate and Development*, *6*(1), 46–52.

Rosegrant, M. W., & Svendsen, M. (1993). Asian food production in the 1990s. Irrigation investment and management policy. *Food Policy*, *18*(1), 13–32. https://doi.org/10.1016/0306-9192(93)90094-R

Sachs, J. D. (2002). Resolving the debt crisis of low-income countries. *Brookings papers on economic activity*, *2002*(1), 257-286.

Sachs, J., McArthur, J. W., Schmidt-Traub, G., Kruk, M., Bahadur, C., Faye, M., & McCord, G. (2004). Ending Africa's poverty trap. *Brookings papers on economic activity*, *2004*(1), 117-240.

Soludo, C. C. (2003). Debt poverty and inequality. *Okonjo-Iweala, Soludo and Muhtar (Eds.), The Debt Trap In Nigeria, Africa World Press NJ*, 23-74.

Salack, S., Klein, C., Giannini, A., Sarr, B., Worou, O. N., Belko, N., … Kunstman, H. (2016). Global warming induced hybrid rainy seasons in the Sahel. *Environmental Research Letters*, *11*(10), 104008.

Sallu, S. M., Twyman, C., & Stringer, L. C. (2010). Resilient or vulnerable livelihoods? Assessing livelihood dynamics and trajectories in rural Botswana. *Ecology and Society*, *15*(4).

Sampath, R. K. (1992). Issues in irrigation pricing in developing countries. *World Development*, *20*(7), 967–977. https://doi.org/10.1016/0305-750X(92)90124-E

Sarker, M. N. I., Wu, M., Alam, G. M., & Shouse, R. C. (2019). Livelihood vulnerability of riverine-island dwellers in the face of natural disasters in Bangladesh. *Sustainability*, *11*(6), 1623.

Scott, C. A., Zhang, F., Mukherji, A., Immerzeel, W., Mustafa, D., & Bharati, L. (2019). Water in the Hindu Kush Himalaya. In *The Hindu Kush Himalaya Assessment*. https://doi.org/10.1007/978-3-319-92288-1_8

Scheffer, M., van Bavel, B., van de Leemput, I. A., & van Nes, E. H. (2017). Inequality in nature and society. *Proceedings of the National Academy of Sciences*, *114*(50), 13154-13157.

Scott, J. L., Dex, S., & Joshi, H. (Eds.). (2009). *Women and employment: Changing lives and new challenges*. Edward Elgar Publishing.

Sen, A. (1999). Commodities and capabilities. *OUP Catalogue*.

Shackleton, S., Ziervogel, G., Sallu, S., Gill, T., & Tschakert, P. (2015). Why is socially-just climate change adaptation in sub-Saharan Africa so challenging? A review of barriers identified from empirical cases. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(3), 321–344.

Shaffer, P. (2003). Difficulties in combining income/consumption and participatory approaches to poverty: issues and examples. *Q-Squared: Qualitative and Quantitative Poverty Appraisal. Delhi: Permanent Black*, 126–131.

Statistics, B. B. O. (2011). Statistical Yearbook of Bangladesh. *Statistics Division, Ministry of Planning, Dhaka, Government of the People's Republic of Bangladesh*.

Sultan, B., & Gaetani, M. (2016). Agriculture in West Africa in the twenty-first century: climate change and impacts scenarios, and potential for adaptation. *Frontiers in Plant Science*, *7*, 1262.

Tiwari, P. C., & Joshi, B. (2014). Environmental changes and their impact on rural water, food, livelihood, and health security in Kumaon Himalaya. *International Journal of Urban and Regional Studies on Contemporary India*, *1*, 1–12.

Tse-ring, K., Sharma, E., Chettri, N., & Shrestha, A. B. (2010). *Climate change vulnerability of mountain*

ecosystems in the Eastern Himalayas. International centre for integrated mountain development (ICIMOD).

Van der Berg, S. (2008). Poverty and education. *Education policy series*, *10*, 28.

Vyas, S., & Kumaranayake, L. (2006). Constructing socio-economic status indices: how to use principal components analysis. *Health Policy and Planning*, *21*(6), 459–468.

Walingo, M. K., Liwenga, E. T., Kangalawe, R. Y. M., Madulu, N. F., & Kabumbuli, R. (2009). *Perceived impact of land use changes and livelihood diversification strategies of communities in the Lake Victoria Basin of Kenya*.

Wedgwood, H. (1855). I."On False Etymologies;" *Transactions of the Philological Society*, *2*(6), 62–72..

Weichselgartner, J. (2001). Disaster mitigation: the concept of vulnerability revisited. *Disaster Prevention and Management: An International Journal*.

Wiederkehr, C., Beckmann, M., & Hermans, K. (2018). Environmental change, adaptation strategies and the relevance of migration in Sub-Saharan drylands. *Environmental Research Letters*, *13*(11), 113003.

Woolcock, M., & Narayan, D. (2000a). Social Capital: Implications for Development Theory, Research, and Policy. *The World Bank Research Observer*, *15*(2), 225–249. https://doi.org/10.1093/wbro/15.2.225

Woolcock, M., & Narayan, D. (2000b). Social Capital: Implications for Development Theory, Research, and Policy. *The World Bank Research Observer*, *15*(2), 225–249. https://doi.org/10.1093/wbro/15.2.225

Yifei, S. (2011). China in the" Post-Patriarchal Era" Changes in the Power Relationships in Urban Households and an Analysis of the Course of Gender Inequality in Society. *Chinese Sociology & Anthropology*, *43*(4), 5-23.

Annex I: PCA Indicators and their respective weightage

Mean ownership of assets/variables used in wealth assessment using principal component analysis

Variables	Extreme poor (n=646)	Poor (n=826)	Middle (n=414)	Rich (n=217)	Weightage (Factor loading on 1st principal component)
Percentage of HH members (>18 years) with Primary education or above	25%	51%	72%	84%	0.429
Percentage of HH members (>13 years) with Mobile phone	47%	59%	72%	77%	0.584
Electric fan	0.43	0.88	0.97	1.00	0.491
Refrigerator	0.00	0.01	0.17	0.82	0.666
Computer/ laptop	0.00	0.01	0.07	0.27	0.396
Television	0.07	0.37	0.71	0.84	0.555
Almirah/ wardrobe	0.37	0.81	0.95	0.99	0.510
Number of rooms used for sleeping	1.27	1.65	2.20	3.31	0.658
Floor material (1 = Earth/ mud; 2 = Brick/ cement)	1.01	1.08	1.37	1.81	Housing material = MAX (Roof, wall, or floor material)
Roof material (1 = Leaves/straw; 2 = Tin/ corrugated iron; 3 = Brick/ cement)	1.83	1.99	2.15	2.48	
Wall material (1 = Earth/ mud; 2 = Tin/ corrugated iron; 3 = Brick/ cement)	1.13	1.49	2.28	2.83	0.661
Cooking fuel (1=Dung/straw/wood; 2=Gas/ electricity)	1.00	1.05	1.41	1.86	0.676

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.827
Components with eigenvalue>1	3
Total variance explained	53.70%

Annex II: Questionnaire for the Household Questionnaire Survey

Start date and time of the survey	
End date and time of the survey	
Section 1. Introduction and Identifiers	
1.1 Identification number of enumerator	
1.2 Consent and confidentiality agreement *I am working with the University of Dhaka and BUET as part of a research programme. I want to carry out a survey, where I will be asking questions about you and your household members. The survey is expected to take approximately 45 minutes to complete. If you agree to participate, the information you provide will be used for research purposes only. Your responses to these questions will remain strictly confidential and your name will not appear in any data that is made publicly available. You may withdraw from the study at any time and if there are questions that you would prefer not to answer then we respect your right not to answer them. We would like to write down your contact information in case some issues in the questionnaire are unclear and we need to follow up with you for more information or clarification. Do you consent to participate in and provide information for this study?*	
1.3 Is the respondent happy to continue with the survey? *If no, thank the respondent for their time and move on to the next survey*	**SELECT ONE** Yes No
Household location	
1.4 Please select the UNION where this interview is occurring	**SELECT ONE** Dumuria Bhandar para Sahas Sarappur Surkhali
1.5 Please select the MOUZA where this interview is occurring	*Choice filter based on option selected in 1.4*
1.6 How long have you been living in this area? *Area refers to the broader study site selected above, not the particular house in which the respondent is staying at present*	**SELECT ONE** Less than 1 year 1 - 2 years 2 - 5 years 5 - 10 years More than 10 years

Section 2. Household demographics	
2.1 How many people live in this household?	**INSERT INTEGER**
To be repeated for each household member mentioned in 2.1	
2.2 Name of household member	**INSERT TEXT**
2.3 What is X's relationship to HH Head?	**SELECT ONE** Head Spouse Son or daughter Son-in-law or daughter-in-law Father or mother Father-in-law or mother-in-law Grandchild Brother or sister Adopted/foster child /step child Other relative Not related Others
2.4 Sex of X	**SELECT ONE** Male Female
2.5 X's age	**SELECT ONE** 5 years and below 6 - 12 years 13 - 18 years 19 - 50 years 51 and above
2.6 What is the highest grade X completed? *Relevant if age>5*	**SELECT ONE** No education Can sign name Pre-school/ kindergarten Class 1 Class 2 Class 3 Class 4 Class 5 (PSC) Class 6 Class 7 Class 8 (JSC) Class 9 Class 10 (SSC) Class 11 Class 12 (HSC) Bachelors/diploma or higher Don’t know
2.7 Does X have a personal mobile phone? *Relevant if age>13*	**SELECT ONE** Yes No

Section 3. Water and sanitation	
3.1 Drinking water - Source and Payments	
3.1.1 Name ALL the sources of DRINKING water used by your household in the past 1 year	**SELECT MULTIPLE** Public tap/ stand pipe Deep tubewell 1 Deep tubewell 2 Shallow tubewell 1 Shallow tubewell 2 Rainwater (roof catchment) Rainwater (community source) Water vended through pick-up truck Water vended through nossimon/van Bottled water River/Canal Lake Pond Pond sand filter Others (specify)
3.1.1 (a-d) Who owns this tubewell? *Relevant if Deep/Shallow tubewell is selected in 3.1.1*	**SELECT ONE** Own immediate family/ Extended family (cousin, brother, etc.) Another unrelated family (neighbor) Group of families (collective) Community/ government (Public) School/ Mosque/ Other institutes Others
3.1.1 (e-h) Where is the tubewell located? *Relevant if Deep/Shallow tubewell is selected in 3.1.1*	**SELECT ONE** Near - Inside own/ neighbour's yard Bit far, but within the village Very far, outside the village
3.1.1 (i-l) What type of tubewell is this? *Relevant if Deep/Shallow tubewell is selected in 3.1.1*	**SELECT ONE** Handpump operated Motorised pump operated Don't know/ No response
3.1.2 These questions are applicable for the MAIN source only	
3.1.2 (a) Of the sources mentioned above, which one is your MAIN drinking water source?	*Choice filter based on options selected in 3.1.1*
3.1.2 (b) Do you share this water source with other households?	**SELECT ONE** Yes No
3.1.2 (c) How many households share this water source?	**SELECT ONE** Less than 5 Between 5 and 10 More than 10
3.1.2 (d) How much time does it take to go to	**SELECT ONE** Inside dwelling/yard

the source, get water, and come back?	Less than 15 minutes 15-30 minutes 30 minutes – 1 hour 1 - 2 hours More than 2 hour Don't know
3.1.2 (e) Who usually goes to this water source to fetch the water for your household? *Not relevant if 'Rainwater (roof catchment)', 'Water vender through pick-up truck', or 'Water vended through nossimon/ van' is selected in 3.1.2 (a)*	**SELECT MULTIPLE** Adult men Adult women Boys (<16 years) Girls (<16 years)
3.1.2 (f) Has this person(s) ever faced any challenges while fetching water?	**SELECT MULTIPLE** No challenges Quarrels/ conflicts with neighbours Verbal abuse Felt uncomfortable in using someone else's source Felt unsafe Eve teasing Physical/ sexual assault Physical burden associated with carrying heavy water containers Other (Specify)
3.1.2 (g) Have you taken any measures to address these challenge(s)?	**SELECT MULTIPLE** Remained silent/ No action Improve mutual understanding Protect oneself/ not travel unaccompanied Reconcilation with the help of village elders Others [specify]
3.1.2 (h) How is this water usually transported? *Not relevant if 'Rainwater (roof catchment)', 'Water vender through pick-up truck', or 'Water vended through nossimon/ van' is selected in 3.1.2 (a)*	**SELECT ONE** Not Applicable Carried by individual Sliding cart Bicycle/ van Nossimon Motorcycle Trawler/ Boat/ Raft Others (specify)
3.1.2 (i) Do you or someone in your house pay for this water? *This includes payment for electricity to pump water, costs of transporting water and price of water itself; NOT infrastructure repair or maintenance costs*	**SELECT ONE** Yes No
3.1.2 (j) How often do you pay?	**SELECT ONE**

	Monthly (Fixed amount) Variable amount (One-off payment/ for transport) Per container
3.1.2 (k-l) How much do you pay? *Relevant if payment frequency is 'monthly/variable' in 3.1.2(j)*	**INSERT INTEGER**
3.1.2 (m) What is the size of the container? *Relevant if payment frequency is 'per container' in 3.1.2(j)*	**INSERT INTEGER**
3.1.2 (n) How much do you pay per container? *Relevant if payment frequency is 'per container' in 3.1.2(j)*	**INSERT INTEGER**
3.1.3 These questions are applicable for the SECONDARY source *Relevant if number of sources>1 in 3.1.1*	
3.1.3 (a) Of the sources mentioned above, which one is your SECONDARY drinking water source?	*Choice filter based on options selected in 3.1.1, and not selected in 3.1.2 (a)*
3.1.3 (b) Why did you use this source instead of your main source?	**SELECT ONE** Infrastructure not working Easier access Alternative source is cheaper Alternative source has better quality Unreliable supply (in case of piped water only) New infrastructure installed Not enough water (source dried up) When cash is available/ there is no one to carry wat Other (Specify)
3.1.3 (c) For how long did you have to use this secondary source? *Record cumulative number of days in the past one year*	**SELECT ONE** Less than 5 days Between 5 and 30 days Between 1-2 months More than 2 months Don't know
3.1.3 (d) Do you or someone in your house pay for this water? *This includes payment for electricity to pump water, costs of transporting water and price of water itself; NOT infrastructure repair or maintenance costs*	**SELECT ONE** Yes No
3.1.3 (e) How often do you pay?	**SELECT ONE** Monthly (Fixed amount) Variable amount (One-off payment/ for transport)

	Per container
3.1.3 (f-g) How much do you pay? *Relevant if payment frequency is 'monthly/variable' in 3.1.3(e)*	**INSERT INTEGER**
3.1.3 (h) What is the size of the container? *Relevant if payment frequency is 'per container' in 3.1.3(e)*	**INSERT INTEGER**
3.1.3 (i) How much do you pay per container? *Relevant if payment frequency is 'per container' in 3.1.3(e)*	**INSERT INTEGER**
3.1.3 (j) Did you face any additional challenges as a result of switching from your MAIN source to this SECONDARY source?	**SELECT MULTIPLE** No challenges Felt uncomfortable in using someone else's source Higher costs Poor water quality Women and girls spent more time/ effort in collecting water Women and girls felt unsafe collecting water Other (Specify)
3.2 Drinking water - Intervention and maintenance	
3.2.1 In the past 5 years, has there been any development intervention that has improved your drinking water situation? *This refers to community level interventions by the government or private sector, NOT by individual households for their private use*	**SELECT ONE** Yes No Don't know/ No response
3.2.2 What type of intervention has been implemented? *Relevant if 'yes' is selected in 3.2.1*	**SELECT MULTIPLE** Installation of deep/shallow tubewell Piped water system (new/expansion) Water vending (new/ expansion) Rain water harvesting system Public Pond excavation Installation of Pond Sand Filter (PSF) Managed aquifer recharge Other (specify)
3.2.3 Has your household contributed any money/ labour to this installation? *Relevant if 'yes' is selected in 3.2.1*	**SELECT MULTIPLE** Yes - Cash Yes - Labour Yes - Materials Yes - Space/ land No Don't know
3.2.4 How much cash did you contribute at the	**INSERT INTEGER**

time of installation? *Relevant if 'cash' is selected in 3.2.3*	
3.2.5 In the past 5 years, did your household install any new water related infrastructure? *This refers to installation of new tubewell or new motor/pipes, NOT repair or maintenance work*	**SELECT ONE** Yes No Don't know/ No response
3.2.6 What did you install? *Relevant if 'yes' is selected in 3.2.5*	**SELECT MULTIPLE** New shallow tubewell (handpump/motorised) New deep tubewell (handpump/motorised) Electric/diesel motor to existing tubewell Pipes/Storage tank to existing tubewell Storage tank for rainwater harvesting Other (Specify)
3.2.7 How much money did your household spend/contribute to this installation?	**INSERT INTEGER**
3.2.8 In the past 1 year, did you/anyone else conduct any maintenance or repairs to the water source? *This involves replacing washers, buckets, pipes, or handles of tubewells; electric parts of pump motor; or cleaning/replacing sand layer of PSF*	**SELECT ONE** Yes No Don't know/ No response
3.2.9 How much money did your household spend/contribute to this maintenance/repair work? *Relevant if 'yes' is selected in 3.2.8*	**INSERT INTEGER**
3.3 Drinking water - Quality and storage	
3.3.1 Do you think that the water you drink is safe?	**SELECT ONE** Yes No Don't know/ No response
3.3.2 If not, why? *Relevant if 'no' is selected in 3.3.1*	**SELECT MULTIPLE** Water has Arsenic Water has Iron Water is saline Water has germs Water doesn't taste/ smell/ look good Other (Specify)
3.3.3 Do you do anything to the water to make it safer to drink?	**SELECT ONE** Yes No
3.3.4 What do you usually do to make the water safer to drink?	**SELECT MULTIPLE** Boil Add bleach/chlorine

Relevant if 'yes' is selected in 3.3.3	Add alum Add halotab Strain through a cloth Water filter (Bio sand/composite/ceramic filter) Solar disinfection Let it stand and settle Other (specify)
3.4 Water for domestic uses	
3.4.1 What are your household's source(s) of water for the following purposes?	
Cooking and food preparation	**SELECT MULTIPLE** Public tap/ stand pipe Deep tubewell 1 Deep tubewell 2 Shallow tubewell 1 Shallow tubewell 2 Rainwater (roof catchment) Rainwater (community source) Water vended through pick-up truck Water vended through nossimon/van Bottled water River/Canal Lake Pond Pond sand filter Others (specify)
Washing clothes and dishes	
Bathing	
3.5 Sanitation and hygiene	
3.5.1 What kind of toilet facility do ADULTS of your household use?	**SELECT ONE** Flush to septic tank Pour flush to pit latrine Ventilated improved pit latrine Pit latrine with slab Pit latrine without slab/open pit Hanging toilet/waste discharged directly into waterbodies No facility/bush/field
3.5.2 Where is this toilet located?	**SELECT ONE**
3.5.3 Where do you dispose of your child's waste? *Relevant if a child (under 5) uses a potty/re-usable cloth*	**SELECT ONE** Not applicable (no child under 5) In the toilet On dry open ground/ bush Into waterbodies (pond/ river) Other (specify)
3.5.4 Do you share this toilet facility with other households?	**SELECT ONE** Yes No

3.5.5 How many households share this toilet facility?	**SELECT ONE** Less than 5 Between 5 and 10 More than 10
3.5.6 Where do you or other members of your household most often wash your hands?	**SELECT ONE** Fixed facility (tap/tubewell) in dwelling/yard Mobile object (bucket/jug) No specific handwashing place Other (specify)
3.5.7 What do you wash your hands with?	**SELECT ONE** Only water Soap/ Detergent Ash Mud/ Sand Other (specify)
Section 4. Poverty	
4.1 Assets	
4.1.1 What is your current occupancy status?	**SELECT ONE** Owner Tenant Free accommodation (public land/embankment) Other (specify)
4.1.2 Does your household have any of the following assets?	
Television	**SELECT ONE for each** Yes No
Radio/CD player	
Computer/ laptop	
Bicycle	
Motorcycle	
Autobike/tempo/CNG	
Car/truck/microbus	
Rickshaw/van/animal cart	
Almirah/wardrobe/showcase	
Electric fan	
Refrigerator	
Power tiller/tractor	
Electric/diesel pump	
IPS/ Generator	
4.2 Power sources and housing material	
4.2.1 What is the power source for lighting and electronics?	**SELECT MULTIPLE** Grid supply electricity Generator Solar panel Kerosene Other (specify)
4.2.2 What type of fuel does your household mainly use for cooking?	**SELECT MULTIPLE** Electricity Natural gas (piped supply/

	cylinder) Animal dung Kerosene Wood/fuel sticks Straw/shrubs/grass Other (specify)
4.2.3 Main material of the floor of house	**SELECT ONE** Earth/mud Wood/ bamboo Brick or Cement Tiles/ Mosaic Other (specify)
4.2.4 Main material of the roof of house	**SELECT ONE** Leaves/straw/ plastic Wood/bamboo Tin/corrugated iron Brick/ Cement Other (specify)
4.2.5 Main material of the exterior walls of house	**SELECT ONE** Leaves/ straw/ cardboard/ plastic Earth/mud Wood/ bamboo Tin/ corrugated iron Brick/Cement Others (specify)
4.2.6 How many rooms do members of this household usually use for sleeping?	**INSERT INTEGER**
Section 5. Priority concerns	
5.1 Socio-economic concerns	
5.1.1 Now I am going to go through a list of CONCERNS that some families in this area have expressed. Suppose that the government could help your area with just THREE of these issues, which would YOUR FAMILY choose? *Rank in order of importance*	
Concern #1	**SELECT ONE for each** Healthcare Erosion and flood protection Canal dredging Transportation and roads Sanitation Drinking water services Clean environment Security and crime Employment Education Electricity Gas supply
Concern #2	
Concern #3	

	Financial services Agricultural support No concerns/ Don't know Others (Specify)
5.2 Concerns regarding water	
5.2.1 Do you have any concerns regarding the WATER you drink and use for domestic purposes?	**SELECT ONE** Yes No
Rank in order of importance (Do not Prompt)	
Concern #1	**SELECT ONE for each** Water is unsafe to drink Water supply is too costly Water source is too far Water for domestic use is dirty Water supply is unpredictable Not enough No concerns/ Don't know Other (Specify)
Concern #2	
Concern #3	
5.3 Concerns regarding the natural environment	
5.3.1 Do you have any concerns regarding your NATURAL ENVIRONMENT?	**SELECT ONE** Yes No
Rank in order of importance (Do not Prompt)	
Concern #1	**SELECT ONE for each** Increasing water salinity Waterlogging Tidal flooding Cyclones/ storms Embankment breaching/ river erosion Decline of fisheries population Forests and vegetation are decreasing Rivers/canals are dirty or polluted No/ inadequate rubbish collection or cleaning People commonly defecate in public spaces No concerns/ Don't know Other
Concern #2	
Concern #3	
Section 6. Livelihoods and water-related risks	
6.1 Land ownership and agriculture	
6.1.1 Is your household involved in any type of farming for subsistence and/or sale? *This includes farming in agricultural land (own/ leased in or leased out), NOT homestead land*	**SELECT ONE** Yes No
6.1.2 How many land parcels do you own or operate?	**INSERT INTEGER**

A parcel is a contiguous piece of land with a single operator or owner. This also includes agricultural land that are left fallow throughout the year, due to land degradation.	
To be repeated for each land parcel mentioned in 6.2.1	
6.1.3 Size of Parcel X	**INSERT INTEGER**
6.1.4 Ownership status of Parcel X	**SELECT ONE** Owner Leased in/sharecropping (for whole year) Leased in/sharecropping (for part of the year) Leased out/sharecropping (receiving rent/crops) OR mortgaged Govt/Khas land Don't know Others (specify)
6.1.5 How many crops do you grow in Parcel X in a year? *This refers to the number of seasons (out of 3) in which the household conducts agriculture and/or aquaculture on their own/leased in land* *Not relevant if 'Leased out' is selected in 6.1.4*	**INSERT INTEGER**
6.1.6 In which of the following seasons, do you grow crops/ fisheries in Parcel X?	**SELECT MULTIPLE** Kharif – I (March - July) Kharif – II (July/Aug - Dec) Rabi (Dec - Feb)
Kharif – II (July – Nov/Dec) *Relevant if 'kharif -II' is selected in 6.1.6*	
6.1.7 (a) What types of crops/ fisheries did you cultivate in Parcel X during Kharif – II?	**SELECT MULTIPLE** Paddy (Local/HYV) Wheat/ Maize Fiber crops (Jute/ Bamboo) Pulses (Lentils/Peas/Beans) Oil seeds (Mustard/ Soybean/ Sesame) Vegetables Fruits Galda prawn Bagda shrimp White fish Crabs Sugarcane/ Date / Palms Others (Specify)
6.1.7 (b) Do you irrigate the crops grown in Parcel X during Kharif – II?	**SELECT ONE** Yes No

6.1.7 (c) What is the source of water for irrigating your crops in Parcel X during Kharif – II? *Relevant if 'yes' is selected in 6.1.7(b)*	**SELECT ONE** Ground water Surface water from river/ canals Surface water from pond/ stagnant source Others (specify)
6.1.7 (d) What is the method of irrigation? *Relevant if 'yes' is selected in 6.1.7(b)*	**SELECT ONE** Low lift pump Shallow tubewell Deep tubewell Others (specify)
6.1.7 (e) Do you face any challenges in irrigating your crops in Parcel X during Kharif – II? *Relevant if 'yes' is selected in 6.1.7(b)*	**SELECT ONE** Yes No
6.1.7 (f) If YES, what is the main challenge? *Relevant if 'yes' is selected in 6.1.7(e)*	**SELECT MULTIPLE** Lack of water in river/ canal Fall in groundwater level High salinity of surface/ ground water Waterlogging/ Drainage congestion Problems with gate operation (infrastructure leakage/ management issues) Could not access irrigation pumps/ tubewells (conflicts, power failure, financial constraints) Others (specify)
Kharif – I (Feb – June) *Relevant if 'kharif -I' is selected in 6.1.6*	
6.1.8 (a) What types of crops/ fisheries did you cultivate in Parcel X during Kharif – I?	**SELECT MULTIPLE** Paddy (Local/HYV) Wheat/ Maize Fiber crops (Jute/ Bamboo) Pulses (Lentils/Peas/Beans) Oil seeds (Mustard/ Soybean/ Sesame) Vegetables Fruits Galda prawn Bagda shrimp White fish Crabs Sugarcane/ Date / Palms Others (Specify)
6.1.8 (b) Do you irrigate the crops grown in Parcel X during Kharif – I?	**SELECT ONE** Yes No
6.1.8 (c) What is the source of water for irrigating your crops in Parcel X during Kharif – I? *Relevant if 'yes' is selected in 6.1.8(b)*	**SELECT ONE** Ground water Surface water from river/ canals

	Surface water from pond/ stagnant source Others (specify)
6.1.8 (d) What is the method of irrigation? *Relevant if 'yes' is selected in 6.1.8(b)*	**SELECT ONE** Low lift pump Shallow tubewell Deep tubewell Others (specify)
6.1.8 (e) Do you face any challenges in irrigating your crops in Parcel X during Kharif – I? *Relevant if 'yes' is selected in 6.1.8(b)*	**SELECT ONE** Yes No
6.1.8 (f) If YES, what is the main challenge? *Relevant if 'yes' is selected in 6.1.8(e)*	**SELECT MULTIPLE** Lack of water in river/ canal Fall in groundwater level High salinity of surface/ ground water Waterlogging/ Drainage congestion Problems with gate operation (infrastructure leakage/ management issues) Could not access irrigation pumps/ tubewells (conflicts, power failure, financial constraints) Others (specify)
Rabi (Dec - Feb) *Relevant if 'Rabi' is selected in 6.1.6*	
6.1.9 (a) What types of crops/ fisheries did you cultivate in Parcel X during Rabi?	**SELECT MULTIPLE** Paddy (Local/HYV) Wheat/ Maize Fiber crops (Jute/ Bamboo) Pulses (Lentils/Peas/Beans) Oil seeds (Mustard/ Soybean/ Sesame) Vegetables Fruits Galda prawn Bagda shrimp White fish Crabs Sugarcane/ Date / Palms Others (Specify)
6.1.9 (c) Do you irrigate the crops grown in Parcel X during Rabi?	**SELECT ONE** Yes No
6.1.9 (d) What was the source of water for irrigating your crops in Parcel X during Rabi? *Relevant if 'yes' is selected in 6.1.9(b)*	**SELECT ONE** Ground water Surface water from river/ canals Surface water from pond/ stagnant source Others (specify)
6.1.9 (e) What was the method of irrigation? *Relevant if 'yes' is selected in 6.1.9(b)*	**SELECT ONE** Low lift pump Shallow tubewell

	Deep tubewell Others (specify)
6.1.9 (f) Did you face any challenges in irrigating your crops in Parcel X during Rabi? *Relevant if 'yes' is selected in 6.1.9(b)*	**SELECT ONE** Yes No
6.1.9 (g) If YES, what was the main challenge? *Relevant if 'yes' is selected in 6.1.9(e)*	**SELECT MULTIPLE** Lack of water in river/ canal Fall in groundwater level High salinity of surface/ ground water Waterlogging/ Drainage congestion Problems with gate operation (infrastructure leakage/ management issues) Could not access irrigation pumps/ tubewells (conflicts, power failure, financial constraints) Others (specify)
Homestead land	
6.1.10 Does your household own any homestead land?	**SELECT ONE** Yes No
6.1.11 How much homestead land do you own? *Relevant if 'yes' is selected in 6.1.10*	**INSERT INTEGER**
6.1.12 What types of crops do you grow in your homestead land? *Relevant if 'yes' is selected in 6.1.10*	**SELECT MULTIPLE** Not enough land Vegetables Fruits Paddy (Local/HYV) Wheat/ Maize Fiber crops (Jute/ Bamboo) Pulses (Lentils/Peas/Beans) Oil seeds (Mustard/ Soybean/ Sesame) Sugarcane/ Date / Palms Others (Specify)
6.2 Aquaculture and Livestock	
6.2.1 Do you own or operate any pond?	**SELECT ONE** Yes No
6.2.2 Do you cultivate fisheries in this pond? *Relevant if 'yes' is selected in 6.2.1*	**SELECT ONE** Yes, for subsistence only Yes, for subsistence and sale Yes, for sale only No
6.2.3 What fisheries do you cultivate in your pond? *Relevant if 'yes' is selected in 6.2.2*	**SELECT MULTIPLE** Galda prawn Bagda shrimp Crab White fish (Rui, Ayer, Boal etc.) Others

6.2.6 Does your household own any livestock or poultry?	**SELECT ONE** Yes No
6.2.5 No. of Cow/buffalo 6.2.6 No. of Goat/sheep 6.2.7 No. of hens/duck *Relevant if 'yes' is selected in 6.2.6*	**INSERT INTEGER**
6.3 Income sources and gender division of labour	
6.3.1 In the past 1 year, what were the main sources of income for your household?	**SELECT MULTIPLE** Agriculture Aquaculture Fishing Livestock/ poultry Full-time/part-time job (fixed income) Skilled labour Casual labour Remittances Cash transfers Business Property rent Others (specify)
6.3.2 Do women in your household engage in open-access fishing? *Relevant if 'fishing' is selected in 6.3.1*	**SELECT ONE** No, not at all Yes, sometimes on their own Yes, sometimes along with men Yes, always on their own Yes, always along with men
6.3.3 Who works as a casual labour? *Relevant if 'casual labour' is selected in 6.3.1*	**SELECT MULTIPLE** Adult men Adult women Boys (<16 years) Girls (<16 years)
6.3.4 Where do the women of your household usually go to work as a casual labour? *Relevant if 'women' is selected in 6.3.3*	**SELECT ONE** Inside village/ Nearby Outside village/ Far away
6.3.5 Where do the men of your household usually go to work as a casual labour? *Relevant if 'men' is selected in 6.3.3*	
6.3.6 Do women in your household engage in farm activities? *Relevant if 'yes' is selected in 6.1.1*	**SELECT ONE** Yes No
6.3.7 If so, which of the following types of work do they engage in? *Relevant if 'yes' is selected in 6.3.6*	**SELECT MULTIPLE** Land preparation (Ploughing, Harrowing, Leveling et Planting (Seeding/Transplanting) Irrigation (channel maintenance etc)

	Harvesting Threshing/drying
6.3.8 How would you describe the current welfare situation of your household?	**SELECT ONE** Doing well Doing just OK Struggling Unable to meet household needs Don't know/ No response
6.3.9 How would you describe the welfare situation of your household about FIVE years ago?	**SELECT ONE** Better than present situation Same as present situation Worse than present situation Don't know/ No response
6.4 Water-related risks and impacts on livelihoods	
6.4.1 In the past 5 years, has your household been affected by any of the following water-related risks?	**SELECT MULTIPLE** No risks Waterlogging/ Drainage congestion Embankment breaching/ river erosion Tidal flooding Increased salinity Cyclones/ storms Untimely/ Heavy rainfall
6.4.2 Waterlogging/ drainage congestion This refers to waterlogging (ranging from a week to a few months) caused due to heavy rainfall and/or drainage congestion in internal canals; NOT flooding due to embankment breaching *Relevant if 'waterlogging' is selected in 6.4.1*	
6.4.2 (a) When was the last time you were affected by waterlogging?	**SELECT ONE** 2017 2016 2015 2014 2013 Don't know/ No response
6.4.2 (b) How long did this waterlogging persist? *Relevant if 'waterlogging' is selected in 6.4.1*	**SELECT ONE** 1 - 2 weeks 2 weeks - 1 month 1 - 2 months 3 - 6 months More than 6 months
6.4.2 (c) How did this waterlogging affect your household? *Relevant if 'waterlogging' is selected in 6.4.1*	**SELECT MULTIPLE** Decline in crop/ vegetable yield Decline in fish/ shrimp yield Higher cost of production Land degradation / Decline in soil fertility Loss of agricultural/ homestead land Decline in fish population/ diversity Decline in labouring opportunities

	Death of livestock/ poultry Damage to house or belongings Health problems of household member Others [specify]
6.4.2 (d) What type of illness did you/ your household members suffer from?	**SELECT MULTIPLE** Skin diseases Diarrhoea/ Dysentry High blood pressure Stomach cramps/ Ulcer Eye infection Menstrual cramps/ Reproductive health problems Others (Specify)
6.4.2 (e) What did you do to cope with this waterlogging? *Relevant if 'waterlogging' is selected in 6.4.1*	**SELECT MULTIPLE** Nothing Survived on relief Took loan from NGO/relative Bought food items on credit Sold/mortaged land Sold livestock/ poultry Sold asset (e.g. jewellery) Ate less/ lower quality food to reduce expenses Reduced spending on health care Disruption in education of children Household member took job elsewhere temporarily Sent non-working household member to work Others (specify)
6.4.3 Embankment breaching/ river erosion *Relevant if 'embankment breaching' is selected in 6.4.1*	
6.4.3 (a) When was the last time this embankment breaching/erosion occurred?	**SELECT ONE** 2017 2016 2015 2014 2013 Don't know/ No response
6.4.3 (b) How did this embankment breaching/erosion affect your household?	**SELECT MULTIPLE** Decline in crop/ vegetable yield Decline in fish/ shrimp yield Higher cost of production Land degradation / Decline in soil fertility Loss of agricultural/ homestead land Decline in fish population/ diversity Decline in labouring opportunities Death of livestock/ poultry Damage to house or belongings Health problems of household member

	Others [specify]
6.4.3 (c) What type of illness did you/ your household members suffer from?	**SELECT MULTIPLE** Skin diseases Diarrhoea/ Dysentry High blood pressure Stomach cramps/ Ulcer Eye infection Menstrual cramps/ Reproductive health problems Others (Specify)
6.4.3 (d) What did you do to cope with it?	**SELECT MULTIPLE** Nothing Survived on relief Took loan from NGO/relative Bought food items on credit Sold/mortaged land Sold livestock/ poultry Sold asset (e.g. jewellery) Ate less/ lower quality food to reduce expenses Reduced spending on health care Disruption in education of children Household member took job elsewhere temporarily Sent non-working household member to work Others (specify)
6.4.4 Increased salinity *Relevant if 'salinity' is selected in 6.4.1*	
6.4.4 (a) What do you think was the cause of this increased salinity?	**SELECT MULTIPLE** Sluice gate not functioning properly Issues with gate management Other farmers brought in saline water Tidal flooding/ cyclone Embankment breaching Don't know Others (specify)
6.4.4 (b) How did this increased salinity affect your household?	**SELECT MULTIPLE** Decline in crop/ vegetable yield Decline in fish/ shrimp yield Higher cost of production Land degradation / Decline in soil fertility Loss of agricultural/ homestead land Decline in fish population/ diversity Decline in labouring opportunities Death of livestock/ poultry Damage to house or belongings Health problems of household member Others [specify]
6.4.4 (c) What type of illness did you/ your	**SELECT MULTIPLE**

household members suffer from?	Skin diseases Diarrhoea/ Dysentry High blood pressure Stomach cramps/ Ulcer Eye infection Menstrual cramps/ Reproductive health problems Others (Specify)
6.4.4 (d) What did you do to cope with this increased salinity?	**SELECT MULTIPLE** Nothing Survived on relief Took loan from NGO/relative Bought food items on credit Sold/mortaged land Sold livestock/ poultry Sold asset (e.g. jewellery) Ate less/ lower quality food to reduce expenses Reduced spending on health care Disruption in education of children Household member took job elsewhere temporarily Sent non-working household member to work Others (specify)
6.4.5 Tidal flooding This refers to water overtopping the embankment; NOT flooding due to embankment breaching *Relevant if 'tidal flooding' is selected in 6.4.1*	
6.4.5 (a) When was the last time your household was affected by tidal flooding?	**SELECT ONE** 2017 2016 2015 2014 2013 Don't know/ No response
6.4.5 (b) How did this tidal flooding affect your household?	**SELECT MULTIPLE** Decline in crop/ vegetable yield Decline in fish/ shrimp yield Higher cost of production Land degradation / Decline in soil fertility Loss of agricultural/ homestead land Decline in fish population/ diversity Decline in labouring opportunities Death of livestock/ poultry Damage to house or belongings Health problems of household member Others [specify]
6.4.5 (c) What type of illness did you/ your household members suffer from?	**SELECT MULTIPLE** Skin diseases

	Diarrhoea/ Dysentry High blood pressure Stomach cramps/ Ulcer Eye infection Menstrual cramps/ Reproductive health problems Others (Specify)
6.4.5 (d) What did you do to cope with this tidal flooding?	**SELECT MULTIPLE** Nothing Survived on relief Took loan from NGO/relative Bought food items on credit Sold/mortaged land Sold livestock/ poultry Sold asset (e.g. jewellery) Ate less/ lower quality food to reduce expenses Reduced spending on health care Disruption in education of children Household member took job elsewhere temporarily Sent non-working household member to work Others (specify)
6.4.6 Cyclones/ storms *Relevant if ''cyclones/storms' is selected in 6.4.1*	
6.4.6 (a) When was the last time your household was affected by cyclones?	**SELECT ONE** 2017 2016 2015 2014 2013 Don't know/ No response
6.4.6 (b) How did this cyclone affect your household?	**SELECT MULTIPLE** Decline in crop/ vegetable yield Decline in fish/ shrimp yield Higher cost of production Land degradation / Decline in soil fertility Loss of agricultural/ homestead land Decline in fish population/ diversity Decline in labouring opportunities Death of livestock/ poultry Damage to house or belongings Health problems of household member Others [specify]
6.4.6 (c) What type of illness did you/ your household members suffer from?	**SELECT MULTIPLE** Skin diseases Diarrhoea/ Dysentry High blood pressure Stomach cramps/ Ulcer Eye infection

	Menstrual cramps/ Reproductive health problems Others (Specify)
6.4.6 (d) What did you do to cope with the impacts of this cyclone?	**SELECT MULTIPLE** Nothing Survived on relief Took loan from NGO/relative Bought food items on credit Sold/mortaged land Sold livestock/ poultry Sold asset (e.g. jewellery) Ate less/ lower quality food to reduce expenses Reduced spending on health care Disruption in education of children Household member took job elsewhere temporarily Sent non-working household member to work Others (specify)
6.4.7 Rainfall variability This refers to lack of, untimely and/or heavy rainfall *Relevant if 'rainfall variability' is selected in 6.4.1*	
6.4.7 (a) When was the last time your household was affected by rainfall variability?	**SELECT ONE** 2017 2016 2015 2014 2013 Don't know/ No response
6.4.7 (b) How did this rainfall variability affect your household?	**SELECT MULTIPLE** Decline in crop/ vegetable yield Decline in fish/ shrimp yield Higher cost of production Land degradation / Decline in soil fertility Loss of agricultural/ homestead land Decline in fish population/ diversity Decline in labouring opportunities Death of livestock/ poultry Damage to house or belongings Health problems of household member Others [specify]
6.4.7 (c) What did you do to cope with this rainfall variability?	**SELECT MULTIPLE** Nothing Survived on relief Took loan from NGO/relative Bought food items on credit Sold/mortaged land Sold livestock/ poultry

	Sold asset (e.g. jewellery) Ate less/ lower quality food to reduce expenses Reduced spending on health care Disruption in education of children Household member took job elsewhere temporarily Sent non-working household member to work Others (specify)
6.5 Water management group	
6.5.1 Is there any water management group in your community?	**SELECT ONE** Yes No Don't know
6.5.2 How much do you think this group influences water management in your community? *Relevant if 'yes' is selected in 6.5.1*	**SELECT ONE** Not at all A little A lot
6.5.3 Do you feel you can influence the decisions made by this group? *Relevant if 'yes' is selected in 6.5.1*	**SELECT ONE** Not at all A little A lot
6.5.4 Is anyone in the household a member of this group? *Relevant if 'yes' is selected in 6.5.1*	**SELECT ONE** None Adult male Adult female Both
Section 7. Closing Questions	
7.1 Images	
7.1.1 If the respondent mentions soap/detergent, please request to show it, to validate the answer. Is soap present? *Relevant if 'soap' is selected in 3.5.7*	**SELECT ONE** Yes No
7.1.2 Please take a photo of the rainwater harvesting system *Relevant if 'rainwater harvesting (roof catchment)' is selected in 3.1.1*	
7.1.3 Take a picture of the house so that the roof, wall and floor materials are clearly visible.	
7.1.4 Please show me your toilet. Take photo of the outside of the toilet	
7.1.5 Take photo of the inside of the toilet	
7.2 Enumerator feedback and contact information	
7.2.1 Did the respondent understand the majority of the questions?	**SELECT ONE** Understood all the questions well Understood most of the questions, but not all Understood some of the questions (roughly half) Did not understand many questions (less than half)

	Understood very few questions
7.2.2 How would you rate the accuracy of the respondent's answers?	**SELECT ONE** Accurate Satisfactory Average Poor
7.2.3 Contact phone number 1	**INSERT TEXT**
7.2.4 Name of person for contact number 1	**INSERT TEXT**
7.2.5 Contact phone number 2	**INSERT TEXT**
7.2.6 Name of person for contact number 2	**INSERT TEXT**
7.2.7 GPS Location: Stand directly in front of the main entrance of the house. Accuracy level must be 20m or below.	
7.2.8 According to your judgment, how would you rate the socio-economic status of this household?	**SELECT ONE** Rich UpperMiddle LowerMiddle Poor ExtremePoor

End of household survey questionnaire

Annex III: Images from the studied villages

Photo: 1

Photo: 2

Photo: 1 description

Photo: 2 description

Photo: 3

Photo: 4

Photo: 3 description

Photo: 1=4 description

Photo: 5

Photo: 6

Photo: 5 description

Photo: 6 description

Photo: 7

Photo: 8

Photo: 7 description

Photo: 8 description