Gendered Culture and Water Security: an exploratory study in some selected coastal areas of Bangladesh

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Certificate

This is to certify that the study entitled "Gendered culture and Water Security: an exploratory study in some selected coastal areas of Bangladesh", submitted by Sabrina Zaman for the award of the Degree of MPhil of the Institute of Disaster Management and Vulnerability Studies, University of Dhaka, Bangladesh, has been carried out under my supervision. The dissertation or a part thereof has not been submitted for the award of any other degree or diploma of either this or any other University.

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DECLARATION

I hereby declare that the dissertation entitled "Gendered culture and Water Security: an exploratory study in some selected coastal areas of Bangladesh", submitted by me for the award of the Degree of MPhil of the Institute of Disaster Management and Vulnerability Studies, University of Dhaka, Bangladesh, is original work carried out by me. The dissertation or a part thereof has not been submitted for the award of any other degree or diploma of either this or any other university.

Place: University of Dhaka, Bangladesh (Sabrina Zaman)

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ABSTRACT

Access to sufficient water is a human right and part of human survival, health, wellbeing, and livelihoods for consumption and domestic use. However, the gendered culture of water access, use and livelihoods has remained silent in the world of water management. The dimension to development perspectives also denotes that gendered behavior in ensuring water security is also an imperative aspect of achieving sustainable growth and development. But, this dimension is invisible worldwide and overlaid by patriarchal system and gender inequality. Although, different water usage behaviors generate risks among people of different ages in the line of the coastal region, the water situation is worse when compared to other regions, because of salinity, river erosion, unpredictable rainfall, and cyclonic situation. Thus, the abortive water management process could not minimize the water risk in the coastal area. The present research is an effort to bridge between science and policy in mitigating water risks of the vulnerable coastal people in line with the REACH framework. Water risks of the coastal people identified as one of the constraints towards achieving sustainable livelihood. The REACH Khulna observatory is especially looking for alternative dimensions in reducing water risks to build a resilient community. The prime objective of the study is to appraise the nature of water-related risks and to identify water-dependent livelihoods of coastal poor using gender lens. The second objective is to explore the differential impacts of water risks on their livelihood. Finally, the researcher intended to address gender-based alternative adaptation options taken by the coastal people to reduce water risks. In this perspective, the study explores how gender dimensions form a nexus between water collection challenges, spatial differences, and gender division of labor comparing data from water-secure and water insecure mouzas. Using a sample from 515 households in southern coastal, this study conducted in four mouzas of Polder 29 from Khulna district of Bangladesh. The researcher applied the mixed-methods approach to examine the water usage behavior of coastal people. To conduct this research work, the researcher employed the structured interview questionnaire as the quantitative tool to measure some variables related to gendered culture and water security in coastal Bangladesh. Statistical Package for the Social Sciences (SPSS) was used for processing and analyzing the survey data. For the qualitative study, Focus Group Discussions (FGDs), Case Studies, In-depth interviews, Key informant interviews (KII) were conducted to identify the water risks and their impacts on the selected communities. The researcher presented the theoretical construction of methodology, the research

tools and the methods of data collection, sampling, methods of data analysis and relevant others to gain an insight about the whole procedure of the study. The theoretical foundations of the present study stand on gender differences theory, liberal feminism, Gender and Development (GAD) approach, feminist theory, and gender-disaster resilient theory. These theories were reviewed to understand the significance and adaptability for the study. The findings showed that the quality of water deteriorated because of the high prevalence of saline water along with iron in southern polder of coastal region. Water collection is a gender-based role for women and for this reason and proximity to saline water, both women and girls suffered more compare to male counterparts. The present study also showed that women face various types of gender discrimination: women are often paid less than men, even for the same workload. They also worked longer hours than men. Women, who worked in the sector of agriculture and aquaculture, and as casual labors, earned only half the amount men earned. In contrast, those villages, which suffer from less water risks, most women, were able to self-sustain themselves without searching for a job in other areas. The findings additionally indicated that due to water insecurity many women and men had to work outside of their locality to sustain livelihoods. The present study explored the nature of water risks and vulnerabilities and to identify the gender-specific intra-household water using behavior from the concurrent literature and empirical evidences. Findings of the study additionally indicated that both women and men involved in harvesting rainwater and used their own indigenous methods to have better access to water.

The study supported that gender based adaptation options such as involvement of women in workplace, preserving water system, decision making regarding water infrastructure have been reducing gender disparity and enhancing resilience capacity to water risks of coastal Bangladesh. Finally, a ‘people-centered’ participatory inclusive system will be needed to reduce water risks. Sustainable water management will be ensured by strengthening institutional capacities for effective, efficient and inclusive water distribution at the community level as well as state level. Community-level water resources distribution process-considering women’s strategic interests and practical needs at the center will be more priority issues.

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ABBREVIATION AND ACRONYMS

ADB- Asian Development Bank

APF-Adaptation Policy Framework

BCCSAP-Bangladesh Climate Change Strategy and Action Plan

BIPSS- Bangladesh Institute of Peace and Security Studies

BWA-Bangladesh Water Act

ccGAP- Climate Change and Gender Action Plan

DWEF- Davos World Economic Forum

EIA- Environmental Impact Assessment

FAO- Food and Agriculture Organization

FHH- Female-Headed Households

FGD- Focus Group Discussion

GAD-Gender and Development

GCRI - Global Climate Risk Index

GDP-Gross Domestic Product

GIDs-Gender-Inclusive Dimensions

GGG- Global Gender Gap

GWP- Global Water Partnership

HDR- Human Development Report

IDI -In-depth Interview

IFAD- International Fund for Agricultural Development

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IGA-Income-Generating Activities

ILO-International Labor Organization

IWA- International Water Association

KII- Key Informant Interview

MDGs-Millennium Development Goals

MHH-Male-Headed Households

MICS- Multiple Indicator Cluster Survey

MoEF- Ministry of Environment and Forest

MPTFWS-Millennium Project Task Force on Water and Sanitation

NCS- National Conservation Strategy

NAPA-National Adaptation Program of Action

NPDM- National Plan for Disaster Management

NWDP- National Women Development Policy

NWP-National Water Policy

NWMP-National Water Management Plan

NWSI- National Water Security Index

PSF- Pond Sand Filter

SDGs -Sustainable Development Goals

SFDRR- Sendai Framework for Disaster Risk Reduction

SIDA- Swedish International Development Corporation Agency

SNP- Safety-Net Programs

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SPSS- Statistical Package for the Social Sciences

UNDESA- United Nations Department of Economic and Social Affairs

UNDP- United Nations Development Programme

UNICEF- United Nations Children's Fund

UNISDR- United Nations International Strategy for Disaster Reduction

UN-Water- United Nations Water

WB- World Bank

WEDO- Women's Environment and Development Organization

WEF- World Economic Forum

WHO- World Health Organization

WID- Women in Development

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GLOSSARY

Abara	The name of a pond of polder 29
Akra, Chandgarh, Gajendrapur and Sundar Mahal	Name of four mouzas in Polder 29, Khulna District of Bangladesh
Bhadra	Bhadra is the 5^{th} month in 12^{th} months of Bengali Calender
Bigha	A measure of land area varying locally from 1/3 to 1 acre. One bigha means 17452.0069808 square feet
Fajr azan (early dawn)	Morning prayer time for Muslims
Fitkari	Potassium Alum used as purifying the water
Easha azan (night)	Night prayer time for Muslims
Gher	Enclosure- an area that is surrounded by a barrier for cultivating shrimp/ fish
Hectare	A metric unit of square measure, equal to 100 acres. 1 Hectare = 10000 square meters
Jorakall	Local name of two tubewells located in Gajendrapur Mouza
Kolsi	Water pot or Jar
Mouza	Mostly used as a synonymous with the village *(gram)* in Bangladesh
Palong	Spinach.
Polder	In the 1960s, 123 polders were constructed in order to protect the low-lying coastal areas from tidal flooding and salinity intrusion in southern Bangladesh (low-surface areas with earthen embankments), including 49 sea-facing polders.
Puishak	Basella- a popular tropical green leafy vegetable, commonly cultivated in home gardens as a backyard herb/ creepers.
Upazila	Sub-district, formally called Thana, is an administrative region in Bangladesh
Union	A community or organization that consists of people of common interest or purpose.
Shomiti	Village association for the people

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CHAPTER I: INTRODUCTION

This chapter provides the outlook of the background of the study along with the rationality of the study. This chapter also highlights the objectives, research questions, and hypotheses of the research related to gendered culture and water security in Coastal polder of Bangladesh.

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1.1 Introduction

Over the last couple of decades, climate change has posed double exposure and engendered new risks among the peripheral people living in extreme fragile areas. Empirical studies (Iglesias et al., 2015; UNISDR, 2009) construe that climatic events have increased risks related to livelihood of people and these climatic unexpected stressors like floods, cyclones, heatwave, drought, storm surge, sequential patterns of rainfall, scarcity of surface and groundwater, etc. are regularly striking in the vulnerable regions. Because of these unfavorable events, water scarcity, food shortage, losses of livelihood, extinction of ecosystems, etc. have become more imperative in vulnerable regions of the planet (UNISDR, 2009). Water paucity is estimated as one of the factors, which is intensifying the risks of livelihood (UNDESA, 2014). Water in the concurrent of climate change, is considered as one of the basic parameters for ensuring human well-being, healthy and reproductive lives, and sustainable livelihood (GWP, 2000). In the current era, water scarcity is causing unfavorable effects on public health, the safety of people, social steadiness and especially agricultural sectors which are the main sources of livelihood of the destitute populations across the globe and it is adversely decimating economic progress (Darcy, 2010; Iglesias and Garrote, 2015). Bangladesh is one of the most vulnerable countries in the world and has encountered various unfriendly geomorphological and hydrological stressors such as cyclone, floods, drought, tidal surge, etc. resulted from climatic variations. The recent Global Climate Risk Index (GCRI) (2017) report asserts that Bangladesh stood in 6thposition (CRI score 25.00) as a climate-vulnerable country and between 1996 and 2015 the country's annual average death toll was estimated 679 and economic loss was USD 2283 million (Kreft et al., 2017). In another Global report 'National Water Security Index' (NWSI) of 2016, Bangladesh scored 35.3 out of 100 which is very meager. The indicators behind this report are water security of household level, an economic perspective of water security, urban and ecological water security and access to water (ADB, 2016). This report predicts that the people living in coastal areas of Bangladesh are continuously suffering from water scarcity due to a shortage of sweet water.

The erratic behavior of nature has brought a change in natural events. For example, the frequently lengthy monsoon season every year in Bangladesh results in flooding while the dry season causes drought and salinity intrusion in coastal areas. This is mainly because of the rising sea levels which is endangering the availability of pure and safe water. Due to not having any alternative options for sweet and safe drinking water, people become bound to

drink saline water causing serious health complications such as high blood pressure, gastric, preeclampsia in women and others (REACH, 2015; CGIAR, 2014; Tushar et al., 2013). Rapid environmental change, emerging population, excessive salinity of water, increased dilapidation of ecosystems and chronic water-related hazards are becoming a risk to the coastal areas of Bangladesh. Approximately, 40 million people are vulnerable to cyclonic squall, water and soil salinity and river flooding in the coastal zone of Bangladesh which has affected 70 percent of the agricultural area and their livelihood (REACH, 2015). Inclusive access to safe water has been an imperative indicator of strengthening the country's economic development. But, the water development processes have condoned gender-sensitive issues in planning and designing water resource management from holistic perspectives. This gap has been outlined in internationals and national journals, reports etc. According to the Global Gender Gap (GGG) Index, 2016 Bangladesh was ranked 72 out of 144 countries gaining the score 0.698 (World Economic Forum, 2016) where 0.00 is imparity and 1.00 is parity. Longitudinal studies (Clement, 2012; Nasreen: 2008, 2012) provide putative arguments that there are a great variation and discrimination in the participation of jobs, having a prevalence of division of labor among men and women, causing workload over women, less participation in decision making at household and community level. Conversely, unequal access to safe water has increased the burden of the females and social insecurity because of unavailable safe drinking water points. Apart from this, patriarchal structure of the society has assigned the responsibility of women and girls for collecting water (Jambrina, 2013; Earle et al., 2013; Nasreen, 2012) from distant places that exposes them to sexual harassment and reduces their productive and economic functionalities (Sarwar, 2005; Mahmuduzzaman et al., 2014).

The prolonged process of gender discrimination and unequal access to water has created water insecurity and threats to their livelihood (Mutahara et al., 2016, Deb and Haque, 2011). The researches (Wright et al., 2012; Darcy, 2010) affirm that innovative adaptation strategies and techniques towards mitigating water risks would be more functional and could develop the resilient adaptive capacity of the local people to adjust with unresolved water risks and uncertain livelihoods. Considering the concurrent scenarios of coastal people, this piece of study has aimed to depict the nature of water risks and the unfavorable impacts of water risks of the coastal people following the gender lens.

1.2 Background of the study

Bangladesh has 19 districts in the coastal area which covers 47,211 km^2 (about 32 percent of the total area of the country) along with 710 km long coast which is at the Bay of Bengal. This coastal area is frequently affected by disasters like- cyclone, tidal surge, drought, flood, salinity intrusion, etc. which are creating water scarcity and water risk (Sarwar, 2005; Mahmuduzzaman et al., 2014; Toufique and Yunus, 2013; REACH, 2016). The risk of the coastal regions is also increasing due to unexpected population growth, urbanization and sea-level rise. In the region, flood and cyclonic disasters affect every year and damaging 2 percent-10 percent of Gross Domestic Product (GDP) (REACH, 2015). It also affected the climate-sensitive industries such as fisheries, coastal agriculture, and tourism, transportation and communication infrastructure (USAID, 2009).

In Bangladesh, around 8 million people live inside polders, which approximately cover 8 percent of the country and 53 percent of the coastal area is affected by salinity and water-related hazards (REACH, 2016). Overall to protect the communities from flood and salinity intrusion, 139 polders were constructed in the coastal area during the 1960s and 1970s, which facilitated food security and economic growth of the community (REACH, 2016). The positive interventions have several constructive impacts of the community, such as increased production of the agricultural sector and a better transport system. However, it also brings some negative impacts such as changing sediment balance in the delta, defectively managed embankments and waterlogging in some of the polders (REACH, 2016)-which is the real scenario of the polders. There is also an extreme stratum of poverty ridden families in the polders; estimating 80 percent of households are below the national poverty line equivalent to a national average of almost 31.5 percent (REACH, 2016). The pathway of poverty alleviation is complicated due to differentiated impacts on men and women (Ahmed, et al., 2015). In the 1950s, to illustrate water situations, Wittfogel interpreted that- "control of water is inevitably control of life and livelihood" (Strange, 2005: 21).

In 1997, the Human Development Report revealed that high poverty rates and little access to water, health, and sanitation are interlinked with the lowest gender-related development indicator (Schreiner, 2001).Thus, poverty and gendered culture play a crucial role in the water management process. Women are the core meticulous and traditional amenable person for domestic water management (WEDO, 2003; UNICEF-WHO, 2011). But there are significant gender differences in use, access, and behavior of water management.

Gender discrimination is surrounded over the world and interrupted the development of the society where patriarchal domination is seen in every aspect of social life. Gender discrimination constrained the water use behavior of men and women in society as well as their access to water resources (CAP-NET, 2006).

In developing countries, performing as the collector of water, women constitute only 17 percent of the formal and paid water workers, whereas, they work 80 percent of the casual and unpaid water collector or worker (IWA, 2014), some countries the percentage is more than 90 percent (UNICEF-WHO, 2011). From the perspective of holding power over water and natural resources management, women have only 6 percent of all ministerial positions (IPUandUN Women, 2015). Moreover, water crises make women and children more vulnerable due to climate-induced hazards, waterlogging, salinity intrusion, floods, riverbank erosion and agricultural droughts. They also causes higher death, personal insecurity, dropout of girls from school and early marriage, unhygienic menstrual system, reproductive problems, disabilities, physical and sexual violence etc. (Geere et al., 2010; Azad et al., 2013; REACH,2015). Thus gender identity leads to a vulnerable condition of women and children due to water-related disaster and it is extremely convoluted issues (Nasreen, 2003; Wisner et al., 2004). Furthermore, poor women, children, and elderly person are conceded as a carrier of 'vulnerability bundles' and place them in the pinnacle of risk (Wisner et al., 2004:1).

Despite the rhetoric on water collection, women's participation is less everywhere in the world of water management. Over the years, male domination degenerated into any forms of differences in indoor and outdoor spaces which were the barrier for women's involvement in development pathways. In the modern era, women's empowerment is embryonic in every aspect of life. However, they lack behind in any organizational, institutional or household level decision-making process.

Securing water management and gendered behavior are juxtaposed in the concurrent pieces of literature the coastal areas, but both issues are not simultaneously working for the development of water security. This paper gives a glimpse of water security challenges and also identified the gendered risks and its impacts on the coastal people regarding water-related issues from the concurrent works of literature.

1.3 Statement of the problem

The water crisis has emerged as a global challenge and it is predicted that in the 21st-century water scarcity will emerge as a major problem in the world (Vidal, 2012; Lautze and Hanjra, 2014).Bangladesh has an abundance of surface and groundwater, which are used in households, and, industrial and agricultural productions. For example, 80 percent of water for agricultural production is used from the ground (Faruque and Ali, 2005). Water is intrinsically linked to the economic growth of the country. But, this economic imbalance and water risks are aggravating due to extreme climatic events striking frequently in Bangladesh (Lal, 2011). Water insecurity is also increasing due to rapid environmental change, overconsumption, and lack of water management. A recent report of REACH (2016) denotes that coastal people in developing countries like Bangladesh are encountered with double challenges such as water crisis and water-related hazards like sea-level rise, cyclones, salinity intrusion, etc. The same report also pointed out that nearly 40 million people live in coastal areas and are vulnerable to cyclonic storm surges and river flooding (REACH, 2016). Eighty percent of the land area and people's water-related livelihoods are vulnerable to water risks. It is drawing urgent attention to the impact of water insecurity and interventions in accelerating economic growth and reducing poverty.

Access to sufficient water for consumption and domestic use is considered a basic need and a human right which is part of human survival, health, wellbeing, and livelihoods. But, the gendered nature of water access, use and livelihoods are typically neglected. Women are believed to have a special affinity with water. Water is connected with feminine power (Lawuyi, 1998; Strange, 2005) and across cultures; women bear the burden of water collection. Women are also managers of domestic/household water, responsible for household health and wellbeing, and water users in their own right. Women are positioned in these roles by their gender, age and household status (Nasreen, 2008; Hemson, 2002). In the water sector, gender tends to be equated with women and, beyond the notion that improved water access will reduce women's workload and therefore is good for gender equity; analysis has tended to be superficial. For many years women's productive and community management roles in the water sector were hidden. It was assumed women's primary concerns were to do with collecting water and domestic use, and men were productive water users. Failure to understand the gendered culture of water access leads to water insecurity and increases inequalities among men and women and increases water risks unconditionally.

With these arguments, the present study is intended to explore the nature of water risks and vulnerabilities and to identify the gender-specific intra-household water using behavior. The study has also planned to analyze the gendered roles in reducing water risks and water management in the coastal zone of Bangladesh. The study, moreover, will lend sustainable policy strategies for reducing water risks, which will support both parties of society.

1.4 Rationale of REACH in relation to the study

This study is funded by the REACH program led by Oxford University, United Kingdom (UK). REACH is working for improving water security for the poor especially in developing countries like Bangladesh, Kenya, and Ethiopia. The goal of the REACH project, by means of interdisciplinary and transformational work at eight 'water security observatories' in Sub-Saharan Africa and South Asia, is to enhance water quality for the vulnerable community. In particular, the REACH program uses a 'risk based approach' to direct decision-making in situations characterized by limited, ambiguous or lack of data (REACH 2015), which analyzes the essence and likelihood of possible undesirable results. The REACH program, by innovative quantitative and qualitative research methods, aims to build evidence of the complex connections between water security and poverty. In order to contribute to a program-wide awareness of water security risks and the welfare of individuals, a standardized 'Household Survey' approach is used in all observatories. To address the gender issues is also a key component of REACH program. As a part of REACH program, the study contributes to the REACH Coastal Water Security observatory by exploring the impacts of water insecurity through gender lens. The present research is an effort to bridge between science and policy in mitigating water risks of the vulnerable coastal people in line with the REACH framework. Water risks of the coastal people identified as one of the constraints towards achieving sustainable livelihood. The REACH Khulna observatory is especially looking for alternative dimensions in reducing water risks to build a resilient community.

1.5 Rationale of the study

Bangladesh is highly vulnerable to disasters and climate change adds a new dimension to community risk and vulnerability (NPDM, 2007-2015). The national policy frameworks Standing Orders on Disaster (SOD), 2010; National Plan for Disaster Management (NPDM), (2007-2015); Disaster Management Act; Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009; and international framework Sendai Framework

for Disaster Risk Reduction (SFDRR, 2015-2030) provides high priority on risk reduction. The international drivers SFDRR (2015-2030) urges member states to focus on four priority areas first of which contains understanding the risk. It is crucial to state that vulnerability to water-related risks and other climate effects are closely linked to gendered culture and sustainable development. Whilst economic growth in Bangladesh is said to improve the position of many people, the differences between women and men persist and get worse if compared to other countries. Over the years, various organizations and programs have paid attention to gender relations in the water sector, but this has hardly resulted in more equal gender-disaggregated macro data. The Dublin Principles has been recognized for women's role in water governance in 1992 (IFAD, 2012: 3).Though the gender issues in relation to water management had been mainstreamed in the decade 2005-2015of the International Water for Life, it has become less effective in practice because of numerous pitfalls in terms of understanding, unwillingness, and lack of commitment of practitioners, unavailability of relevant tools of measuring gender roles (IFAD, 2012: 3).

Women's access to water security is not improving, and control over resources even less so. Large inputs in water infrastructure, for domestic water and sanitation, for agriculture and the environment are often not benefiting those who need it most: women and poor segments of the population. These categories of people usually have no right to decisions regarding the new infrastructure, and as such hardly benefit. Women and girls carry the main responsibility for water and sanitation at the lowest level, so an increase in the water supply is assumed always to be in their favor, but practice shows evidence of the contrary.

A number of studies (Nasreen, 2008; Shamsuddoha and Chowdhury, 2007) showed that the living standard, average life expectancy, per capita farming land, access to education, health, and other basic services, social security, etc. in the coastal and disaster-affected areas are not at expected level in comparison to national average. Besides, the increasing trends of climate change-related vulnerabilities and natural disasters gradually making people's life more helpless (Shamsuddoha and Chowdhury, 2007). Under considering the above situation the study has given attention to the gendered impacts of water risks variability and to highlight vulnerabilities of their low-income populations. Due to the geo-socio-economic characteristics, the recurrent climatic variability and natural disasters put marginal communities entirely in a risky position especially the women, who are at severe risks compared to men. To adopt with the calamities women bear more physical burden than men due to gender-specific tasks (Nasreen, 2008). Moreover, gender issues based discrimination

(i. e. limited access to information and services, technology, lack of access to or ownership over reproductive resources) are strong factors contributing to increasing women's vulnerability and water risks (Kumbetoglu and User, 2010; Nasreen, 2008).

Women are also faced with grave poverty, increasing instances of violence and abuse after the disaster, which are often taken into poor consideration (Nasreen, 2008; Kumbetoglu and User, 2010). With introduction to the experiences of women and men the new insights have tried to focus on water risk mitigation strategies and efforts on how they are building their capacity to reduce risks induced by climate change. Moreover, considering this view, the proposed research falls within the larger field of inquiry concerned with water using behavior in the coastal regions. The present study, therefore, explores the nature of the socio-economic condition of local people and to analyze its impacts on livelihood.

Though Bangladesh has achieved remarkable success in managing disaster risk reduction, social protection policies are not adequately effective to mitigate these vulnerabilities. Even, these communities are considered more vulnerable to disaster-related hazards compared to other parts of the country. By introducing the major polices the study will also evaluate the gender-specific policy by assessing the nature of access to policy planning and development strategies of women experienced in responding to water risks. Several international, regional and local NGOs and government agencies are practicing such kind of activities and mechanisms for being more effective in the policies. They are also supporting women to enhance their capacity in addressing climate variability. The proposed study has also intended to identify what types of practices and mechanisms performed by several bodies of agencies in addressing water risks and its' variability and how they are strengthening the capacity of vulnerable people. As, International organizations, NGOs and Governmental Agencies play a vital role in the case of climate change-related disasters, the following research will also focus on different activities of NGOs in empowering women's behavior in water management. Besides, it is also noticeable, very few studies have emphasized to focus on health problems, food problems and the dynamics of water risks adaptation strategies of the coastal communities. The present study, thus, has a modest endeavor to explore the impact of water risks resulted from climate change on livelihood and to find out the alternative livelihood options for reducing water risks that minimize an individual's vulnerability to water risks in the context of gendered culture.

1.5 Objectives of the study

Broad Objective: The overall purpose of the study is to explore the role of gendered culture in water security from the gender lens.

Specific objectives: The study had been guided by the following specific objectives:

- To assess the nature of water-related risks and vulnerabilities of coastal poor from a gender perspective;
- To identify water-dependent livelihoods of women and men;
- To explore the differential impacts of water risks on women and men and their livelihoods;
- To find out the gender-based alternative adaptation options to water risks.

1.6 Research Questions of the study

- How do people, differentiated by gender, use water in the coastal region?
- What are the gendered impacts of water risks on the coastal poor?
- How do the coastal people, especially women, reduce water risks?
- How do the decision-makers respond to gender-related water risks?

1.7 Hypothesis of the study

Based on the review of different water and gender-related literature I assumed two hypotheses for this piece of study. The hypotheses are as follows:

- **H1:** Water-related risks are exacerbating gender-based vulnerability.
- **H2:** Gender-based adaptation options to water risks are bolstering women's resilience mechanisms.

To test the hypotheses the present study provides a review of literature on the gender-differentiated impacts of water security. This review evaluates how the evidence relates to both hypotheses and mitigating water risks among the people of the coastal poor based on primary and secondary data.

CHAPTER II: REVIEW OF LITERATURE

This chapter explores the water insecurity and gender situation in the context of global, national and regional levels. It also aims to present the gender and water policy in Bangladesh context to understand the gap in water and gender policy in terms of water security.

2.1 Introduction

Although the notion of water security and gender has long been legitimized by International development agencies**,** what, indeed, comprises empowerment of women, and how it is measured, is debated in the development literature. Many studies relating to water and women's roles in the world have emerged during the past few decades. But very few studies have attempted to address the issue of both women's and men's roles in water management in Bangladesh context especially based on both qualitative and quantitative methods. So, the chapter highlights the water insecurity issues in the context of gender culture in coastal polder comparing with the global, national level. Additionally, the gender and water policy of Bangladesh represents the water security issues at the national level. So, this chapter also highlights the water and gender situation in the policy level of Bangladesh.

2.2 Conceptualizing water security from gender dimension

Literature noted that water security is a gendered issue in terms of collecting and preserving water. Women and adolescent girls are mainly the primary users, providers, managers, collectors of the water which is used in household chores (WGF, 2014; Nasreen, 2012; WSP, 2010). While discussing gender and water, most of the articles and literature interpreted about women as a prime actor and men as an optional group. However, the perception of gender does not consist of women's issues only; but, it's all about the roles of both women and men in every aspect of life. The roles of men and women mingle equally as a safeguard of the water management process. Therefore, cultural values, norms, attitudes, behavior, gender differences of the society are indications of good water management process (Cap-Net, 2006).

The increased population, uncertain climate change, and depleting water sources have put a significant amount of pressure on the availability of water on the planet and an overwhelmingly large number of populations are struggling with the uncertainty of water. Most of the communities of the world have no easy access to sufficient water for their necessary daily use (Srinivasan et al., 2017; Cook and Bakker, 2016). This scenario has drawn global attention from policymakers, academia, global leaders and practitioners. In general, water security is understood as the ability to get adequate water for drinking, cooking, production, self-care, sanitation and for other uses (Cook and Bakker, 2016) while Global Water Partnership defines w*ater Security as "every person has access to enough safe*

water at affordable cost to lead a clean, healthy and productive life, while ensuring that the natural environment is protected and enhanced" (GWP, 2000: 1).

In defining water safety, balance access and trade-offs have been emphasized to provide a clear overview (REACH, 2015). Water security is such a type of activity and trade-offs for balancing safe and sufficient water for the people to use for drinking, daily work, agriculture, industry and other socio-economic activities under increasingly uncertain future of availability of water. These definitions have given a similar fashion in understanding water security focusing on the availability of water and the environment. But, Naomi et al., (2014) have addressed the capacity of people to withstand water-related risks. In her definition, water security is defined in the context of sufficient and good quality of water along with the ability of stressed people to cope with water risks. From these arguments, it is very difficult to define water security for the coastal people.

As the availability of water is not the main problem in the coastal zone of Bangladesh, the sea level rise has induced salt into the water which has put an apex problem upon the peripheral people and at great water risks. In connection to the study the researcher looked into different studies (i.e., Wounters, 2005; Allan, 2011; Parker et al., 2016) related to water security and these studies provided some similar explanation of water security in terms of food production, security, livelihood, poverty, hazards. On the other hand, the environmental, geographical and hydrological perspectives have similar explanation regarding water security and worked for the sustainable development through facilitates different measures to avoid stress. So, defining water security from any one perspective is not logical and appropriate to understand the overall situation of any region. Thus, the understanding of water security should be redefined from multidisciplinary standpoints. The following table-1 explaining the existing and non-existing gender theme in defining water security based on literature.

Table-1: Literature defining water security with and without focusing gender issues

Different Perspectives	Definition	Key themes/focus area of water security	Gender Theme	References
Holistic	The aptitude of the people regarding water quality and sufficient quantities of water for sustaining livelihoods, human safety against water-borne pollution and water-related disasters, and for conserving ecology for sustainable development as well as socio-economic development to inflate peace and political stability in society.	• Coordinate improvement of water, space, and assets • Optimizing financial and communal interests without conciliation sustainability of the ecological system	Nil	UN-Water (2013)
Organizational	Water security as- the manageable risk of water-related disasters united with sufficient capacity, quality and dependable access to water for basic human needs, indiscernible livelihoods and the local environment.	• The available supply of water for the population • Basic Human needs • Managing dependable livelihood • Ensuring quality and quantity • Protection of environment	Nil	WaterAid (2012)
Institutional	Water security plays an ascendant role for health and wellbeing, fiscal and political stability, minimizing risks of water-related hazards, a sustainable environment, and its hydrologic succession, equitable and cooperative sharing of water resources for humans and its environment.	• Economical and political stability • Sustainable environment • Sharing of water resources	Nil	BIPSS (2009), WaterAid (2012)
Academic	Water security is based on three pillars which are sovereignty from want, fear and live in individual etiquette. Water safety measures	• Hazards and vulnerability • Freedom and human dignity • Water availability, • human vulnerability to hazards,	Nil	Wouters (2005)

	may direct clash of interests which could minimize by reconciliation at the global, state and neighboring levels.	• food security and sustainability		
Hydrological	Water security is a state of unswerving and secure access to water in times of water scarcity which facilitates different measures to avoid stress.	• Groundwater variability • Sustainability of hydrological cycle • unswerving and secure access to safe water • water scarcity • different measures to avoid stress	Nil	Abrams (2003)
Law academics	Accessibility to water is the matter of fundamental individual rights to national sovereignty rights which coalesce with equitable and affordable water resources including distribution, regulation, and allocation of water and its prices. To maintain household chores, agricultural activities or industrial demands, water resources are the priority in every sector as well as social and political decision making.	• Rules of allocation of water, • Homeland water security • Equitable and affordable water resources	Nil	WaterAid (2012)
Agricultural	Climatic variability and water insecurity have obliterated agricultural productions and annihilate livelihoods options of the people. Drought, loss of livestock and poor harvesting push households into poverty, food insecurity, distress displacement.	• Protection from flood and drought • Food production and security • Poverty and livelihood	Nil	Parker et al., (2016)
Geographical	Most of the people are incapable to link water problems with environmental security, water security, and food security. As, water security also related to the	• Water stress, • water shortage and water scarcity, • demand has driven apparent scarcity, • number of people	Nil	Falkenmark (2001)

	supply of water and sanitation, food production, hydro-solidarity between upstream and downstream in a river basin, aquifers, industrial production, agricultural activities, protection of biodiversity, wetlands and marine ecosystems in rivers and coastal waters.			
Political	Water security linked up with food trade, energy security. He explained that secure and safe water use determined by the political processes.	• Safely use of water and political dimensions, • energy security, • food trade	Nil	Allan (2011)
Environmental	Water security linked up with agricultural production and water pollution, salinity and land subsidence also associated with the growing demand for groundwater resources. Floods, droughts, and cyclones are forceful disastrous events which are the barrier for the accessibility and availability of water.	• Sustainable development, • food security, • hydrological variability	Nil	Savage et al., (2015)
Public Health	Water security amalgamated with a tolerable level of water-related risks to people, surroundings and financial systems which coherent with adequate water for the dimension of health, livelihoods, environments, and productivity.	• Water and Sanitation • Child Health, Diseases and safe water • Pregnant Women and drinking water sources • Water, sanitation and health	Exist	Grey and Sadoof (2007)
Disaster Management	All segments of the population are affected by disasters and climatic variability but women and girls suffer more than others due to their gender identity.	• Different types of disasters and hazards • Water insecurity • Disaster risk, mitigation, prevention • Women's role and responsibility	Exist	Nasreen (1995) ; Nasreen (2008)

Policy	The web of sustainable water security based on national water security including security resources such as water resources, energy, climate, food as well as individual, community, nation and multiple spatial levels.	• Water resources and national water security • Energy and Food security • Climate • Individual and community level • Nation and multiple spatial levels	Nil	Zeitoun (2012)

* Source: Compiled by the researcher based on review of literature, 2018

The concept of gender has not been expressed in water-related literature as well as the practical field. As, the holistic perspective explained about various factors related to water security from different aspects such as biophysical to infrastructural , institutional and so on. Some organizations such as Food and Agriculture Organization (FAO), Asian Development Bank (ADB), UNDP, International Fund for Agricultural Development (IFAD), World Bank (WB), etc. also incorporate gender issues in different fields, but the situation of the coastal region is still undermine compared to other regions. Thus, the gender dimension is invisible in water issues in most of the fields.

2.3 Water insecurity and gendered culture in Global context

The trend of sustainable development is still going on in different issues but the lack of access to safe water is remaining across the worldwide. Moreover, one billion people perhaps cannot access the safe drinking water, but, in the year of 1980s, it was declared the 'International Drinking Water Supply and Sanitation Decade' by the United Nations (Coles and Wallace, 2005). Different water uses behavior generates risk among people of different ages. In the line of the coastal region, the water situation is worse compared to other regions, because of salinity, river erosion, unpredictable rainfall, and cyclonic situation. Thus, the abortive water management process could not minimize the water risk in the coastal area.

In the 21st century, around 250 million were pinpointed with a water-borne disease and 75 percent of the people lived in rural areas (UNICEF/WHO, 2000). Respectively, everyday 4000 children die; 1.2 billion people have no access to clean water; 2.4 billion people are short of access to sanitation due to unhealthy water and unhygienic sanitation system (WHO, 2015). At the Davos World Economic Forum in 2016, water insecurity was ranked as one of the most urgent threats to the global economy (Vaughan. et al., 2016). Climate change is one of the foremost contributors to create water risk and crisis in the world of water. Climate change also downward impacts the cycle of water, ecology, agricultural productivity, and biodiversity as well as GDP of the country (MoEF, 2012; Goh, 2012) and forwarding long-term changes in the livelihood of the people.

The progress in gender mainstreaming and water security was introduced at the 1977 UN Water Conference (UNDESA, 2004), with emphasized on community water management, access

to drinking water based on people's needs. In 1990, the Committee on Sustainable Development (Neto and Tropp, 2000) discussed gender issues. Water security and women's empowerment later became the main focus of many organizations and activities from 1992 to 2000. However, both women and men were focused on the management of water at the International Freshwater Conference (Rijsberman, 2006). Nevertheless, the advancement of gender mainstreaming in the water sector is still going on with sustainable development objectives. Table-2 indicated the progression of gender mainstreaming into water related policies over the years (1977 - 2016).

Table-2: Chronology of mainstreaming gender and water security over the years

Year	Organizations/Events	Articulation of gender pertinent to Water security	References
1977	United Nations Water Conference, Argentina	Action plan on Community Water Supply, access safe drinking water based on people's crucial need.	UNDESA, 2004
1981-90	International Drinking Water and Sanitation Decade, Dublin	Association of water supply and sanitation with other health programs	WHO,1991
1990	Commission on Sustainable development, New York	Financial Resources and Mainstream Gender in all aspects of water management	Neto and Tropp, 2000
1992	United Nations Conference on Environment and Development, Rio	Contribution, capability, education, and enlistment of women, women role as decision-makers and collector of water resources and hygiene.	UNDESA, 2004
1992	International Conference on Water and the environment, Dublin	Women participation in the provision, management and safeguarding of water is a crucial part	UNDESA, 2004
2000	Millennium Summit, New York	Promote gender equality and empower women, halve the population without access to safe drinking water	UNDESA, 2005;
2000	Millennium Development Goals	Appropriate access to water and hygiene facilities	UNDESA, 2005; Millennium Project Task Force on Water and Sanitation, 2005
2001	International Conference on Freshwater, Bonn	Managing of water by involving men and women	Rijsberman, 2006

2002	World Summit on Sustainable Development, Johannesburg	Insurance of women's empowerment, emancipation and gender equality, facilitation of women participation in policy and decision making in water resources.	Backstrand, 2006
2003	International Year for Freshwater	Water became an opportunity for cooperation and peace	UNDESA, 2005
2005-15	International Decade-'Water for life'	Women's involvement in water improvement issues.	WHO/UNICEF, 2005; UNDESA, 2005
2008	International Year of Sanitation	Human Right to water and sanitation.	UNDESA, 2005
2012	Rio+ 20	Importance of rural women as critical agents	Sida, 2015
2016	Sustainable Development Goals	Women's equality and empowerment ensure access to water and sanitation for all.	WHO, 2016

* Source: Prepared by the researcher, 2018

2.4 Water insecurity in South Asian Countries

By the escalation of population in South Asia, it will project that in three decades the population will boost up 32 percent and become 2.22 billion in 2040 (Price et al., 2014). Ultimately, it will estimate that overpopulation will conflict with access to water for their sustainability. The water crisis has emerged as a global challenge and it is predicted that in the 21st-century water scarcity will emerge as a major problem in the world (Azad et al., 2013; Vidal, 2012; Lautze and Hanjra, 2014). The countries of South Asia such as Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka are home to about a quarter of the world population but contain only about 4.5 percent of the world's annual renewable water resources (Lacombe, et. al., 2016).

The water availability in these countries is lower than the world average, which is continuously declining due to the rapid growth of populations. It is estimated that by 2025, per capita water availability could be less than 1,000 m^3 (figure-2) indicating extreme water stresses (Lacombe et al., 2016). As, the agriculture sector (figure-1) is the main livelihood option for South Asian countries, so water-dependent livelihood is leading to concerns everywhere. In South Asian countries approximately 90 percent of water used in agricultural production and the rest of the water used in household level and industrial sector respectively (Price et al., 2014). International Labor Organization (ILO) in the year of 2012 revealed that South Asian women are more involved (68.8 percent) in the agriculture sector compared to their male counterparts (44.4 percent) and this feminization trend is more prominent in South Asia (ADB, 2013).

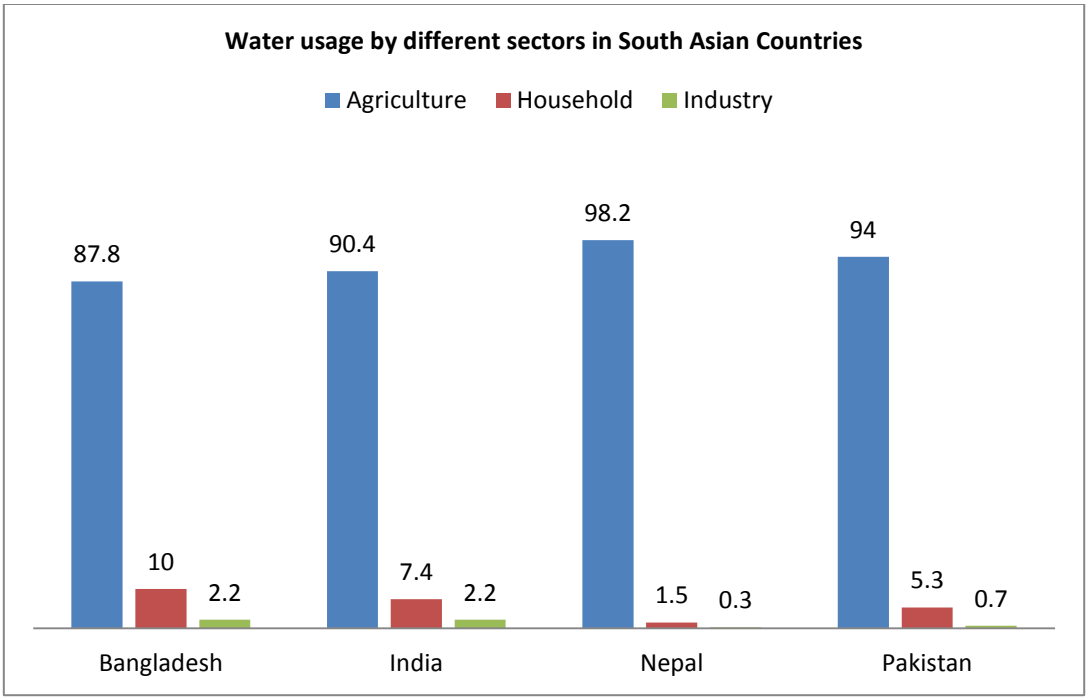


Figure-1: Water usages by different sectors in South Asian Countries

*Sources: Price et al.,2014, Compiled by the researcher

Undoubtedly, comparing with the population growth water is available to fulfill people's daily needs. But, "Is the water safe"- this is a major difficulty for all population in South Asian Countries. Only Bhutan and Nepal have abandoned water sources, on the other hand, India, and Pakistan have more water stress (World Bank report, 2017). Bangladesh depends on the water sources originating outside of the country (World Bank report, 2017). However, the countries such as Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka have some common climate and water-related risks such as flash flood, groundwater depletion, salinization, drought, coastal flood, river erosion, cyclone/storm, coastal flood etc. (World Bank report, 2017). Salinization, flood, river erosion have a longer effect on the countries residents. Generally, the water risks are affected overall the GDP growth and economy of the country, but, the women, children, aged persons, and disabled persons are more vulnerable due to any disastrous and post-disastrous situation (Hasan et al., 2019; Nasreen: 1995, 2008, 2012; Reyes, 2002).

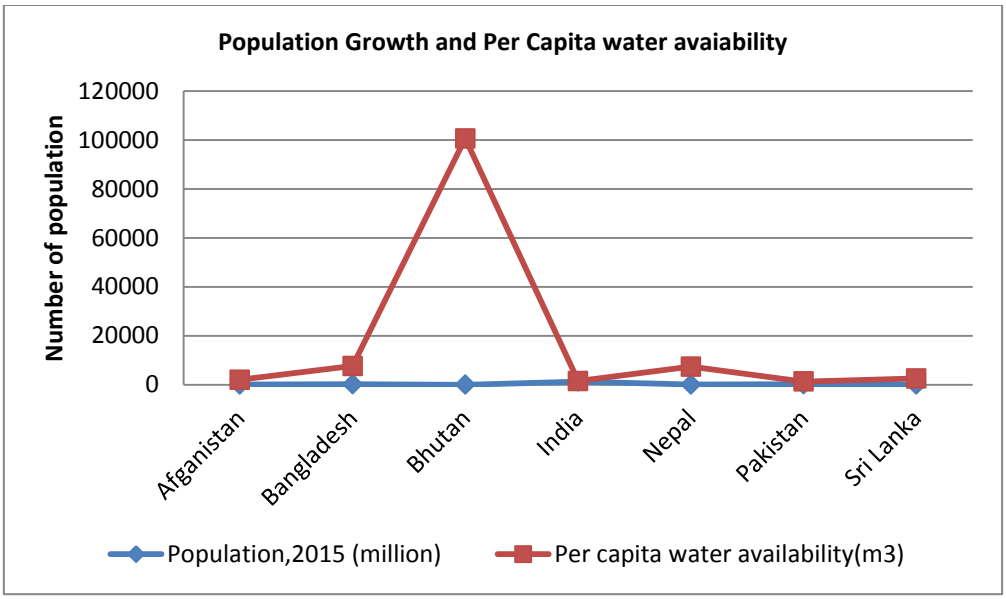


Figure-2: Cross-tabulation of population growth and availability of water in South Asian Countries

* Source: World Bank Report, 2017; Compiled by the researcher

Currently, health and economy are the dominant research sector on the water security issue and in developing countries, water-borne diseases are persistent (Sorenson etal., 2011). The results of using unsafe water push both men and women unhealthy conditions. Water risks associated with gender in terms of fetching water, the distance of water point, crop failure, washing clothes, cleaning utensils, psychological stress, unhygienic latrine, food storage (Stevenson, 2012). The current study finds out that women and men assumed that they are suffering from gastric pain, vomiting, menstrual cramps, genital problems, infection in eyes, breathing problems, diarrhea, pain, and itching in the whole body, skin diseases due to drinking and using saline water and women's situation is worst among all groups.

Asian countries face a gender-discriminatory social and cultural norms which lead to restricting educational and employment opportunities and the results of such hindrance for reducing access to adequate food,water, and nutrition (ADB, 2013). In Coastal Bangladesh where poor were not able to buy sufficient water for their households, women saved the safer water (from water vendors) for their children and husbands and they drank the largely unsafe

water from shallow tube-wells (Zaman, 2018). More women also reported to have increased workload in planting food crops compared to male partners (Nelson et al., 2009), but men get different/higher incomes for the same production (Bynoe, 2009).

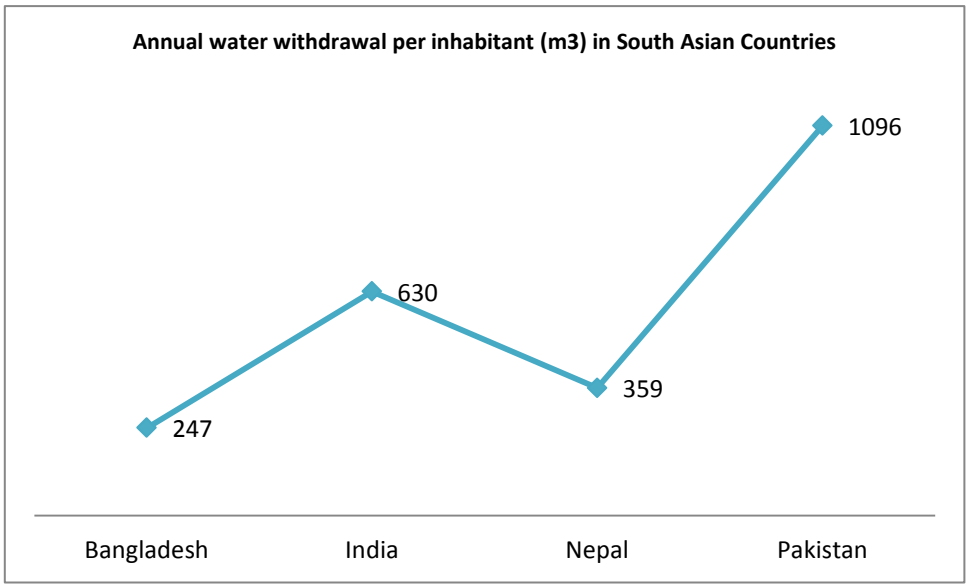


Figure-3: Annual withdrawal of water in South Asian Countries

* Sources: Price et al.,2014, Compiled by the researcher

Pakistan and India have more Annual water withdrawal per habitant (m3) among the other South Asian countries such as Bangladesh and Nepal (figure-3), but who are more users of this water among men and women - this question is embryonic by every country data.

2.5 Water insecurity and gendered culture in Bangladesh

Bangladesh is highly vulnerable due to climate change hazards as well as water risks. These disasters intensify the groundwater risks through the devastating flood, cyclones, and tornadoes and diminishing freshwater supplies, production growth, food (Nasreen and Hossain, 2002; Nasreen, 2008). The impacts in some areas suffering from extreme water crises are dramatic because of the drastically falling layer of groundwater and changes in the quality of water. In South Asian countries, Bangladesh has an abundance of surface and groundwater, which are being used for household, industrial and agricultural production. For example, 80 percent of water for agricultural production is using from the ground (Faruque and Ali, 2005).

Water is intrinsically linked to the economic growth of the country; but this economic imbalance and water risks are aggravating due to extreme climatic events striking frequently in Bangladesh (Lal, 2011). Insecurity in relation to water is also increasing due to rapid environmental change, overconsumption, and lack of water management. The concept of water fetching depends on the women, girls, and children in the literature (Sorenson et al., 2011) as well as pragmatic life. Women are also managers of domestic/household water, responsible for household health and wellbeing, and water users in their own right. Some gender analysts explained (Nasreen, 2012) that where women's productive activities were visible, they were considered to be 'merely subsistence' and not as important as men's income-generating activities. Thus, women's productive water needs were overlooked, to the detriment of women, their households' and the economy (Michael, 1998). Women were also excluded from and marginalized in management roles and decision-making structures, creating efficiency and equity problems (Hemson, 2002; Michael, 1998).

Recognizing the crisis of water in the global and nationwide, water risk has bonded with basic human needs and their livelihoods. Water risks also antagonistic relationships and interlinked with the ecosystem, productivity, agriculture, livelihoods, industry, environment, health, education, food, migration, job security, etc. (WaterAid, 2012). Overall, in turn, the water insecurity affect livelihood systems, rain-fed agriculture, human settlement patterns and movement, sanitation, human health, income opportunities, water supplies as well as human and natural systems (Nicol and Kaur, 2009)

Bangladesh is highly susceptible to expected hazards and climate change appends a new-fangled aspect to threat and defenselessness of the community (NPDM, 2007-2015). It is crucial to state that vulnerability to water-related risks and other climate effects are closely linked to gendered culture and sustainable development. Whilst economic growth in Bangladesh is said to improve the position of many people, the differences between women and men persist and even get worse if compared to other countries. Over the years, various organizations and programs have paid attention to gender relations in the water sector, but this has hardly resulted in more equal gender-disaggregated macro data. The Dublin Principles has been recognized for women's role in water governance in 1992 (IFAD, 2012:3). Though, the gender issues in relation to water management had been mainstreamed in the decade 2005-1015 of the International Water for

Life, it has become less effective in practice because of numerous pitfalls in terms of understanding, unwillingness, and lack of commitment of practitioners, unavailability of relevant tools of measuring gender roles (IFAD, 2012:3).

High-levels of salinity and erosion in the southern parts of the polder affected agricultural production and force many women had to work outside of their locality to sustain livelihoods (Zaman, 2018). The present study also finds out that women face various types of gender discrimination: women are often paid less than men, even for the same workload. They also work longer hours than men. Women, who worked in the sector of agriculture and aquaculture, and as casual labors, earned only half the amount men earned. In contrast, those villages, which suffer from less water risks, most women, were able to self-sustain themselves without searching for a job in other areas.

Some literature provides evidence that due to poverty and resource scarcity of women are affected in different ways compared to men (FAO, 2011; Nasreen: 2008, 2012) and shocks also differ from each individual (Cohen et al., 2007). Women have less access to assets, capital and resources than men (Antonopoulos et al., 2005; Deere et al., 2006; Quisumbing, 2009; Nasreen, 2012) and they have less decision-making power in the household, community, and national level.

2.6 Water insecurity in coastal Bangladesh

In 1995, UNICEF and local governments started to monitor the situation of women and children in third world countries by the program of Multiple Indicator Cluster Survey (MICS) by developing a survey section on sanitation and water supply which help to illustrate the water use behavior and water accessibility in the developing world. (Sorenson et al., 2011).

Generally, intra-household water using behavior reveals the impacts of water to the people of that region. However, there is a major difference between rural and urban communities in terms of accessing water. In the urban community, they get supply water mostly, whereas this facility is lacking in the rural community. The popular sources of water for rural people are ponds, shallow tube-wells, and rivers. In the coastal areas rural people also depend on the same sources of water. To assess water use behavior in the community, there are many methods used such as observations, a diary that prompted recall and free recall (Wutich, 2009). These methods

are useful for identifying the per capita water use of households. The global climate change also estimated through household water use in recent years (Wutich, 2009). Some gender analysts, institutions and organizations specified the roles of women and men regarding water use behavior. Mostly they mentioned that women are seen to be best represented by household water source and men are representing the income-generating activities. It was noted in the literature that 44 countries in the world, women are the most common water collectors 58.6 percent on average and men 30.4 percent, children 9.1 percent respectively (Sorenson et al., 2011). The situation is also the same in the context of Bangladesh and the data was presented (figure-4) in the graph below:

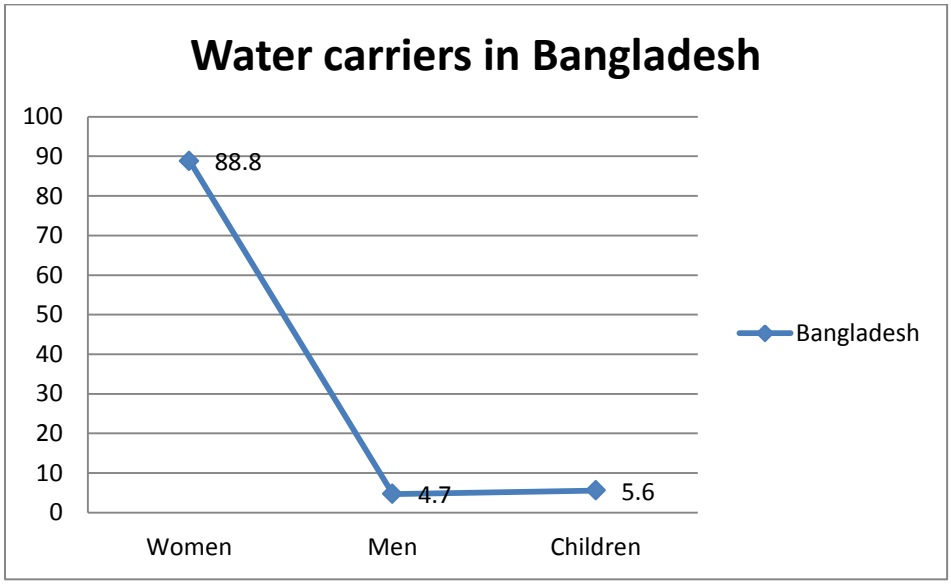


Figure- 4: Household-level water collectors in Bangladesh

Source: Sorenson et al., 2011, Compiled by the researcher

Though women are the popular water collector the literature interpreted that there was a direct association between not having access to improve water sources with the water collector who are women (Sorenson et al., 2011). This correlation also depended on the time of water collection as well as the distance of the water point. Literature showed that if the societal burden of collecting water was less, the role of collecting water also shifted to men and children (Sorenson et al., 2011). The Joint monitoring program of water and sanitation explored that water collectors would carry 0.62 miles with a container/jar which obtained 5 gallons water and

came back with the same distance (Sorenson et al., 2011). Thus, fetching water, time, distance affected the health, opportunity and economic condition of the household as well as women's emancipation (Buor, 2004; Ray, 2007; Sorenson et al., 2011, Nasreen, 2012).

Although the researcher measured the water use behavior by identifying thirteen areas such as bathing, face washing, hair washing, tooth brushing, making breakfast, lunch, dinner, beverages, dishwashing, mopping, cloth washing, toilet flushing and bathroom cleaning (Sorenson et al., 2011). But, who are the most users/consumers of this water? The answer to this question is remained untouched by most of the researchers in their literature. On the other hand, different methods of measuring daily water consumption did not rectify the gender-based intra-household water use behavior. The struggle for water on a daily basis creates a painful physical and social burden of women and girls who are spending most of their valuable time to fetching water over long distances (UN Water, 2015; Nasreen: 2009, 2012). Millennium Development Goals (MDGs) have already been met and Sustainable Development Goals (SDGs) have yet to address its goal. But, the water conditions of coastal people are worsening day by day due to climate change and gender behavioral approach. So, climate change will need to be considered in the water sector to construct alternative adaptation strategies as well as to understand the emerging trends (Nikol et al., 2009). Indeed, understanding the gender dimension is the prerequisite to mitigate risks among the coastal community because they are the consumers and safeguard water.

2.7 Gender issues in water-related policies in Bangladesh

Over the past century, there has been a dramatic increase in water policy in Bangladesh. Since 1998, National Policy for Safe Water Supply and Sanitation aimed to improve the environment and public health through behavioral changes in use of water, promoting sustainable water and sanitation services, access to water for all citizens, building capacities, storage and use of rainwater, management and proper use of surface water, reducing water-borne diseases and ensuring proper drainage of storm-water in urban areas. The aftermath of several policies has been developed to associate with gender and water security.

Considering the integrated water resource management Bangladesh Water Act (BWA) 2013 has been formulated which is based on National Water Policy. Chronologically in this act

drinking water, domestic usage, irrigation, fish culture, bio-diversity, wild-life, in-stream flow, industry, salinity control, power generation are getting more priority. However, the act provides a legal framework for the management, distribution, and protection of water resources, but the gender dimension is inconsistent with this act.

To ensure equal rights for all and decreases discrimination and inequality especially of women in all spheres of life Climate Change and Gender Action Plan (ccGAP) has been working since 2013 in Bangladesh. Article 28 of the Bangladesh Government also states about the equal rights of women with men in every aspect of life. Women are increasingly recognized as a part of solutions to climate change disasters and contributor to sustainable development. SDGs goals-5 indicates to cease the discrimination of women and girls in every sphere of life through giving equal work opportunities, increasing school enrollment, gender parity in primary education.

It is difficult to assume the situation and decide where to intervene or to mitigate water-related problems of the coastal areas. Although, the Adaptation Policy Framework (APF) indicated four approaches and tools to minimize the vulnerable condition of water risks of local communities. These four approaches are- i) hazard-based approach (building physical infrastructure and disaster preparedness planning), ii) vulnerability-based approach (safety-net programs and strengthening livelihoods), iii) adaptive-capacity approach (insurance and technological development) and iv) policy-based approach (mainstreaming with sectors and climate-proofing) (Lim and Siegfried, 2004). However, gender issues are untouched in institutional approaches but different organizations started gender analysis in their field of work. In 1990's gender pertinent to water security in different institutions and organizations as well as developing policy. Still, there is a lack of information on gender and water-related policy (Nasreen, 2012). As a result, implementing gender issues work as redress to mitigate water-related risks in the real world.

Several attempts were adopted in National Water Policy, such as-the National Water Management Plan (2001) aimed at equitable, safe and reliable access to water for health, hygiene, and production. Coastal Zone Policy also give emphasize on gender equity but giving more importance in women's development. Both policies do not recognize the gender terminology in the water world. Moreover, the National Adaptation Program of Action (NAPA) and Bangladesh Climate Change Strategy and Action Plan (BCCSAP) must address to meet the

climate change risks and mitigation strategy, yet gender issues are not recognized in any of these adaptation strategies (Ayers et al., 2014). Although, NAPA recognized women are the most vulnerable group in society, yet there is little statistical evidence on gender inequality in terms of education, property ownership, health facilities, occupation, income levels, etc. Thus women are not considered active participants in climate change adaptation strategy in the NAPA program (Dankelman et al., 2008). Additionally, BCCSAP was established to implement NAPA and addressed women and climate change in terms of food security, health and social protection (Brown, 2012). Though men are hidden in all policies and gender justice is absent in the policy level, yet no specific guidelines for ensuring gender in the program (MoEF, 2012). It is visible that water-related risks due to climate change hampered the supply of freshwater, food security, health problems, etc. and the policy is not gender-neutral in rural Bangladesh as well as the coastal zone.

Though Bangladesh has achieved remarkable success in managing disaster risk reduction, social protection is not adequately effective to mitigate vulnerabilities of all categories in the locality. In 2011, the National Women Development Policy was stirred with the vision of giving equal opportunity for both women and men and fundamental rights on an equal basis. NWDP (2011) has also included a section on women and children in disaster for the first time. As in the coastal communities are considered more vulnerable to hazards and disasters compared to other parts of the country, more attention needs to be given for policy implementation. Despite the rhetoric on water collection, women's participation is less in everywhere in the world of water management. Over the years, male domination degenerated into many forms of differences in indoor and outdoor spaces which were the barrier for women's involvement in development pathways. Over the past few decades, women's empowerment is embryonic in every aspect of life. However, still, they have limited access to organizational, institutional or household level decision-making processes in a country like Bangladesh.

Summary

Water insecurity emerged as a global, national as well as regional problem. This chapter highlights the water insecurity situation in global perspectives as well as Bangladesh's aspects. This chapter also indicates the gender and water policy in the context of Bangladesh and addressed the gender and water security gap at the policy level. Gender perception does not

consist solely on the question of women; however, in all aspects of life it is all about both the roles of women and men. Men and women's functions are similarly merged as a precaution for water management. Thus, cultural values, regulations, attitudes, behavior, social gender differences are signs for a good process of water management (Cap-Net, 2006). The progress in gender mainstreaming and water security was introduced at the 1977 UN Water Conference (UNDESA, 2004), with emphasized on community water management, access to drinking water based on people's needs. In 1990, the Committee on Sustainable Development (Neto and Tropp, 2000) discussed gender issues. Water security and women's empowerment later became the main focus of many organizations and activities from 1992 to 2000. However, both women and men were focused on the management of water at the International Freshwater Conference (Rijsberman 2006). Some literature provides evidence that due to poverty and resource scarcity of women are affected in different ways compared to men (FAO, 2011; Nasreen: 2008, 2012) and shocks also differ from each individual (Cohen et al., 2007). Women have less access to assets, capital and resources than men (Antonopoulos et al., 2005; Deere et al., 2006; Quisumbing, 2009; Nasreen, 2012) and they have less decision-making power in the household, community, and national level. In 2011, the National Women Development Policy was stirred with the vision of giving equal opportunity for both women and men and fundamental rights on an equal basis. NWDP (2011) has also included a section on women and children in disaster for the first time. As in the coastal communities are considered more vulnerable to hazards and disasters compared to other parts of the country, more attention needs to be given for policy implementation.

CHAPTER III: THEORETICAL FRAMEWORK AND CONCEPTUAL FRAMEWORK OF THE STUDY

This chapter aims to develop a theoretical framework of the study as well as the conceptual framework. Different theories interrelated with gender and water need to be analyzed to induce a root analysis of the notion of this study. In essence, gender differences theory, feminist theories, liberal feminism theory make a case concerning gender relations within the society. Additionally, the Gender and Development (GAD) approach, water security framework of REACH explain the current scenario of gender and water security. These theories and approaches have been reviewed to understand the significance and adaptability of the study.

3.1 Introduction

As the renewability of natural systems along with the management of food, water, and shelter depended on the responsibilities of women over the years. Though there are some changes in the development pathway the responsibility of women could be seen in various discriminated forms. To diminish the impact of insecure water within the family and natural environment, women's roles could not be counted in patriarchal domination. In the line of discussion with water, men's roles are also seen as equivocal in the context of Bangladesh. The subordination of women's position tends to be regarded in the water sector as the collector of water, challenges faced to the collection, gender division of labor, decision making and so on. Many scholars have pointed out the subordination position of women in society; however, still, discrimination is central and most debatable in the analysis of gender.

The theoretical foundations of this study are gender differences theory, feminist theory, liberal feminism theory, gender and development (GAD) approach, Gender resilient livelihood framework, REACH water security framework. To understand the water security and gendered culture of the coastal polder, the researcher has used a couple of theories that have been reviewed to shed light on the nature of the study. These theories have been reviewed to understand the significance and adaptability of the study. So, the nexus between water and gender are theoretically briefly reviewed in the following section.

3.2 Theories on gender and water discourse

Gender differences theory

Undoubtedly, gender differences have been seen in various ways in the worldwide in terms of roles and responsibilities, preferences, performances, payments, coping styles, spatial variations and so on. Women and men in society affect differently for their gender identities and roles. The early 1970's gender concept came across to draw a partition line between the biological sex and social construction behavior of both women and men.

Instinctively, people are trying to ensure the transfer of their genes to future generations, but men and women are using different strategies to accomplish this (Pilcher and Whelehan, 2004).Women ensure their offspring's survival by finding partners who can best support and

protect them. Males can maximize their chances by getting multiple sexual partners to pass on their genes to future generations. In this way, men compete with other men to build competition and violence for sexual exposure to women. Those are according to Buss the fundamental characteristics of our former selves that contribute to human species ' survival. Therefore, gender differences in behavior are based on the variation between women and men, from the viewpoint of sociobiology and evolutionary psychology. Functionalists reinforce the conservative point of view by arguing that traditional gender roles lead to social integration. Women traditionally specialize in educating children and running families, according to Talcott Parsons (Tarrant, 2013). Men are traditionally employed by paid labor. With gender roles, each generation learns to fulfill these complementary roles. Men have qualities such as rationality, self-assurance and competition for boys and girls are nourished by femininity and are sensitive to others (Freed, 2003) .For the first time, boys and girls know their sexuality in the family as the parents go about their day-to-day activities. The wider society encourages equality between the sexes as well. In functionalist opinion, it integrates and enables social education to function properly in the essential features of femininity and masculinity (Tarrant, 2013; Brym et al., 2012).

This variance negates the idea that the action of women and men is basic and universal. For societies where gender inequality is small, women tend to stress the role of a good supplier for choosing male partners, and men tend to stress the domestic skills of women (Tarrant, 2013).Over the last four decades, women have become much more positive, competitive, knowledgeable and analytical. There are no lasting gender differences, nor are men and women inevitable. Essentialism attempts to generalize differences in sex groups by way of average. In certain ways, on average, women and men differ. For example, one of the most documented differences between men and women is that men are more verbally and physically aggressive on average than women (Holmes and Meyerhoff (Eds.), 2008).

But it seems to essentials that this trend is true for all men and women. More socio-biologists and evolutionary psychologists did not identify any of the genes causing envy, female food, unequal labor sharing between women and men, etc. Finally, fundamentalists are ignoring the role of power in explaining gender differences. Essentials presume that current behavior patterns help to ensure species survival and society's smooth operation (Tarrant, 2013). However,

the assumption of conflict and feminist theorists overlooks how men are normally in a better position than women to have greater power and authority.

Feminist theory

The contemporary feminist theory focused on two basic questions: -what about the women? and - why is women's situation as it is? Feminist theories of difference, theories of inequality and theories of oppression explained these basic two questions and led to draw a picture from everyday life. The questions seek the answer from society that women are different from men in terms of life experiences and the power relations between women and men. Liberal feminism and Marxist feminism also explained about gender inequality and considered women not only different from men but also less privileged. Women's work is only confined to "private-sphere" responsibilities rather than the public sphere (Ritzer, 1992). Gender differences hold a minority position in discussion of feminist theory, but modern feminist theory explained it well. The main root of contemporary literature on gender differences is that clairvoyant life of women are different from men in terms of values and interests (Ruddick, 1980), value judgments power (Gilligan, 1982), creativity (Gilbert and Gubar, 1979), sexual fantasies (Radway, 1984; Snitow et al., 1983), identity (Laws and Schwartz, 1977) and so on. From childhood to the old age experience of women is distinct from men's experiences (Bernard, 1981). All these constructions of women represent the answer to the question that "What about the women?". Why the situation as it is- this answer presents the biological, institutional and socio-psychological explanation of gender differences (Ritzer, 1992). Feminist theorists deny that male supremacy is so intimately associated with industrial capitalism's growth. Gender inequality in agrarian society is greater than in capitalist industrial societies. Within cultures that consider themselves capitalist and democratic, male domination is clear. These observations lead many feminists to conclude that male domination is less rooted in industrial capitalism than in the relationships of patriarchal authority relations, family structures, and socialization and cultural patterns that exist in nearly all societies (Brym et al., 2012).

The fundamentalism has been opposed by conflict and feminist theorists. Under their opinion, essentialists neglect gender and sexuality's historic and cultural heterogeneity. In what is masculinity and femininity, there are wide variations. Therefore, for the essentialists, there are widely varying levels of sexual discrimination, rates of female violence and requirements for

matric selection and other discrepancies between the genders, which seem common (Brym et al., 2012). In addition, for the essentialists it is widely different than the level of gender inequality, the rate of male violence towards women, and the criteria used for matching and other differences between sexes seem universal (Brym et al., 2012; Ritzer, 1992).

However, theories of oppression indicated the subordinate position of women in society and used and abused by the norms and values of patriarchy. Employing these feminist approaches helped the researchers to identify the gendered impact and risk associated with the coastal people in everyday life struggle.

Gender-disaster resilient theory

Gender-disaster resilient theory is the grounded theory in the subcontinent developed by Nasreen and explained about gender coping, gender resilience during three phases of disaster. The researcher Nasreen, M. (2012) extended her theory on coping mechanisms of women (1995) to gender-disaster resilient theory. It has been pointed out that women play crucial role in water related crisis situation through their indigenous knowledge and practices. They procure, preserve and apply special techniques to meet the household's water requirements. This grounded theory has developed in South Asia to argue that despite their gender-based vulnerability women are the major contributors for their household sustenance in meeting the basic needs through supply of food, water, fodder, health care services and other essentials during crisis situation. This theory also argues that disaster affected both women and men, but women play the major role of coping after disaster situations. Women have a greater physical burden than men in the event of calamities because of gender-specific tasks. Gender discrimination is a major factor leading to increased vulnerability for women and the risk of water (Nasreen: 2008, 2012) in accessing and controlling information and services, technology, lack of access to or control of reproductive resources. This theory also argues the role of women not in the context of vulnerability, but also 'contributory' perspective (Nasreen, 2012).

Liberal feminism

Liberal feminism's main contribution was to demonstrate how much modern society discriminates against women by insisting on having to view women and men differently (Ritzer, 1992). The liberal feminist theory says that to achieve gender equality biological differences

should be overlooked. Liberal feminists argue that women should be independent of themselves. In other words, we believe that women should live their lives of choice. Some of them offer personal autonomy "procedural" accounts (Mackenzie et al., 2002). These accounts indicate that women must have personal autonomy means that they have the right to a wide range of conditions of autonomy. From this point of view, the women's movement should seek to recognize these issues and encourage them. The detection of such favorable conditions requires careful analysis of the specific ways independence deficits arise in different women's lives.

Women and men, particularly under the law, should be handled in a gender-neutral manner. Patriarchal law restricts the choices of women on the premise that the needs of women fall within these limits. Consider legislation limiting women's job opportunities, for example, because it is in female interest to take those jobs (Gupta, et al., 2008).Patriarchal moral laws limit women's choices on the basis that women should not have access to certain alternatives because moral law prohibits women from having them. In liberal feminist terms, these are unfair restrictions on women's decisions, since the choices of women should be guided by their own self-interest and their own values. In liberal feminist opinion, women have the right to option (Baehr, 2007). Feminization of poverty is especially a result of economic inequality, and women's access to choices is often arbitrarily limited (Baehr, 2007; Pearce 1978). Stereotyping and gender discrimination in education and employment are other examples of disproportionately limited opportunities for women (Gupta and others, 2008; Rhode 2003). These stereotyping and prejudice especially hurt some racial, ethnic and cultural groups.

Liberal feminists also highlight the unequal restriction of the cultural homogeneity of women's choices (Baehr, 2007), for instance when society determines personalities and social roles by sex (Okin, 1989; Lewis, 2006; Meyers, 2004; Chambers, et al., 2008). In this way, the women's movement must seek to recognize and foster conditions for independence. The identification of these conditions requires careful consideration of how autonomy gaps are created in women's lives. For example, while it is possible for the state to abstain from preventing these attempts, women themselves should create new "emancipatory alternative imagery" (Meyers, 2004) and create new ways of being a woman and new connections through l-experiments. Liberal feminism has succeeded in breaking down many obstacles to women’s

entrance into previously male-dominated occupations and careers, helping to increase pay levels, and legalizing abortion.

But the prevailing belief that women and men are inherently different has not been overcome by liberal feminism. While gender differences can coexist with fair or even-handed treatment, the way women are treated in modern society, particularly in the workplace, still creates large gaps in wages, job opportunities, and progress. Liberal feminism acknowledged that gendered organizational structure and unequal domestic work distribution were the interconnected roots of workplace discrimination (Baehr, 2007).

Politically speaking, an emphasis was on tangible sources of gender discrimination, such as gendered job markets and inequitable pay levels, and the transition of women in the professions, the state and cultural institutions to the position of authority. Liberal feminist politics takes imperative civil rights movement weapons— antidiscrimination legislation and confirmatory action programs— and uses them to struggle with gender inequality, especially in the labor market (Ritzer, 1992). This theory helps the researcher understand the gender inequality in income-generating activities as well as the decision-making power of the women at the household level.

Gender and Development (GAD) approach

Dealing with gender inequality within society, the Gender and Development (GAD) approach represented the gender roles and ensuring equal participation in both women and men in development by reshaping power relations. Initially, it was recognized that women's involvement was identified but was not benefitting. Gender and Development approach also pays attention to the social and gender relations between women and men to address the inequality in terms of access, use, control over resources and power relations (Momsen, 2006). Arising from the GAD analysis, gender analysts explained that women as a key actor of change and the gender division of labor enforce “triple roles” to women including household chores with reproductive and productive roles (Muyoyeta, 2004). Women are also recognized by the power of patriarchal societies and by their status at the household, community and national levels (Parpart et al., 2000).

The Gender and Development (GAD) approach focuses on the socially constructed differences between men and women, the need to challenge existing gender roles and relations, and the creation and effects of class differences on development. This perspective was largely influenced by the writings of academic scholars such as Oakley (2016) and Rubin (1975), who argue that the social relations of men and women are a process of subordination, and economists Lourdes Beneria (2015) and Amartya Sen (1987) also explained about gender inequality. They argue that imperialism has placed a model of economics "that encourages the accumulation of capital and causes class distinction" more than "value system" in developing countries (Ritzer, 1992). GAD leaves the concept of WID, where the subordination of women and the lack of inclusion in international development debate have been discussed without any discussion of broader systems of gender relations. GAD focuses mainly on the division between gender and labor in institutions as a power relationship. 'Sex roles ' focuses on the social construction of family identities and also show the perceptions of ' maleness and femininity ' in their equal access to resources (Momsen, 2006)."The study of social relations" reveals the social aspects, rooted in social institutions, of patriarchal force relations as well as their effect on "the relative condition of men and women in society" (Momsen, 2006).

The social aspect of the hierarchy of power in social institutions as well as the deciding effect on the "relative position of women and men in society" is defined in the "Social Relations Analysis" relevant to the position of women.GAD is performing sex analysis to understand how men and women work together in order to produce outcomes in positive economic and productive environments. GAD policy aims at redefining the societal perceptions of gender roles in an attempt to create gender equality (referred to as women having the same chances as men including the ability to participate in the public sphere). Women are expected to perform their household management functions, domestic production, childcare, and family care. Men will nevertheless be breadwinners in connection with paid work and market development. The role of women is generally interpreted as "motherhood's responsibilities (Momsen, 2006). Women generally earn less than men in the labor market. GAD has been commonly used in policy discussions but this pattern is not reflected in planning agencies ' current practice and development plans. During her work at London University's Development Planning Unit, Caroline Moser developed the Moser Gender Planning Framework for a GAD-focused development plan in the 1980s. She expanded it in a gender policy and planning methodology

with Caren Levy (Moser, 1995).By emphasizing the importance of gender relations, the Moser model incorporates the sex and growth approach. The Moser Framework encompasses the identification of gender roles, the assessment of gender needs, the breakdown of control of resources and decisions in the home, work balance planning, and household responsibility, a separation of the various goals of intervention and the involvement of women and gender-conscious organizations in planning (Moser, 1995) which also indicated the coastal women's situation regarding water-related risks.

3.3 Conceptual Framework of the study

REACH is a global seven-year (2015-22) initiative sponsored by the UK, DFID and implemented by the University of Oxford in three countries: Bangladesh, Kenya, and Ethiopia. The Project aims to improve water safety for poor people through the creation of new evidence of water security by means of innovating, interdisciplinary based on risk; developing alliances for science, practitioners, and businesses for ground research in ways that benefit the vulnerable; and building capacity and networks for the next generation. Throughout the coastal area of Bangladesh, water insecurity rises with growing populations, rapid changes in climate and chronic threats. REACH will develop methods for evaluating alternate investments in water protection, to eliminate the water-climate poverty trap and to promote sustainable growth pathway to define long-term water security. REACH developed a framework of water security to reduce the water risks and poverty in Bangladesh, Kenya, and Ethiopia which is the conceptual framework of the study. REACH water security framework indicated the four major components to discuss the water-risks situation: Hazard, Vulnerability, Exposure, and Risk (figure-5). In the study, the researcher used the framework for explaining the water-crisis situations of the coastal polder through gender lens.

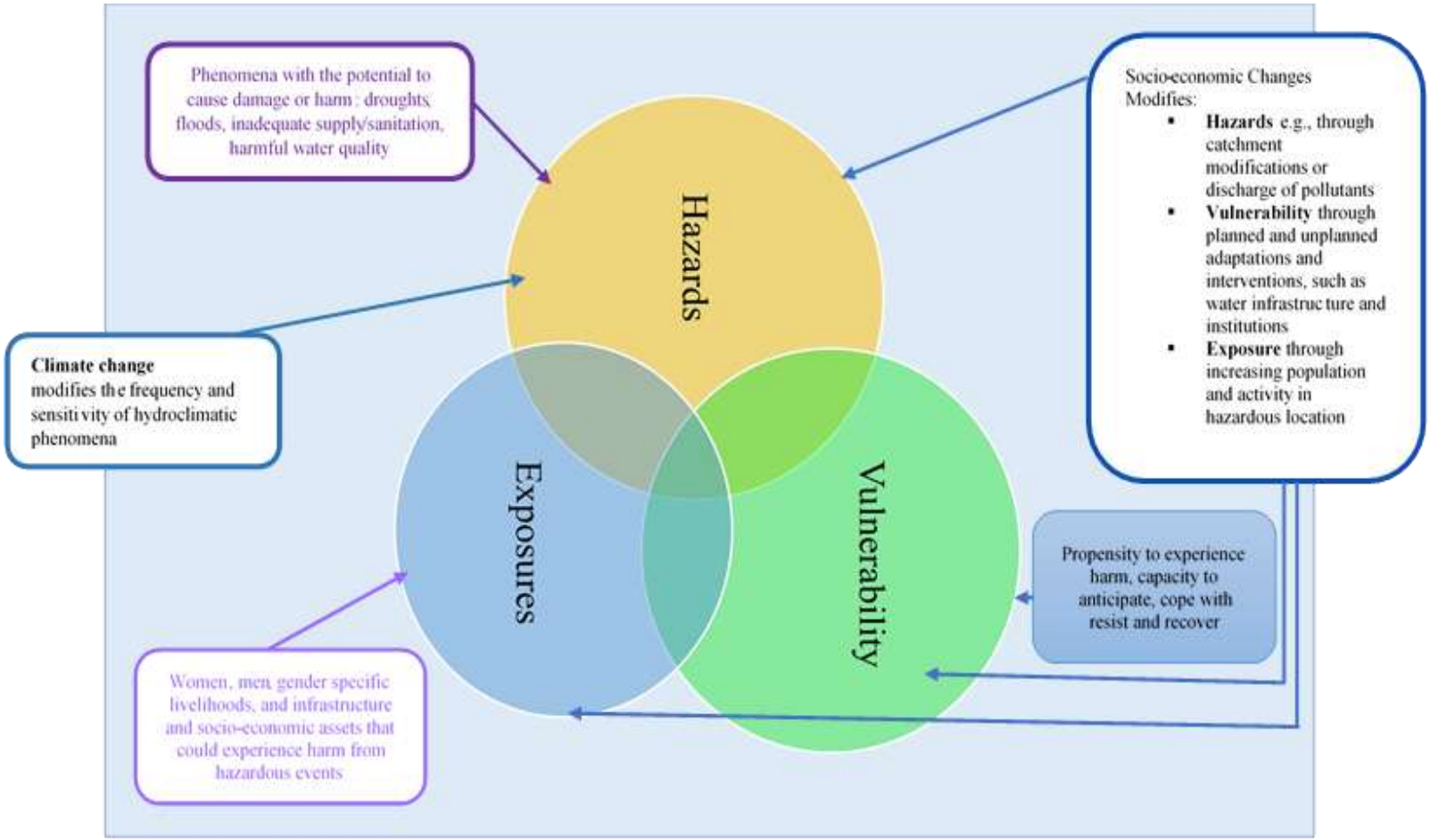


Figure-5: Conceptual framework of the study

Source: Crunch model of gender-water framework (Modified by the researcher, REACH, 2015: 13)

The researcher selected the "water security framework" from the REACH project because the coastal polder has the same water crisis situation and these four components explained the coastal denizen's livelihoods quite well. In the line of the framework, the present study thus critically examines how the water security framework integrated with the coastal water security and how the people anticipated the risks through gender lens. Salinity, riverbank erosion, iron problem, seasonal drought indicated as the water risks situation of the coastal polder, where all these disasters affected both women and men differently. The extreme climatic events such as floods, cyclones, salinity intrusion, and heavy precipitation etc., which are threatening livelihood and intensifying water risks in the coastal areas of Bangladesh. These unfavorable pressures put massive impacts basis on gender identity. Women and children are more exposure and vulnerable due to water risks and hazards. At a structural level, as the male participation dominates the social, cultural and political spheres, the system runs in favour of men, while it subordinates women. Moreover, sensitivity of women's health is attached to the patriarchal control and control over water, assets and property linked with the male counterpart in our society. Women are the core meticulous and traditional amenable members for domestic water management within the family. Still there are significant gender differences in use, access and behavior of water management. Gender discrimination constrained the water use behavior of men and women in the society as well as their access to water resources. Due to the geo-socio-economic characteristics, the recurrent climatic variability and natural disasters put marginal communities entirely at risk position especially the position of women come down at severe risks compared to men . Thus, gender identity leads a vulnerable condition of women and children due to water related disaster. Moreover, considering this view, the study falls within the larger field of inquiry concerned with water using behavior and impacts of water risks in the coastal regions and some recommendations to way forward.

Summary

The chapter highlighted the theoretical link up with the gendered culture in the coastal polder. The chapter provided an outlook of gender differences theories, gender-disaster resilient theory, feminist theory, liberal feminism, Gender and Development (GAD) approach, and the conceptual framework of the study. The behavioral gender differences are based on the sociobiology- and evolutionary psychology discrepancies between women and men. Functionalists expand the

conservative view by arguing that traditional gender roles contribute towards social integration. Women have been historically skilled in educating children and running families.

Men are traditionally employed by paid labor. With gender roles, each generation learns to fulfill these complementary roles. Men have qualities such as rationality, self-assurance and competition for boys and girls are nourished by femininity and are sensitive to others. For the first time, boys and girls know their sexuality in the family as the parents go about their day-to-day activities. In functionalist opinion, it integrates and enables social education to function properly in the essential features of femininity and masculinity. However, the liberal feminist theory says that to achieve gender equality biological differences should be overlooked. Liberal feminists argue that women should be independent of themselves. In other words, we believe that women should live their lives of choice. The gender disaster resilient theory argues that disaster affected both women and men, but women play the major role of coping after disaster situations. Women have a greater physical burden than men in the event of calamities because of gender-specific tasks. Gender discrimination is a major factor leading to increased vulnerability for women and the risk of water in accessing and controlling information and services, technology, lack of access to or control of reproductive resources. This theory also argued the role of women not in the context of vulnerability, but also ‘contributory’ perspective. Feminist theories of difference, theories of inequality and theories of oppression explained these basic two questions and led to draw a picture from everyday life. The questions seek the answer from society that women are different from men in terms of life experiences and the power relations between women and men. Marxist feminism also explained about gender inequality and considered women not only different from men but also less privileged. In addition, GAD policy aims at redefining the societal perceptions of gender roles in an attempt to create gender equality. Women are expected to perform their household management functions, domestic production, childcare, and family care. Men will nevertheless be breadwinners in connection with paid work and market development. In the line of the conceptual framework, the present study thus critically examines how the water security framework integrated with the coastal water security and how the people anticipated the risks through gender lens.

CHAPTER IV: METHODOLOGY OF THE STUDY

This chapter introduces the methods of the study including the philosophical worldview of the study, study location, sampling strategy, data collection tools and techniques, sources of data and ethical consideration of data. Overall, this chapter presents the methodological procedure of the study.

4.1 Introduction

Research in social sciences focuses on describing, understanding, analyzing and likely prediction of the social processes, dynamics, and phenomena. It is normally very difficult to predict and explain social phenomena precisely, and therefore, social researchers depend on different methodological approaches. The research method is a planned and systematic approach of investigation that denotes the detailed framework of the unit of analysis, data gathering techniques, sampling focus, and interpretation strategy and analysis plan. The methodology is a vital part of the research design. According to Nachmias and Nachmias (1996) "A scientific methodology is a system of explicit rules and procedures upon which research is based and against which claims for knowledge are evaluated" (Hyde, 2000). The method originally means the way to the goal. This research needed both quantitative and qualitative methods for collecting data and analyzing it to reach its purpose. It has included sampling, data collections method, methods of data analysis, etc.

To conduct research responsibly, methods of this study aimed to explicit the gender and water relation and provide an insight on how gendered behavior intensifies water insecurity. The major purpose of the study is that gender dimensions play a nexus between water use behavior, water collection challenges, spatial differences and intra-household decision-making regarding water and gender division of labor in Coastal Bangladesh. As women are the collector of water, but water insecurity impacts both women and men differently. To fulfill the purpose of the objectives the mixed-method approach is using to get an insight into the study. The data was collected from intensive fieldwork during 2017 and 2018. Based on quantitative and qualitative primary data, water security and associated risks have been depicted from a gender perspective.

The philosophical worldview guides the researcher to adopt the methods (qualitative, quantitative or mixed-method) and rationale to select the method for their research. In this study, the mixed-method is used to get facts of water security and gendered culture. Quantitative research explains the relationship among variables through testing numeric data using the statistical procedures (Creswell, 2009; Nueman,2006).On the contrary, qualitative research involves explaining the meaning of the data to a social or human problem (Creswell,2009; Nueman, 2006). A mixed-method of the study explains the data combining both quantitative and

qualitative forms. Creswell (2009) explain philosophical worldviews as the general orientation about the nature of the research. He mentioned four types of philosophical worldviews that guide the research i.e. postpositive, social construction, advocacy or participatory and pragmatic.

This study is guided by the pragmatic worldview, to the intended understanding of gendered culture relation with water security among the coastal people of Bangladesh. Pragmatic worldview explains the action, situation, and consequences rather than theory verification and generation (Creswell, 2009). It also interprets the solution of social or real-life problems (Patton, 1990: cited in Creswell, 2009: pp-10).The pragmatic worldview of the study explained the discrimination of women and challenges regarding water safety through their traditional method (action). This is exploratory research to explain both women's and men's situation in the water crisis of coastal polder along with their daily life struggle.So, for mixed-method pragmatism unlock the study by using different methods, different assumptions and different forms of data collection and analysis (Creswell, 2009).

4.2 Gender Resilient Livelihood Framework: a methodological approach of the study

The methodological procedure of the study based on the "Christian Aid Effectiveness of Resilient livelihood" (2012) framework of Dr. Mahbuba Nasreen (gender specialist) which was modified by the researcher of the study. Within the framework of "Christian Aid Effectiveness of Resilient livelihood", she coined six pillars to build resilient livelihoods by means of profitability, risk and resource management, adaptability, sustainability, voice, health and well-being. This framework aimed to empower poor women and men to survive and take advantage of opportunities to enhance their livelihoods.

It also included all tools and resources to protect lives and livelihoods from climate change and disaster risks shocks and pressure. Study participants learned that river salinity and floods involve long-standing disasters and local threats as well as short-term disasters and associated risk for water, drought and cold waves. High salinity is exacerbated every day, agricultural land is losing productivity due to large sand dams and the absence of pure water is extremely important in the coastal zone. The vulnerabilities of societies in the coastal region have appeared in this situation. Based on this context, the researcher implemented and updated the study methodology model on the basis of the study objectives.

The researcher used four components to describe the water crisis situation in the coastal polder; these are a hazard, vulnerability, exposure, and adaptation. In order to describe the water crisis in coastal polder, the researcher used four components: risk, vulnerability, exposure, and adaptation. Women in the poorer economic categories experience different kinds of vulnerabilities due to their gender identity. They are holding subordinate positions than men in both the private and public spheres. Even today, gender discrimination is visible in context of wage distributions and decisions making roles. However, it is evident that despite vulnerabilities, women play major roles in domestic water management. The doctrine of gender differentiation focuses not only the roles of women and men but also the resilience and durability to fight with the existing circumstances. Considering the above situation the present study has given attention to the gendered roles and water-related vulnerabilities of low-income populations. Table-3 indicated the methodological framework of the study based on the objectives which are presented below:

Table-3: The methodological framework of the study

Key Components	Objectives	Methods/Tools	Indicators	Participants
Hazard	To assess the nature of water-related risks and vulnerabilities of coastal poor from a gender perspective;	Focus Group Discussion (FGD), In-depth Interview (IDI), Key Informant Interview (KII), Case studies	Types of hazards, Frequency of hazards, Time period of different water-related hazards based on gender, Understanding on water security and water risk	Women and Men, Key stakeholders
Vulnerability/ Susceptibility	To assess the nature of water-related risks and vulnerabilities of coastal poor from a gender perspective;	Focus Group Discussion (FGD), In-depth Interview (IDI), Key Informant Interview (KII), Case studies	Based on gender role- Livelihood, Occupation, and variations occurred in occupations in the recent period due to water risks, Food security and vulnerability, Economy/income, Social Cultural, Health	Women and Men, Key stakeholders
Exposure	To explore the differential impacts of water-related risks and hazards on male and female and their livelihoods;	Focus Group Discussion (FGD), In-depth Interview (IDI), Key Informant Interview (KII), Case studies	Agricultural activities, Dependency on water for agricultural cultivation in different periods, Irrigation methods for agricultural crops cultivation, Prices of water and payment process, Challenges faced by the household due to water risks or water problems[gender variations],Cooking and food preparation, washing clothes and	Women and Men, Key stakeholders

			dishes, Bathing, and use, Distances of water point, Duration of collection of water from sources, transportation system of water, Quality of water	
Capacity/ Adaptation	To identify water-dependent livelihoods of women and men; and To find out the gender-based alternative adaptation options to reduce water risks.	Observation, Focus Group Discussion (FGD), In-depth Interview (IDI), Key Informant Interview (KII), Case studies	Agriculture, Types of crops cultivated by the household in different periods, Rainwater harvesting, PSF, Managed Aquifer Recharge system, Alternative livelihood adaptations options, Installation of deep/shallow tube-well, Piped water system [new/expansion], Water vending [new/expansion], Rainwater harvesting, Installation of pond sand filter (PSF), Problems/challenges faced by the households , Decision making to installing the new water-related infrastructure , Any water management group at the community level, Members of these groups, Types of groups and roles in water related risks management, Challenges in managing water sources	Women and Men, Key stakeholders

* Source: Modified by the researcher, 2018 (adopted from Nasreen, 2012)

4.3 Research methods

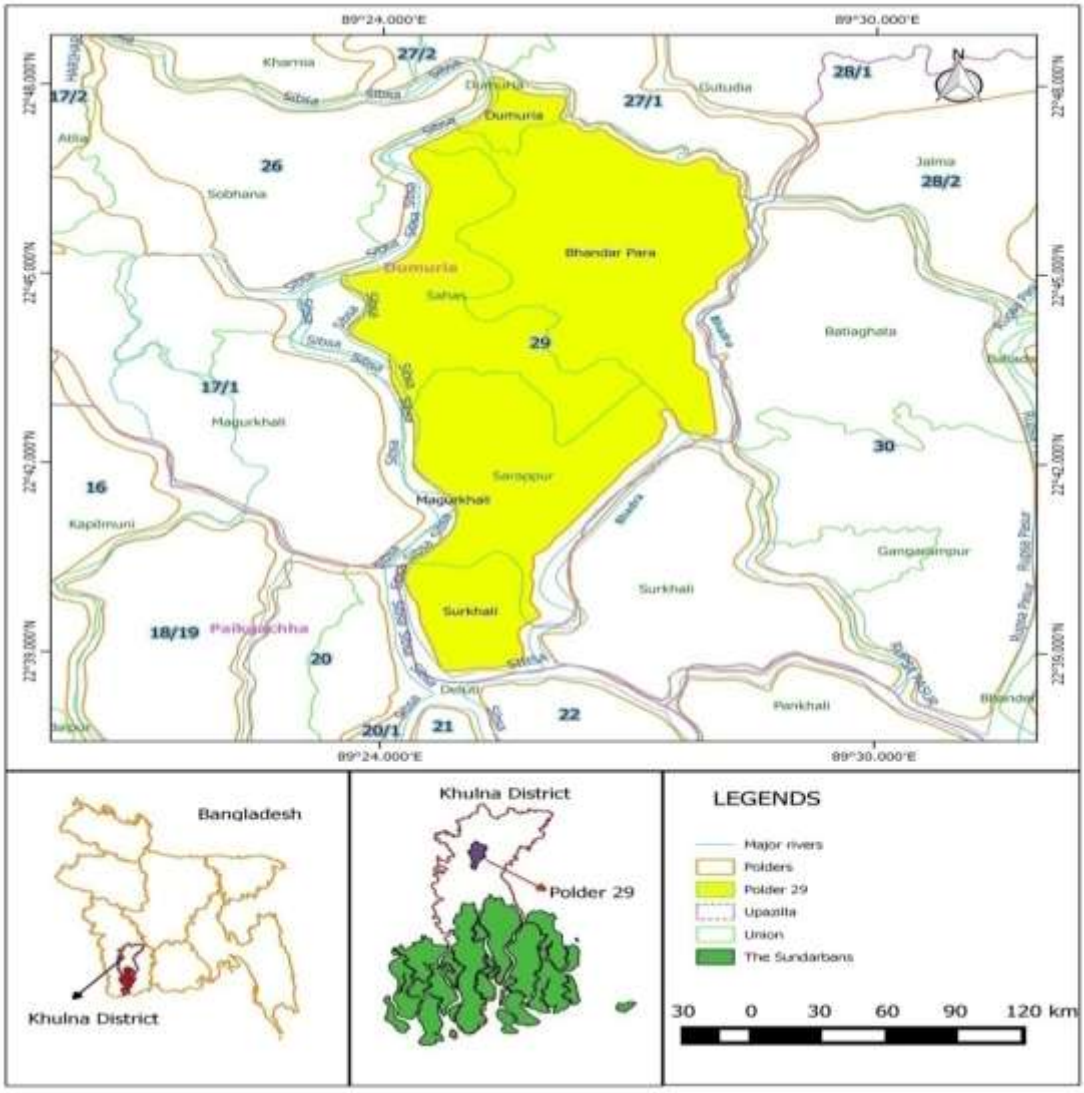
The mixed-method or triangulation strategies are well known as the collection and analysis of data in both quantitative and qualitative ways (Creswell, 2009; Nueman, 2006). Creswell (2009) clarified mixed method as a type of research which involves both quantitative and qualitative data in a particular study where the information is gathered simultaneously, transformative and consecutive way. Quantitative strategies associated with estimating factors or measuring variables and testing hypotheses linked with general casual explanations (Nueman, 2006: pp-151). Alternatively, qualitative approaches emphasize detail examinations of social life cases (Nueman, 2006: pp-151).

Both qualitative and quantitative research confers balancing each other; however, they are different in many ways. So, the piece of the study relies on the mixed-method approach or triangulation approach to find out the gender dimensions in the coastal water insecurity context. All methods have some limitations, so a mixed-method approach emphasizes to eliminate the biases of the study by using different methods in one study and provide validity to the research. Both quantitative and qualitative data can be merged into one study to support each other through analysis (Creswell and Plano Clark, 2007; Neuman, 2006; Tashakkori and Teddlie, 1998; Jick, 1979). This study is based on the mixed methods analysis to giving a clear picture of water and gender analysis.

Study location

The study was carried out in Polder 29, in Khulna district of Bangladesh. The polder was constructed in the 1960s under the project of Coastal Embankment Improvement supported by the World Bank. The total area of Polder 29 is about 7930 hectors[1] (CEGIS, 2016). Polder 29 includes Dumuria, Sahas, Bhandar para and Sarappur unions of Dumuria upazila and part of the Surkhali union of Batiaghata upazila and covers a total of 77 mouzas (Map-1).

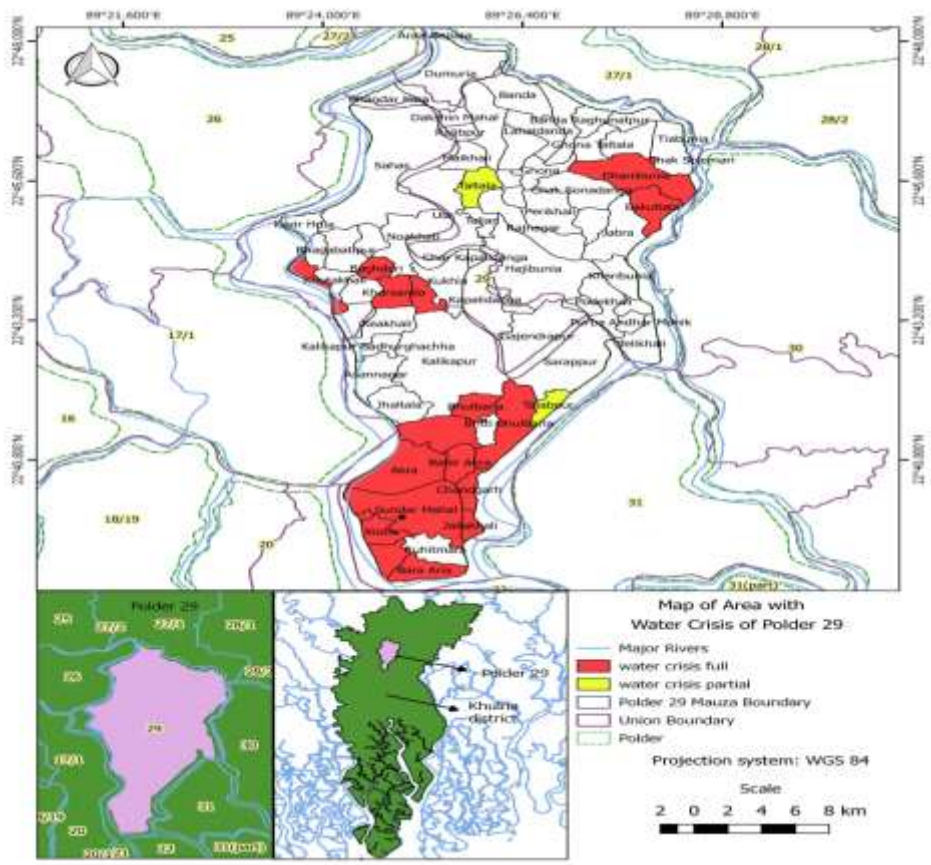
[1] 1 Hector= 10000 square meters



Map-1: Administrative Map of Polder 29 (Source: BUET)

Total surveyed households of the 'REACH'[2] project were 2103 households including two phases. However, following the objectives of the study four mouzas of polder 29 were selected purposively based on the risk profile of REACH (2016/2017): Akra, Chandgarh, Gajendrapur, and Sundar Mahal respectively (Map: 2).

[2]This study is funded by the REACH program led by Oxford University, UK and REACH program will work for improving water security for the poor specially developing countries like Bangladesh, Kenya, and Ethiopia.



Map 2: Study location of Polder 29 indicating water crisis.

(Source: Ashroy Foundation and BUET)

Four mouzas of Polder 29 were selected purposively to capture a holistic aspect of water insecurity pertinent to gender issues. The participants of the study were categorized into three groups – men, women, and mixed groups (both women and men) – for this study. The reasons behind the selection of these mouzas were the prevalence of salinity intrusion, riverbank erosion, and unsafe water stress, but all mouzas were not in similar condition. For instance, water stress was lower in Gajendrapur compared to other areas.

4.4 Sampling Strategy

The survey was conducted of polder 29 in two phases based on purposive selections of Mouza's[3] within the unions and random selection of households based on the risk profiles of

[3]Mouza= Mostly used as a synonymous with the gram or village in Bangladesh

differential water security (REACH, 2017). The Phase -1 focused on communities of different spatial with the different risk profile and phase-2 persistent with the communities who have relatively higher risk profiles in terms of water services (REACH, 2017).

The researcher has identified the study sample based on phases I and II taking high-risk profile populations. Multiple scoping visits to the polder 29 were completed to divide the respondents into three groups as the high, moderate and low risk through subjective judgment and considering water risks. The total household of these four mouza's comprised 1773 and the sampled household was 515 (Including 1st phase 142 and 2nd phase 373) (table-4).

Table-4: List of Mouza's and Sample Size

Union	Mouza	Total Households	Number of Sample Household in Phase 1	Number of Sample Household in Phase 2	Total Number of Women respondents	Total Number of Men respondents	Total Number of Both respondents	Risk Profile
Sarappur	Akra	193	19	39	43	7	8	High
Sarappur	Chandgarh	195	20	42	41	12	9	High
Sahas	Gajendrapur	726	35	153	97	36	55	Moderate
Surkhali	Sundar Mahal	659	68	139	98	28	81	High
Total		**1773**	**142**	**373**	**279**	**83**	**153**	

*Source: Field Survey, Khulna Observatory Research Team of REACH (2017)

The southern part of Polder 29 faces critical water stress which is the main characteristic of Akra, Chandgarh and Sundar Mahal. Gajendrapur mouza has been selected as a control group that has less water stress in the risk profile. A data from the field survey showed that the households of these four mouza's are headed by males with a few headed by females. The water use behavior of coastal people and gender water relationships through a narrative description of their struggles with unsafe water in their everyday lives has been used for this reason.

Pretest

The researcher conducted Focus Group Discussion (FGDs) with a small number of respondents in two groups before finalizing the questionnaire and checklist. Scoping visits were done to prepare the questions. However, the pilot test was conducted to check the clarity of the questions. The researcher also checked the language to address the sensitive issue and the

consistency of questions. Based on the pretest the final questions were made for final data collection.

Criteria of Samples

Primary data were collected from several groups of the profession such as cultivators of agricultural and aquaculture, casual labor, housewife, businessman, poultry farmer, different job holder and so on. For the selection of the household's random route quota sampling technique was used based on census data on housing structures and different wealth categories. For the quantitative study, 515 household's survey data of these four villages (partial data of Polder 29) has been selected and analyzed according to the gender-related aspects of water to give a clear picture of the coastal polder. For the study, members of women respondents were selected more than men respondents. Most of the respondents lived in this locality for more than ten years. For the qualitative study, Focus Group Discussions (FGDs), Case Studies, In-depth interviews have been conducted to identify the water risks and their impacts on the selected communities (table-2). The FGD participants included people from selected four villages based on the vulnerability to water stress.

The main characteristics of the sample are following-

i) Female and male-headed households

ii) Rural women and men

iii) Age not below 18 years

iv) Suffering from water-related risks and disasters in the coastal polder

v) Voluntarily participation as a respondent

The researcher took 1-1.5 hours to conduct the interview for the qualitative study. The qualitative checklist and guidelines developed by the researcher based on the objectives of the study.

4.5 Techniques of Data Collection

In conducting research on a certain problem or issue, a researcher has to adopt some methods and techniques. The logic of adopting a certain methodological approach depends on

the nature and purpose of the study. In quantitative research, social inquiry a well-constructed design that covers in details all the steps of the investigation (Sarantakos, 2005). Both qualitative and quantitative techniques were used to collect the data. The techniques of data collection of the study are presented below:

4.5.1 Quantitative

Field Survey

It usually uses the survey method and presents the data in tables, graphs, charts, etc. To conduct this research work, the researcher has employed the structured interview questionnaire as the quantitative tool to measure some variables relating to gendered culture and water security in Coastal Bangladesh. The researcher and the REACH team formed a structured questionnaire that contained seven sections with several sub-question for collecting the quantitative data. The sections that were included in the structured questionnaire are:

- Section 1: Introduction and Identifiers (Identification number, consent, Household location, union and mouza name, living duration of the locality)
- Section 2: Household demographics (Number of a household member, member of the household relation with household head, age of the household head, education, having a mobile phone or not)
- Section 3: Water and Sanitation (Drinking water sources and payments, owner of the tubewell, location of the tubewell, type of the tubewell, sharing water sources, water collection time and challenges, water collector of the households, address to face the challenges, transportation system of water, payment of water sources, container size, information regarding usage of secondary sources, type of intervention, household contribution to installation of water sources, water quality, domestic uses of water including cooking, bathing and washing, toilet location, disposal of child's waste, sharing toilet facilities or not, source of water for washing hands)
- Section 4: Poverty (occupancy status, fuel using for cooking purposes, power sources and housing materials)
- Section 5: Priority Concerns (Socio-economic concerns, concerns regarding water, concerns regarding the natural environment)

- Section 6: Livelihoods and water-related risks (Land ownership and agriculture, type of farming for subsistence, number of land parcels, ownership status, crops cultivation information, method of irrigation and challenges, homestead land and types of crops, aquaculture and livestock, income sources and gender division of labor, main sources of income, women's involvement in open access fishing and farm activities , who work as casual labor and where, current welfare situation, water-related risks and impacts on livelihoods such as waterlogging, cyclones, salinity intrusion, riverbank erosion, tidal flooding and rainfall variability how people cope with this challenges, water management group and how it will influence).
- Section 7: Closing Questions (Images, Contact number of the respondents and GPS location of the household).

The gender part of survey questionnaire developed by the researcher, while the other part of questionnaire developed by the REACH team (including Oxford University, BUET, University of Dhaka).

4.5.2 Qualitative

Focus Group Discussions (FGDs)

Focus group discussion is a form of qualitative data collection where researchers engage by gathering people from identical backgrounds to converse a particular area of interest. FGD guides us to understand an issue more deeply way and focusing on 'why' and 'how' the event occurs (Kitzinger, 1995). It emphasizes to generate the data based on the belief, interest, opinions, ideas, and perception of the people about a particular field of knowledge and helpful for creativity, solutions, and strategies to overcome the situation (Ritchie et al., 2013). This particular study also asks questions about why there is water insecurity in the coastal polder and how it will impact on the people of that area. To fulfill the purposes of the objectives, 12 FGDs were conducted in the four mouza's of polder 29. Three FGDs in three groups such as women, men and mixed groups (both women and men) were conducted in each mouza and comprising 10-12 participants of each FGD. A moderator directed the discussion and data were collected in an audio recorder. The researcher has translated the data from Bengali to English.

Case study

Qualitative data gathered from the case study was analyzed manually and represented in a descriptive mode. Yin (2011) explained that the case study is an investigation of an existing phenomenon using several sources of evidence of real-life context. This method is guided to the researcher to understand the real-life complexity in great depth (Yin, 2011; Noor, 2008). To gain in-depth knowledge of the study, the researcher conducted 12 case studies of women and men in the four mouzas. Three case studies were conducted in each mouza purposively including one female-headed household, two male-headed households who were suffering from the water crisis and water-related impacts. They were asked various questions and also used a checklist for the collection of data. These case studies provided in-depth information about the impacts of the water risks and their stories of struggles to survive in the worst situation.

Table-5: Qualitative Field Plan of the study

Name of the Mouzas	***Focus Group Discussions (FGDs)***	***In-Depth Interviews (IDI)***	***Case Studies***	***Key informant Interviews (KII)***
Akra	3	2	3	2
Chandgarh	3	2	3	2
Gajendrapur	3	2	3	2
Sundar Mahal	3	2	3	2
Total	12	8	12	8
Participants: Female-headed households, Male-headed households, Women and Men, Key Stakeholders, i.e. Responsible local officials and leaders, Union Parishad Chairman and members, focal person of the water management group. The data were collected from February to June in 2018 in three times of field visits.				

* Source: Prepared by the researcher, 2018

In-depth Interviews (IDI)

An in-depth interview is a cost-effective data collection tool in qualitative research. A face to face in-depth interview technique was administrated to obtain comprehensive information (Milena et al., 2008) of the study that how water insecurity has been discriminating and accelerating inequality between women and men. In-depth interviews conducted with a person in a structured, semi-structured or unstructured way; however, this is a formal discussion about a particular event or issue. For this study, 2 in-depth interviews were conducted in each mouza

including one woman and one man from water insecure areas and secure areas. A total of 8 in-depth interviews were conducted in polder 29 to get an insight into the water crisis experienced by the people of Coastal Bangladesh.

Key Informant Interviews (KII)

Key informant interviews are conducted among those people who are experts about a particular organization, problem, interest group, social crisis or issues (Lavrakas, 2008). Key informants are able to provide detailed information with deeper insights through their skills and positions within a society (Marshall, 1996). They are counted as a knowledgeable person within the community. Key informant interviews have obtained qualitative data within a short period and can also be used to supplement the findings of the study. This method can be used alone or mix with another study. The key informants of the study are:

a) School teacher of the water insecure locality

b) Responsible local officials and leaders of water management group

c) Union Parishad Chairman and members

d) Focal person of the water management group.

Sources of data

The study is primarily dependent on primary data. Data were collected directly from the respective field through survey, focus group discussion (FGDs), in-depth interviews (IDI), case studies, key informant interviews (KII) along with researcher's keen observation. Some secondary data have also been used to strengthen the rationality of the study and for better and comprehensive analysis. Following the secondary sources, the data were collected from different journals, books, articles, reports and relevant documents. Data from both secondary and primary sources helped a lot to give the study a powerful logical framework.

4.6 Data processing and analyzing

The use of multiple methods was extremely useful in gathering required data for the study, but the presenting method in a consolidated manner was a difficult task because of

different measurement levels. The measurement problem becomes complicated when the data were collected through different methods and were used for explaining one particular problem.

Quantitative data processing involved the following steps:

- Questionnaire registration and editing
- Edit verification
- Code transfer from ONA to excel
- Verification of coding and code transfer to SPSS
- Recode some of the data
- Entering data as per questionnaire structure in SPSS 20.0 version
- Verifying the logic and accuracy of the data as per filled up questionnaire
- Tabulation data in SPSS data 20.0 version
- Development of analysis plan
- Program running and report generation

The household survey was conducted using electronic software developed in ONA[4] . The REACH Khulna observatory team (BUET, University of Dhaka and University of Oxford) supported programming the software and collection the survey data. REACH provided the required number of tablets with installing ONA software for data collection purposes. This system offers the hosted portal to access, update, display, and send data. Firstly, the REACH Oxford team were programmed the questionnaire in English, and then the Khulna observatory and Oxford team translate it into Bengali to test the field. With help from the University of Oxford, BUET teams were charged with assigning a field supervisor and recruiting and training enumerators. The researcher also provided training enumerators for collecting the survey data. The survey data was checked by a data analyst and REACH team.

The data was transformed from ONA to Excel format. The data was also converted into SPSS for further analyses. Written as well as verbal consent was taken from all the respondents before collecting the data and informing them about the study purposes to ensure the ethical principles.

[4]ONA (Https://ona.io/)- a mobile survey platform that provides a hosted server. It helps to upload, edit, view and submit the forms easily.

4.7 Reliability and Validity

Reliability refers to the capacity of measurement to produce consistent results and validity refers to the truthfulness of findings (Neuman, 2006). This research is also based on the reliability and content validity through using several methods to testing the data both qualitative and quantitative way. The study was to validate and reliable through the triangulation of the data sources and management.

4.8 Ethical Consideration

According to Bulmer in Gilbert (2001), confidentiality and anonymity are two most important ethical issues. Those who worked in the data collection procedure gave all the information regarding the research purpose to all the interviewees. The research report is not using anyone's details address of respondents and using a pseudonym to ensure the confidentiality of respondents. The major findings of the research were disseminated in the 'REACH' team as well as the BUET and the Dhaka university team who are involved with this project. The researcher shared the qualitative findings with the Oxford team in the Water security conference held in March 2019.

4.9 Limitations of the study

The research has some limitations-

- Limitation of time
- The sample size of the study was limited
- Some respondents did not answer for their lack of time.
- From the nearly educated respondents is not easy to take interview.
- From quantitative data, health problems could not be possible to address properly.

4.9 Timeline of research activities

Timeline of the research activity is presented below (table-6):

Table-6: Timeline of research activities [Activity Schedule/chart (in months) [is shown by the symbol **]

Serial No.	Work Plan/Activity Plan	First Quarter		Second Quarter		3rd Quarter		4th Quarter	
		April, 2017 – November, 2017		**December, 2017 – March, 2018**		**April, 2018 – February, 2019**		**March, 2019 – , December, 2019**	
1.	Selection of Research title	****	****						
2.	Literature review		****						
3.	Review of Related Documents and provide critical feedback on the survey instrument		****						
4.	Fieldwork logistics		***						
5.	Developing Semi-Structured Questionnaire and qualitative guidelines		***						
6.	Field Visit			***					
7.	Pre-test			***					
8.	Finalization of Questionnaire			***	***		***		
9.	Data Collection and Field Work			***	***		***		
10.	Data entry of survey responses and translation				***	***	***	***	

11.	Data Analysis and Processing, Finalization of Findings, Preparing Draft Outline of the Report					***		***	
12.	Report Writing and Submit Draft Report					***		***	
13.	Project outputs and dissemination and Finalization of Dissertation								***
14.	Submission of Final Dissertation								***

4.10 Operational Definition of the study

Operational definitions of the study are presented below:

Adaptation - Adjustment in natural or human systems to a new or changing environment; adaptation can be anticipatory or reactive, private or public, autonomous or planned.

Climate change - A statistically significant change in either the mean state of the climate or in its variability, persisting for an extended period (decades or longer).

Climate risk - The likelihood of a natural or human system is suffering harm or loss due to climate variability or change.

Community management - An approach to service provision in which communities take responsibility for operating and maintaining their water supply systems.

Culture- is the way of life consisting of norms, values, beliefs, practices, communications, customs, laws, arts, knowledge, language, traditions of a social group.

Division of Labor- Division of labor refers to the distribution of tasks into different stages to focus on specific tasks by given different roles to the workers.

Domestic water - Water used by households for drinking, washing, and cooking and so on.

Equality- Equality refers to the state of being equal in terms of opportunities, rights, status, etc.

Exposure- Exposure refers to the people, assets, and livelihoods that could experience harm and loss due to the hazard (REACH, 2015).

Gender- Gender refers to the state of being male or female (typically used concerning social and cultural differences rather than biological ones).

Gendered- Gendered is a reflection of changed understandings of gender as an active ongoing process. This also refers to actively engaged in social processes that produce and reproduce distinctions between women and men (Pilcher et al., 2016).

Hazard- Hazard is a phenomenon with the potential to cause damage or harm (REACH, 2015).

Inclusive- Including or covering all the services, facilities, or items normally expected or required.

Spatial differences- Spatial differences refer to explain the difference between different geographical information including location, features, boundaries and distinctive characteristics.

Susceptibility- Susceptibility refers to the state or fact of being influenced or harmed by a particular thing.

Patriarchy- Patriarchy is a system of government in which the male holds the power and society is controlled by the male power.

Risk- Risk refers to a situation involving exposure to danger.

Vulnerability - The exposure and sensitivity of a system (or population) to external shocks and stresses, such as climate impacts, mitigated by the ability of that system to adapt. Vulnerability captures the propensity to experience harm as a dynamic function of the capacity to anticipate, cope with and recover from harmful events (REACH, 2015).

Water security - The availability of an adequate 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 (REACH, 2015).

Summary

This chapter provides the outlook of the research method of the study. This study is based on the mixed method (both qualitative and quantitative methods). The survey tool was used for quantitative data and FGDs, case studies, in-depth interviews, and key informant interviews are conducted for qualitative research. SPSS version 20 was used to explain the quantitative data and for qualitative data ATLAS.ti 5.2 was used to analyze the data.

CHAPTER V: NATURE OF WATER–RELATED RISKS AND VULNERABILITIES

This chapter introduces the socio-demographic profile of the respondent including the essence of water-related risks and its impact on the gender dimension of Coastal polder. The researcher has presented a quantitative and interpretative analysis of data in a meaningful way. The findings of the study are shown in tables and chi-square analysis. Graphs are also used to display the results of the study as required figures. Overall, the findings of the nature of water-related risks and vulnerability of the coastal people are described in this chapter.

5.1 Introduction

The findings of the study were mainly concerned with the gender dimension of water collection challenges, gender division of labor, and spatial variations in water insecure and water-secure areas. Analyzing the intensive fieldwork in coastal Bangladesh several issues emerge from the research associated with the gender dimension of water security. For research purposes, the majority of the respondents were selected from the women's category (figure-1). In some cases, both female and male respondents selected from the same households. To identify the water insecurity situation in the coastal polder, the study focused on three water insecurity areas namely Akra, Chandgarh and Sundar Mahal quantitatively and qualitatively compared with a glimpse of water secure area -Gajendrapur. Both female and male-headed households were included in the study to examine the overall impact of water insecurity in households.

5.2 Socio-demographic profile

A socio-demographic profile represents the distinctive character of a population-based on their age, sex, income, occupation, religion, education, duration of living in the locality, ethnicity and marital status, etc. The demographic information of this study were included in the location of the households, age, and sex of the respondent, their educational qualification, duration of living in the locality and the overall number of the household members. In this study, each respondent above 18 years old was considered as a unit of analysis. At the beginning of each interview, the researcher collected the socio-demographic background of the participant. The objective of this section is to know about their age, education, and living duration of the locality and number of household members so on.

Table-7: Percentage distribution of mouzas according to union

Name of Union	Name of the mouzas								Total	
	Akra		Chandgarh		Gajendrapur		Sundar Mahal			
	n	Percent	n	Percent	n	Percent	n	Percent	n	Percent
Sahas	0	0	0	0	188	36.5	0	0	188	36.5
Sarappur	58	11.3	62	12	0	0	0	0	120	23.3
Surkhali	0	0	0	0	0	0	207	40.2	207	40.2
Total	58	11.3	62	12	188	36.5	207	40.2	515	100

*Source: Household Survey data, 2018

The four mouzas particularly Akra, Chandgarh are part of Sarappur union. In addition, Gajendrapur and Sundar Mahal are part of Sahas and Surkhali union respectively. The households of the study were mainly from three unions of coastal polder 29 namely Sahas, Sarappur, and Surkhali. A total of 515 households were selected for the study. Water insecure areas namely Akra 11.3 percent (58), Chandgarh 12 percent (62), and Sundar Mahal 40.2 percent (207) and water-secure area Gajendrapur 36.5 percent (188) households were selected purposively based on the research objectives (table-7). Among 21 households (4.1 percent) were female-headed and 494 households (95.9 percent) were male-headed households from a total of 515 households. The average age of the household heads was 48.47, of which the mean age of the female-headed households was 44.83 and 49.62 for the male-headed households.

It was revealed by age that the majority of the head of households were living in the middle span of their life. The majority of the male-headed households (52.2 percent) and female-headed households (2.7 percent) belonged to the 19-50 age groups (table-8) which indicated the prime working-age of the respondents in the Bangladesh context. Besides, mostly the educational qualification of both female-headed (47.6 percent) and male-headed households (27.3 percent) were only able to sign their name. The following trend of the coastal people educational qualification showed that the second largest data represented from the male-headed households (23.1 percent) and female-headed households (14.3 percent) belonged to the IX-XII class group (table-8). The living duration of the majority of the respondents of the locality was more than 10 years both female-headed (85.7 percent) and male-headed households (96.4 percent). The study represented that most of the respondents were experienced with water-related risks due to their residential surroundings.

Table -8: Socio-demographic profiles of the head of the households

Socio-demographic variables	All (n=515) (%)	Biological Identity of HH (%)		Descriptive statistics		
		Female (n=21)	Male (n=494)	χ^2	df	p-value*
Sex		4.1	95.9			
Age of HH	Average age= 48.47	44.83	48.62	1.21	1	0.19
19 - 50	55.0	2.7	52.2			
51 and above	45.0	1.4	43.7			
Educational status				11.51	13	0.568
No education	10.5	14.3	10.3			
Can sign name	28.2	47.6	27.3			
one to class V	19.6	14.3	19.8			
VI-VIII	13.8	9.5	13.9			
IX-XII	22.7	14.3	23.1			
Bachelors/diploma	5.2	0.0	5.5			
Duration of living in disaster-prone areas				11.35	4	0.023
Less than 1 year	0.8	0.0	0.8			
1 - 2 years	0.6	4.8	0.4			
2 - 5 years	1.0	4.8	0.8			
5 - 10 years	1.7	4.8	1.6			
More than 10 years	95.9	85.7	96.4			
HH members	Average=5.05	Average=0.15	Average=4.89	60.812	11	0.000
1-3	23.7	2.4	21.4			
4-7	74.1	1.6	72.6			
8-11	4.1	0.2	3.9			
12+	0.2	0.0	0.2			

*Source: Household Survey data, 2018

The average family members of the households were 5.05 with an average mean of 0.15 for female-headed households and 4.89 male-headed households. It is shown from table-8 that 72.6 percent of the male-headed households have 4 to 7 members, on the other hand, 1.6 percent of female-headed households have the same number of household members. In the water insecure areas, the number of family members results in vulnerable situations for the vulnerable group due to their economic crisis and water-related risks of the coastal area.

Table-9: Percentage distribution of sex of the respondents according to mouzas

Name of the Mouzas	Sex of the respondents							
	Female		Male		Both		Total	
	n	Percent	n	Percent	n	Percent	n	Percent
Akra	43	8.3	7	1.4	8	1.6	58	11.3
Chandgarh	41	8	12	2.3	9	1.7	62	12
Gajendrapur	97	18.8	36	7	55	10.7	188	36.5
Sundar Mahal	98	19	28	5.4	81	15.7	207	40.2
Total	279	54.2	83	16.1	153	29.7	515	100

*Source: Household Survey data, 2018

To obtain the purpose of the study, the majority of the respondents, who provide the information about selected households, were women because of their availability at the household level. In rural Bangladesh, women are solely responsible for household chores. In some cases, both female and male respondents have been selected from the same households. The 54.2 percent (279) respondents are female, 16.1 percent (83) respondents are male from the 515 households (table-9). Besides, 29.7 percent of both females and males have been selected from the same households to get an insight into the agricultural sector related to water-risks (figure-6).

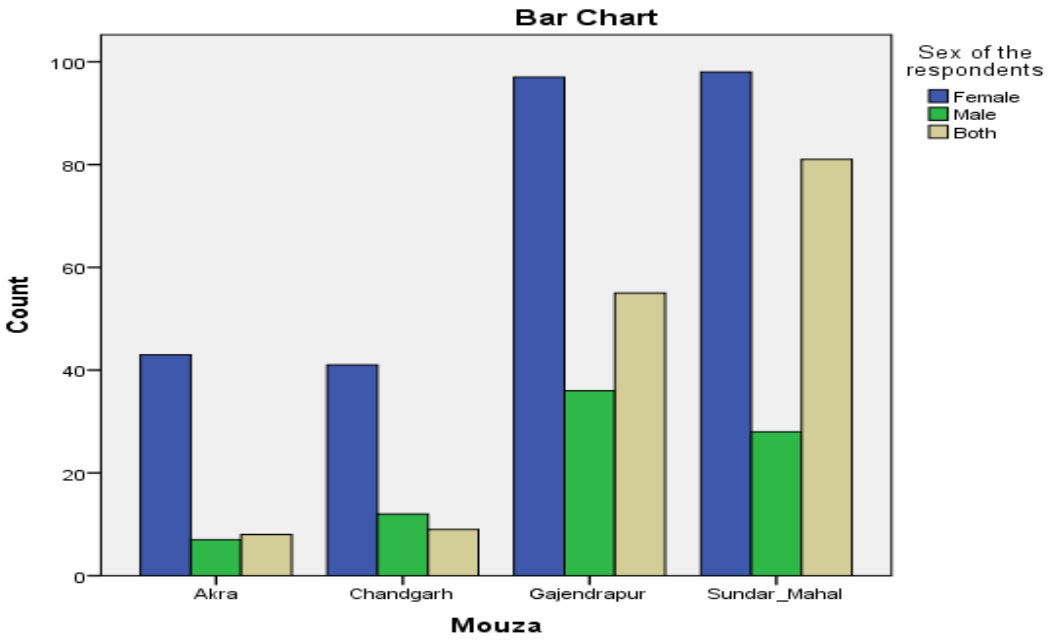


Figure-6: Percentage distribution by sex of the respondents according to different mouzas

*Source: Household Survey data, 2018

5.3 Nature of water-related risks and vulnerabilities

Water-related risk results from climate change determine water using the behavior of the vulnerable communities as people determine the nature of water-related risks and vulnerabilities. Several studies revealed that the prolonged process of gender discrimination and unequal access to water has created water insecurity and threats to their livelihood (Mutahara et al., 2016, Deb and Haque, 2011). In this study, it was found that multiple sources of drinking water used by the households in the past year and their water using behavior for cooking, washing and cleaning purposes. The drinking water sources of the coastal people were varying between each mouzas. The water insecure areas depended on the shallow tubewell water; on the contrary, water-secure areas had the supply water system. Different people were using different sources for their drinking purposes, but water-related risks were associated with the sources of water due to salinity intrusion, iron and arsenic problems. Table-10 indicates that the common sources of water for the coastal polder was shallow tubewell-1 and 55.3 (285) percent of the respondents used these sources for their drinking purposes. About 35.7 percent (184) also use rainwater for their drinking and cooking purposes in Chandgrah and Sundar Mahal. Mostly Akra people depended on the vended water due to their distance from safe water sources.

Table-10: Percentage distribution of sources of drinking water

Sources of Drinking water used by HH	Sex of the respondents of households							
	Female*		Male *		Both*		Total	
	n =	Percent	n=	Percent	n =	Percent	n =	Percent
Public tap/ stand pipe	61	11.8	20	3.9	33	6.4	114	22.1
Deep tube-well 1	67	13	29	5.6	40	7.8	136	26.4
Deep tube-well 2	40	7.8	16	3.1	29	5.6	85	16.5
Shallow tube-well 1	161	31.3	37	7.2	87	16.9	285	55.3
Shallow tube-well 2	42	8.2	14	2.7	29	5.6	85	16.5
Rainwater (roof catchment)	92	17.9	34	6.6	58	11.3	184	35.7
Rainwater (community source)	0	0	0	0	1	0.2	1	0.2
Water vended through pick-up truck	36	7	7	1.4	9	1.7	52	10.1
Water vended through nossimon/van	59	11.5	15	2.9	22	4.3	96	18.6
Bottled water	1	0.2	0	0	0	0	1	0.2
River/Canal	0	0	1	0.2	0	0	1	0.2
Pond	9	1.7	3	0.6	8	1.6	20	3.9
Pond sand filter	37	7.2	6	1.2	25	4.9	68	13.2

* Source: Multiple responses (Survey data, 2018)

Besides, different types of ownership of tubewells were observed in polder 29 such as family ownership, extended family ownership, community ownership, institutional ownership, private ownership, etc. Mostly, deep tubewell-1 and deep tubewell-2 belonged to the community member or government ownership state by the majority of the household respondents (respectively 25.4 percent and 15.7 percent). On the other hand, shallow tubewell-1 and shallow tubewell-2 belong to private ownership stated by respectively 27 percent (139) and 12.8 percent (66) of the respondents (table-11). In the water-secure area, Gajendrapur had deep tubewell-1 and deep tubewell-2 water sources more compared to other water insecure areas.

Table-11: Percentage distribution of types of ownership of tubewell by mouzas

Type of tube wells	Mouza	Akra		Chandgarh		Gajendrapur		Sundar Mahal		Total	
	Type of ownerships	n	Percent	n	Percent	n	Percent	n	Percent	n	Percent
Deep tubewell-1 (n=136) *	Communal	0	0	1	0.2	131	25.4	0	0	132	25.4
	Institutional	0	0	0	0	1	0.2	0	0	1	0.2
	Other Private	0	0	1	0.2	1	0.2	1	0.2	3	0.6
	Total	**0**	**0**	**2**	**0.4**	**133**	**25.8**	**1**	**0.2**	**136**	**26.2**
Deep tubewell-2 (n=85) *	Own Tubewell	0	0	0	0	0	0	1	0.2	1	0.2
	Communal	0	0	0	0	81	15.7	0	0	81	15.7
	Institutional	0	0	0	0	3	0.6	0	0	3	0.6
	Total	**0**	**0**	**0**	**0**	**84**	**16.3**	**1**	**0.2**	**85**	**16.5**
Shallow tubewell- 1 (n=285) *	Own Tubewell	14	2.7	0	0	17	3.3	37	7.2	68	13.2
	Extended Family	5	1	0	0	4	0.8	6	1.2	15	2.9
	Group Families	1	0.2	0	0	0	0	0	0	1	0.2
	Communal	1	0.2	10	1.9	0	0	14	2.7	25	4.9
	Institutional	0	0	0	0	0	0	37	7.2	37	7.2
	Other Private	18	3.5	34	6.6	15	2.9	72	14	139	27
	Total	**39**	**7.6**	**44**	**8.5**	**36**	**7**	**166**	**32.3**	**285**	**55.4**
Shallow tubewell-2 (n=85) *	Own Tubewell	0	0	0	0	0	0	1	0.2	1	0.2
	Extended Family	1	0.2	0	0	3	0.6	1	0.2	5	1
	Communal	1	0.2	0	0	0	0	5	1	6	1.2
	Institutional	0	0	0	0	0	0	7	1.4	7	1.4
	Other Private	4	0.8	1	0.2	2	0.4	59	11.5	66	12.8
	Total	**6**	**1.2**	**1**	**0.2**	**5**	**1**	**73**	**15.3**	**85**	**16.6**

*Source: Multiple responses (Survey data, 2018)

Mostly the primary source of water was shallow tubewell-1 in Chandgarh and Sundar Mahal which were mentioned by about 8.5 percent (44) and 32.3 percent (166) of the respondents among 515 respondents. In Sundar Mahal, the ownership of shallow tubewell-1 and shallow tubewell-2 were mainly private ownership (figure-7). In Akra, the majority of the tubewell ownership belongs to families stated by the 3.5 percent (18) of the respondents (figure-8). The ownership of most of the tubewells belonged to community ownership rather than individual family in the coastal polder. The qualitative findings indicated that the owner of the tubewell both women and men generally did not protect to collect water from their tubewells

except personal collision. But, some of the pond owner told to their neighbors not using their water sources for washing dishes as well as clothes.

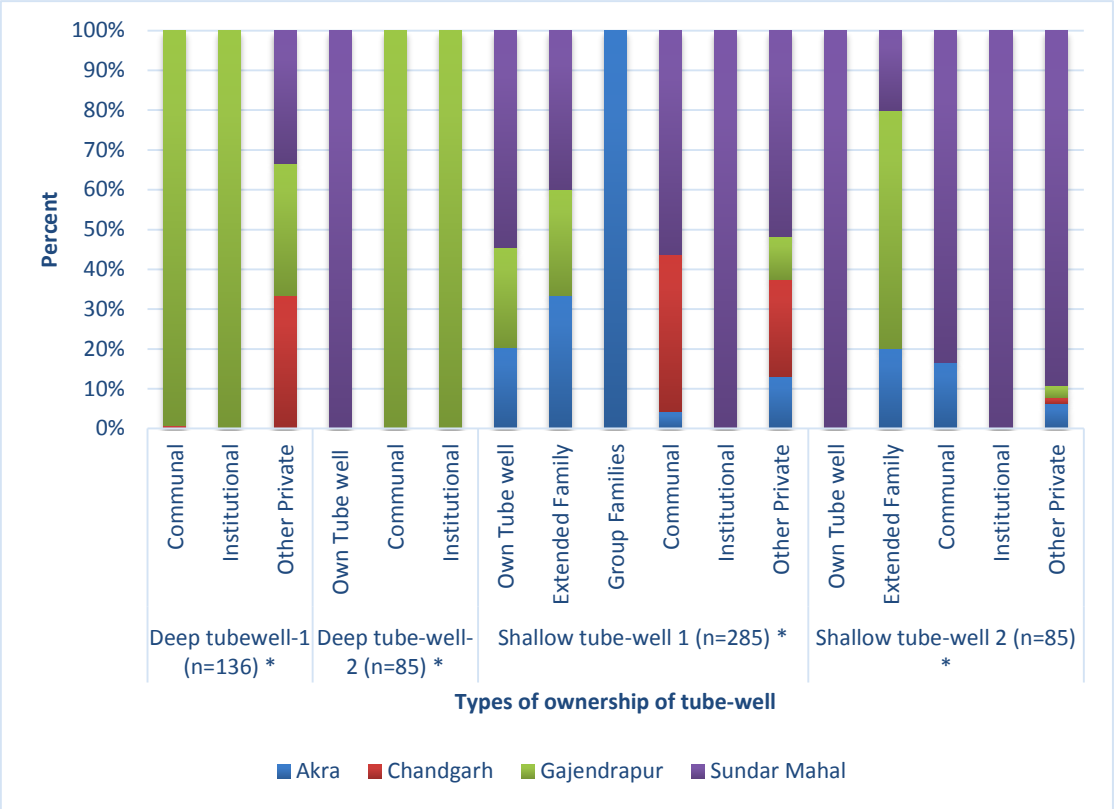


Figure-7: Percentage distribution of types of ownership of tubewell

*Source: Multiple responses (Survey data, 2018)

The locations of the tubewells were not similar in these four mouza's. In the water-secure area, the location of water sources was a bit far from the majority of the respondents (21.7 percent) opined (table-12). On the other hand, water insecure areas also had the same situation in terms of distance of water points, but still, the respondents did not get a good quality of water due to salinity, iron and arsenic problems in the shallow tubewell. Deep tubewell water sources was recognized as good quality water sources for the coastal people, but high-priced will be needed to install the deep tubewell in the locality. However, the marginalized didn't have the capability to install it.

Table-12: Percentage distribution of type of tubewellby mouzas and location of the tubewell

Type of tubewell	Mouza	Akra		Chandgarh		Gajendrapur		Sundar Mahal		Total	
	Location oftubewell	n	Percent	n	Percent	n	Percent	n	Percent	n	Percent
Deep tubewell-1 (n=128) *	Near	0	0	0	0	9	1.7	0	0	9	1.7
	Bit Far	0	0	0	0	112	21.7	0	0	112	21.7
	Very Far	0	0	1	0.2	6	1.2	0	0	7	1.4
	Total	**0**	**0**	**1**	**0.2**	**127**	**24.6**	**0**	**0**	**128**	**24.8**
Deep tubewell-2 (n=85) *	Near	0	0	0	0	5	1	0	0	5	1
	Bit Far	0	0	0	0	73	14.2	1	0.2	74	14.4
	Very Far	0	0	0	0	6	1.2	0	0	6	1.2
	Total	**0**	**0**	**0**	**0**	**84**	**16.4**	**1**	**0.2**	**85**	**16.6**
Shallow tubewell-1 (n=235) *	Near	21	4.1	0	0	24	4.7	14	2.7	59	11.5
	Bit Far	6	1.2	12	2.3	8	1.6	132	25.6	158	30.7
	Very Far	0	0	18	3.5	0	0	0	0	18	3.5
	Total	**27**	**5.3**	**30**	**5.8**	**32**	**6.3**	**146**	**28.3**	**235**	**45.7**
Shallow tubewell-2 (n=68) *	Near	1	0.2	1	0.2	2	0.4	1	0.2	5	1
	Bit Far	2	0.4	0	0	2	0.4	59	11.5	63	12.2
	Total	**3**	**0.6**	**1**	**0.2**	**4**	**0.8**	**60**	**11.7**	**68**	**13.2**

***Source: Household Survey data, 2018

Almost all the tubewell including deep and shallow tubewell were operated by hand pump of coastal polder stated by 515 respondents (table-13). Hand pump tubewell is characterized with a lever/ handle outside the pump to move water up from a well underground that is pumped by a person in the up and down direction. To operate hand pump tubewell, most of the women have faced the physical pressure by continuously pushing the pump for their daily household chores. Above 31.1 percent (160) of the female respondents used hand pump shallow tubewell for their daily needs. On the contrary, 7.2 percent (37) male respondents of the households use the hand pump tubewell.

Table-13: Type of operator of the tubewell in the coastal polder

Type of tubewell	Sex of the respondents	Female		Male		Both		Total	
	Type of tubewell	n	Percent	n	Percent	n	Percent	n	Percent
Deep tubewell-1 (n=136) *	Hand pump	67	13.0	29	5.6	40	7.8	136	26.4
Deep tubewell-2 (n=85) *	Hand pump	40	7.8	16	3.1	29	5.6	85	16.5
Shallow tubewell- 1 (n=284) *	Hand pump	160	31.1	37	7.2	87	16.9	284	55.1
Shallow tubewell- 2 (n=85) *	Hand pump	42	8.2	14	2.7	29	5.6	85	16.5

* Source: Household Survey data, 2018.

Due to the low quality of water, coastal people purchase water from the water vendors. The survey on purchasing of water revealed that 28.57 percent (6 out of 21) of female-headed households (FHHs) purchased water from the water vendors; 22.46 percent (111 out of 494) of male-headed households (MHHs) purchased water from the water vendors. The chi-square test (.798) and p-value (0.671) of the payment for water (table-14) also indicates that there is a significant relationship between the household head and the payment system of water. The payment systems of water were based on three ways in coastal polder such as jerrycan, monthly and seasonally payment. Most of the female-headed households (4.2 percent) and male-headed households (70.08 percent) paid on a monthly basis for purchase water from vendors. The monthly payment for purchasing water between BDT 1(USD-0.012) - BDT 150 (USD-1.77) and 87 respondents out of 515 households paid in small amounts monthly to the water vendors (table-14). The payment depends on the size of the container of the households. Per litre jar cost BDT 20 (USD-0.24) in water insecure areas, which is not affordable by most of the households in coastal polder. Most of the female-headed households faced economic crisis to pay for the water to water vendors. They had to survive on the shallow tubewells and pond water for their daily survival.

Table-14: Cross-tabulation of water-related variables by head of households

Purchasing of water-related variables	Biological Identity of the household head				Overall (n=515)	%	Descriptive statistics		
	Female	%	Male	%			χ2	df	p-value*
Payment for water									
Yes	6	28.57	111	22.46	117	22.71	.798[a]	2	0.671
No	15	71.42	383	77.53	398	77.28			
Paymentsystem (n=117)									
Jerrycan	1	.85	19	16.23	20	17.08	1.186[b]	3	0.756
Monthly	5	4.2	82	70.08	87	75.0			
Seasonally	0	0.0	10	8.54	10	8.54			
Payment for purchasing water (monthly) (n=87)									
1- 150	5	5.74	79	90.80	84	96.54	.464[c]	6	.998
151 - 300	0	0.0	2	2.29	2	2.29			
301 +	0	0.0	1	1.14	1	1.14			
Payment for purchasing water (Seasonally, n=10)									
1 - 15	0	0.0	8	80.00	8	80.0			
16 - 30	0	0.0	2	20.00	2	20.0			
Size of container (n=20)									
10 - 20	1	5.0	8	40.00	9	45.0	1.287[d]	4	.864
21 - 40	0	0.0	6	30.00	6	30.0			
40+	0	0.0	5	25.00	5	25.0			
Amount paid for the per container (n=19)									
5 - 14	1	5.26	8	42.10	9	47.36	1.415[e]	4	.835
15 - 24	0	0.0	8	42.10	8	42.10			
25 - 34	0	0.0	1	5.26	1	5.26			
45 - 54	0	0.0	1	5.26	1	5.26			

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 1.43.

b. 3 cells (37.5%) have expected count less than 5. The minimum expected count is .41.

c. 13 cells (92.9%) have expected count less than 5. The minimum expected count is .06.

d. 9 cells (90.0%) have expected count less than 5. The minimum expected count is .05.

e. 8 cells (80.0%) have expected count less than 5. The minimum expected count is .05.

* Source: Survey data, 2018

Typically, the mean of seasonal payment was 6.25 for water sources of 10 households among 515 households (Standard deviation-10.264). The monthly main source (table-15) payment mean was 42.18 where the standard deviation 56.557.

Table- 15: Descriptive Statistics of the payment for water sources and size of the container

Main source	N	Minimum	Maximum	Mean	Std. Deviation
Main source payment (seasonally)	10	0	30	6.25	10.264
Main source payment (monthly)	87	10	480	42.18	56.557
Size of container	20	20	100	32.75	19.566
Main source Payment (per container)	19	5	50	16.84	9.890

* Source: Survey data, 2018

5.4 Quality of water in selected areas

The present research revealed that water quality is currently low in the southern polder. Among 515 respondents (multiple responses), 39 percent of Akra, and 50 percent of Gajendrapur stated that the taste of water was not good in quality and had a salty taste (table-16). Bangladesh has remarkable success in reducing arsenic problems, which is also seen in coastal polder. About 23 percent of people of Gajendrapur mentioned water problem linked with iron, germ, saline and arsenic problems. About 1.16 (6 out of 515) percent of people indicated about the arsenic problem in Akra as well as Gajendrapur. From the qualitative findings, some respondents of Chandgarh also explained the problem of arsenic problems in their locality. Close to 80 percent of the respondents of Sundar Mahal told that iron in the tubewell became worse day by day whereas the situation was also awful in Akra and Chandgarh as reported by respectively 50 percent and 77 percent of the respondents. Compared to these three mouzas, in Gajandrapur water had less saline and iron problems. The salinity level of southern polder was the worst whereas in Gajendrapur only 14 percent of respondents mentioned it.

> *"Water is a vital element of life. No one can live without water. If we can't drink water outside the home then we drink it after coming home. Yet if there is not enough drinking water, we cannot help but drink the unsafe water for survival."-Akra, FGD, Male participant.*

Table-16: Reasons for deterioration of water quality in the coastal polder

Reason for unsafe water quality	Name of Mouza and percentage of the respondents (N=515)			
	Akra	**Chandgarh**	**Gajendrapur**	**Sundar Mahal**
Water contains arsenic, iron, saline, germ	5.56	0.00	22.74	0.00
Water contains germ	0.00	0.00	4.55	2.68
Water contains iron	0.00	13.95	4.55	4.03
Iron with germ and tastes bad	5.56	2.33	4.55	0.67
Iron with saline	50.00	76.75	13.64	87.92
Water has saline	38.89	2.33	50.00	3.35
Water is smelly	0.00	4.66	0.00	1.34

*Source: Multiple responses (Survey data, 2018)

The authorities of the Gajendrapur and Sundar Mahal mouza told people that the more water they would collect from tubewell, arsenic will increase which was the wrong perception of the people in these localities. People didn't use shallow tubewell water for drinking purposes but used this water for cooking purposes. They faced difficulties while cooking with this water that contains arsenic. One female respondent stated that "when we use saline and arsenic water from shallow wells, cooked food color is black and sometimes the rice becomes sticky. However, if we preserve water for two days and use it, the color of the rice does not change (a women respondent, FGD, Akra, 2018).

"*There is no security of water in our locality. We could not get safe drinking water. The water level has gone so down that we cannot get water from tubewell as well. We use the water of our nearby pond. If you want to know about our water risk, we would say we are suffering in all aspects of life. Women and men suffer equally due to a safe water crisis. The problem is much severe in our locality because we live just beside the river. The water we drink is the water of shallow tubewell. We use pond water for other purposes. Due to cyclones, the saltwater intrudes on the banks of the rivers. You will find water everywhere. But, it is difficult to drink and to use for our daily necessities."- Male participant, FGD, Chandgarh.*

Table-17: Respondents knowledge of water quality and contribution to make water safer to drink

Knowledge of water quality and storage		Biological identity of HH				Overall	
		Female (n=21)		**Male (n=494)**			
		n	**%**	**n**	**%**	**n**	**%**
I	**Knowledge of water quality (n=515) (% within the column)**						
1	Yes	14	66.7	266	53.8	280	54.4
2	No	7	33.3	228	46.2	235	45.6
II	**Contributions to make water safer to drink(n=515) (% within in row)**						
4	Yes	3	14.3	110	22.3	113	21.9
5	No	18	85.7	384	77.7	402	78.1
III	**Types of contribution by HH (n=172)* (% within in column)**						
8	Boil	0	0.0	11	6.39	11	6.39
10	Add alum	1	0.58	39	22.67	40	23.25
11	Add halotab	0	0.0	1	0.58	1	0.58
12	Strain through a cloth	3	1.74	79	45.93	82	47.67
13	Water filter	0	0.0	21	12.20	21	12.20
15	Let it stand and settle	1	0.58	14	8.13	15	8.71
16	Other	0	0.0	2	1.16	2	1.16

*Source: Multiple responses (Survey data, 2018)

Table-17 represented the knowledge of water quality within the community. The 66.7 percent (14) of female-headed households knew about the water quality, but only 14.3 percent (3) of the household contributed to making the water safer to drink. On the other hand, 53.8 percent (266) of the male-headed household knew about the water quality, but only 22.3 percent (110) of the household contributed to making the water safer to drink. Both female and male-headed households (47.67 percent) used a strain through a cloth to make water safer to drink in their households. Some families also used alum and water filters to keep the water quality safe in households.

5.5 The secondary source of water and payment process

Due to the safe water crisis, coastal people used some secondary sources for other household chores, such as rainwater harvesting, shallow tubewell, vended van, pond, etc. But the most popular secondary source was rainwater harvesting. Around 28 percent (111) used the rainwater harvesting system including both female and male-headed households (table-18).

Table-18: Usages of secondary sources according to the biological identity of the head of households

Uses of secondary source of water	Overall (n=515)	%	Rank mode	Biological Identity of the household head			
				Female	**%**	**Male**	**%**
I Do you use water from the secondary source							
Yes	409	79.41		14	2.71	395	76.69
No	106	20.58		7	1.35	99	19.22
II Secondary sources of water (n=409)				**n=14**		**n=395**	
Pond	7	1.77	6	0	0.0	7	1.71
Vended bottle	1	0.25	12	0	0.0	1	0.25
Vended by truck	8	2.02	9	0	0.0	8	2.02
Vended by van	19	4.64	7	1	0.24	18	4.40
Rainwater harvesting	111	27.13	2	5	1.22	106	25.91
Tube-well deep 1	62	15.15	3	3	0.73	59	14.42
Tube-well deep 2	44	10.75	1	1	0.24	43	10.51
Tube-well shallow 1	1	0.24	4	0	0.0	1	0.24
Tube-well shallow 2	72	17.59	5	1	0.24	71	17.35
Public tap	8	1.95	10	0	0.0	8	1.95
Pond Sand filter	6	1.46	8	0	0.0	6	1.46
River canal	1	0.24	11	0	0.0	1	0.24

* Source: Multiple responses, Survey data, 2018.

The reasons behind using the secondary sources were; it was cheaper, easy to access, primary sources infrastructure were not working properly, better quality than primary sources and so on (figure-8). The majority of respondents about 228 mentioned that the infrastructure not working, so they had no other option to choose the secondary sources. About 80 respondents among 409 respondents mentioned that secondary sources of water had easy access to collect the water (figure-8).

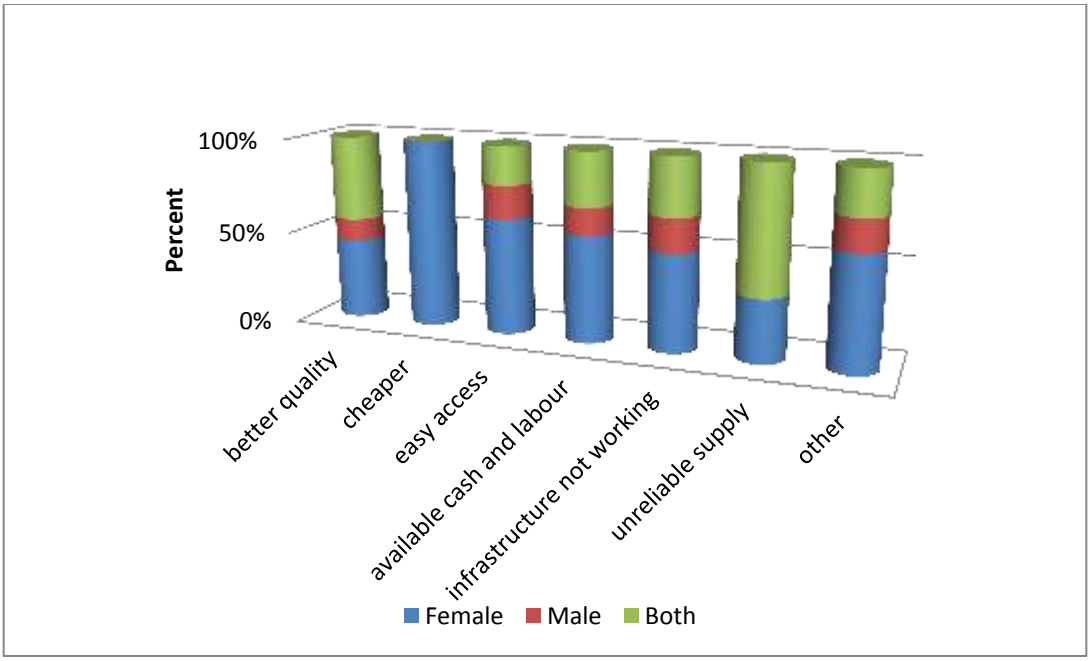


Figure-8 Reasons for using secondary sources of water

* Source: Multiple responses, Survey data, 2018

Chandgarh : Case Study- 1

Kulsum Begum, 37-38, a woman with illiteracy (merely can write her own name) lived at Chandgarh village under Khulna district. She worked as a housemaid, also does part-time in Gher (shrimp farm), and agricultural farm. She had very small-scale poultry. She is a divorcee. She was also working as a housemaid for 10-11 years after her divorce. Her family consists of her mother, a son of 13 years of old and herself. Her monthly income is around BDT 4000 (USD-47.21) while the expenditure was almost equal. Her village is suffering from acute water salinity. Village dwellers are bound to buy drinking water every time. One barrel of water costs BDT 25 (USD-0.3). A person delivers the water barrels by van. Rahila contacted with the van driver to get water barrels according to her need. He delivered 10-15 barrels at a time and Rahila paid for them on a daily basis.

She was the only breadwinner of her family. Sometimes, she didn't even get work in farms or Gher as male workers dominate the workplace over female workers and a collision happens at the workplace for getting the work deal even among female workers. She said 'I have to struggle so much to run my house expenses and manage by borrowing money mostly. I get BDT 150

(USD-1.77) by working in crop fields whereas male workers get BDT 350 (USD-4.13).' With this petty earning, buying drinking water everyday has become a burden to her. Hardly 2 days can be passed with the water barrel. She used pond water for bathing, washing and cleaning purposes and sometimes the owner of the pond misbehaves with water collectors, but this is their only option left. There were few tube wells in the village, but they were not so useful, the water was full of iron and salinity. When utensils were washed with these tubewells water, they became iron-stained. Pond water that she used for the additional purpose was also fully saline water which caused death and illness to Rahila's poultry. She said 'I can't even afford a cow due to this saline water. She reserved rainwater and provided that to the poultry for their health safety, only if there was enough rain, otherwise, this also became challenging for her. She also said, 'the salinity of the pond water caused itching, fever and darkening skin of hand, feet.' When she was asked about occurring problems for washing clothes that were used during the menstrual cycle, Rahila Begum replied that it also caused itching problems and women must purchase medicine for cure which was a temporary solution. The doctor advised women not to use the pond water, but they had no alternative option. Thus, their menstrual health was at great risk of having an infection and other problems.

Three years ago, Rahila Begum had faced river erosion in her village. She used to work in Shingar Char as a housemaid where she had a good wage but for the erosion, she was forced to leave the work and come back to her village as her son was alone with his grandmother, which hadhindered her secured earning. She was still connected with the housemaid occupation in her locality, but her economic condition worsened after the erosion. During that time, water entered her house, sometimes snakes intruded into the house with the flow of water, it was quite dangerous. She also didn't use any water purifying tablets or 'Fitkari' (Potassium Alum (KAl (SO4)2·12H2O)), rather drank from the barrel water directly. But it created gastric problems often. She also reserved rainwater for additional needs. She also added that if more tubewell can be set with more deep excavation, then water quality might be improved. She also pointed out 'Once I heard that water supply line would be drawn from Bashundia which would provide water of good quality. If that happens, that may solve our problem.'

Table-19: Purchase of water from secondary sources by biological identity of the head of households

Purchase of water from secondary sources related variables	Biological Identity of the household head				Overall (n=515)	%	Descriptive statistics	
	Female	%	Male	%			Mean	SD
Duration of using secondary sources (n=409)								
Less than 5 days	4	.97	111	27.13	115	28.1		
Between 5 and 30 days	3	.73	114	27.87	117	28.6		
Between 1-2 months	1	.24	37	9.04	38	9.28		
More than 2 months	6	1.46	132	32.37	138	33.83		
Don't know	0	0.0	1	.24	1	.24		
Payment for secondary sources of water (n=515)								
Yes	1	.19	23	4.46	24	4.65		
No	20	3.88	471	91.45	491	95.33		
Payment system (n=24)								
Jerrycan	0	0.0	6	25	6	25		
Monthly	0	0.0	8	33.33	8	33.33		
Seasonally	1	4.16	9	37.6	10	41.76		
Payment for the secondary source (monthly, n=8)								
1- 100	0	0.0	5	62.5	5	62.5	103.75	102.530
101 - 200	0	0.0	2	25	2	25		
201 +	0	0.0	1	12.5	1	12.5		
Payment for secondary sources (Seasonally, n=10)								
1 - 100	1	10.0	5	50.0	6	60.0	289.00	423.404
101 - 200	0	0.0	1	10.0	1	10.0		
<200	0	0.0	3	30.0	3	30.0		
Size of the container (n=5)								
10 - 20	0	0.0	3	60.0	3	60.0	21.60	8.081
21 - 30	0	0.0	2	40.0	2	40.0		
Amount paid for the per container (n=5)								
5 - 14	0	0.0	3	60.0	3	60.0	12.00	7.583
< 15	0	0.0	2	40.0	2	40.0		

* Source: Survey Data, 2018

More than two months about 33.83 percent (138) respondents using secondary sources (table-19) of the coastal polder. More than twenty (28.6 percent) of the respondents used secondary sources between 5 -30 days. Mostly the payment system depended on a seasonal basis, 41.76 percent of the respondents paid seasonally. The mean payment for seasonally of secondary sources was 289 (Standard deviation-423.404). Some challenges were also faced by the head of the households while collecting water from secondary sources such as felt uncomfortable in using someone else's source (14.4 percent), poor water quality (25 percent) ,women and girls spent more time and effort in collecting water (5.87 percent), women and girls felt unsafe while collecting water (2.51 percent) and so on (table-20).

Table-20: Challenges faced by the head of the households in collecting water from secondary sources

Challenges faced by the head of the households while collecting water from secondary sources	Sex of household head				Overall (n=477)	
	Female (n=17)		**Male (n=460)**			
	n	**%**	**n**	**%**	**n**	**%**
No challenges	10	2.09	212	44.44	222	56.39
Felt uncomfortable in using someone else's source	0	0.0	57	14.4	57	14.4
Higher costs	3	0.62	36	7.54	39	8.16
Poor water quality	1	.20	98	24.8	99	25.0
Women and girls spent more time/ effort in collecting water	0	0.0	28	5.87	28	5.87
Women and girls felt unsafe collecting water	0	0.0	12	2.51	12	2.51
A bit far from the house	1	.20	7	1.46	8	1.66
Filling sick while collecting water	0	0.0	1	.20	1	.20
Other	2	0.41	9	1.88	11	2.29

* Source: Multiple responses, Survey data, 2018

5.6 Paradoxical challenges towards Gender and Water

Generally, disasters affect all segment populations, but the burden of impact has been observed on persons with disabilities, elderly, women and children group due to their gender and disability status (Nasreen, 2008; 2012). However, Gender-Inclusive Dimensions (GIDs) is also recognized in the coastal zone (polder 29) and these gender dimensional vulnerabilities will be exemplified in connection with the water security model. The survey results indicated (table-21)

that most of the women are the collector of water for daily life chores in the family in terms of water insecure and water-secure area, while men play a supportive role in water secure area. In Sundar Mahal men were involved in fetching water, but the number of men respondents (table-21) was less in number (5.5 percent). The reasons behind it are the social norms which demonstrate responsibility for water fetching are just women's work. In addition, to fetching water from long distance, girls and boys give company to their mothers for reducing her physical burden. Men also collect water when the distance is so far and uses their vehicle as a mode of transport.

Table-21: Water collectors of the mouzas

Name of the Mouza	Collector of water (N=515)			
	Women (n=413)*	Men (n=144)*	Girls(<16 years) (n=47)*	Boys(<16 years) (n=44)*
Akra	4.6	2.2	0	0
Chandgarh	7.2	4.6	0.2	0.9
Gajendrapur	36.9	19.2	6.3	7.4
Sundar Mahal	41.5	5.5	3.7	1.3

*Source: Multiple responses (Household Survey data, 2018)

Water risks are related to gender in terms of fetching water, the distance of water points, washing clothes, cleaning utensils, psychological stress, unhygienic latrines, food storage. In terms of the availability of water in insecure areas, the FGD participants revealed that for about eight months they easily had access to water from different sources, remaining months they had to purchase water or drink dirty pond water or contaminated tubewell water in water insecure area. They also added that mostly they used the shallow tubewell water for their daily needs such as washing clothes, cleaning dishes, taking bath and sometimes cooking too. Fetching water from such far away, both women and men were suffered. It is apparent from the table (table-22) that the nearest 70 percent, 64 percent, 95 percent and 99 percent of people respectively Akra, Chandgarh, Gajendrapur, and Sundar Mahal collected the water by walking a long distance.

Table-22: Transportation system of water collection

Transport using to collect water	Name of the mouza and percentage of the respondents (N=515)			
	Akra	**Chandgarh**	**Gajendrapur**	**Sundar Mahal**
By individual carried	69.23	63.04	95.00	98.48
Nossimon	30.77	6.52	0.00	1.02
Bicycle	0.00	30.43	3.89	0.51
Trawler	0.00	0.00	1.11	0.00

* Source: Multiple responses (Survey data, 2018)

Both female and male-headed households faced a similar situation while collecting water from a far distance. From time to time they have to pay to the water vendors who bring it in the vehicle from 7-8 kilometers away. They give the water pot to the water providers and then they bring water in the evening. It cost BDT 20 (USD-0.24)- BDT 30 (USD-0.35) per jar, which were not affordable for vulnerable populations.

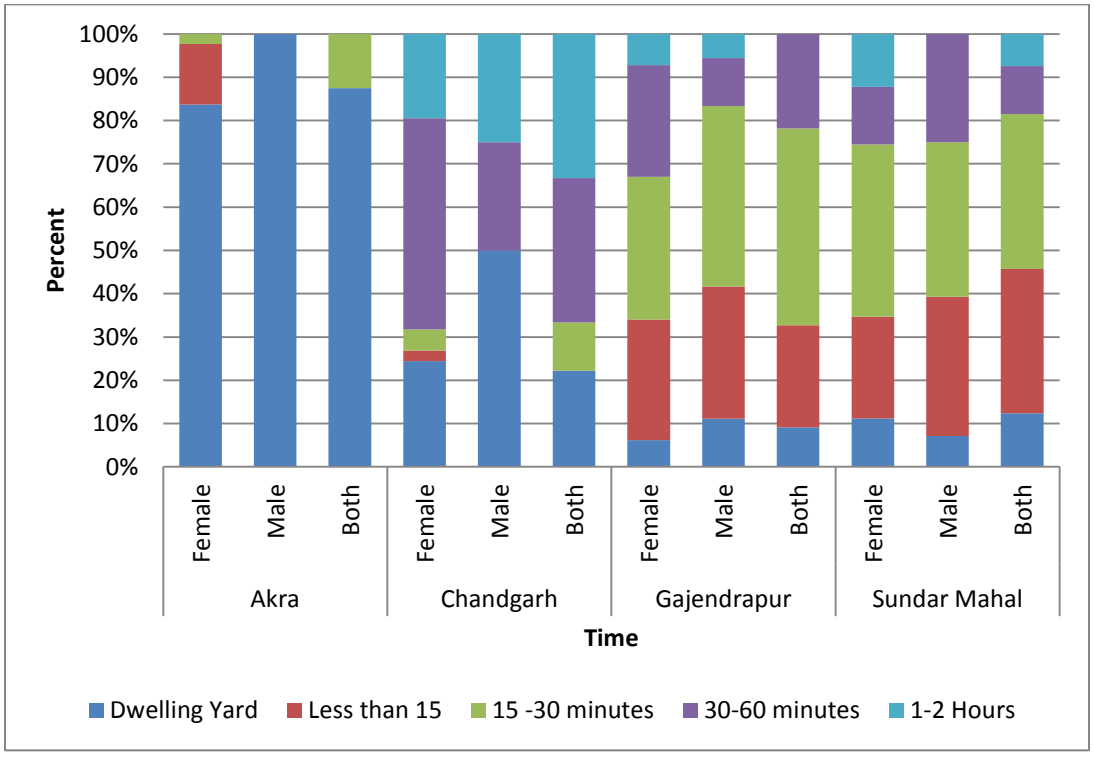


Figure-9: Time to collect water from the sources

* Measures the following questions: How much time does it take to go the source, get water, and come back?
** Multiple responses (N=515), Household Survey data, 2018

Water body was located more than 6-7 kilometers away from Akra, Chandgarh and 3-4 kilometers away from the Sundar Mahal (Qualitative Field data, 2018). It took 30-60 minutes (figure-9) to collect water in Chandgarh. Mostly, respondents collected water from the dwelling yard. In the four mouza's, the women respondents reported on gender-based challenges while collecting water that sometimes they became sick with back pain, sometimes they could not stand on their feet, that time family members like children (picture-1), and their husbands fetched water.

Picture-1: A child accompanying mother in collecting water in Sundar Mahal

The distance of water points and quality of water amplifies the tensions between different groups in coastal polder 29. The women respondent added that when pond water was limited or thicker, they increased pressure on tubewell water. It was also regarded as one of the reasons for serial breaking to collect water and quarrel with each other. Sometimes they have to wait until midnight to collect water and get an early serial. The FGDs participants pointed out that if they did not give more time to fetch water, they might give more time to family members or their children, and also they could persuade them more in the household activity. Some families also face divorce problems in their families due to unsafe water in Sundar Mahal and Chandgarh.

"*Wives sometimes get beaten by their husbands in our locality. The reason is that she could not prepare food timely for her husband due to the paucity of water. This happens within the family most of the time. But, this ill practice is not present on a massive scale. If I talk about myself that I have to do all the household activities on my own. I bring water for my family. The experience of collecting water is not very good. During the fajr azan (early dawn) we start to go out for collecting water. Some of us*

have to go even during easha azan (night). Nobody goes alone to bring water; if possible, we go in a group. During our walk, we gossip and chat about different things in our life. Most of the time we forget about the heavy load of water bucket which we are holding and traveling a long distance."- A female FGD participant, Chandgarh.

Some people left their paternal house and are currently working in the city. Some wives even divorced their husbands and they never backed to the husband's family. Most respondents mentioned physical burden while collecting water from a distance, about 146 respondents of these four mouza's. The above 45 respondents (figure-10) mentioned quarreling and verbal abuse due to collection time of water regarding serials.

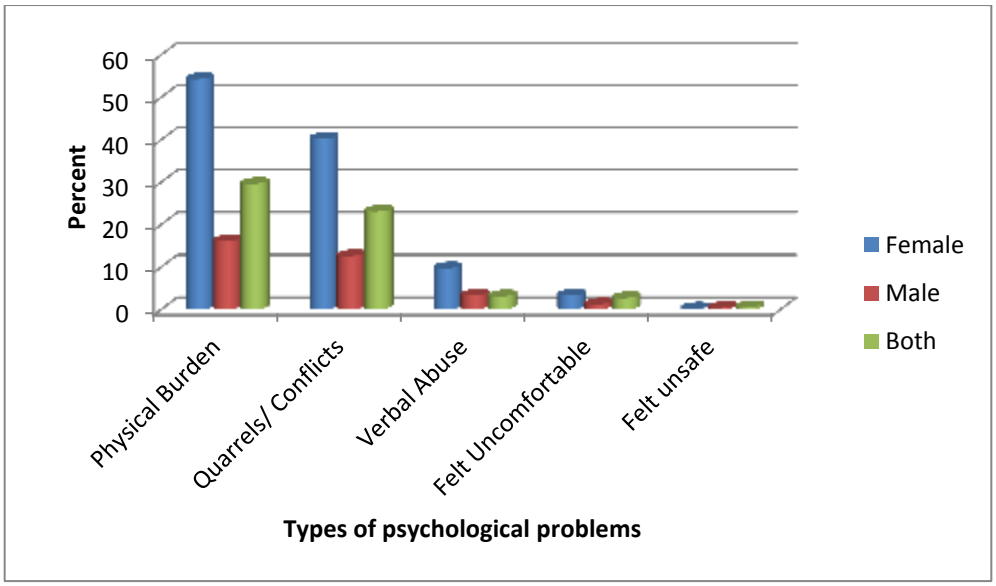


Figure-10: Challenges of women in water collection (N=515)

*Source: Survey data, 2018 (Multiple responses)

When women went to collect water from other tubewell/ponds, sometimes the owner of that pond/tubewell locked it, so women are unable to fetch water. It was sufferings for women to fetch water from other tubewell/ ponds that lead to social unrest and also have to go to distant places for fetching water. The extra distance was about half kilometers from Chandgarh which exacerbated the suffering of women in that area. Moreover, if the owner asked BDT 10 (USD 0.12) to collect one pitcher of water from that reservoir, people do not agree to do it due to their meager economic conditions. Respondents mentioned that they have tubewell nearby, but the

water quality was not good. During the rainy season, women collected rainwater assisted by men through using polythene/plastic sheets to store rainwater on the roof or the house premises in Sundar Mahal and Chandgarh. Sometimes unknowingly drinking water was misused by men mostly e.g. washing hands with drinking water after eating. One female respondent mentioned, "When there is not enough water in the house, we mix safe water with unsafe water and then drink it" (FGD participants, 2018).When there was a shortage of water; they had to go for deep tubewell. '*First come, first serve'* - was the rule for collecting water of the villagers.

Moreover, water crisis detriment the women and children more due to climate change-induced hazards, waterlogging, salinity intrusion, floods, riverbank erosion and agricultural droughts which cause higher death, personal insecurity, dropout of girls from school and early marriage, unhygienic menstrual system, reproductive problems, disabilities, physical and sexual violence etc. (Geere et al., 2010; REACH, 2015). The theoretical perspectives showed that women have a greater physical burden than men in the event of calamities because of gender-specific tasks. Gender discrimination is a major factor leading to increased vulnerability for women and the risk of water (Nasreen: 2008, 2012) in accessing and controlling information and services, technology, lack of access to or control of reproductive resources. Thus, gender identity leads to a vulnerable condition of women and children due to water-related disaster and it is extremely convoluted issues (Nasreen, 2003; Wisner et al., 2004).

The realities of water related situation are similar with the theoretical perspectives of the study. Theories of oppression and discrimination indicated the subordinate position of women in society and used and abused by the norms and values of patriarchy. The female-headed households faced a lot of discrimination in terms of getting assistant due to water related risks and hazards. A group of people got benefited from the NGOs and other organizations through their previous relation. Thus, the water situation got complicated in coastal polder. The real scenario of the coastal zone presented below (table-23) which is derived from the voice of vulnerable people who are living in the coastal zone:

Table-23: Water realities in the Coastal zone of polder 29 based on qualitative findings

Water realities in the Coastal zone of polder 29 based on Qualitative findings	
❖ NGOs and organizations did not manage or allocate water based on people's needs. A group of people gets the benefits that are familiar with them. ❖ Poor people have no access to safe water. ❖ Women are considered as less valuable and available casual labor in the agriculture sector as well as aquaculture. ❖ Men speak on behalf of collectives in the community; women speak but no one counts their voices in the decision-making process. ❖ Female is more representative at the community level, but the decision is articulated by the men participants. ❖ Mostly men are taking the decisions in income-generating activities, but women make decisions about installing new infrastructure in their households.	❖ Based on the choices of the local leaders a group of people gets more assistance in the period of disaster, but it is difficult for the female-headed household who were suffered more. ❖ Women want supply water and own tube well in their households, but men think about their livelihood options. ❖ Water point distance and quality of water amplify the tensions between different groups. ❖ Due to the low quality of water in Chandgarh, Sundar Mahal and Akra, women walked on average around 3-4 kilometers and 6-7 kilometers respectively to fetch water from shallow tube-wells. However, the quality from those shallow tube-wells remains low, and their only alternative is to purchase it from water vendors by paying BDT 20 (USD-0.24) for 20 liters water.

* Source: Qualitative data, 2018.

5.7 Gender division of labor a jeopardizing dimension

High-levels of salinity and erosion in the southern parts of the polder 29 in Khulna district (Chandgarh, Sundar Mahal and Akra) affect agricultural production and drive predominantly women and men to search for work outside of the locality, being susceptible to

multiple gendered discriminations at their workplace. Gender division of labor and wage discrimination was found everywhere in the coastal polder. Women who work outside their family farms encountered various types of gender-based discrimination in their workplace in the form of lower payment, unequal division of labor (e.g. water collection only women's work) and working longer hours than men. The women, who work in agriculture and aquaculture, and casual laborers (picture-2), who earned only half of the wages compared to men in the more water stress areas.

> *Women revealed that they received BDT 150 (USD-1.77) per day and their male counterparts were paid BDT 250 (USD-2.95) per day. "However, we got less money though we work as much as our counterpart did. Only because we are women we get less amount of money, except this, I find no other reason."- A women FGD participants, Sundar Mahal, Polder 29.*

However, getting women in agricultural activities were easy and available due to their poor economic conditions. In Gajendrapur village, distinctive with less water insecure areas, women were capable of self-sustaining themselves without moving to another place in search of work outside the locality. Still, the recognition of women's work was limited at the household level and they are not valued by the patriarchal social norms. Marginalized women (poor, lack of access to rights and treated as less important) are recognized as less valuable and available as casual laborers in the agriculture sector. Functionalists' theory also explained the situation in line of the study that, men were traditionally paid labor, whereas, women were confined to household activities. In coastal polder, men make most decisions in income-generating activities such as agricultural activities and investment in farming; whereas women make decisions about daily household chores. More women were members of community organizations such as NGOs and other private institutions, but decisions are articulated by men at the community and household level. Men spoke on behalf of the collective in the community and their decisions have remained. Women also spoke but got less attention to their voices (Qualitative data, 2018). Some male members in the family do not want to hear the voice of women; therefore, the situation became pathetic. Though women had to work with equal pressure as men do, their work did not count as valuable in water insecurity areas such as Akra, Chandgarh and Sundar Mahal. In contrast, water-secure area as Gajendrapur, women helped their husbands in their land instead of doing

outside work. They revealed that the production of their locality is good because of its lack of saltwater.

> *When she was asked, why such wage disparity exists, she said, "Not that women work less than men, in some instances, they work more than men. But a woman will get BDT 200 (USD-2.36) and a man will get BDT 500 (USD-5.9). But the workload is equal. Men bear things on their head, women bear things on their waist. It is just that you are a woman and men want to portray you weaker than them."Women are becoming more aware. In the near future, this discrimination will go away. –Chandgarh, KII, Female participant.*

In water insecure areas, the women FGD participant said that they were planting, nursing, cutting the paddy, bring it home and harvest it through machines, etc. They additionally cultivated paddy, potatoes, brinjal and many others in the fields. Whereas they revealed that, female members received BDT 150 (USD 1.77) per day and the male member received BDT 250 (USD 2.95) per day. However, women claimed that they received less money though they worked as much as their counterparts did and provided at the same time. They also added that "Just because we are women, we receive less money there is no other reason except that. Besides, who works in the enclosure (Gher) from 8:00 am to 2:00 pm, they get BDT 150 (USD 1.77) per day. Those women who work in Khulna get BDT 450 (USD 5.31), in contrast, men get BDT 650 (USD 7.67) per day."

Picture-2: Woman pushing van in Chandgarh

5.8 Domestic use of water and payment of water

In coastal polder, some of the people drunk shallow water and some purchase safe water which cost about BDT 20 (USD-0.24) /per day/20- litres of water. The amount of water needed everyday per family varied according to family size, but only for drinking purposes one family (including 5 members) need 20 litres water.

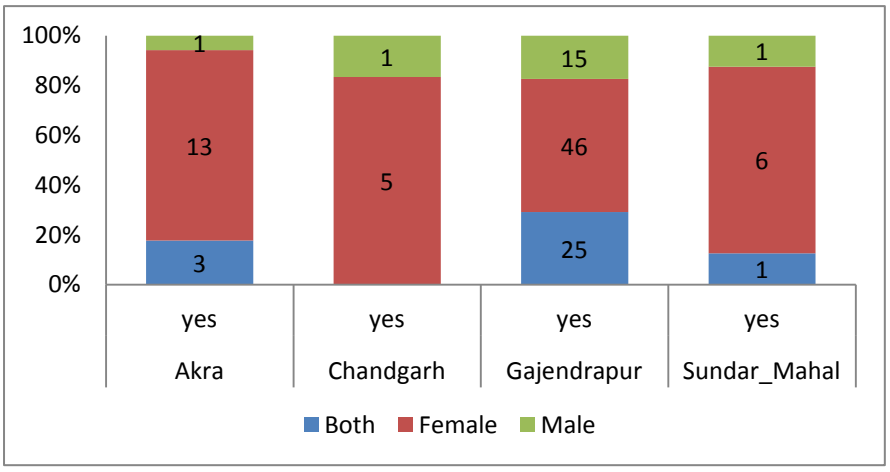


Figure-11: Payment for primary sources of water

* Source: Survey data, 2018 (N=117)

In the figure-11, it was clear that in Gajendrapur, people have to pay money compared to other mouzas for water sources. The reasons behind that public tap were more in Gajendrapur. In the Sundar Mahal and Chandgarh people had less capacity to pay for water sources due to their economic crisis. People used shallow tubewell water or pond water for cooking. They took bath and used toilet with pond water or shallow tubewell water. The number of water pots or drums varied according to the affordability of families of coastal communities. Families in the village helped one another in their needs and any occasion (such as- Eid, Puja, wedding) when they need more water (Qualitative data, 2018). They collected water prior to the occasions which added cost to their daily life. The more water they needed, the more costs added to their daily life. Those who bought shorappur's water they said that they actually gave the money to them who brought the water like a van driver and added that they provided the money mainly for bringing though Shorappur. People of coastal polder try to accommodate with limited resources. Sometimes unknowingly drinking water is misused by men mostly e.g. washing hands with drinking water after eating. One participant said, "when there is not enough water in the house, we mix safe water with unsafe water and then drink it" (Qualitative data, 2018).

In Gajendrapur, there were only two sources of drinking water for villagers. One was supply water and the other was deep tubewell water (jorakall). There were two deep tubewells in the same place as the village that was locally known as 'Jorakall'. 'Jorakall' was the main source of drinking water in Gajendrapur mouza. People, who lived close to deep tubewell, use 'Jorakall' tubewell water for drinking purposes and those who were far from using supply water. People had to pay BDT 30 (USD- 0.35) per month for supply water and many people use this tubewell water. Residents of the nearest mouzas also came in Gajendrapur to get good quality of drinking water. They also had to pay BDT 30 (USD-0.35) per month. Through mutual understanding and needs, water was distributed among villagers. Supply water was not available for the whole day, it was mostly available during the morning and the villagers had to collect it . When there was a shortage of water, they had to go for deep tubewell. It worked on a first come, first serve basis - rule of collecting water of the villagers. Sometimes pregnant women go to fetch water that is very dangerous for their health and for their unborn baby. People who had solar energy have access to supplied water at any time, but those who didn't have solar energy during load shedding had to rely on deep tubewell. There is no water crisis in the Gajendrapur village as they had

supply water and deep tubewell. But it took 20 minutes to go to 'Jorakall' to collect water. Women used more water than men as they need water for cooking, washing and so on.

'Jorakall' was public property, if any disturbance found, money was collected from the villagers and with that money it was repaired. Because, river water was salty and it could not be used for irrigation or in household chores.

5.9 Recognition of women works and decision making

Qualitative findings indicated that long- term and short-term rainfall hampered overall crop production, which had caused food shortage and scarcity of food for humans and animals. People used more chemical fertilizer to increase crop productions which created respiratory diseases according to the villagers. Some villagers practiced combined crop production such as fisheries and paddy cultivation on the same land. So, they had no coping strategies except for some fertilizer. They had to pay BDT 150 (USD-1.77) - BDT 200 (USD-2.36) for irrigation. Women of the village also played several important roles in agriculture. They worked as a helping hand to their male counterparts. In addition to agricultural production, they also assisted in fishing activities. They raised various domestic animals and cultivate vegetables in courtyards. Women were more conscious of water because they had to be in touch with water almost all the time. The FGD participants used rainwater for agricultural purposes. After the three months of the rainy season, they could not use the river water because of salinity. Sometimes the coastal people used deep tubewell for agriculture purposes. They don't use shallow tubewell water as it is not usable. Again, in Akra, Chandgarh and Sundar Mahal, paddy did not grow well due to arsenic and salinity of the water. If they cultivated the land on their own, yet there will be no production of paddy. So, it will bring nothing but financial losses of around BDT 50000 (USD-590.09) for the two "bigha" field. If some paddy was grown, people now use raw sugar in soil and water. One of the respondents in Chandgarh shared his own experience regarding this that he used 4 kg of sugar, first in water than on the ground. The respondents assumed that this increases crop production and this was his coping strategy to counter this climatic variability.

While asked about decision making about production, they revealed that their male family members made decisions. They also added that they support their male members in irrigation such as extracting water from the reservoirs, starting the machine and pumping

tubewell, etc. In addition, the FGD participants said that each decision was made together in the family, sometimes they raise arrogance and it ended up in a physical fight. However, recognition of women's work is confined to their households which are not valued by the patriarchal social norms. Marginalized women (poor, lack of access to rights and treated as less important) were recognized as less valuable and available casual laborers in the agriculture sector. Men made most decisions in income-generating activities such as agricultural activities and investment in farming; whereas women made decisions about daily household chores. More women were members of the community, but decisions were articulated by men at both the community and household levels. Men speak on behalf of the collective in the community and their decisions have remained. Women also spoke but received less attention to their voices (Qualitative data, 2018). There are some male members in the family who do not want to hear the women's voice; therefore, the situation has changed to become pathetic. Though, women have to work with equal pressure as the men, their work did not count as valuable in Akra, Chandgarh and Sundar Mahal. In Gajendrapur, women helped their husbands in their own land instead of doing outside work. They revealed that the production of their locality was good because it lacked salt water.

5.10 Water for domestic use

Various sources of water were used by respondents of households for cooking and food preparation in the coastal polder. Table-24 indicated that the most common source for cooking food preparation was pond water. 56.9 percent (293) respondents used the pond water for their household cooking and food preparation. The second most popular source for cooking preparation was shallow tubewell water, 33.6 percent (173) of the respondents were using it.

Table-24: Sources of water used by respondents of households for cooking and food preparation

Sources of water used by respondents of HH	Sex of the respondents							
	Female*		Male*		Both*		Total	
Cooking and food preparation	n	Percent	n	Percent	n	Percent	n	Percent
Public tap/ stand pipe	48	17.2	16	19.3	27	17.6	91	17.7
Deep tube-well 1	45	16.1	23	27.7	26	17.0	94	18.3
Deep tube-well 2	21	7.5	12	14.5	17	11.1	50	9.7
Shallow tube-well 1	91	32.6	23	27.7	59	38.6	173	33.6
Shallow tube-well 2	7	2.5	2	2.4	6	3.9	15	2.9
Rainwater (roof catchment)	49	17.6	16	19.3	29	19.0	94	18.3
Water vended through nossimon/van	11	3.9	2	2.4	2	1.3	15	2.9
Bottled water	1	0.4	0	0.0	0	0.0	1	0.4
River/Canal	8	2.9	5	6.0	1	0.7	14	2.7
Pond	162	58.1	53	63.9	78	51.0	293	56.9
Pond sand filter	21	7.5	2	2.4	13	8.5	36	7.0
Other	0	0.0	2	2.4	0	0.0	2	2.4

***** Source: Multiple responses, Survey data, 2018

"Everyone was facing financial problems and purchased water in the evenings due to work pressure. After the market, there was a place Shorappur from where he bought water for BDT 200 (USD-2.36) - BDT 250 (USD-2.95) with low costing. If I had a tube well, we would not feel the need to go to others' ponds to wash our utensils. We bought the drinking water and used the pond's water for other purposes. Most of the women use this water of the pond by filtering the dirt by using fitkari for cooking purposes. My wife only used alum (fitkari) to filter the water and used it to cook. They used the same pond's water in toilets, carrying 5 times with a bucket to fill the big bucket of the toilet and this water can be used for 2 days." –IDI, Chandgarh, Male participant.

Table-25: Sources of water used by respondents of households for washing clothes and dishes

Sources of washing clothes used by respondents of HH	Sex of the respondents of the households							
	Female*(n=279)		Male *(n=83)		Both*(n=153)		Total (N=515)	
Washing Clothes and dishes	n =	Percent	n=	Percent	n =	Percent	n =	Percent
Public tap/ stand pipe	3	1.1	0	0.0	0	0.0	3	0.6
Deep tube-well 1	3	1.1	0	0.0	0	0.0	3	0.6
Shallow tube-well 1	86	30.8	21	25.3	46	30.1	153	29.7
Shallow tube-well 2	4	1.4	0	0.0	2	1.3	6	1.2
Rainwater (roof catchment)	1	1.2	1	1.2	0	0.0	2	0.4
Water vended through nossimon/van	0	0.0	0	0.0	1	0.7	1	0.2
River/Canal	10	3.6	8	9.6	6	3.9	24	4.7
Pond	240	86.0	72	86.7	136	88.9	448	87.0
Lake	0	0.0	1	1.2	0	0.0	1	0.2

* Source: Multiple responses, Survey data, 2018

Table-25 indicated the multiple responses of respondents of water used in households for washing clothes and dishes. The most popular source was the pond for washing clothes and dishes of households in the coastal locality. Nearby 87 percent (448) of the respondents used pond water. The second most popular source was shallow tubewell used by 29.7 percent (153) of the respondents. Thus women faced a variety of skin diseases due to the use of the saline pond water and lead to a health hazard in the coastal polder.

Many of us do not even have the financial capability of bearing this cost. So, they travel far to collect water from different sources and they hold the jar (Kolsi)on their waist. They keep the water in drums and Kolsi (bucket/jar). A drum of water costs approximately, 1000 BDT (USD-11.8). It is too costly; therefore I use kolos (Amena). Besides, water remains cooler in Kolsi. Women reserve water as they are more aware than men regarding this. Elderly, even the children of the family also help in collecting and preserving the water. Men work outside the house. If women sit idle, then who will do the household chores? Therefore, it is women's responsibility to look after the household and collecting water. Cooking, washing clothes are some of their other responsibilities. –FGD, Mixed group, Chandgrah.

Table-26: Sources of water used by respondents of households for bathing purposes

Sources of water used by respondents of HH	Sex of the respondents							
	Female*(n=279)		Male*(n=83)		Both*(n=153)		Total (N=515)	
Bathing	n	Percent	n	Percent	n	Percent	n	Percent
Public tap/ stand pipe	3	1.1	0	0	0	0	3	0.6
Deep tube-well 1	2	0.7	0	0	0	0	2	0.4
Deep tube-well 2	1	0.4	0	0	0	0	1	0.2
Shallow tube-well 1	78	28	19	22.9	36	23.5	133	25.8
Shallow tube-well 2	3	1.1	0	0	4	2.6	7	1.4
River/Canal	17	6.1	11	13.3	11	7.2	39	7.6
Pond	245	87.8	78	94	143	93.5	466	90.5

* Source: Multiple responses, Survey data, 2018

The pond water was commonly used for bathing purposes and 90.5 percent (466) of the four mouzas used it (table-26). The excessive use of pond water affected both female and male by many diseases such as infection in body and eyes, itching problems and wound in the whole body, etc.

5.11 Sanitation and hygiene

Table-27 pointed toward the sanitation and hygiene system of coastal people and both female-headed households (71.4 percent) and male-headed households used pit latrine with slab /ring (77.7 percent). The yard was the location for the toilet of 91.1 percent (469) of households. 1.6 percent of the respondents disposed their child's waste in the water body, but most of them use it to dispose this waste in the toilet. 16.9 percent (87) both female (23.8 percent) and, male (14.8 percent) headed households shared their toilet facilities with others. The p-value 0.167 indicated that there was a close relation with gender in terms of location of toilet, where the chi-square was .506. The FGD participants revealed that after erosion their houses were totally destroyed and they were sheltered over the roadside; there was no gender-friendly shelter center. There were no separate toilet facilities for men and women.

Table-27: Sources of water used by respondents of households for sanitation and hygiene

Sanitation and Hygiene related variables	Biological Identity of household head				Overall (n=515)	%	Descriptive statistics		
	Female	%	Male	%			χ^2	df	p-value
Toilet facility of HH (N=515)									
Flush to septic tank	0	0	29	5.9	29	5.6	**7.621**[a]	5	0.178
Pour flush to pit latrine	0	0	24	4.9	24	4.7			
Ventilated improved pit latrine	3	14.3	24	4.9	27	5.2			
Pit latrine with slab/ring	15	71.4	384	77.7	399	77.5			
Open pit	3	14.3	32	6.5	35	6.8			
Hanging toilet	0	0	1	0.2	1	0.2			
Location of toilet									
Dwelling	1	4.8	32	6.5	33	6.4	.5066[b]	3	0.167
Yard	18	85.7	451	91.3	469	91.1			
Elsewhere	2	9.5	10	2	12	2.3			
Dispose of the place of the child's waste									
No child	17	81	375	75.9	392	76.1	1.354[c]	4	0.852
Dry ground	0	0	17	3.4	17	3.3			
Water body	0	0	8	1.6	8	1.6			
Toilet	4	19	89	18	93	18.1			
Other	0	0	8	1.6	8	1.6			
Sharing toilet facility									
Yes	5	23.8	82	16.6	87	16.9			
No	16	76.2	412	83.4	428	83.1			
Number of households who sharing toilet facility									
Less than 5	5	23.8	73	14.8	78	15.1			
Less than 10	0	0	5	1	5	1			
More than 10	0	0	4	0.8	4	0.8			

a. 6 cells (50.0%) have expected count less than 5. The minimum expected count is .04.

b. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .04.

c. 5 cells (50.0%) have expected count less than 5. The minimum expected count is .20.

(* Source: Multiple responses, Survey data, 2018)

5.12 Impact on health

At a structural level, male participation dominates the social, cultural and political spheres; the system runs in favor of men, whereas it subordinates women. Moreover, the sensitivity of women's health was hooked up to the patriarchal management and control over water, assets, and property coupled with the male counterpart in our society. It was assumed by the coastal women that they suffered from stomach ache, vomiting, menstrual cramps, genital problem, itching problems, skin diseases, abdominal pain and infection in uterus (Field data: 2018) because of drinking unsafe water or mistreatment saline water for bathing, sanitation, and cleaning purposes. Most of the male respondents mentioned about the gastric problems due to drinking saline water in water insecure areas. In contrast, people of the water secure area also indicated some health problems due to iron which affects their tubewell.

Sometimes pregnant women go to collect water and the pain they have to undergo is unimaginable. Many of their babies died in the womb, due to this reason. They collect water from a distant place named Fulbari, which is too far from their village. They almost have to walk for two hours to reach that place and again walk for two hours on the way back after collecting water. If we buy water, it costs so much. We cannot afford to buy water, therefore, I travel every day this far to collect water. When I am ill, my son goes to collect water. –Chandgarh, Female participant, Case study.

For that, reproductive health was emerging as a burning issue within the coastal community. One of the women respondents aforesaid that she faced difficulties in using toilets, doing household chores and bringing water from about a half kilo away on foot. Additionally to those, she conjointly faced health hazards and therefore the family because of their financial loss. So, women were suffered more than men due to water problems. Another respondent said due to lack of awareness children were littered with varied health issues e.g. diarrhea, cholera, fever, respiratory diseases, etc. were more frequent.

They were asked about their mental health concerning this issue. One of them replied psychologically they remain sick, they cannot concentrate on work and sometimes they are depressed and feel helpless. Md. Faruk said "none of us can concentrate on work. Most of the time, we remain physically and psychologically sick. There is a huge scarcity of safe drinking water in our locality. On one side, setting up the enclosure (gher) is going on and on the other hand the health hazards we are facing is also harmful. How can we remain healthy despite all these? They mentioned that the salinity of water causes skin or external body irritation. Md.

Ayed said, "We can feel the irritation and burning of the inner organs with the outer organ." After they get up from bed and wash their faces with this water, it causes irritation in their eyes. Yet they have to use it but still some of them have to fight with the situation. –Akra, FGD, Male Participants.

Once interrogating with in the field concerning health impact connected with water salinity and its result on pregnant women and therefore the newborns, one participant replied that infants were suffering from several diseases after birth e.g. pneumonia, jaundice, eye problems, etc.

Akra: Case Study 1- (FHHs)

Rahima, a 30 year old woman, lived at Akra village under Khulna district. She lived in Akra area for 20 years. She completed her education till class 10 but got married before the SSC exam and couldn't continue further studies. She had 2 daughters. The elder one was married off after the SSC exam as her expense couldn't be borne anymore. The younger one was currently studying in class 7. It had been 6-7 years since she separated from her husband. At present, her family consisted of 3 members; Rahima herself, her younger daughter and Rahima's mother-in-law. She worked as day laborer in agricultural fields, Gher (shrimp farm), also runs sewing machine at home. At present, she lived with her younger daughter, but she still dragged her elder daughter's expense, along with her husband like buying dresses for them, etc.

Rahima's monthly expense was about BDT 6000 (USD-70.81)-BDT 7000 (USD-82.61) but monthly income was merely BDT 4000 (USD-47.21). By sewing clothes, she merely earns BDT 100 (USD-1.18) daily as the sewing rate in rural areas was comparatively low than urban areas. She says, 'if I work in market, I can earn much more than this, but my daughter was still young, and I was concerned about her security. Moreover, people gossip if any woman worked in market, especially women like me without husband must faced many difficulties when working outside, so I remained at home and work within my capacity.' She mentioned that as a day laborer, she got BDT 200 (USD-2.36)- BDT 250 (USD-2.95) by working 5-6 hours, whereas male workers got BDT 400 (USD-4.72) – BDT 500 (USD-5.9). She had to bear expenses of daily food, school fees, private tuition fees, pocket money for her daughter. When she was asked that how she managed with comparatively low income, she replied that she seeks help from her paternal house. She often borrows money for these expenses. Her husband didn't have any

contact with his family, even with the children and doesn't even care how the family struggled. With this day to day struggle, acute water problem had been added which made life more miserable. Rahima said that she had to buy water pot at BDT- 25 (USD-0.3) each for drinking water. Each pot contained about 20 liters of water. At first, she used to collect water from a place called Barapurkanda, which was in Akra, for cooking purpose. But for 2-3 years, that water has also become saline. So now, the purchased water was also used for cooking. For bathing and washing purposes, her only option was pond water. Though the water was also saline, it became a bit usable when rainy season appears. So, she had to rely on the rainfall for having pure water because pond water causes itching problems which took a problematic form; especially during menstrual cycle because she and her daughter washed their cloth pads in this pond water. Rahima said 'we are poor people and we can't afford sanitary napkins for its cost and unavailability. Therefore, we must use cloth pieces and wash them with pond water. As the water quality is not good, reusing the cloth pieces causes itching and, we suffer from infection of skin as we bathe in that pond. My elder daughter was suffered from infection on her leg for some days; the doctor said that it was skin disease and gave medicine. After having the medicine, the infection has reduced much but the infectious spot of her leg had darkened. After that we hadn't visited the doctor yet.' She relied on rainwater for drinking purposes also; collected rainwater could be used for 4-5 days. She didn't use any purification tablet or 'Fitkari' (Potassium Alum (KAl (SO4)2·12H2O)). When she was asked if there is any other resource of water in village, she said that there is also a shallow pump in her village, but its water created gastric problem for her. As she worked with sewing machine continuously, it becames troublesome for her. So, she had to consume the purchased water.

There had been a dam breakage about 2 years ago in her village, water entered Akra, but there hadn't been any major structural damage as water influx was not very huge. Therefore, diarrhea spread in that area as an epidemic. She didn't get any significant help from the local government during that critical time; and merely had a drinking water stock of 5 days. She said 'As I live without husband, I never get any noteworthy help. Those who have husband got some help. Who will get help, was always pre-decided by the local government and a beneficial group always got the privilege whereas poor people are often deprived.' Referring to the water scarcity, Rahima said that sometimes she brought drinking water from a distant place called 'Sundar Mahal' which takes 1-2 hours, even sometimes she didn't get water after reaching the place as the water

collection spot was under ownership of a 'huzur' (an expertise of religious practice of Islam). Her statement expressed some religious differences existing between them. Still, she went there as the water of that source was pure. Collision and conflict arise often between tubewell owners and water collectors; and she faced the same situation over and over just for collecting good quality of drinking water for her family. She had finished her statement with this last sentence 'In Akra, everyone is having acute water scarcity and no one lives with water-secure life'.

The respondent referred that this was often the end result of drinking unsafe and saline water while being pregnant. During dry season pond water has reduced and they faced many problems like diarrhea, eye infection, skin infection, etc. Due to the water crisis, women had some problems in their menstrual time. Pregnant women conjointly face complexities and children are the worst sufferers as they have less resilient capacity. Gender disaster resilient theory argued that despite their gender-based vulnerability women are the major contributors for their household sustenance in meeting the basic needs through supply of food, water, fodder, health care services and other essentials during crisis situation. This theory also argued that disaster affected both women and men, but women play the major role of coping after disaster situations.

Both qualitative data and quantitative data supported the first assumption of the study. Women and men conjointly suffered from water-related risks. Women and children are more exposure due to the vulnerable conditions compared to their male counterparts. Water-related risks associated with their daily life chores such as drinking, cooking, washing, bathing and as well as their livelihoods. The quantitative and quantitative data of the study showed the water use behavior of coastal people. Additionally, the qualitative data supported the impact of water-risks of both women and men in terms of water use, collection, production, health and so on.

Summary

This chapter reflected the findings based on the demographic profile, the nature of water-related risks and impacts, water use behavior of coastal people based on domestic purposes, the gender dimensions of water collection and its challenges and impact on health. Overall, this chapter also highlighted the gender division of labor and recognition of women's work of the four mouzas based on the qualitative findings of the study. The study findings focused on the

distance of water point and quality of water amplifies the tensions between different groups in coastal polder 29. The women respondents added that when pond water is limited or it went thicker, it raised pressure on tubewell water. It is also regarded as one of the reasons for serial breaking to collect water and quarrel with each other. Sometimes they have to wait till midnight to collect water and get early serials. Some families also faced divorce problem in their family due to unsafe water in Sundar Mahal and Chandgarh. Some people leave their paternal house and currently work in town. Even some wives divorced their husband and they never went back to the husband's family due to the water crisis situation in coastal polder. It was difficult for family members to search bridegroom for their daughter due to their skin color by using the saline water. It was assumed by the coastal women that they suffered from stomach ache, vomiting, menstrual cramps, genital problem, itching problems, skin diseases, abdominal pain and infection in uterus because of drinking unsafe water or mistreatment saline water for bathing, sanitation, and cleaning purposes. Most of the male respondents mentioned about the gastric problems due to drinking saline water in water insecure areas. In contrast, people of the water secure area also indicated some health problems due to iron which affects their tubewell.

CHAPTER VI: WATER DEPENDENT LIVELIHOODS OF COASTAL PEOPLE

This chapter addressed water-dependent coastal residents' livelihoods on the basis of employment and work in secure and insecure areas of water. On the basis of the qualitative study findings, this chapter illustrated the dialectic relationship between water and gender.

6.1 Introduction

The livelihood of coastal people mainly depends on the agriculture production. Water is associated with their daily life chores as well as their livelihood options. The water-dependent coastal resident's livelihoods involved in different jobs due to their water problems. Both women and men had to move elsewhere in search of work and for better livelihood. However, most of the residents struggle with the terrible situations.

6.2 Diversification of jobs between women and men

Women and men both engaged in various types of work in coastal polder 29, including casual work, trade, agriculture and aquaculture activities, property rental income, poultry and so on (figure-12).The situation in the agriculture and casual employment sector respectively amounted to 69.9 percent and 41 percent compared to men. Many surveyed families also revealed that both women and men were engaged in the same job. Another popular employment sector was livestock, where both women (34.8 percent) and men (47 percent) were involved in Sundar Mahal and Gajendrapur (figure-13).Most of Akra and Sundar Mahal households also engaged in the business due to the losses for salinity and river erosion in the agriculture sector.

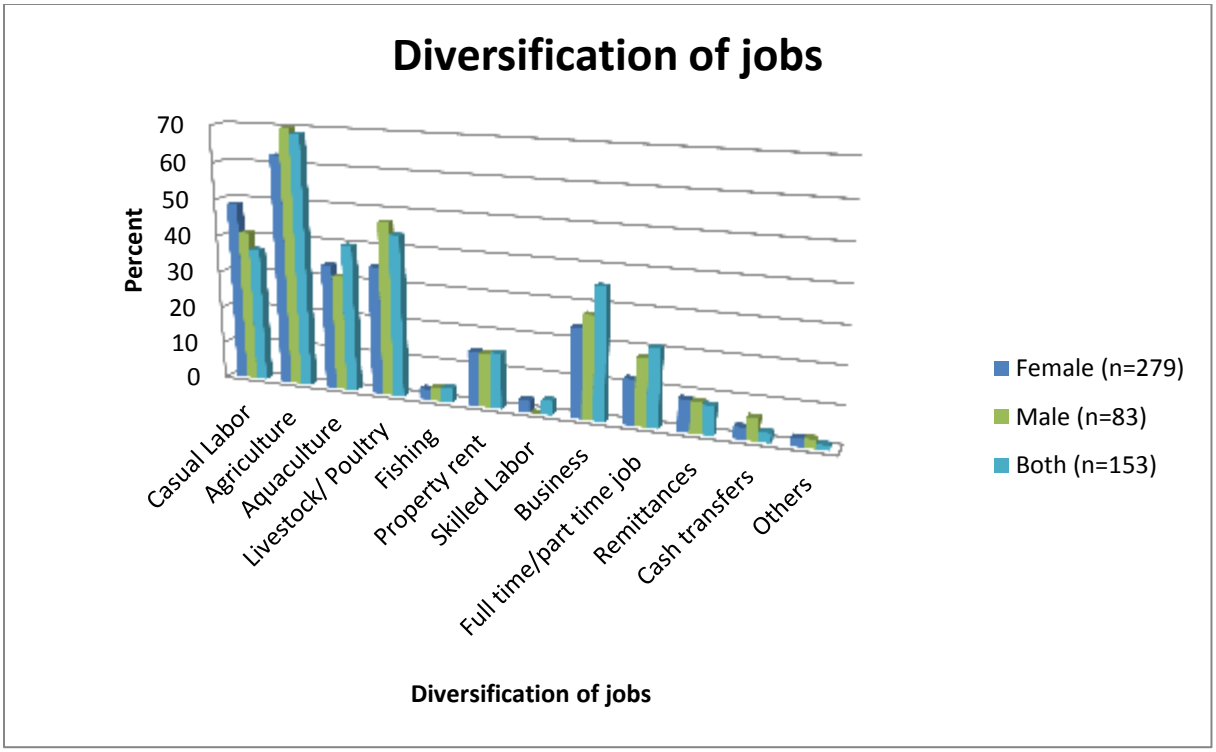


Figure-12: Diversification of job in Coastal Polder

* Source: Survey data, 2018 (Multiple responses)

Women earned half of what was earned by men in farming and aquaculture but had equivalent work pressure. The results from the study showed that men in the coastal region believed they possess more physical skills so that they were worth more money than women. Women, in contradiction, rejected this view by saying that they maintained both households and workplaces. In Gajendrapur village women were able to self-sustain themselves without needing to find work in other areas due to less water crisis. In line of the study, the social aspect of the hierarchy of power in social institutions as well as the deciding effect on the "relative position of women and men in society" is defined in the "Social Relations Analysis" relevant to the position of women.GAD is performing sex analysis to understand how men and women work together in order to produce outcomes in positive economic and productive environments.GAD policy aims at redefining the societal perceptions of gender roles in an attempt to create gender equality (referred to as women having the same chances as men including the ability to participate in the public sphere).Women are expected to perform their household management functions, domestic production, childcare, and family care. Men will nevertheless be breadwinners in connection with paid work and market development. The role of women is generally interpreted as

"motherhood's responsibilities (Momsen, 2006).Women generally earns less than men in the labor market. The similar situation was observed in coastal polder.

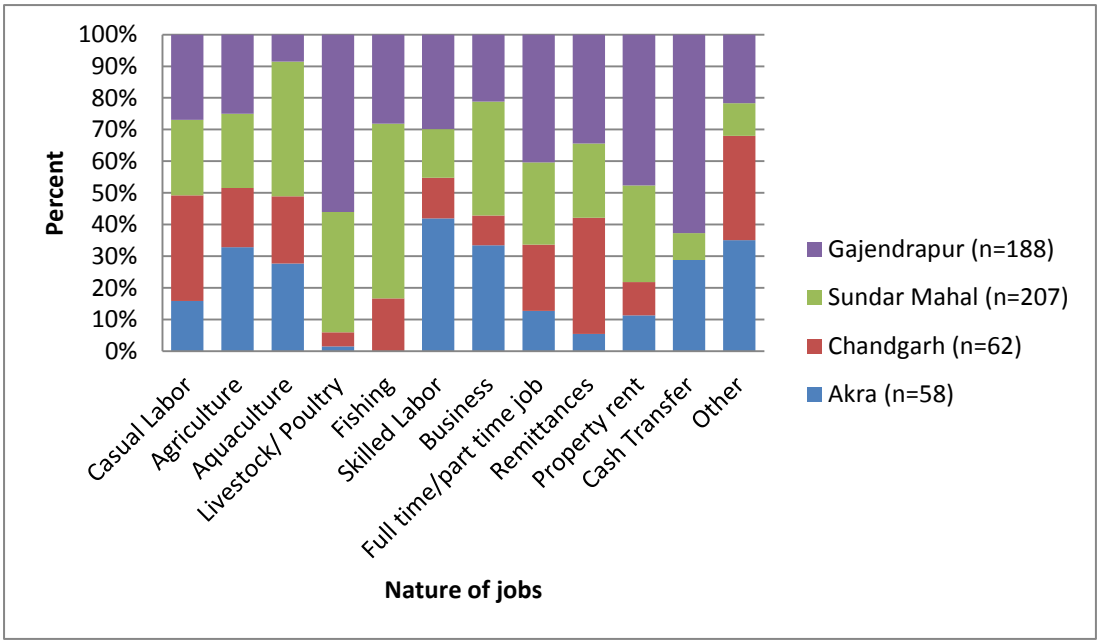


Figure-13: Different type of job in water-secure and insecure areas

*Source: Survey data, 2018 (Multiple responses)

Table-28 indicated a case summary of land parcel owner and landowner of home including four polders 29 mouzas. Of 515 respondents, a total of 75.3 percent (388) were the owner or land managers. Approximately 24.7 percent (127) had no land of their own.

Table-28: Case summary of the owner of land parcels and homestead landowner

Case Processing Summary	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
How many land parcels do you own or operate? * Sex of the households head	388	75.3	127	24.7	515	100.0
Does your household own any homestead land? * Sex of the households head	515	100.0	0	0.0	515	100.0

(*Source: Survey data, 2018)

Moreover, the owners of property parcels were 3.1 percent (12) of the women who headed households.96.9 percent (376), on the other hand, of the male-led households had their own property plots of land. Most of the male-headed households 34.3 percent (129) had one parcel of land, 58.3 percent of female-headed households had two parcels of land. Furthermore, 14.4 percent (54) of male-headed households owned three plots of land (figure-15) and 2.4 percent (9) belonged to the seven plots of land.

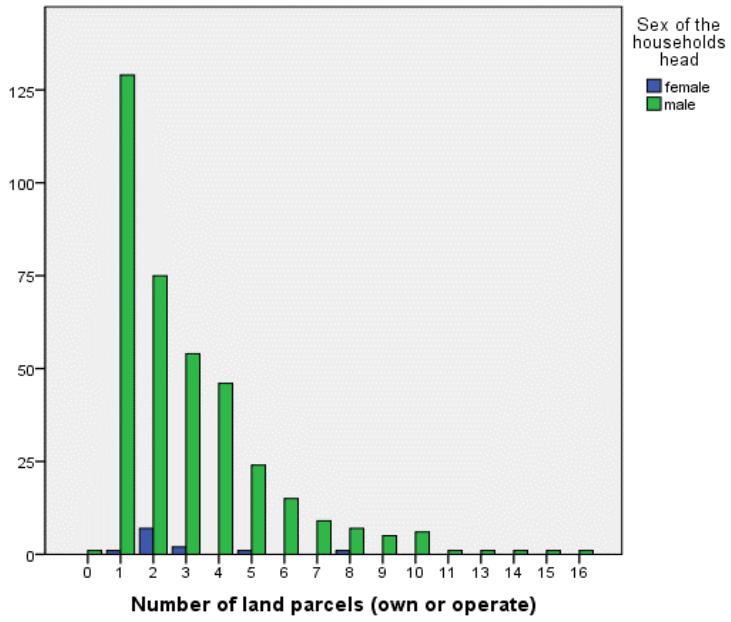


Figure-14: Number of land parcels of the head of households in four mouzas of the coastal polder (*Source: Survey data, 2018)

About 95.2 percent (20 out of 21) of the female-headed households had their own homestead land and 98.6 percent (487 out of 494) of the male-headed households had their own homestead land (table-29). A total of 1.6 percent (8 out of 515) of both male and female-headed households had no homestead land in coastal polder.

Table-29: Cross-tabulation of the owner of homestead land and head of households

Cross tabulation			**Sex of the household's head**		**Total**
			female	male	
Does your household own any homestead land?	no	n	1	7	8
		% within Sex of the households head	4.8	1.4	1.6
		% of Total	0.2	1.4	1.6
	yes	n	20	487	507
		% within Sex of the households head	95.2	98.6	98.4
		% of Total	3.9	94.6	98.4
Total		N	21	494	515
		% within Sex of the households head	100.0	100.0	100.0
		% of Total	4.1	95.9	100.0

(*Source: Survey data, 2018)

Around 28.6 percent (6) of the female-headed household women engaged in farms, while between 42.9 percent (221) of the polder 29 households, about 43.5 percent (215) of male-headed households women participated in farming activities (figure-15).

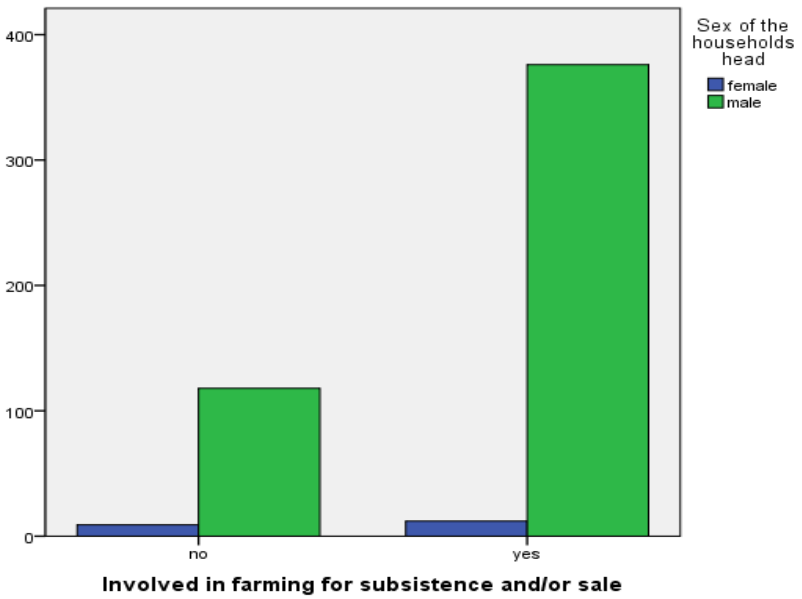


Figure-15: Involved in the farming activity of the head of households in the coastal polder

(*Source: Survey data, 2018)

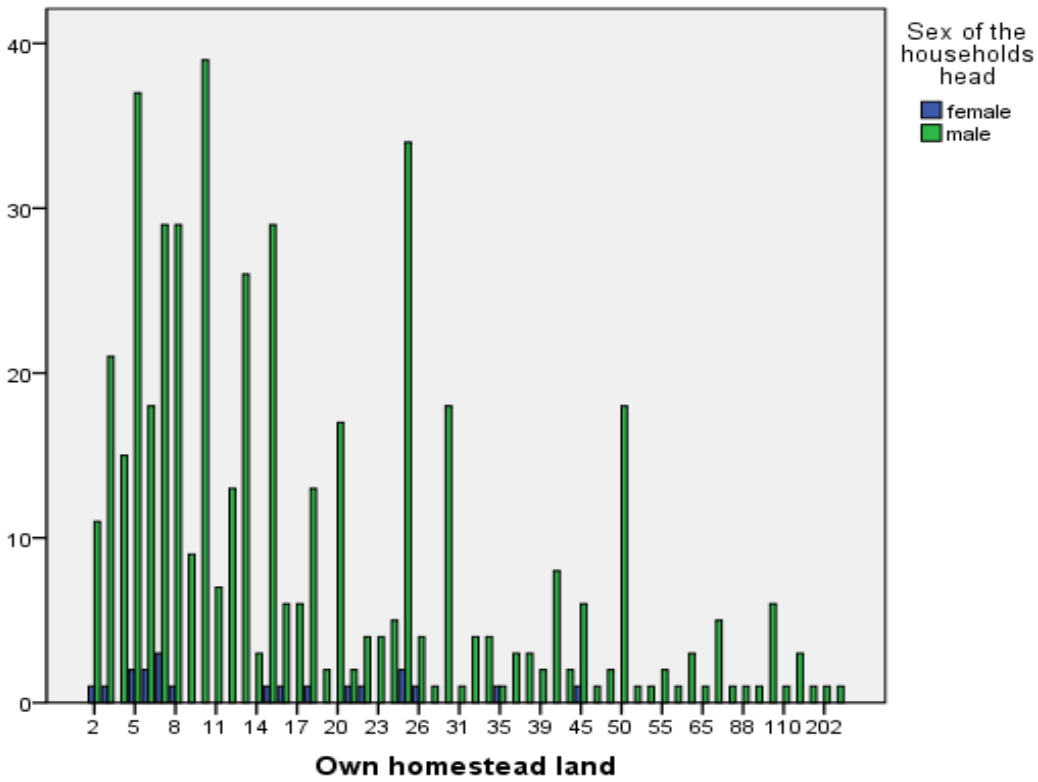


Figure-16: Number of homestead land belonged by the head of households

(*Source: Survey data, 2018)

Most male-headed households were belonged 10 homestead lands, while most female-headed households were belonged seven homestead lands (figure-16). Roughly 7.0 percent (34) of the households in the male households was the owner of 25 homestead lands, while 0.2 percent of female-headed households had 25 homestead lands. Yet, due to the economic downturn, the majority of coastal people could not keep their own land.

To test their hypotheses such as normality, linearity, homoscedasticity, autocorrelation, and multicollinearity, etc, are needed before applying regression analysis. The curve is approximately normal in shape for coastal rural households; figure-17 shows the histogram with the normal curve.

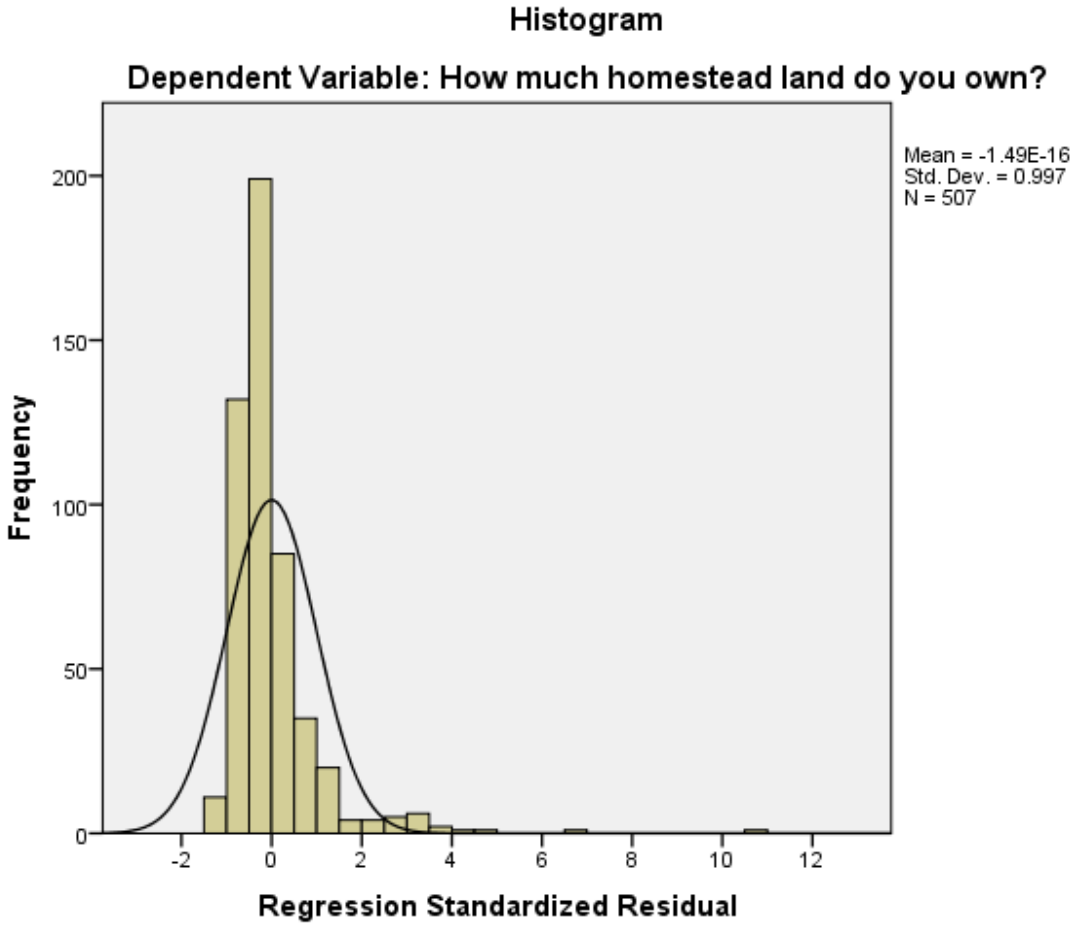


Figure-17: Histogram of Number of homestead land own by the head of households

(*Source: Survey data, 2018)

Figure-18 represents the normal P-P regression plot of variable residual and dependent that tells us that the error terms are distributed normally. Figures 19, 20, and 21 illustrate the linearity of our variable's action in the scattering plot of regression normalized expected values and dependent variable. The researcher performed Levena statistics to test the homogeneity of variances, which shows the insignificant p-value, which means that variations in data are approximately consistent. Here, part value and partial correlation are not dramatically decreased by the zero-order correlation so we can assume that multicollinearity is not a possible problem. Furthermore, the small tolerances show that a large proportion of the variance is accounting for in a certain independent variable. The closer to zero the sensitivity value is, by describing their disparity in the dependent variable, the lower multicollinearity in independent variable. The value of tolerance is close to 1 which means that multi-linearity is not problematic and most values are above one and larger than .56, so multi-linearity is not a concern. That means the homestead land and ownership of land have significant linear relation in coastal polder.

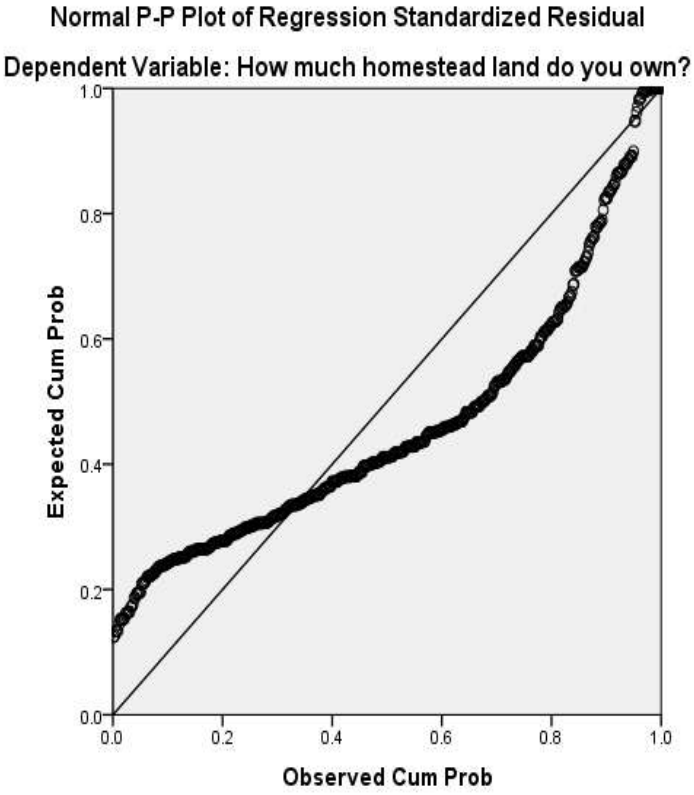


Figure-18: Normal P-P regression plot of variable standardized residual

(*Source: Survey data, 2018)

VIF is a collinearity alternative measure. A large value shows a strong relationship between the predicted variables when the VIR is greater than 2 there is a collinearity problem. In this case, the Variance inflation rate (VIR) is no larger than 2, indicating that all VIF values are less than 2 and thus multicollinearity does not exist. The multi-linearity that the Eigen Values and Condition Index is used in many steps. When own values are small (near to zero), a collinearity problem exists. This data showed that there is no collinearity problem exists with the land ownership and sex of the households head as well as age of the households head in coastal polder. But the collinearity problems exist with the education and homestead land belonged of the head of the households.

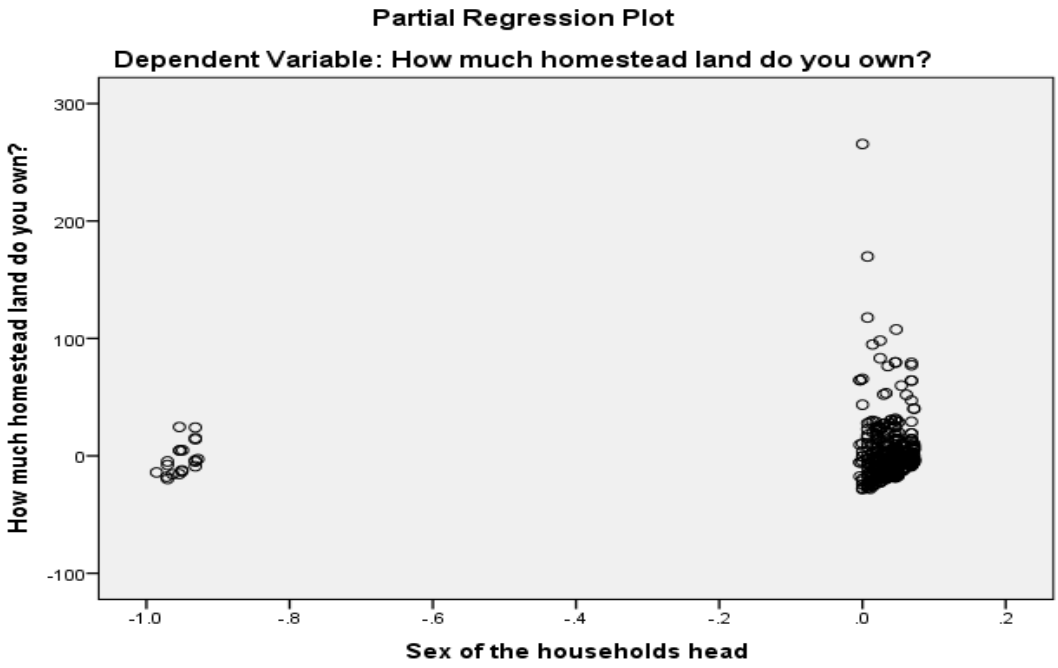


Figure-19: Partial regression plot of homestead land by sex of the head of households

(*Source: Survey data, 2018)

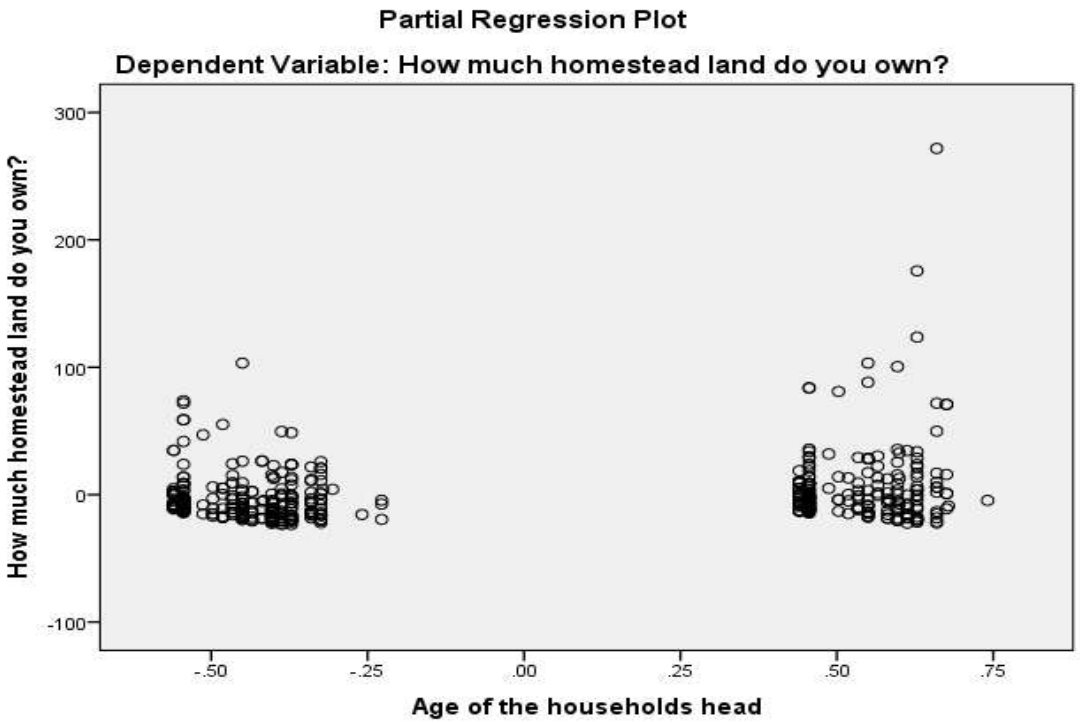


Figure-20: Partial regression plot of homestead land by age of the head of households

(*Source: Survey data, 2018)

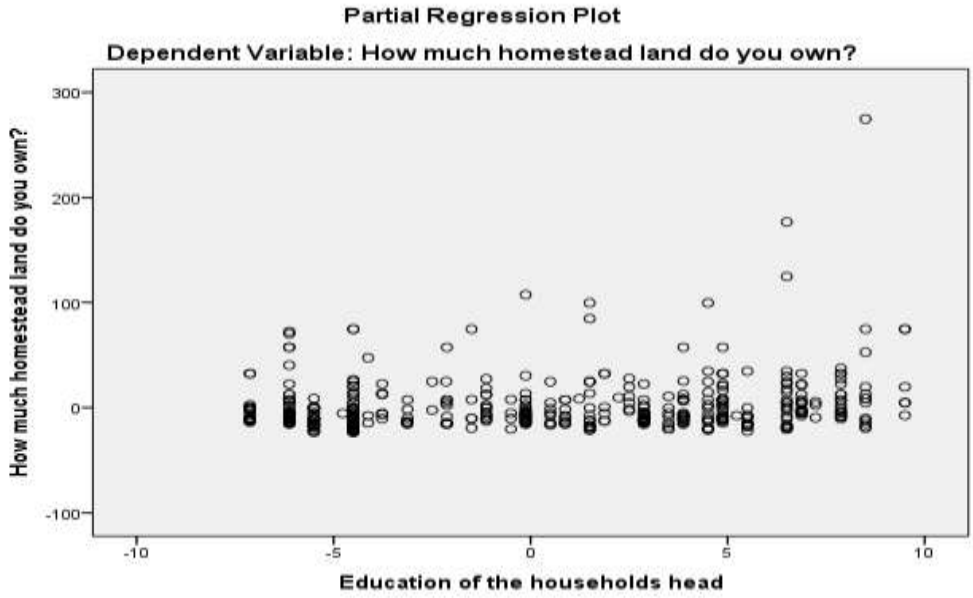


Figure-21: Partial regression plot of homestead land by the education of the head of households (*Source: Survey data, 2018)

The condition indices are determined by measuring the square roots of the ratios of the biggest value for each individual value. Therefore, there is no serious problem in collinearity with all the condition index values of less than 15. Here (table- 30, 31, 32) the value of R shows the correlation coefficient that measures the interlinear relationship among households of head age, sex, education, and households with their dependent variable "homestead land."

Table-30: Interlinear relationship among head of households age, sex, education, and households by homestead land

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22718.895	3	7572.965	12.465	.000[b]
	Residual	305599.105	503	607.553		
	Total	328318.000	506			
a. Dependent Variable: How much homestead land do you own?						
b. Predictors: (Constant), Education of the households head, Sex of the households head, Age of the households head						

(*Source: Survey data, 2018)

Table-31: Coefficients among head of households age, sex, education, and households by homestead land

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	-15.223	12.214		-1.246	.213
	Sex of the households head	2.585	5.652	.020	.457	.648
	Age of the households head	9.477	2.229	.185	4.253	.000
	Education of the households head	1.071	.219	.214	4.889	.000
a. Dependent Variable: How much homestead land do you own?						

(*Source: Survey data, 2018)

Table-32: Residual statistics among head of households age, sex, education, and households by homestead land

Residuals Statistics[a]					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	7.39	35.51	20.92	6.701	507
Residual	-28.436	265.564	.000	24.575	507
Std. Predicted Value	-2.020	2.176	.000	1.000	507
Std. Residual	-1.154	10.774	.000	.997	507
a. Dependent Variable: How much homestead land do you own?					

(*Source: Survey data, 2018)

Residual statistics among head of household's age, sex, education, and households by homestead land showed that the predicted value was too low, but the residual, standard predicted value and Standard residual are correct and the prediction was correct.

Handicrafts in our region are not very widely practiced. Most households, however, have ducks or chickens. As a consequence of salinity intrusion, the number of cows declined significantly. The quality of the grass here has been deteriorated by salinity and cows suffer from health problems. Therefore, cow farming has declined considerably.-KII, Sundar Mahal, Male Respondents.

6.3 Spatial variation and climatic impacts on different groups

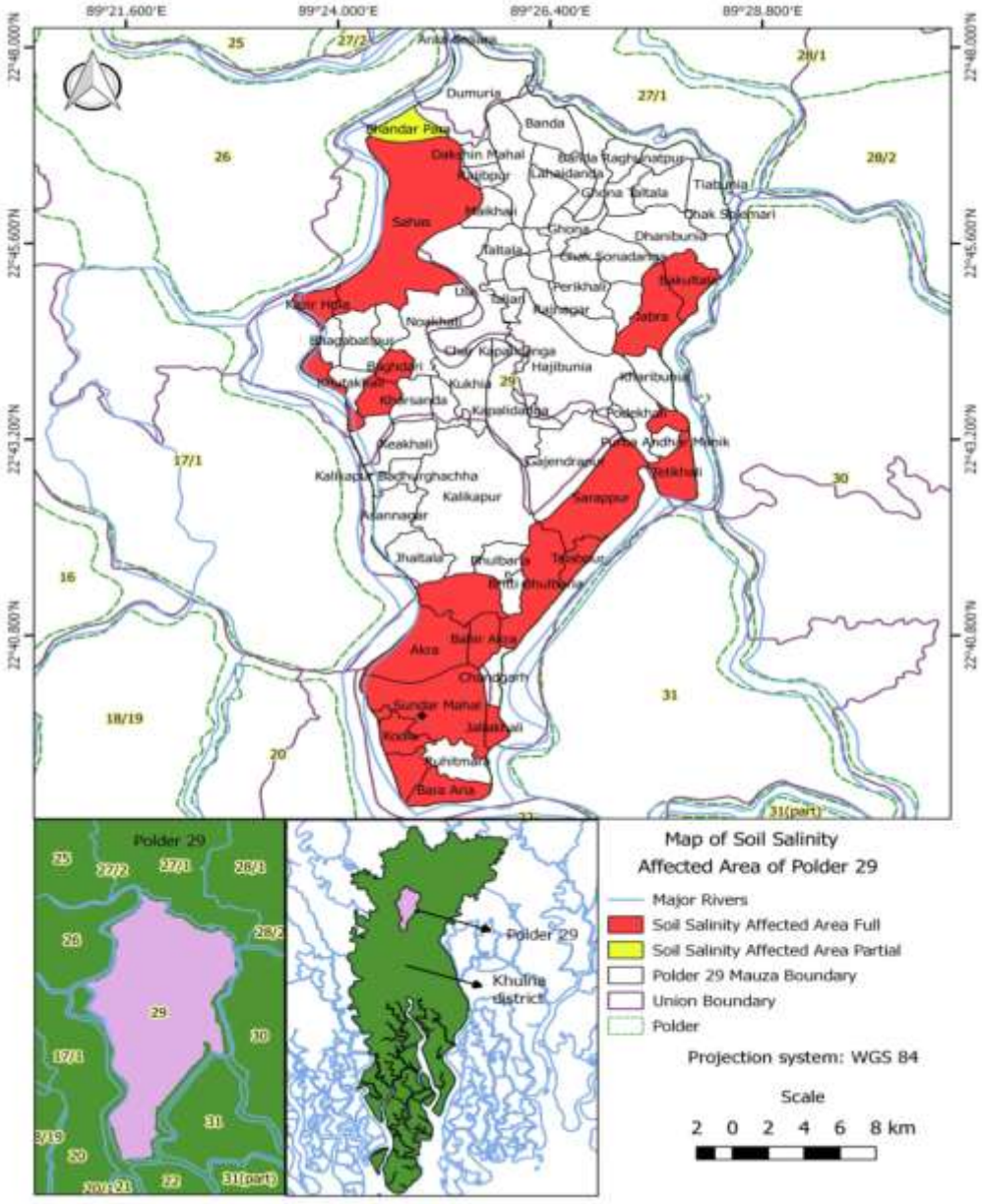
The main reasons for the water crisis were that the level of water was getting down and geographical location in the area. In Gajendrapur, people of the village were economically solvent but the problem was not solving. There was iron in the water, being used in the farmlands that caused product failure.

"Due to salinity intrusion, we cannot grow trees and vegetables. We live in extreme scarcity of freshwater. We can't do this, even if we want to grow any fruits. The erosion of the river bank has engulfed the coconut, guava, mango, papaya trees that remained. We have lost everything due to this. I have repeatedly mortgaged my jewelry and given my husband the money to lead a sustainable life." - Voice of a woman (28 years), Case study, Akra, Polder 29.

In the study, it is found that more water insecurity lead more involvement of women in the workplace in Akra, Chandgarh, Sundar Mahal compared to Gajendrapur area. The respondents noted that they lost everything they earned by their occupation because of the salinity (map-3) and erosion (map-4) of the coastal polder.

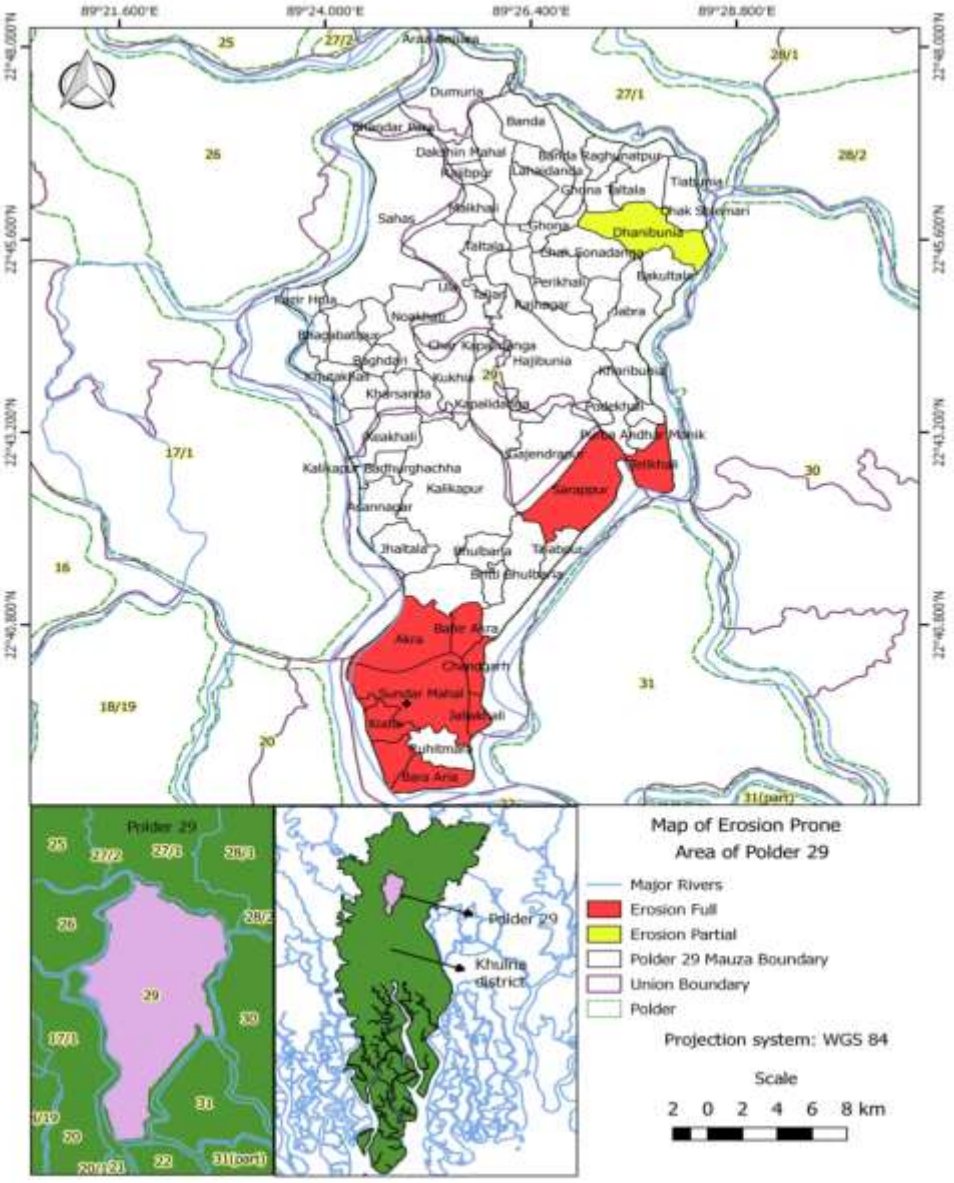
"Nowadays climate change is unpredictable in the coastal area. Thunderstorms occur very regularly, around 1-2 times a month. There were two thunderstorms in their town at midnight in the month of February. Erosion of the river and erosion of the embankment has increased. All belongings such as production, houses, property everything goes underwater twice a year. Tide and ebb rates also increased in the river. The level of water in the river has risen. Measurement has been made to set a dam. But, we need to refurbish the dam this year as the water level has increased." –Akra, FGD, Male participants.

Some people have left their father's house and went to town to work. When asked about financial /environmental losses, they revealed that after erosion of the paddy and fish farm was destroyed, they could not grow paddy for about two years, adding lastly that the paddy could be grown. Moreover, female-headed households also exposed that they did not get any benefit due to their social identity. The leaders provided facilities only to families they were close to / known.



Map-3: Soil salinity in Polder 29

(*Source: Ashroy Foundation)



Map-4: River erosion in Polder 29

(*Source: Ashroy Foundation)

The water management committee controls gate management activities. There is a committee for each of the gates. The committees primarily include those who have some experience and live near the gates. Most of the funds were raised from the users of the gates. If any major problem arises, there is also a contribution from the water development board. Most of the work is done by the water management committee. There is a percentage for the government. Government subsidies come very little and as far as our Sundar Mahal are almost at the last corner of the union. NGOs such as BRAC, ASA, and Grameen do nothing in the area of water, but they provide the loans to the public. Individuals use loans only for their own purposes.-KII, Sundar Mahal, Male participant.

6.4 Comparative dimensions of water risks and gender differentiated roles

The high impact of saline water and riverbank erosion were the main causes of water risks in water insecure areas. This water risks created differential impacts on different groups and their livelihoods. Both women and men moved elsewhere to search work for their better livelihood. High salinity increased the shrimp cultivation in the water insecure areas but only a group of people get the benefitted from it and supported regarding entrance of salinity in the polder. On the other hand, agricultural production was less by using the shallow water from tubewell which was directly impact on their main income sources. The sources of water were good in Gajendrapur compared to other mouzas. So, in Gajendrapur people (both women and men) worked in their own locality for their survival without moving elsewhere. Comparison analysis of dimension of water risks with gender-differentiated roles and impacts between four villages namely Akra, Chandgarh, Gajendrapur and Sundar Mahal based on the findings of FGD participants of these four villages which are presented in Table33:

Table-33: Comparison analysis of dimension of water risks by gender-differentiated roles and impacts in four villages of polder 29

Name of the village (polder 29)	**Akra**	**Chandgarh**	**Gajendrapur**	**Sundar Mahal**
Risk Profile (based on water stress situation)	• High	• High	• Moderate	• High
Disasters/ Causes of water risks	• River erosion • Salinity	• River erosion • Salinity	• Salinity • Iron problem	• Salinity • Shrimp cultivation
Main Challenges in their locality	• Deep tubewell is not successful: ground water layer level not found • High salinity • Breaching of Embankment	• Deep tubewell not working: ground water layer not found • High salinity • Depthness of river is less • Mostly Sandi soil which is difficult for production • Less production by using shallow (*boring*) water in agriculture • Arsenic problem	• Salinity • Iron problem in Shallow tubewell • Less production and conflicts by using shallow (*boaring*) water in agriculture • From Jorakol(tubewell) get less water • Supply water (getting odor) • Insects increases in agriculture productiondue to water pollution • Telekhali gate-collapsed which causes water salinity more	• High Salinity • Deep Tubewell is not successful • Involvement of a group in aquaculture (gher) is increasing salinity
Differential impacts	• Social Impact (women go to other places for work which decreases their family status) • Sharing water sources-conflicts between person to person	• People are displaced to Khulna/ Dhaka for their livelihood • Women drink less safe water to survive her family • Conflict (between husband and wife) for not getting food in proper time • Economic problem due to water (less family planning)	• Conflicts to collect water (person to person, mouza to mouza) while other villages people take water from their water sources)	• Social Impact (women go to other places for work which decreases their family status) • Sharing water sources-conflicts between person to person

		• Sharing water sources- conflicts		
Diversification of Jobs	• Agriculture (both women and men) • Aquaculture (women are cleaning darnel and providing food) • Casual labor (both women and men)	• Women- use wire net to catch fish in the river • Agriculture (both women and men) • Aquaculture (women are cleaning darnel and providing food) • Casual labor (both women and men)	• More involvement in Agriculture less involvement in Aquaculture • Women are mostly a homemaker	• Agriculture is the priority for all of them(both women and men) • More involvement in Aquaculture(both women and men) • Casual labor (both women and men)
Installation of water sources	• The decision is taken by women • Cost and materials are provided by men	• Boarding in Agriculture is decided by men • Loss minimize to install water sources and aquaculture related water source is decided by women	• To install water sources is decided by mostly women	• Mostly decided by men to install water sources
Spatial Differences	• More water insecurity-more involvement of women in the work place	• More water insecurity-more involvement of women in the work place	• Less water insecurity- less involvement of women in the work place	• More water insecurity-more involvement of women in the work place
Concern regarding water	• Cleaning water pot and glass, using fitkiri- all activities done by women • Men are more concerned about the agricultural water sources	• All activities done by women regarding water for their household • Men are more concerned about the agriculture water sources	• Women are more concerned regarding water sources for their households • Preserving Rain water- burden for women • Men are concerned about agricultural water sources	• Women are responsible and more concerned for water • Men are concerned about agricultural and aquaculture water sources

* Source: Qualitative data, 2018.

The main differentiated in terms of gender relation with water is that more water insecurity leads to more involvement of women in the workplace and less water insecurity leads to less involvement of women in the workplace.

6.5 Spatial variations: dialectical relation with water and gender

The main reasons for the water crisis were, the level of water was getting down and geographical location in the area. The results of the study showed that most of the respondents in water insecure areas explained the main problems at the riverbank erosion and salinity. In Chandgarh and Sundar Mahal interviewees, 96.8 percent and 92.8 percent of the respondents reported erosion on the riverbank, while 26.1 percent and 12.9 percent reported infiltration of salinity (figure-22). In Gajendrapur, people spoke of the iron and cyclone issue in comparison. Furthermore, the Gajendrapur mouza people were economically solvent, but the problem was not resolved. There was iron in water, which was used in the farms and caused a loss in production.

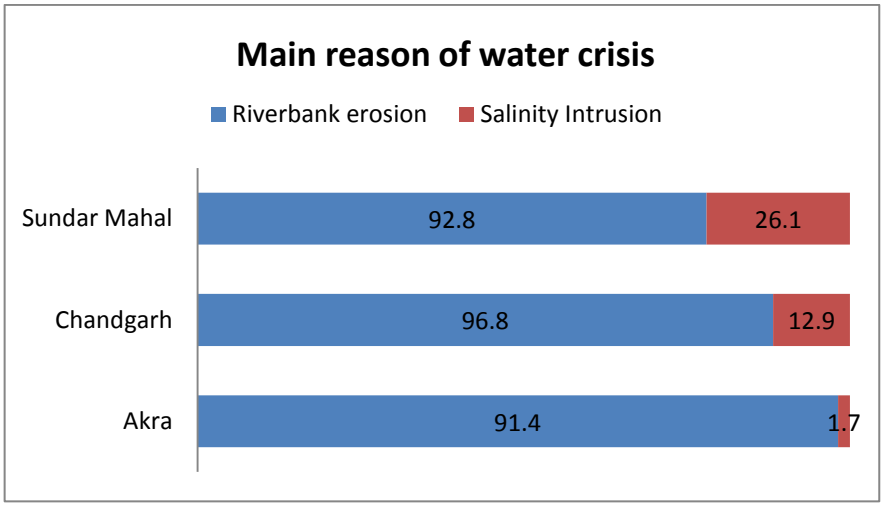


Figure-22: Main reason for the water crisis

* Source: Survey data, 2018 (Multiple responses)

The respondents pointed out that they have lost everything they earned from their occupations due to the salinity (map-3) and erosion (map-4) of the coastal polder. Male respondents said they suffered more because they were the family's main earners. The resulting river erosion has nearly grasped their houses due to the rise of river water. For this, they have to live with a sense of risk all the time. Water on the river rose each year and water salinity also significantly increased, causing problems in the cultivation of fish and paddy. After the river erosion, all the locality tubewell were affected with salinity and became

completely undrinkable. After drinking this water, both women and men faced stomach problems and even now the water from the tubewell was unsuitable for drinking.

> *We won't find the right direction without observing the soil salinity, condition of water, warming, etc. Then we must rid ourselves of the salinity intrusion. We must close the gates (sluice) so that saltwater cannot reach our water sources. Blue Gold formed a committee to manage the gates controlled primarily by the most influential people. These things are mainly controlled by that influential group*. - FGD participants, Sundar Mahal.

The FGD's participants reported that their homes were destroyed and built on the side of the road after erosion; no gender-friendly shelter and no prevalence of sanitary facilities for men and women were found. Moreover, female-headed households (FHHs) have also revealed that their social identity does not provide any advantage. Only the households who had close acquaintance with the leaders received services. Thus a dialectical relationship was found from the results of the FGDs and the conclusions of case studies (table-34).

In water insecure areas some factor decreases the women's resilient capacity such as water collection conflict, religion, ownership of land and water sources, shrimp cultivation, health and so on. The qualitative data also illustrates that the resilient capacity of men decreases due to water collection conflict, ownership of land and water sources at a moderate level. In contrast, decision making of installation tubewell in household level, workshop, and training about water security, involvement of women in work outside locality- all work as an increasing factor for women resilient capacity. The researches (Wright et al., 2012; Darcy, 2010) affirm that innovative adaptation strategies and techniques towards mitigating water risks would be more functional and could develop the resilient adaptive capacity of the local people to adjust with unresolved water risks and uncertain livelihoods.

Table-34: Dialectical relation between water and gender (FGDs and Case studies Findings)

Dialectical relations of water security and gender dimensions (* ** ***)				
Thematic Variables and Reason of Conflict	Women Resilient Capacity		Men Resilient Capacity	
	Water insecure areas	Water secure area	Water insecure areas	Water secure areas
Land Ownership	- -	+ +	- -	+ +
Ownership of water resources	- - -	+ +	- -	+ + +
Religion	- - -	- - -	+ + +	+ + +
Shrimp Cultivation	- -	+ +	- - -	+ + +
Funding from donor agencies	- - -	+ +	+ +	+ +
Water Collection Conflict	- - -	+ +	- -	+ +
Divorce rate	- - -	+	- - -	+
Wage conflict	- - -	- - -	+ + +	+ + +
Workshop and education, trainings	+ +	+ +	+ +	+ +
Migration	- -		- - -	
Diversification of Job	+ +	+	+ +	+ +
Health impact	- - -	+	- - -	+ +
Installation of water sources	+ +	++	++	++
Involvement of water management group	++	++	- - -	- -
Involvement of women and men in outside village	++	- -	++	-

*Increase in high level= +++ ⟷ Decrease in high level= - - -

**Increase in moderate level= ++ ⟷ Decrease in moderate level= - -

***Increase in low level= + ⟷ Decrease in low level= -

As, both women and men faced more health issues in Akra, Sundar Mahal and Chandgarh (Zaman, 2018), they perceived salinity to be the key driver of health hazards. However, to reduce the impact of salinity, women kept water in the washroom for three-four days and used it later. They assumed that it will decrease the salinity level of water and reduce their health problems. "Women take the decision of establishing tubewell through physical labor and selling their domestic animals" -said one of the FGD women participants.

Actually, I didn't tell the chairman about the water problem. I talked to a female member of my area. She assured me that I would get one tubewell when the allotment comes. But in the end that didn't happen. They distributed tubewell according to their own will and there are no rules and regulations in place for distribution of water sources. Actually those who deserve these don't get any. Those who are not in dire need usually end up getting them. This is the real problem. The tubewell distributed recently didn't go to those who actually needed those. Chairman doesn't monitor this himself. They work based on the recommendation of the inhabitants of the village. Sometimes those who can afford to give money or have good relationship with them get the goods. The members are there and besides the local leaders also play a part in it. I had suffered a lot during the disaster. I had to go to work leaving my ailing mother behind. My son was in school. Someone from my village (I won't mention his name) told me that I had to give away the tent I received as relief otherwise the police would arrest me. My son started crying after returning from school. He was saying that "Police will arrest my mother if the tent wasn't given away." After knowing this, I informed my father and other uncles. They told me that I was being foolish. They also told me that they wouldn't be able to help me in this matter and I would have to hand over the tent. Then I told them that I will immediately hand over the tent but before that you will have to make an arrangement for my mother. You will have to bring government people if you want to take the tent away. Only then I will give you my tent. My intention was that government people will ask them about the houses which were allotted previously. Even then they didn't stop scaring me in various ways. After that some houses were being allotted but they removed my name from the list. As a result, I didn't get that house. After that, this house in which I am currently living was built by some foreigners. They came today to inspect the house. The fencing hasn't been done yet. They will start that work soon.-Case Study, Sundar Mahal, Female-headed households

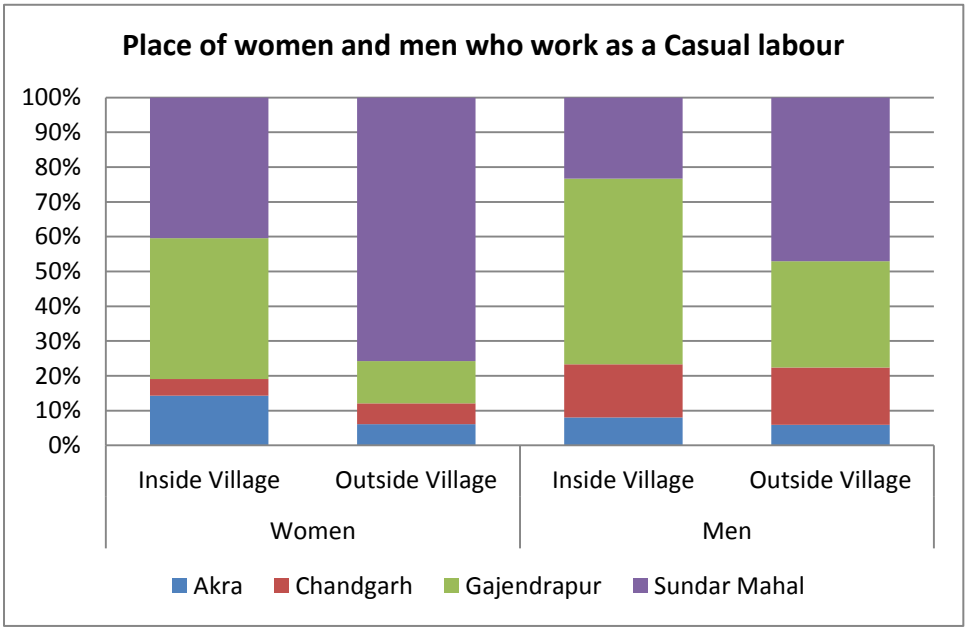


Figure-23: Location of work as casual labor based on gender

* Source: Survey data, 2018.

In the study, it has been found (figure-23) that more water insecurity leads to more involvement of women in the workplace in Akra (0.2 percent), Chandgarh (0.2 percent), and Sundar Mahal (2.5 percent) when compared to Gajendrapur (0.4 percent). Thus, a dialectical change has been seen between the water-secure and insecure areas.

There is differentiation that all women in this area do not get the same amount of money. If I decline to work under the current payment structure, some other lady will do it. Some may even work for less than the usual rate. But I won't be able to support my family if I work for under the usual rate. -Case Study, Sundar Mahal, Female-headed households.

6.6 Gendered Poverty

Inequality between women and men is among the oldest and most prevalent forms of inequality in the world. It ignores women's voices, depreciates their work and separates the position of women from the family, the national and global scales. Despite some significant progress towards changes in recent years, women have not achieved economic equality with men in any region, and women still live in poverty more than men. Regarding this, women of the coastal polder also faced some miserable conditions which made them more vulnerable compared to their male counterparts. Figure-24 indicated the occupancy status of the household's head of four mouzas of polder 29. The occupancy status of about 94.2 percent male-headed households were owner, while 3.7 percent were female-headed households was owner in status. Both 0.4 percent of female and male-headed households stayed in others houses in coastal polder.

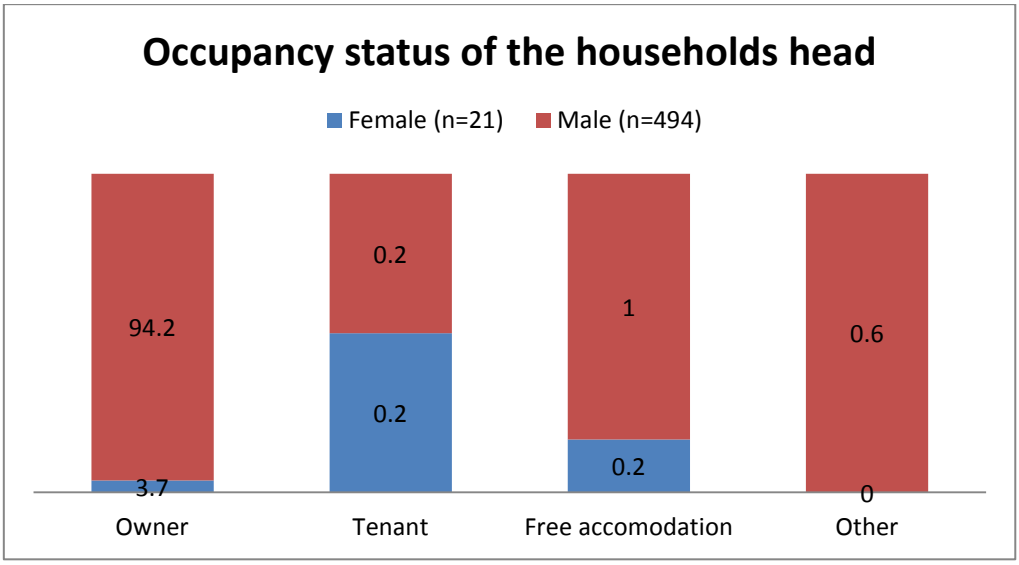


Figure-24: Occupancy status of the head of households

* Source: Survey data, 2018.

There is still a lot of water pressure during the month of ' Bhadra.' So the river gets flooded, and this overflow moves into fishing perimeters and causes the perimeters to be damaged. However, it causes less harm to the crops. That's why during this time people tend to work more on grain plants.-KII, Chandgarh, Male participant.

The wealth of the head of the household reflected their local social status. In their assets list, (table-35) both female and male-headed households had electric fans (74.2 percent), almirah (72.6 percent) and bicycles (41.7 percent).

Table-35: Assets of respondents of the head of households

Following assets of respondents of the HH	Sex of the respondents of households head					
	Female*(n=21)		Male*(n=494)		Total (N=515)	
Assets	n =	Percent	n=	Percent	n =	Percent
Television	4	0.8	161	31.3	165	32
Radio/CD player	1	0.2	18	3.5	19	3.7
Computer/ Laptop	1	0.2	14	2.7	15	2.9
Bicycle	6	1.2	209	40.6	215	41.7
Motorcycle	1	0.2	46	8.9	47	9.1
Auto bike/ Tempo/ CNG	0	0	25	4.9	25	4.9
Rickshaw/Van/Animal Cart	2	0.4	45	8.7	47	9.1
Almirah/ wardrobe/Showcase	11	2.1	363	70.5	374	72.6
Electric Fan	12	2.3	370	71.8	382	74.2
Refrigerator	3	0.6	59	11.5	62	12
Power tiller/ Tractor	0	0	19	3.7	19	3.7
Electric/ Diesel pump	2	0.4	79	15.3	81	15.7

* Source: Survey data, 2018.

"Due to the unavailability of water, they sell their cattle. Many of them sold their cows and goats when the water level rose during the flood. They tried to rear livestock again after the monsoon season, but the lack of cattle food created trouble for them. Earlier, there was enough grass in this area next to marshy land (a form of the body of water).You could purchase 10 cattle, and in the adjacent areas of marshy land they could graze alone. They, therefore, have to buy cattle food; otherwise the cow will be skinny. You have to feed her straw and other cattle feed worth BDT 10,000 (USD-118.02). You didn't have to spend cash on livestock feed earlier. Now there is no vegetation in the marshy land because of the salinity intrusion." -Chandgarh, FGD, Mixed group participants.

Table-36 displayed the household head's power source for lighting and electronics, which also represents the households ' economic condition. The grid electricity supply was used by 45.4 percent (234) of the female of the households, compared to 12.8 percent (66) of the male-headed households. Furthermore, the electricity as power sources to their households used by 25.2 percent (130) of respondents both men and women. Some of the households used solar panels (42.9 percent) and kerosene (30.1 percent) as they were unable to afford their electricity in their homes.

Table-36: Power Source for lighting and electronics of the head of households

Power Source for lighting and electronics	Sex of the respondents of the households head							
	Female*(n=279)		Male *(n=83)		Both*(n=153)		Total (N=515)	
Power Sources	n =	Percent	n=	Percent	n =	Percent	n =	Percent
Grid supply electricity	234	45.4	66	12.8	130	25.2	430	83.5
Solar panel	101	19.6	37	7.2	83	16.1	221	42.9
Kerosene	90	17.5	28	5.4	37	7.2	155	30.1
Other	3	0.6	2	0.4	0	0	5	1

*Source: Survey data, 2018.

For cooking purposes, the majority of participants (94.4 percent) used wood or fuel sticks. Animal dung was another popular source (74.6 percent) of respondents from coastal families for their daily household use (table-37).Many families also used straw or grass (31.5 percent), electricity (13.8 percent), natural gas (6.8 percent),etc. Houses with economic stability in their occupation used the electric stove and cylinders.

Table-37: Types of fuel used by the respondents of the head of households

Types of fuel used by the respondents of the HHs	Sex of the respondents of households head					
	Female*(n=21)		Male*(n=494)		Total (N=515)	
	n =	Percent	n=	Percent	n =	Percent
Electricity	4	0.8	67	13.0	71	13.8
Natural Gas (piped supply/ cylinder)	1	0.2	34	6.6	35	6.8
Animal Dung	13	2.5	371	72.0	384	74.6
Kerosene	1	0.2	7	1.4	8	1.6
Wood/ Fuel sticks	21	4.1	465	90.3	486	94.4
Straw/ Shrubs/ Grass	11	2.1	151	29.3	162	31.5

*Source: Survey data, 2018.

"Most people are thinking of how to secure additional income; many are engaged in companies, some work and some try to expand their lands and even cultivate fish. As we are not getting adequate paddy and our lands have also grown higher, so we are thinking of cultivating other vegetables such as water melons and various vegetables. In our current condition, after next two to three years, I think that if salinity is eradicated, we will return to previous good conditions. Otherwise, we have nothing to do. Now that you are here, we can see a glimmer of hope that you can help us to boost our condition. We doubt that we can live to reconcile ourselves with nature. We will strengthen our condition to some degree if we receive help from experts."-FGD participants, Sundar Mahal.

6.7 Water use in production and gender dimension

The qualitative findings indicated that long term and short term rainfall hampered the overall crop production that created a shortage of food for both humans and animals. In broad sense, water crisis created economic crisis as it hampered crop production. People used more chemical fertilizer to increase crop productions that created breathing problems according to the villagers. "We have nothing to cope with because we can't change the decision of God", said the villagers. Sometimes the coastal people went to the next village in search of work when there was no work in their village. Some of the villagers practiced combined crop production like fishing and paddy cultivation in the same land. So, they had no coping strategies except some fertilizer. They have to pay BDT 150 (USD-1.77)-BDT 200 (USD-2.36) for irrigation. Women of the village also played an important role in agriculture by working as a helping hand to the males. Besides, agriculture they also helped in fishing activity. They rear various domestic animals and cultivate vegetables in courtyards. Women were more conscious of water because they had to be in touch with water most of the time. The participants of the FGD used rainwater for agricultural purposes. Sometimes the coastal people used deep tubewell for agriculture purposes. They didn't use shallow tubewell water as it is not usable. Again, in Akra, Chandgarh and Sundar Mahal, paddy did not grow well due to arsenic and salinity in water. If they cultivated the land on their own, there will still be no production of paddy. So, it will bring nothing but financial loss of about BDT 50000 (USD-589.07) for 2 "bigha" field. If some paddy was grown, people now used raw sugar in soil and water. Some of the respondents in Chandgarh shared his own experience regarding this that he used 4 kg of sugar, first in water then in soil. The respondents assumed that this increases the production of the crops.

"The water used to feed livestock was mainly tubewell. We also feed them water from ponds where rainwater was collected as the cattle were unable to drink saltwater. In contrast to chickens and ducks, cows were less affected by diseases. If any disease breaks out, almost all of the village's chickens and ducks die from that disease. The prawns suffer from a form of virus-induced disease. If this disease takes place, the fish becomes reddish and dies. We consider excessive temperature and salinity as the main reasons for the diseases. It depends on luck absolutely. After all my fishes died, I thought if I had built a shade over my cultivation area, it would have been better. But it was too late and by that time all of my fishes had died. This year, the death rate was higher than last year"- FGD participants, Sundar Mahal.

In regard to the irrigation water, the FGD participants answered that they were using boring water and pond water. When asked about decision making regarding boring water, the participants revealed that their male members of the family took the decision about this matter. They also added that they supported their male members in the irrigation process such as extracting water from the reservoir, starting the machine and pumping tubewell, etc. Besides, the FGD participants said that every decision has been made together by the family, sometimes arrogance shown by a family member ended up in a physical fight. There was some male member in the family who did not want to hear the women's voice, and therefore, it turned in to a miserable condition. Though, women have to work with equal pressure as the men, their work did not count as valuable in Akra, Chandgarh and Sundar Mahal. In Gajendrapur, women helped their husbands by working on their own land instead of outside. They informed that the production in their locality was good due the less salinity in their water.

Summary

This chapter reflected the results based on the gender dimensions of job diversification, spatial changes and climate effects on gender and the dialectical relationship between water and gender. Overall, the gendered poverty and water use in the production of the four Mouzas, based on qualitative research, were highlighted in this chapter. Female-headed households (FHHs) also exposed that they did not get any benefit due to their social identity. The leaders only provided facilities related water security for those families who they are close/ familiar. Thus a dialectical relation observed from the FGDs findings as well as case studies findings.

In water insecure areas some factor decreases the women resilient capacity such as water collection conflict, religion, ownership of land and water sources, shrimp cultivation, health and so on.

The qualitative data also illustrates that the resilient capacity of men decreases due to water collection conflict, ownership of land and water sources at moderate level. In contrast, decision making of installation tubewells in household level, workshop, and training about water security, involvement of women in work outside locality- all are work as an increase factor of women resilient capacity. So, water insecurity increases women resilient power in water crisis situation in coastal polder. Women who work outside their family farms encounter various types of gender-based discrimination in their workplace as lower payment, unequal division of labor (e.g. water collection only women's work) and working longer hours than men. The women, who work in agriculture and aquaculture, and casual laborers, who earned only half of the wages compared with men in the more water stress areas. However, getting women's in agricultural activities are easy and available due to their poor economic condition. In Gajendrapur village, distinctive with less water insecure areas, women were capable of self-sustain themselves without moving in another place in search of work outside the locality. Still, the recognition of women's work is limited at the household level and they are not valued by the patriarchal social norms. Marginalized women (poor, lack of access to rights and treated as less important) are recognized as less valuable and available casual labourers in the agriculture sector. Men make most decisions in income-generating activities such as agricultural activities and investment in farming; whereas women make decisions about daily household's chores. More women are members of community organizations such as NGOs and other private institutions, but decisions are articulated by men at the community and household level. Men spoke on behalf of the collective in the community and their decisions have remained. But interestingly water infrastructure related decision was taken by the female members of the households, so the nature of decision was changed over time.

CHAPTER VII: GENDER BASED CONCERN RELATED TO WATER AND ALTERNATIVE ADAPTATION OPTIONS

This chapter raised questions about water issues and people's alternative adaptation to mitigate the risks of water in the coastal polder. This section also addresses structural disparities in water management systems and water-related socio-economic concerns.

7.1 Introduction

Research findings indicated that water and alternative adaptation by coastal inhabitants is a matter of gender concern to reduce water risks at the household and at the community level. Both qualitative and quantitative evidence centered on water issues as a socio-economic concern. In addition, some organizational differences existed in coastal polder water management groups, which have also been clarified in this section. Priority issues of household survey data on coastal polder have highlighted socio-economic concerns, water concerns, and environmental concerns. Qualitative information from the study also reflected the gender-based water management issues in the household and concerns regarding the treatment of water in coastal polder 29.

7.2 Gendered concern on water

With regard to gender-based water issues, coastal household respondents reported that women were more concerned and attempted to solve the household level water crisis problem compared to men counterparts.FGD participants added that the men had to work outside the house because they didn't have much time to take care of household water.FGD participants also said that if anyone within the family was using safe water, the female members encouraged them to become aware of water use and also told them, instead of using safe drinking water, to wash their hands with pond water. Women often borrowed water from neighboring homes and returned it as needed. The participants also added that sometimes, by obtaining public subscriptions in water-insecure areas, they had to wash the tubewell. The people who used the tubewell had to provide BDT 5 (USD 0.059)- BDT 10 (USD 0.12) as tubewell maintenance subscription fees. The maintenance charges were fixed by the maintenance committee member in the area. Sundar Mahal (water-insecure area) participants of the FGD reported it: "These subscriptions are collected from fifty members."

FGD participants reported that male members were involved in the filter cleanup because women were unable to perform cleaning tasks such as entering into ponds and filters**.**In the community institution, most of the members were women, because of the membership cards were issued in the names of women- stated by most of the respondents. When asked about the ownership of the pond, the participants replied someone had their own pond and some didn't. Those who had no pond had to use others' ponds for household chores and sought permission from the pond owner. However, no one paid money in the water insecure areas to use the pond water.

"Men have more knowledge of the need to safeguard drinking water in households than women because men have to spend most of their time out of the home. Women stay in the house and look after drinking water more than any other activity."-Sundar Mahal, KII, Male participants.

7.3 Involvement of women and men in establishing water infrastructures

Many people from vulnerable southern water areas such as Akra, Chandgarh and Sundar Mahal had lower opportunities to earn because of their water crisis issues. They had to be dependent on the government and other private organizations, to install water infrastructure in their locality. Some people took loans from others to solve their water problems and to share the water sources.

Table-38: Role of head of households in contributing to the intervention of water infrastructure in locality

Role in establishing water infrastructure		Biological identity of HH				Overall		Descriptive statistics				
		Female (n=21)		**Male (n=494)**								
		n	**%**	**n**	**%**	**n**	**%**	**Mean**	**STD**	**χ2**	**df**	**p-value***
I	**Contributing to the intervention of water infrastructure (n=515) (% within in column)**											
1	No	4	19.0	94	19.0	98	19.0			6.613[a]	2	0.037
2	Yes	16	76.2	398	80.6	414	80.4					
3	Don't Know	1	4.8	2	0.4	3	0.6					
II	**Types of contributions (n=147) (% within in row)**											
4	Cash	8	38.1	132	26.7	140	27.2					
5	Labor	0	0.0	5	1.0	5	1.0					
6	Materials	0	0.0	1	0.2	1	0.2					
7	Space/land	0	0.0	1	0.2	1	0.2					
III	**Amount in cash contributed by HH (n=140) (% within in column)**											
8	1 - 2000	8	5.71	126	90.0	134	95.71	513.500	890.630	8.844[b]	25	0.999
9	2001 - 4000	0	0.00	1	.71	1	.71					
10	4001 - 6000	0	0.00	5	3.57	5	3.57					

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is .12.

b. 46 cells (88.5%) have expected count less than 5. The minimum expected count is .06.

(* Source: Survey data, 2008)

Table-38 represented the household head's role in contributing to water infrastructure interventions in the selected coastal locality. The survey data showed that both men and women were involved in the development of new infrastructures in the area.

Roughly 76.2 percent of the female-headed households (16 out of 21 respondents) and 80.6 percent of the male-headed households (414 out of 515 respondents) were involved in the development of new water infrastructure.In total, 27.2 percent (140 respondents), including male and female-headed households were paid cash for the new infrastructure being built.

Table-39: Role of head of households in contributing to establishing water infrastructure at households

Role in establishing water infrastructure in Household		Biological identity of HH				Overall		Descriptive statistics				
		Female (n=21)		Male (n=494)								
		n	%	n	%	n	%	Mean	STD	χ^2	df	p-value*
I	**Contributing to the intervention of water infrastructure (n=515) (% within the column)**											
1	No	17	81.0	359	72.7	376	73.0			.722[a]	2	.697
2	Yes	4	19.0	134	27.1	138	26.8					
3	Don't Know	0	0.0	1	0.2	1	0.2					
II	**Types of contributions (n=138) (% within in row)**											
4	Deep tubewell	0	0.0	1	0.2	1	0.2					
5	Electric motor	0	0.0	1	0.2	1	0.2					
6	Rain water harvesting	0	0.0	2	0.4	2	0.4					
7	Shallow tubewell	4	19.0	128	25.9	132	25.6					
8	Electric motorized Shallow tubewell	0	0.0	1	0.2	1	0.2					
9	Shortage tank	0	0.0	1	0.2	1	0.2					
III	**Amount in cash contributed by HH (n=138) (% within in column)**							5826.812	2781.99	10.628[b]	25	0.995
8	1 - 2000	0	0.0	5	3.62	5	3.62					
9	2001 - 4000	0	0.0	17	12.31	17	12.31					
10	4001 - 6000	2	1.44	76	55.07	78	57.1					
11	6001-8000	1	.72	30	21.73	31	22.45					
12	8001< above	1	.72	6	4.34	7	5.06					

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is .04.

b. 43 cells (76.8%) have expected count less than 5. The minimum expected count is .04.

(* Source: Survey data, 2008)

Table-39 showed how many household heads contributed to building a new infrastructure for water in their households in the coastal polder. The 19 percent of female-headed households contributed to the construction of new infrastructure in their household and about 27.1 percent of male-headed households contributed to this. In households, there were different kinds of contributions, such as deep tubewell construction, digital generator, rainwater harvesting and so on. But both women and men on the coastal areas prefer to put a shallow tubewell in their homes because they were unable to get the deepwater layer for deep tubewell. Most of the respondents bear the costs BDT 4000 (USD-47.15) -BDT 6000 (USD-70.73) by borrowing money from NGOs and others to install the shallow tubewell in the house. For installing the new infrastructure the average amount was 5,826,812.

Some of the FGD participants said that "women took the decision to establish tubewell through physical labor and sell their domestic animals."Owing to the water crisis, crop production often failed and the economic crisis forced women to sell their valuable items to cope with the situation. Many families were out of reach of water supply services. Works of women (in-house and outside) did not appear to be recognizable by the male-dominated society. Within the coastal polder, the male- centered decision-making system was observed in income-generating activities. Women contributed to decision-making in the construction of new infrastructure at the household level as women were responsible for the collection and protection of household water. In all four mouza's, men were more preoccupied with agricultural water. In the water sector, gender is usually equal to women and beyond the notion that improved access to water reduces women's workload and, therefore, is a good thing for gender equality; for coastal polder, this analysis has tended to be superficial. The productive and community management role of women in the water sector were overshadowed for several years. However, their direct contribution to agriculture, homestead gardening, food and water securing in Coastal Polder remains unappreciated (NCS, 2016).

"The impossibility of purchasing water from the van system, most of the people who are living in the water crisis try to preserve rainwater in every purpose during the month of May (Baishakh). He sets a line with the tinned roof of his home and keeps a drum where the waterfalls. When it is not the rainy season, he keeps this line off. This preserved water can be used for one month. Moreover, he does not have to use it during the rainy season for the availability of the water. This responsibility of preserving rainwater comes on to everyone in his family. The younger son fills the big drums with rainwater by jars. However, it is the duty of the women to preserve the water and inform the men when they need more".-(Chandgarh, IDI, Male Participant.)

7.4 Institutional difference and role of the water management group

There is no significant difference in the gender norms for rural and urban women. Most of the decision was articulated by male members of the coastal community. Therefore, within the water management sector, there was a certain group of people in control, the marginalized group did not have the power. The respondents mentioned that most of the water management group's members were men. On the other hand, the committee's female respondents were about two-thirds. Without counting their valuable decision, which was a major challenge in the coastal polder, women's only participation did not indicate the welfare of society.

There were no water problems in Khorappur, Kalikapur and the Sottendropur localities. The chairman tried to bring water from these areas through the pipe so; the people of this locality could eat and live properly.I tried to go to the house of the Chairman and asked him if it is better for us to bring water through the pipe in our area. Then the chairman said-'Look, it's about so much money, yet I'm going to try it.'The chairman then tried to find safe water sources, but no solution was found.-(Sundar Mahal, KII, Male participant).

Table-40: Respondents knowledge about the existence ofa water management group in the locality

Name of the mouzas		Existence of water management group in the locality			Total
		don't know	no	yes	
Akra	n	2	11	45	58
	% within	4.3	17.2	11.1	11.3
	% of total	0.4	2.1	8.7	11.3
Chandgarh	n	0	5	57	62
	% within	0	7.8	14.1	12
	% of total	0	1	11.1	12
Gajendrapur	n	39	13	136	188
	% within	83	20.3	33.7	36.5
	% of total	7.6	2.5	26.4	36.5
Sundar Mahal	n	6	35	166	207
	% within	12.8	54.7	41.1	40.2
	% of total	1.2	6.8	32.2	40.2
Total	n	47	64	404	515
	% within	100	100	100	100
	% of total	9.1	12.4	78.4	100

* Source: Survey data, 2018

Table-40 also showed the water management group's contribution to local water safety. In order to ensure its water situation, Gajendrapur mouza had more water management groups. Approximately 33.7 percent (136) of respondents reported having a water management group in a water-safe area. On the other hand, in water insecure areas Akra, Chandgarh and Sundar Mahal, 11.1 percent (45), 14.1 percent (57), 41.1 percent (166) of respondents preferred to the presence of water management groups in their communities respectively.

"Water is retained from deep layers of earth. In order to get safe and clean water tubewell, a depth of between 1,000 and 2,000 feet must be set. Without considering the depth and necessity of safe water, the authority has set up the tubewell and it is for that reason that we cannot have good water. The tubewell suffers from the water crisis, due to improper layering." -(Akra, FGD participants).

Table-41 indicated that most women respondents reported little contribution from the water management group, although they had good representatives in water-management groups(Akra-57.14 percent, Chandgarh-14.29 percent, Gajendrapur-47.62 percent, and Sundar Mahal-37.21 percent). Moreover, male respondents had similar opinions on this issue. Nevertheless, because of geographical variations, water management groups in the locality were unable to resolve the problem.

"Akra has one water management group, but there is still no improvement in our area on safe water.The deep tubewell will not solve the problem of water in our area, because the deeper you dig for tubewell, the more sand, and mud you get. The places that have safe water supplies are Sorrapur, Fulbaria, etc. We have to take water from Sorrapur to get rid of this problem and it is important to install supply water for the locality".-(Akra, FGD male participants).

Table-41: Percentage of the respondents in the water management group

Sex of the respondents	Percentage of the respondents in water management group (N=515)		
Mouza	Female	Male	Both
Akra	**16.92**	**14.29**	**5.00**
Female	7.14	8.08	10.77
Male	0.00	4.04	4.62
Both	7.14	2.02	1.54
Chandgarh	**28.57**	**21.21**	**23.08**
Female	0.00	4.04	6.15
Male	28.57	14.14	13.85
Both	0.00	3.03	3.08
Gajendrapur	**21.43**	**21.21**	**21.54**
Female	7.14	10.10	12.31
Male	14.29	10.10	9.23
Both	0.00	1.01	0.00
Sundar Mahal	**35.71**	**43.43**	**38.46**
Female	0.00	16.16	15.38
Male	28.57	26.26	23.08
Both	7.14	1.01	0.00
Total	**100.00**	**100.00**	**100.00**

* Source: Survey data, 2018

In the Chandgarh area, there was a water management group. However, the activities of that group were dormant. The residents of the area belonged to that group. People from this area participated in the discussion and decision-making while providing them the sluice gate. The FGD participants mentioned the name of a "DELTA" company, saying that whatever that company was doing, it was of good use to them. For that intervention, they

could cultivate paddy and get a good amount of rice from there. People had an equal share of water.

The water level was so low that water extraction was very difficult and infact, it was salty water. For the community there, nothing was going to favor. They did not find a solution to access to safe potable water at any time. Later the chairman of the region was using his car to distribute water. Nonetheless, the demand for this water was too high to satisfy the people's needs. The chairman also had limited water supply capacity. Therefore, he stopped the supply of the water.

"The community-based organizations and my family are part of ' Blue Gold, ' where I volunteered during river erosion. We do different activities in the community to solve the water problem. It would be a great advantage for the people of the village if deep tubewells were provided in our area and the pipe was delivered with water in an organized way."- (IDI, Chandgarh, Female participant).

The Water Development Board was a government organization that participated in digging channels, water supply, river water, rainwater, tides, sluice gate, etc. PSF is the Government-owned company operated by Union Porishod. It was established by a meeting of the Union council. It was established for the people who lived near *'Abara'* pond in Chandgarh. In the Union council, there were three women and their opinion must be taken into account. A seven-member committee was formed, consisting of the landowner, and the rest were generally class-based farmers. Water has been lifted on the basis of their opinion. More water was raised during the tide if it was harvested in a higher ground. Less water was needed for less land, after rice cultivation. And this is how water in the sluice door was used. Sluice gate was used mostly for the removal of the rainwater and good crops, irrespective of how high or low, in every kind of area.

The water management association was a development organization. Financially, it was a Dutch foreign organization. This organization's main task was to raise awareness and sluice, canal digging, cultivates, etc. The Chandgarh area had 47-48 km dams. The whole dam was fixed and several kilometers of digging of the canal. The entire project had 56 committees, but there were 33 committees under the Water Management Association and the villagers were the members of the community. A survey was performed before an organization was made. The 51 percent of men were compulsory and it must have 33 percent of the female member. They were mostly male, as women did not go outside the house generally. Female members had a system of quotas; one-third quota for woman was the executive body's priority. The company was mainly made up of four bodies: Chairman, Vice-President, and Secretary-General, Treasurer.

Two-part of the organizations were fixed for the female members who were Vice-president and Secretary. Each month there was a meeting taking place. After a two-month break, the next meeting would be help and they came to the meeting, discussed the problem, services, and facilities. They expressed their views, they also signed in the notebook on restitution. They spoke about the problem of the village when water issues, dam problems and waterlogging occurred.

Meena recommended mitigating the water crisis to provide blocks in the river banks to mitigate the water influx during the flood. She said, in the Shorrapur area they had block system. If Chandgarh mouza followed this example, they could prevent the erosion, she added. To mitigate the water insecurity in that area, she said that she had requested the chairman to make a provision of underground piped water system to bring water from Boshundia to Bot-tola because Boshundia's water was good. She knew about government policy on water, she stated, that she had gained some information from Blue Gold. The budget for different areas was allocated from the parliament after MPs agree upon that plan. She added that this was a lengthy process and the lengthier the process was, the more they suffered from water crisis. To solve the water crisis in this area, government officials visited this area twice, but they did not take any step, at least she did not know of any steps or plans that government has taken to support them. Ashroy Foundation (NGO) had taken some steps to lessen the suffering of the people of this area. They used to distribute water and used to make money in return. They used to take BDT 60 (USD-0.71) monthly in order to provide them with adequate water. The excessive demand for water, that intervention was not in practice now. During flood, chairman provided water free of cost for 15 days-(KII, Chandgarh, Female participant).

The government should not give private ownership mentioned by the FGD respondents. The officials did not investigate that much and many people were illegally occupied. The government got tax in that case. Powerful people do such things. But now the public became aware and such activities can no longer be carried out. The principle was that the dam cannot be given in the canal. In the village meeting and seminar, it has been said that these are prohibited and any initiatives should be taken for this situation to be improved. The NAM's communicated with the water development board and they will construct sluice gates, small nuts, bolts, dyeing, grease, cobbling, removing sediment, removing tricks, organizing them. Water Development Board was doing a great job. If there was any problem, the people went there and informed the water development board, they came immediately. The government work was lengthy and many times they said it, "you do, we will pay the money".

Women's opinions were certainly taken into account in the organization, however, not all voices sounded that positive for water development board. At this point if women did not talk, the male were not responsible, as stated by FGD participants. But, the organization confirmed the presence of women. Out of 12, four women were mandatory to take a decision about any issues.

Some days ago an organization named "Ashroy foundation" took a project. They carried water from other places and gave a 20 liter jar which was sold at a price of BDT 620 (USD-7.31). After some days they fell in loss. They had to spend a lot of money on transporting and then finally it was closed.-(Chandgarh, KII, male participant).

The canal excavated by the water development board was not according to the system. There was no other way except the government tubewell. In the canal digging, officially 100-200 feet wide land has been shown. But engineers excavated 30/40 feet and 5 feet wide of designs and rest of the land is being illegally occupied. The area where the canal can be as deep as possible, it would have benefited the coastal area, but it did not. The participants said repeatedly but there was no change. Water Development Board did not take any initiative. The participants have been debating and dispute with them many times. People come from many NGO's. The respondents mentioned that they also have many interviews. But nothing was effective. In order to overcome the problems of water for farming, the canals especially must be excavated, so that water retention capacity is high. When the saltwater does not enter the sluice gate, keep the sweet water off. There are three dams. The first one is 10 feet high, if there is a failure, another dam is inside which is 15 feet high. If this is a failure, there is another 20 feet high. This system can be done by excavating canal; however, this initiative has not been taken by any official or private sector. This year, a budget of BDT 10 lakh (USD-1177.16) for the canal was announced. Whether it is 5 feet or 10 feet deep, as far as the width is widened, but they do not build the canal. In the area there is no crop due to the absence of canals and three kilometers north of Chandgarh area were being away from irrigation due to the sweet water of the river. The government will be able to construct the canal and maybe take one or two years, but the government does not build it.

Development of the farmers lead the development of agriculture, then everyone will develop. This area grows one crop and if there are two or three times the crop, then everyone will develop, employment will increase.

During the period of economic hardship of the family, women sell their jewelry to support the family. If you take loans, the interest is extremely high to be repaid. It is better to bring money by mortgaging jewelry. They can sell fishes from their enclosure (gher) and bring the mortgaged jewelry back. Also, religiously speaking, women fear that if their husband brings loans with interest, their family will be affected in some way. So, they prefer to give away their jewelry as a mortgage. -Chandgarh, KII, Female participant.

7.5 Drinking water: intervention and maintenance

All of the respondents agreed with the fact that the authority managed the water source was WAPDA. They have uttered that there was a conflict before at least 12 years ago regarding the saltwater turning out from the deep soil. Rather the pipes and instruments used were not up to the mark and the instruments were not good and enough to reach to good quality of water. One of the respondents from Akra said, "Basically, all the water-related works and tasks are done solely by the political influences and influential people through tender."

Some families are connected with the organization named MAX from the Netherlands. This organization works not only on the water crisis but also on women pregnancy's issues, child care, etc. This committee consists of young, adult and female members; still, male members are the majority in counts. Most infrastructural decisions are taken by men. The organization has dug a pond, perhaps they are about to take some steps for the water crisis. -Chandgarh, IDI, Male participant.

Table-42: Water infrastructure establishment according to mouzas

Water infrastructure establishment according to mouzas		Name of mouzas								Overall	
		Akra		Chandgarh		Gajendrapur		Sundar Mahal			
		n	%	n	%	n	%	n	%	n	%
I	**Water infrastructure intervention in the last five years (n=515)**										
1	No	9	15.5	9	14.5	41	21.8	39	18.8	98	19.0
2	Yes	49	84.5	52	83.9	145	77.1	168	81.2	414	80.4
3	Don't Know	0	0.0	1	1.6	2	1.1	0	0.0	3	0.6
II	**Types of interventions***										
4	Installation of deep/shallow tube-well	0	0.0	0	0.0	16	11.0	114	67.9	130	31.4
5	Piped water system (new/expansion)	0	0.0	0	0.0	137	94.5	0	0.0	137	33.1
6	Water vending (new/ expansion)	45	91.8	43	82.7	0	0.0	4	2.4	92	22.2
7	Rain water harvesting system	0	0.0	0	0.0	1	0.7	0	0.0	1	0.2
8	Public Pond excavation	0	0.0	0	0.0	2	1.4	1	0.6	3	0.7
9	Installation of Pond Sand Filter (PSF)	0	0.0	0	0.0	0	0.0	160	95.2	160	38.6
10	Others (annual deposit of BDT 620 for formal vending system, annual deposit for a government DTW)	4	8.2	9	17.3	0	0.0	2	1.2	15	3.6

*Multiple responses were accounted (Source: Survey data, 2018)

In the last 5 years, some water infrastructure interventions observed in the coastal polder. Table-42 indicated that 80.4 percent (414) respondents mentioned about interventions of water infrastructures in the four mouzas. However, types of interventions were different in the four mouzas based on their water quality situation. Installation of pond sand filter was common in the Sundar Mahal stated by 95.2 percent (160) of the respondents, but the other three mouzas didn't have this system. In Akra (91.8 percent) and Chandgarh (82.7 percent) had a water vending system, however, Gajendrapur mouza did not need this water vending system due to their piped water supply system availability (94.5 percent). The respondents of both male and female-headed households had knowledge about the repair system of the infrastructures. Around 2.3 percent (21) female-headed households knew about the repair system of infrastructures, whereas 52.6 percent (494) male-headed households had knowledge about it (figure-25) among 515 households.

Employment is required to become financially solvent. Such as- cultivating vegetables, fish, etc. If the salinity can be eliminated, then the production of both rice and fish will increase. Some are doing poultry farms as well. Now if the government comes forward and arranges training programs for us in various sectors, we will be benefitted. It has to be relevant to the context of our locality. Finally, if policymakers take our opinions into consideration and act on that basis, it will help us to a great extent in improving our condition and we will remain ever grateful.-FGD participants, Sundar Mahal.

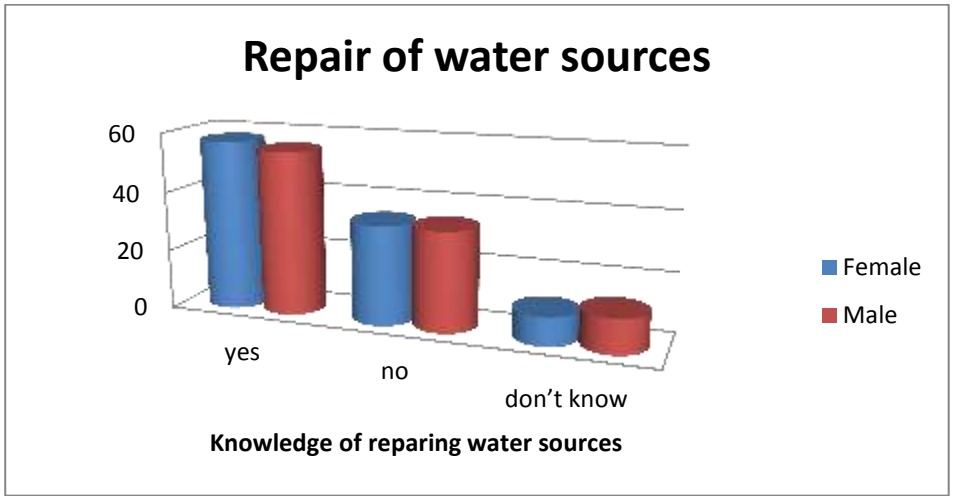


Figure-25: Knowledge of repairing water sources in polder 29

(* Source: Survey data, 2018)

Gajendrapur case studies- Aasia

Aasia was a dweller of Gajendrapur village, Shahosh Union-9, under Khulna district and is 30 years old. She completed her education till class 7 and after marriage, she couldn't continue her studies. Her family consists of 4 members; her husband, and two children. She lived in this village for the past 18 years. She worked in the crop field, along with sewing business. She did not have her own crop field, took a lease of others land; and paid around BDT 20000 (USD-235.98) per bigha. Her monthly income was about BDT 20000 (USD-235.98)–BDT 25000 (USD-294.98) and expenditure were roughly BDT12000 (USD-141.59)–BDT 15000(176.99). Her husband drives auto-rickshaw in his spare time from farming which also brought a moderate amount every month.

About 2 years back, the village dwellers used to bring water from union no. 8. After some time, a tap was planted at a distance of half kilometer from Gajendrapur, but the water problem remained as this one tap was for 6000 people in the union. They had to stand in a long queue which took around 2-2.5 hours to collect water. Then another water tap was planted beside the previous one which they named 'Jorakoll'. Then the NGO called 'Ashroy Foundation'came to Gajendrapur and established a motorized water house/tank with a capacity of 20,000 liters, which provided supplied water. The motor functioned every morning for 1.5 hours. If there was no electricity in the area, which occurred very often, then the motor cannot start which stops the water supply. The tap was allotted for around 20 houses and each house needs 5-10 water pots daily, so it is very much time-consuming. So, the dwellers had a settlement that they used this supplied water for drinking purposes only. Other purposes such as- washing, and bathing, were done with pond water. During dry season, it was difficult to use pond water. Though water scarcity has been reduced to some extent after establishing the water house, Aasia complained about its quality. She said 'first 2-3 minutes, the water flows from tank is dirty and full of odor.

We must throw the first 2-3 pot of water to get rid of this dirty water because by drinking this water, many physical problems can be seen, like- loose motion, vomiting, etc. Moreover, there was no cover on top of that tank. During rainy season, the rainwater gets mixed with the supplied water. Sometimes, small water insects can be seen in that water. Now, I cannot throw the whole water as it is the only stock of drinking water for the whole day. So, we were bound to drink the same water, trying to avoid the insects while drinking'. She also mentioned the conflict of every day during water collection as time is very less and everybody needs to go their respective work also. But she added that unwritten coordination also remains between them; if someone was out of water stock, others help him/her sharing their stocks. Aasia said that she paid BDT 30 (USD-0.35) every month for this supplied water. She told that female members are more conscious than the males. She also does rainwater harvesting during the rainy season.

She replied that she and her husband both have equal involvement in all chores and decision-making process. They consult together about everything and then take decisions together. She, along with her husband was a member of the 'Ashroy Foundation and have attended their meetings about solving their water problem. Aasia says 'We also have been trained about seed planting, fertilizer applying according to season and crops, etc in agricultural land'. She replied that theirs is the most intense water relative as compared to other village's like- Shorappur, Baniyakhali, Phulbaria, etc. It is also been informed by her that, in Union 8 and Union 10, there was one deep tube well for every 5-7 houses and the water problem was not acute in those Unions like them. Gajendrapur is still struggling with the water problem in their day to day life.

7.6 The gender-based socio-economic concern in the coastal polder

There were several socio-economic concerns observed in coastal mouzas such as agricultural, education, drinking water services, embankment, employment, health care, sanitation, transportation, etc. While asked about the prioritization of their concerns, the coastal people made a choice of their three main priority concerns which were different based on the geographical location of four mouzas. The majority of the respondents about 70.7 percent (364) households of four mouzas including water-secure and insecure areas gave their first priority as drinking water services (table-43). The second priority concern was embankment mentioned by 16.5 respondents (85) of water insecure areas such as Akra, Chandgarh and Sundar Mahal.Gajendrapur mouzas people mentioned about transportation and roads as their second priority (12.8 percent). The third priority concern of coastal people was financial services mentioned by 15.4 percent (79) of the respondents.

Table-43: Priority concern of respondents by mouzas

Priority Concerns	Mouza	Percentage of respondents	Rank mode of percentage
Drinking water services	**Akra**	8.3 (43)	**1**
Embankment		7.2 (37)	**2**
Employment		2.5 (13)	**3**
Drinking water services	**Chandgarh**	8.9 (46)	**1**
Embankment		8.7 (45)	**2**
Financial services		4.3 (22)	**3**
Drinking water services	**Gajendrapur**	27.2 (140)	**1**
Transportation and roads		12.8 (66)	**2**
Agricultural support		4.3 (22)	**3**
Drinking water services	**Sundar Mahal**	26.2 (135)	**1**
Embankment		17.1 (88)	**2**
Financial services		11.1 (57)	**3**

* Source: Survey data, 2018

The figure-26 highlighted the concern regarding the water of the respondents of polder 29. About 233 of the female respondents concern about water in households of the coastal polder, while 59 of the male respondent's concern regarding water among 515 households. But both females and males were concerned about water in 127 households among 515 households.

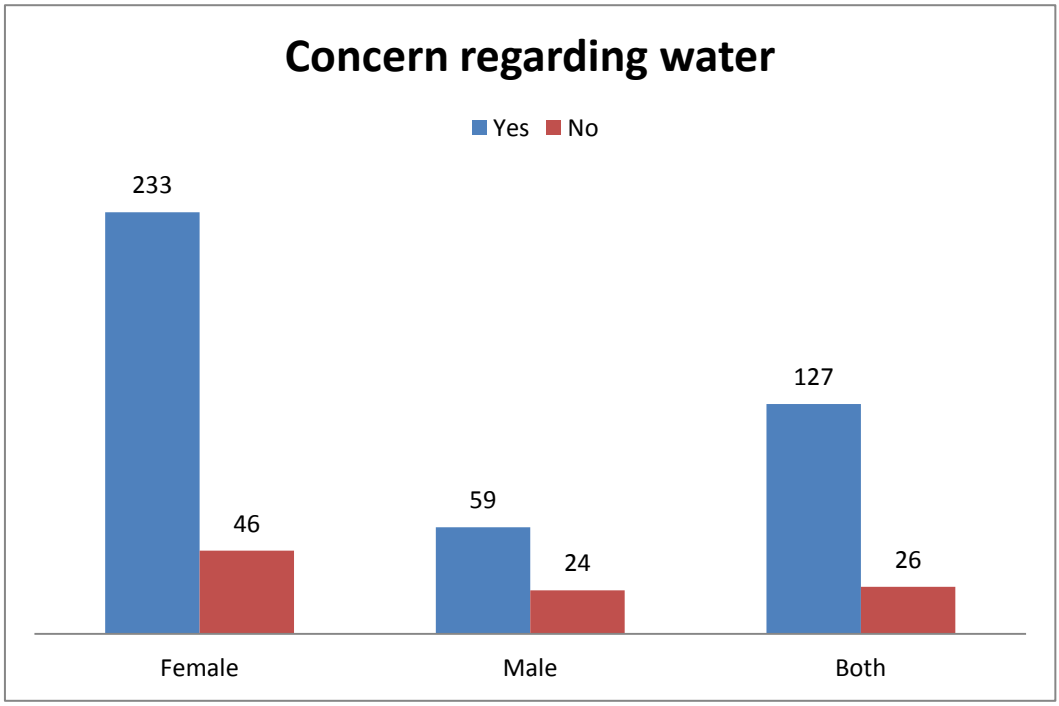


Figure-26: Concern related to water of the respondents of polder 29

* Source: Survey data, 2018

The main obstacles of water sources were the locations which were too far and costly (figure-28) mentioned by 13.2 percent and 12 percent of the female respondents of the coastal polder. The male respondents had a similar thought regarding socio-economic concerns (1).

The main obstacles of socio-economic concern-2 were the location of water sources was too far and not good enough quality water (figure-29) as mentioned by 15.3 percent and 8 percent of the female respondents of the coastal polder. The male respondents had a similar thought regarding socio-economic concerns (2) respectively 4.1 percent of the male mentioned about far location and 2.5 percent mentioned that water sources were not enough among 515 households. Another obstacle mentioned by the 8 percent of the respondents that was domestic waste of the households regarding keeping water sources safe.

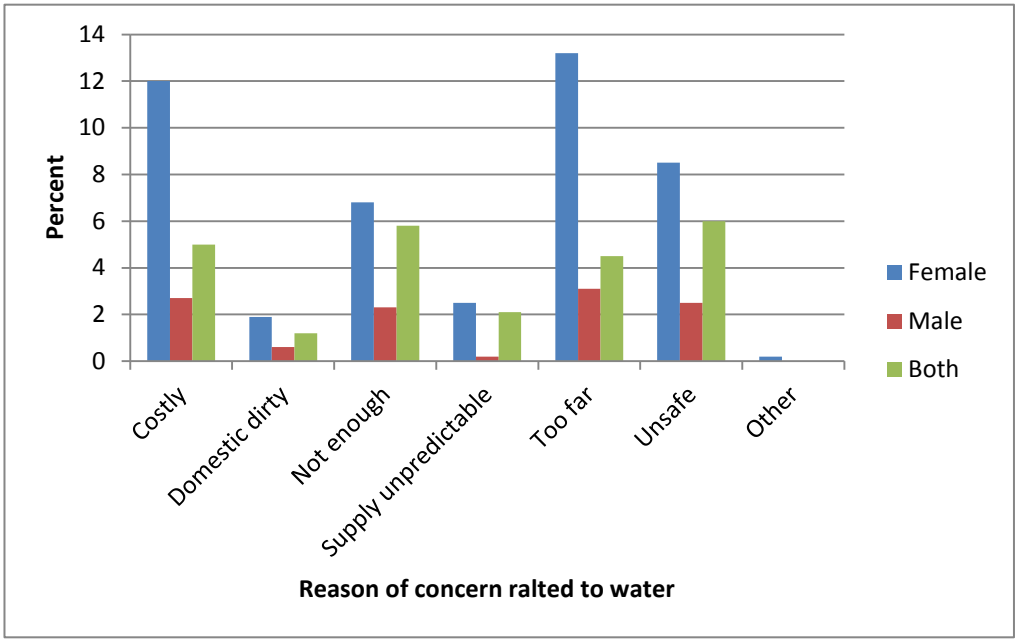


Figure-27: Reason of concern related to water (socio-economic concern-1)

* Source: Survey data, 2018

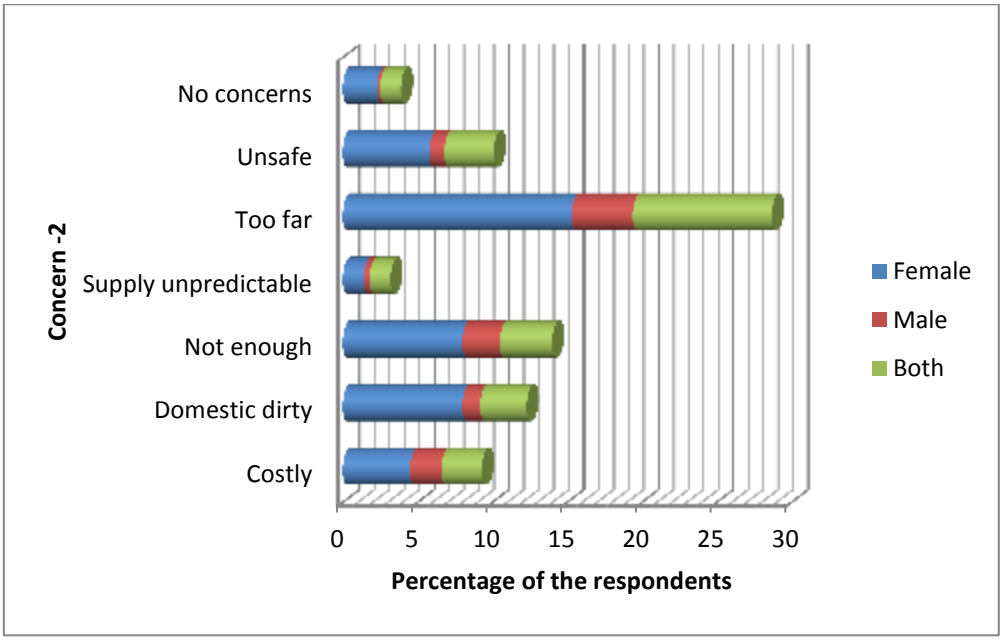


Figure-28: Reason of concern related to water (socio-economic concern-2)

* Source: Survey data, 2018

7.7 Alternative adaptation options

The Sundar Mahal FGD participants revealed that they set up a filter and location was fixed up through a meeting held by FGD members. The filter was not set up on government property; instead it was placed on privately owned land. They did not provide any physical labor just gave BDT 100 (USD-1.18) per family. Moreover, the participants added that not only the member but also the villagers used the filter to collect water. The FGD participants said that they had to keep their rainwater in a clean jar otherwise insects would grow in that water. They also used tablet/alum (fitkaris) for purifying the rainwater in Sundar Mahal (picture-3).

Picture-3: Saline water used in the washroom in Sundar Mahal **Picture-4: Rainwater harvesting system in Sundar Mahal**

Purchase water with BDT 25 (USD-0.29) per pitcher that can be used for both drinking and cooking purposes. But not everyone can afford that in this area. During the rainy season, women store water in different containers. This stored water can be used for a long time. But sometimes, insects affect the water. So, then they filter water manually to get rid of the insects and use that water again. That water can undoubtedly be used for cooking as well as drinking purposes. However, at the time of heavy rains, most people prefer to drink water from the tubewell. (KII, Chandgarh, Female participant).

The male member of the family conjointly helped the woman to purify water like purchasing tablets, alum (fitkaris). The FGD participants revealed that sometimes they tried to cultivate vegetables in their yard; however, they became unsuccessful as a result of salinity in soil and saline water. To cultivate vegetables they had to use purchased water. One of the participants said that she cultivated puishak (one kind of leafy vegetable) in her yard using boring water; although boring water also contains salt for which they had to use fertilizer. They added that basically, women had to take care of the homestead vegetable gardening. Some FGD participants had domestic animals like cows, goat and they also kept hen and duck for further financial gain.

"People do poly cultivation in my area. The following process is followed -Suppose it's time for fishery-farming. So people are busy doing it. When the rain will come then rice is the main product. Then people cultivate fish with rice. When the rice is comported and some chemical medicine then the growth of fish hampers. Poly cultivation is profitable than single cultivation. But the chemical fertilizer; insecticides have a bad effect on the fish. Some medicines have been invented which will help for cultivating fish and rice together, which do not do any harm for fish and useful for the rice also. Some loss happens in poly cultivation."- Chandgarh, KII, male participant.

The FGD participant revealed that some had to drink or use less water as their counterpart consumed more water. As, both women and men faced more health issues in Akra, Sundar Mahal and Chandgarh (Field Data, March 2018) they perceived salinity to be the key driver of those health hazards (picture-4). However, to reduce the impact of salinity, women kept water in the washroom for three-four days and used it later. They assumed that it will decrease the salinity level of water and reduce their health problems.

In this area, a floating vegetable garden can be found. They cultivate red leaf, spinach, pumpkin, different types of leaf, etc. They use a floating garden system because; usually the homestead soil is not suitable for cultivating such vegetables. In the enclosure (gher), the plants die due to salinity and chemicals used in there. -Chandgarh, KII, Female participant.

In water insecure areas due to water problems, people cannot grow crops causing the farming profession to face many problems. Many people who have some land can't cultivate their land all year long. So, they were doing some other work such as, rickshaw pulling, garments work, etc. Women were taking some kind of step for livelihood for example rearing hens, duck, etc. for their survival of their family.

Installing normal tubewell won't work it has to be a deep tubewell, in order for it to function. She also added that there is no piped system of supply lines in Chandgarh. The problem can be solved if a supply line can be connected from Kopaldanga. The transportation cost to travel to Kopaldanga from here is BDT 15 (USD-0.18). It is also difficult to bring water from there. If a provision of piped water system could be made, connecting lines from that area, they could have got safe drinking water- Chandgarh, Case studies, Female.

Women fetched safe water from a long distance which is often misused by the men, who use it to wash their hands and feet. Water management is usually a women's responsibility and her husband or the men in the house do not show much interest to the whole issue, unless the women of the household are sick or unable to fetch water for any particular reason.

Case study: Chandgarh

Mrs. Hema Malekar, aged 28 years, studied up to Secondary School Certificate belonged to a joint family with father in law and mother in law with her children and husband. She was a housewife but teaches children at home for a better life. Her income was daily BDT 200 (USD- 2.36) and monthly BDT 6000 (USD-70.79), but her daily expenditure is 9000 (USD-106.19) which is higher than her income. She teaches some boys and girls at home thus she manages it by her own capacity. She has been married for 10 years, since then she was living in this area. They didn't have tubewell in her household. People used the pond near her house for household chores. The two filters which were used to filter the pond water were broken for a very long time. They were drinking that water from shallow tube wells. But, sometimes they had to purchase the safe water. Shorappur, Basundia, Jorbhanga *we*re the places from where *they* collect*ed* water *from*. The chairman used to give *them* a ride to collect water. But it stopped lately, *due to the transportation problem. The cost was measured by the jar and each jar costs BDT 20 (USD-0.24) and BDT 40 (USD-0.47) for 2 jars. They bought 2 jars for 4/5 days. In the summer, the demand for water for daily survival increased. They had to pay only to the person who brought the water and not for the water itself. They only used it for cooking and drinking, but when they felt the shortage of drinking water, they used the pond water and shallow tubewell for cooking. The women were mostly affected as they have to do household chores. The baby didn't understand the problem, they just asked for water even if there was no water at home. Then they had to borrow it from their neighbour and returned it as per their need. She mentioned that- "Not everyone is alike, only the people they have a good relationship with will let them collect water. Even if they didn't have any acquaintance with anyone they didn'tstop us to take water". Men took the responsibility to collect water most of the time by cars. They took Nosimon car and collected water in 20 pots altogether and returned while distributing those. The males generally paid for the money. As when we see our men are unable to pay or they are not at home then I have to pay the money. She mentioned that –"both riverbank erosion and salinity of water are the reason behind this water shortage. Because of salinity trees and vegetables cannot grow. They lived in extreme scarcity even if we want to grow any fruits we are unable to do that. The riverbank erosion has engulfed the remaining coconut, guava, mango, papaya trees. It affected us time to time. I*

witnessed it after my marriage for like one and a half years. The fishes went outside the Gher which was a great loss. And because of salinity the pet animal hen and cock also died. We went on the roads with our household items but still could not save it. Then I only took our children and went to my father's house. We could not hold the tears. We cannot give consolation to others we had nothing to say."

The woman has to remain aware of water scarcity. As she used tubewell water for daily chores. But those who didn't have a tubewell they have to suffer a lot to go to someone else's houses for bath. She cultivated potato, eggplant in her garden but the quality was not good because of salinity. Her husband does fishing business. She kept for mortgage her jewelry several times and gave that money to my husband. Then used to take load released my jewelry. From the village association (shomiti) she used to take the loan. Around BDT 20000 (USD-235.98) / BDT 30000 (USD-353.97) based on their savings, she got loan from association (shomiti) and within 1 year she had to pay them back the money.

Sometimes she had to drink less water because she had to secure it for her children and also if the person who brings water does not come because of any problem so she secured it in a different place for an emergency. When there was not enough earning then they had to spend it wisely. But when the earning was normal they didn't have to do that.

They tried cultivating potato, eggplant, and papaya but didn't grow. No one is able to cultivate here. She tried to cultivate pumpkin but it didn't grow. But palong (one kind of vegetables) and tomatoes grow well here.

It was her decision to install a tubewell at home as well as the location of the tubewell. She told her husband that it was not possible to bring water from another house every day. They won't tolerate us every day and also my husband's fish business requires water. So, she convinced my husband and took a loan from the village association. Her husband used to return it but when he was unable, I used to return the loan/money. We have a pond. My father in law told us to plant near the pond but I thought that will spoil the pond water, as we use it for other purposes. My husband supported my decision. I also planted some plants there such as Helencha leaf and arum spinach (kochushak). They have collected rainwater, didn't have big containers so it didn't last for a long time. Her neighbor used Gazi Tank for collecting water and used it for consumption. As we don't have any we cannot go for a very long time. Her father in law and mother in law drink the rainwater and also used it for cooking. Because rainwater is very sweet and she can't drink it. I am not used to this because my hometown is in Rupshathana of Khulna District. The water in that area was really good and we had tubewell at every house. We used it for all the purpose. After married to this family my husband has bought two pots now. From then other family members also started drinking that rainwater. Her husband used to drink pond water. Now everyone in the family drink pot water which is bought. But my father and mother in law drink rainwater when it rains. She used pond water for rice and rainwater for cooking other things. We want to solve this problem, even the chairman also tried his best he set a machine in the pond, provided a car for carrying water, set tubewell but the water is not good enough. I cannot personally do anything, I have set a tubewell and it cost me BDT 8000 (94.39) to BDT 9000 (USD-106.19). A pipeline should be established under the ground from where the water is good. This way the problem can be solved she thought. She was more interested than her husband about water and as she is a mother, she has to be aware.

Women resilient power related to water security in terms of the decision-making power in the installation of new infrastructure in households, rainwater harvesting, cultivate seasonal vegetables in the yard. Women's alternative adaptation showed that how water insecurity bolstering their adaptation options and made their households safe in times of crisis. Thus, the second assumption also supported by both quantitative and qualitative data. Women's involvement in the water management group could not minimize the water risks, though their hidden contributions were untold by society.

Summary

This chapter highlighted the gender-based concern regarding water issues and alternative adaptation of the people to minimize the water risks in the coastal polder. It also highlighted the drinking water intervention and maintenance as well as institutional differences in the water management group and socio-economic concerns regarding water.

CHAPTER VIII: DISCUSSIONS AND CONCLUSIONS

This chapter highlighted the overall discussions of the research. This chapter also presented the recommendation from coastal people to the government as well as the researcher for policymakers. This section indicated some of the research gaps in the study findings which will give an outlook for future research scope for early researchers.

8.1 Discussions

Findings from my research highlighted heterogeneous levels of risks and experiences with water security across the four villages sampled in the polder.

1. The southern part of the polder faces higher levels of water-related risks

First, salinity intrusion and river erosion were the main concerns highlighted by respondents in the southern part of the polder, in Chandgarh and Akra. In contrast, respondents in Gajendrapur only highlighted the issue of iron and salinity. These issues are especially severe during the dry season (January-April) when cultivable land becomes more shriveled and the soil becomes more brackish. As such, seasonal drought was also identified as important stress. Some farmers used sugar in agricultural fields to reduce salinity levels for their crops. However, marginalized and economically disadvantaged groups did not have this opportunity.

1. Crisis of the households of polder due to water-related risks

In addition, the southern parts of the polder faced higher risks from the cyclonic storm, damaging people's land and properties. This also contributed to men and women leaving the area to seek better livelihoods, often leaving their families behind. The significant number of women reported having to sell valuable assets like jewelleries, land, livestock, and household utensils to sustain themselves. Higher-levels of hazards in the southern part of the polder, led to more negative impacts on agricultural production, drinking water, and overall well-being and health, as discussed below.

2. Women face high-levels of gender discrimination in the workplace

High-levels of salinity and erosion in the southern parts of the polder (Chandgarh, Sundar Mahal and Akra) affected agricultural production; so many women had to work outside of the area to sustain their livelihoods. There, they faced various types of gender discrimination: women were often paid less than men, even for the same workload, and worked long hours (in addition to their household chores, such as collecting water). The women, who worked in the sector of agriculture and aquaculture, and casual labor workers, earned only half the amount men earned. In contrast, in Gajendrapur village, which suffers from fewer water risks women were for the most part, able to self-sustain themselves without needing to find work in other areas. The women work in the other's farm/plots and they face

fewer difficulties such as getting a lower payment and working more hours. The theory also supported by the findings of the study that women have a greater physical burden than men in the event of calamities because of gender-specific tasks. Nasreen (2008, 2012) explained the situation in her gender-disaster resilient theory that gender discrimination is a major factor leading to increased vulnerability for women and the risk of water in accessing and controlling information and services, technology, lack of access to or control of reproductive resources.

3. Women bear the burden of fetching water

Due to the low quality of water in Chandgarh and Akra, women walked on average around three to four kilometers and six to seven kilometers respectively to fetch water from shallow tube-wells. However, the quality from those shallow tube-wells remains low, and their only alternative was to purchase it from water vendors by paying BDT 20 (USD-0.24) for 20 liters of water. In situations where they were not able to buy sufficient water for their households, women storedthe safer water (from water vendors) for their children and husbands and they drank the unsafe water from shallow tube-wells. Men will only collect water, when there is no woman at home or women of the households were suffering from illness and unable to collect water from a distance. Nasreen (2008) and Hemson (2002) also argued to explain the situation of women which was similar with the study findings that, women are positioned in these roles by their gender, age and household status.

4. Higher levels of health impairments in the southern parts of the polder

This study showed that both women and men faced more health issues in Akra, Sundar Mahal, and Chandgarh, as compared to Gajendrapur (March, 2018). Respondents reported suffering from gastric pain, vomiting, menstrual cramps, genital problems, breathing problems, diarrhea, pain in the body, itching in the whole body, skin diseases, and infection in the eyes. They perceived salinity to be the key driver of those health hazards. The Human Development Report revealed that high poverty rates and little access to water, health, and sanitation are interlinked with the lowest gender-related development indicator (Schreiner, 2001).

5. ***The distance of water point and quality of water amplifies the tensions between different groups***

The distance of water point and quality of water amplifies the tensions between different groups in coastal polder 29. The women respondents added that when pond water is

limited or it went thicker, it raised pressure on tubewell water. It is also regarded as one of the reasons for serial breaking to collect water and quarrel with each other. Sometimes they have to wait till midnight to collect water and get early serials (Qualitative data, 2018). The FGD participant reveals that if they had not given so much time to collecting water, they might have given more time to their family members or children as well as pursued more household activities. Some families also face divorce problem in their family due to unsafe water in Sundar Mahal and Chandgarh (Qualitative data, 2018). Some people leave their paternal house and currently work in town. Even some wives divorced their husband and they never went back to the husband's family.

6. Recognition of women's work and decisions

Recognition of women's works and decisions is not valued by the men of the coastal society due to patriarchal social norms. Brym and Lie (2012) argued that male domination is rooted highly in the relationships of patriarchal authority relations, family structures, and socialization and cultural patterns that exist in nearly all societies. In line of present study, it is observed that marginalized women (poor, lack of access to rights and treated less important) are considered as less valuable and usually available as casual laborers in the agriculture sector. Men are taking most of the decisions in income-generating activities such as agricultural activities and investments in farming; whereas women make decisions about daily household chores. The number of women in the community is higher, but decisions are articulated by the men in both, the community and household levels. Men speak on behalf of collectives in the community and their decisions have remained. Women also speak but get less attention to their voices (Qualitative data, 2018).

7. Gender inhospitable Institutional roles

Discrimination roles of organizations in distribution of water facilities in Coastal Polder 29 (Chandgarh, Sundar Mahal) also gender inhospitable. The allocation of water by the organizations working in the community was not based on the needs of coastal people. A group of people gets most facilities related to water and poor have no access to safe water. These candied people get more support during a disaster or water crisis by the local leaders. However, female-headed households do not get such supports in times of crisis or risk reduction activities. In Sundar Mahal as well as Chandgarh there is no allocation or regulation system of water sources materials such as tubewell. The chairman of the locality does not monitor all the activities. This work is done by the local inhabitants who have some better economic conditions and a close relationship with the chairman (by fawning him).

So, they provide the water sources materials to their relatives/ close person (Qualitative findings, 2018). However, the respondents informed that any support from the government or non-government organization, hand over all materials to the chairman and do not monitor the system to ensure that the people in need benefit from them. They could not get the benefit of water sources due to their economic condition and relation to the member or Chairman. They could not reach them because of all backscratcher people (local leaders). It is revealed from the findings that a certain group of people dominates in the water management sector whereas the marginalized group has less participation in water-related decision making.

8.2 Conclusions and recommendations

Conclusions

Patriarchal ideologies, norms, values and attitudes play a significant role to put a barrier between gender culture and water insecurity in coastal polder. Engels argues that male supremacy "is the simple consequence of [male] economic supremacy." Among the well-off in society (bourgeoisie), male economic supremacy is established by having the male earn all (or most) of a household's income, leaving women doing domestic work, turning her into "the head servant, excluded from all participation in social production." All women then, under the Marxist account, end up oppressed and subjugated to men in one form or another due to their positions in the economy. In Bangladesh society this situation is similar. By ensuring that everyone is equally involved in economy, the Marxist feminists argue that we will get rid of the inequalities by income activities. "The emancipation of woman will only be possible when women can take part in production on a large social scale, and domestic work no longer claims but an insignificant amount of her time" (Engels, 1942:41–43).

In Bangladesh several respondents highlighted the fact that the harmonization of work and family responsibilities for women has been generally neglected. Finally, women need to be made aware of their rights and be equipped with self-confidence and knowledge to raise their voices and be successful in a patriarchal society. In 2011, National Women Development Policy was stirred with the vision of giving equal opportunity for both women and men and fundamental rights on an equal basis. NWDP (2011) has also included a section on women and children in disaster for the first time. As a result, the status of women would

increase, and the treatment of women by their family members, as well as officials, would likely improve, contributing to a more gender-equal society.

As the coastal communities are considered more vulnerable to hazards and disasters when compared to other parts of the country, more attention needs to be given for policy implementation. Despite the rhetoric on water collection, women's participation is less everywhere in the world of water management. Male domination in the society has acted as a barrier to women's involvement in development, which over the years, has degenerated.Women's empowerment is embryonic in every aspect of life and has been brought into attention over the past few decades. However, they still have limited access to organizational, institutional or household level decision-making processes in a country like Bangladesh. The roles of women are hindered by the blockade of socio-cultural values of patriarchy and accelerate the gender gap in the gendered culture as a maxim in terms of water security. Women's participation in decision-making roles in the water management sector needs to be extensively addressed by the government, community level, institutions, and organizations.

The study finds that the accountability of sharing the water sources materials of the community is less and is confined with the power structure in Polder 29. The water resources distribution process should be at the community level, considering women's strategic interests and practical needs at the center. In broad, a balanced representation of both men and women is required for water security in the coastal zone. As revealed in the study, coastal zone in Bangladesh is highly gender sensitive; women's participation in a decision-making role for securing water sources will create vital space to ensure gender equality. The gender balance world is requisite for the development of the water-poor community and therefore would support minimizing the water risks of the coastal zone.

Recommendations

People Expectation from Government

1. Stop the aquaculture (Gher) so that saline water could not enter into the locality.

2. Deep tubewell is not successful in the previous year but helps them economically to try to find out the layer.

3. Develop Block system besides the river to protect the locality from river bank erosion

4. Need more supply water system in water secure area such as Gajendrapur.

5. Develop more water points to the north side and bring that water into the south through the piped water system.

6. Installation deep tubewell and proper monitor from the government side.

For Policy Level

1. A ‘people-centered’ participatory inclusive system is required to conciliate water risks and to establish a sustainable water management process by reducing the discrimination of payment of work and valuing women's work in the coastal polder.
2. By giving women equal opportunity as their men counterparts as well as increasing wages of their work will be valued more. Institutional capacities of government need to be strengthened and enforced for effective equal distribution of water sources across all categories.
3. Empowering women and increasing their education level for mitigating water risks of the community is crucial for ensuring water security.
4. Gender-specific access to land and the market is vital for social recognition and encouraging decision-makers to build a water resilient society at the community level.
5. Sustainable water management will be ensured by strengthening institutional capacities for effective, efficient and inclusive water distribution at the community level as well as state level. Community-level water resources distribution process-considering women’s strategic interests and practical needs at the center will be more priority issues.

However, women’s specific needs, decisions, and participation is controlled by the men in the Bangladeshi context. Thus, the roles of women are hindered by the blockade of men and accelerate the gender gap in society. A balanced representation of both men and women is required for water security in the coastal zone. The coastal zone of Bangladesh will gain more secure water source if they promote more women to participate and help during the decision making process. From the evidence of the literature it was found that women arranged food, reconstructed houses with their own resources, collected water and made it safe to drink (Nasreen, 2012). Thus, the gender balance world is requisite for the development of society and minimizing the water risks from the coastal zones. Considering gender-specific access to resources, market linkages and building awareness of men- all these issues will be worked as a ‘pull factor’ to ensure the water situation in the coastal zone.

8.3 Scope for future research

A) Generally, hazards/disasters affect all segment population but the burden of impact have been observed in people with disabilities, elderly, women and children group due to their gender and disability status (Nasreen: 2008,2012). However, this inclusive nature of gender is unrecognized in the coastal zone (polder 29) and these gender dimensional vulnerabilities will be exemplified in connection with the water security model.

B) At a structural level, as the male participation dominates the social, cultural and political spheres, the system runs in favor of men, while it subordinates women. Moreover, the sensitivity of women's health is attached to the patriarchal control and control over water, assets, and property linked with the male counterpart in our society. It was assumed by the coastal women that they suffered from gastric, vomiting, menstrual cramps, genital problem, and infection in uterus (Qualitative data: Zaman, 2018) due to drinking unsafe water or using saline water for bathing, sanitation, and cleaning purpose. For that, reproductive health is emerging as a burning issue in the coastal community.

C) There is no big difference in the gender norms for rural and urban women. However, it is generally argued that women's education, employment, fertility, and the social processes associated with it affect the status of women. But, the decision making power is still in the hand of men in society. The water management group of the coastal zone also amplified the gendered inequality in terms of decision making power. More women are represented in the group, but they have no right to take the decision over the men (Qualitative data: Zaman, 2018). Thus, a group of people only dominate in the water management sector, not the marginalized group.

Summary

The chapter presented overall discussions of the research study with the recommendation which has been collected from the participants. The researcher also provided a recommendation to reduce the water-crisis situation in the coastal polder and how women and men will develop their situation in disaster situations. A recommended has also been made for the policymakers, businessmen, Non-profit organization and individuals for their responsibilities towards welfare of the coastal society. Some research gaps have also been highlighted in this chapter, so that early researchers get the idea for the future research sector.

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APPENDICES

Appendix 1: Survey Questionnaire (Phase 1)

Start date and time of the survey	
End date and time of the survey	

Section 1. Introduction and Identifiers

1.1 Identification number of enumerators

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?	**SELECT ONE**

Relevant if age>13	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	**SELECT ONE** Less than 5

water source?	Between 5 and 10 More than 10
3.1.2 (d) How much time does it take to go to the source, get water, and come back?	**SELECT ONE** Inside dwelling/yard 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?	**SELECT MULTIPLE** Adult men Adult women

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)	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*	**SELECT ONE** Yes No

maintenance costs	
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?	**INSERT INTEGER**

Relevant if payment frequency is 'per	
container' in 3.1.2(j)	
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 w 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?	**SELECT ONE** Yes

This includes payment for electricity to pump water, costs of transporting water and price of water itself; NOT infrastructure repair or maintenance costs	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?	**INSERT INTEGER**

Relevant if payment frequency is 'per container' in 3.1.3(e)	
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	**SELECT MULTIPLE** Yes - Cash Yes - Labour

money/ labour to this installation? *Relevant if 'yes' is selected in 3.2.1*	Yes - Materials Yes - Space/ land No Don't know
3.2.4 How much cash did you contribute at the time of installation? *Relevant if 'cash' is selected in 3.2.3*	**INSERT INTEGER**
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? *Relevant if 'yes' is selected in 3.3.3*	**SELECT MULTIPLE** Boil Add bleach/chlorine 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	**SELECT ONE**

other households?	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 Financial services
Concern #2	
Concern #3	

	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
Concern #2	

Concern #3	Not enough No concerns/ Don't know Other (Specify)
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? *A parcel is a contiguous piece of land with a*	**INSERT INTEGER**

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	**INSERT INTEGER**

6.2.7 No. of hens/duck *Relevant if 'yes' is selected in 6.2.6*	
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 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 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)
6.4.4 (d) What did you do to cope with this	**SELECT MULTIPLE**

increased salinity?	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]
	SELECT MULTIPLE Skin diseases

6.4.5 (c) What type of illness did you/ your household members suffer from?	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 hal 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 Upper Middle Lower Middle Poor Extreme Poor

Appendix 2. Survey Questionnaire (Phase 2)

In phase 2, the questionnaire was modified slightly to have a greater focus on households' consumption of water vended through vans/ nossimons. As outlined below, there was an additional section, which was applicable for households that mentioned using vended water in Q3.1.1. To avoid duplication Q3.1.2 (i-l) and Q3.1.3 (d-g) were skipped if vended water was selected as the main and secondary source, respectively, and Q3.1.2(m-n) were omitted altogether. Moreover, Q6.4.2(d), 6.4.3(c), 6.4.4(c), 6.4.5(c), and 6.4.6(c) were also excluded in Phase 2, based on findings from Phase 1.

3.1.4 These questions are applicable for VENDED WATER *Relevant if 'Water vended through nossimon/van' is selected in 3.1.1*	
3.1.4(a) For how many months of the year do you purchase water from the vendor?	**SELECT ONE** Always, for the whole year 6 - 9 months 3 - 6 months Less than 3 months Other [Specify]
3.1.4(b) At what interval, do you usually purchase this water? OR What is the frequency of water delivery?	**SELECT ONE** Almost every day Twice/Thrice a week Once a week Once every two weeks Other [Specify]
3.1.4(c) How many containers do you purchase ${frequency_purchase}?	**INSERT INTEGER**
3.1.4(d) What is the size of the container? *Record in litres*	**INSERT INTEGER**
3.1.4(e) What is the price per container? *Record in Taka*	**INSERT INTEGER**
	SELECT ONE One year or less

3.1.4(f) Since when have you been purchasing water from a water vendor?	1-2 years 3-5 years 6-10 years More than 10 years
3.1.4(g) Do all members of your household drink this water? *Ask whether the water is specifically purchased for certain members, like children*	**INSERT TEXT**

Appendix 3: FGD Guidelines

Gendered Culture and Water Security: an exploratory study in some selected coastal areas of Bangladesh

FGD GUIDELINES

Identification

DateofInterview: Union/Ward: **Name with Signature of the facilitator:**

District: Village: **Name with signature of the note taker:**

Thana:

No. Sl.	**Name of Participants**	**Age**	**Education**	**Approximate income (monthly)**	**Approximate expenditure (monthly)**	**Occupation**	**Category of Participants** (Respondents' own explanations of 'poor', 'middle' and 'better off' categories. Identify through ***Social Mapping /wealth ranking***)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							

FGD GUIDELINES

Section- B. Water Security: Knowledge and key factors

1. What do you understand by water insecurity/water related risk?
2. Types of water related risks and variations based on gender (male-female) in the last decade
    - Based on –
        - Variations of water related risks based on gender
        - children
        - elderly
        - person with disabilities (PWDs)
        - pregnant mother
        - gender based violence
3. What are the main causes that making you more vulnerable to water risks?
    - Geographical factors
    - Natural hazards/dimensions [floods, salinity intrusions, cyclone etc.]
    - physical/material related factors
    - economic factors
    - social factors
    - organizational/institutional factors
    - motivational/psychological factors
    - and capacities

C. Differential impacts of water related risks and hazards based on gender (male-female)

4. Nature of water related hazards that affect you based on gender role
    - Floods, cyclones, salinity intrusions, sea level rise, tidal flooding, storm surge, water logging, drainage congestion, river erosion, rainfall variability

5. How these natural hazards and water related risks affect your livelihood based on gender role
    - Livelihood
    - Occupation and variations occurred in occupations in recent period due to water risks
    - Food security and vulnerability
    - Economy/income
    - Social
    - Cultural
    - Health [Gender and age specific variations of diseases and problems]
    - Agriculture
    - Fishing activities
    - Homestead food production process
    - Infrastructure
    - Impacts on environment/nature/ eco-system

D. Water dependent livelihood and use of water

6. Usages and amount of water
    - Agriculture
    - Cooking and food preparation [both males and females]
    - Washing clothes and dishes [both males and females]
    - Bathing [both males and females]
    - Sanitation
7. Drinking water and use
    - Sources of water [primary and secondary]

- Owner of the water sources [please specify the role of men and women and their ownership]
- Collection of water [both males, females, and children]
- Usages of water for domestic purposes [different usages of water: bathing, cooking, washing]
- Prices of water and payment process
- Distances of water point
- Duration of collection of water from sources
- Transportation system of water [for both males and females]
- Sharing of water with other households
- Quality of water

8. Gender-based water conservation behavior and water use
    - Who is more concerned to conserve water in your household?
    - Gender-based measures taken to conserve water at your household
    - Factors influencing to conserve water at your household/in locality
    - Usages of water based on gender role [short shower, minimal water in cooking and bathing, washing, sanitation etc]
9. Agriculture and water use
    - Types of crops cultivate by the household in different periods
    - Engagement of both women and men in agricultural activities
    - Dependency on water for agricultural cultivation in different periods
    - Irrigation methods for agricultural crops cultivation
    - Prices of water and payment process
    - Challenges faced by the household due to water risks or water problems [gender variations]

10. Aquaculture and livestock
    - Any pond (personal or community ownership)
    - Cultivation of fishing in this pond [types of fisheries]
    - Involvement of women in fishing culture and activities performed according to gender role
    - Access of women to open water body for fishing
    - Rearing of livestock at the household
    - Activities performed by the members at the household level [both males and females, children, elderly, PWDs]
    - Water for livestock and collection process by both males and females
    - Challenges faced by the family members based on gender roles
11. Gender-based challenges/constraints faced by the people while collecting water (please ask the questions separately for both males and females and indicate the challenges or problems faced by the respondents for each sector)
    - Drinking water
    - Domestic water (cooking and washing)
    - Livestock
    - Agriculture
    - Shrimp culture
    - Fisheries
12. Steps taken by the respondents to conciliate the challenges
    - Nature of steps or measures [who played crucial roles in terms of gender]
13. Concern about drinking and domestic water based on gender [please ask based on gender roles of male and females, elderly, children and other groups and who are more concern for each issue]
    - Unsafe drinking water

- Price of water and payment process
- Distance of water sources (drinking and domestic water)
- Duration of colleting water from main sources
- Supply of water

14. Gender based concern about natural environment
    - Water salinity
    - Water pollution
    - Soil salinity
    - Tidal flooding
    - Occupational variations

E. Gender-based alternative adaptation options to water risks and decision making

15. Gender-based adaptation mechanism with water related natural hazards [Involvement of both males and females in adaptation and variation of adaptation]
    - Doing alternative small business
    - Involving in handicrafts [vanity bag making, sweetmeat packet making, mat making]
    - Involving in pig rearing
    - Pigeon rearing
    - Livestock rearing
    - Involving in crab fattening
    - Duck rearing
    - Reducing food consumption
    - Cultivating salinity tolerant vegetables/gardening
    - Cultivating crops through floating garden
    - Poly cultivation (combining paddy, shrimp and fin-fish in different seasons)

- Problems/challenges faced by the households
- Suggest at least top three recommendations to solve these types of problems

16. Preservation techniques of water used by the households
    - process of storage - drinking water, domestic and washing water and irrigation
        - based on gender, elderly, person with disabilities and other groups
    - Problems/challenges faced by the households
    - Suggest at least top three recommendations to solve these types of problems
17. Purification process of drinking water [Engagement of both males and females at each step]
    - Boiling
    - Using bleaching powder
    - Using alum,halotab
    - Strain through a cloth
    - Water filter (bio sand/composite/ceramic filter)
    - Three pitcher filter
    - Solar disinfection
    - Problems/challenges faced by the households
    - Suggest at least top three recommendations to solve these types of problems
18. Rainwater harvesting process and gender-based participation
    - Process of rainwater harvesting
    - Involvement of both males and females
    - Challenges faced by the households while harvesting rainwater
    - Suggest at least top three recommendations to solve these types of problems
19. Storage of water and participation family members

- How do the households preserve water? Who is preserving water at your household?
- Preservation processes of water based on gender[plastic tank, plastic barrels/dram, plastic bottles, ferro cement tank, aluminum pitcher, mud pitcher]
- Challenges faced by the households
- Suggest at least top three recommendations to solve these types of problems

20. Measures taken by the household for adaptation to water risks [domestic water, irrigation, and shrimp culture] **[please ask specific question who has taken which measures in terms of gender roles for both males and females]**
    - Installation of deep/shallow tube-well
    - Piped water system [new/expansion]
    - Water vending [new/expansion]
    - Rain water harvesting
    - Public pond excavation
    - Installation of pond sand filter (PSF)
    - Managed aquifer recharge
    - Problems/challenges faced by the households
    - Suggest at least top three recommendations to solve these types of problems
21. Involvement/participation of both males and females in installing water sources
    - Labor and gender roles
    - Cash
    - Materials and types
    - Space and land
22. Installation of new water related infrastructure at household **[please ask about to what extent these new water related infrastructures are gender friendly]**

- New shallow tube-well (handpump/motorised)
- New deep tube-well (handpump/motorised)
- Electric/diesel motor to existing tube-well
- Pipes/Storage tank to existing tube-well
- Storage tank for rainwater harvesting
- Problems/challenges faced by the households
- Suggest at least top three recommendations to solve these types of problems

23. Decision making to installing the new water related infrastructure

- Who have played the key role and how the decision have been taken [any consultation between husband and wife]
- Types of decision [how have women provided their decision?]
- Problems faced at the time of taking decision
- Suggest at least top three recommendations for making amiable atmosphere at household for decision making

24. Water management process at the community level

- Any water management group at the community level
- Members of these groups [males, females, adults, elderly, children, PWDs, and pregnant mother]
- Types of groups and roles in water related risks management
- Challenges in managing water sources
- Suggest at least top three recommendations for consoling water risk

Appendix 4: KII Guidelines

Section A: Personal Information

Date of Interview:		
Address:	Village: Union: Upazila: District:	
Personal Information		
Name		
Age		
Sex		
Occupation		
Education		
Name of Field Investigator		Signature with date
Name of Facilitator		Signature with date

Section- B. Water Security: Knowledge and key factors

25. What do you understand by water insecurity/water related risk?
26. Types of water related risks and variations in your locality based on gender (women-men) in the last decade
27. What are the main causes that making your locality more vulnerable to water risks?

C. Water dependent livelihood and use of water

28. Usages and amount of water in your locality
29. Drinking water and use

- Sources of water [primary and secondary]
- Owner of the water sources [please specify the role of men and women and their ownership]
- Collection of water [both women, men, and children]
- Usages of water for domestic purposes [different usages of water: bathing, cooking, washing]
- Prices of water and payment process
- Distances of water point
- Duration of collection of water from sources
- Transportation system of water [for both women and men]
- Sharing of water with other households
- Quality of water

30. Gender-based water conservation behavior and water use

- Who is more concerned to conserve water in your locality in the context of garner role?
- Gender-based measures taken to conserve water at your locality [ask same question for other groups like women, men, children, adult, elderly, pregnant women and PWDs]
- Factors influencing to conserve water in your locality
- Usages of water based on gender role [short shower, minimal water in cooking and bathing, washing, sanitation etc]

31. Agriculture and water use

- Types of crops cultivate by the household in different periods in your locality
- Engagement of both women and men in agricultural activities in your locality
- Types of activities performed by both women and men in agricultural sector in your locality

- Dependency on water for agricultural cultivation in different periods in your locality
- Irrigation methods for agricultural crops cultivation in your locality
- Prices of water and payment process in your locality
- Challenges faced by the people due to water risks or water problems [gender variations] in your locality

32. Aquaculture and livestock
    - Any pond (personal or community ownership)
    - Cultivation of fishing in this pond [types of fisheries]
    - Involvement of women in fishing culture and activities performed according to gender role
    - Access of women to open water body for fishing
    - Rearing of livestock at the household
    - Activities performed by the members at the household level [both women and men, children, elderly, PWDs]
    - Water for livestock and collection process by both women and men
    - Challenges faced by the family members based on gender roles
33. Gender-based challenges/constraints faced by the people while collecting water in your locality (please ask the questions separately for both women and men and indicate the challenges or problems faced by the respondents for each sector)
    - Drinking water
    - Domestic water (cooking and washing)
    - Livestock
    - Agriculture
    - Shrimp culture
    - Fisheries

34. Steps taken by the respondents to conciliate the challenges in his/her locality
    - Nature of steps or measures [who played crucial roles in terms of gender]
35. Concern about drinking and domestic water based on gender [please ask based on gender roles of women and men, elderly, children and other groups and who are more concern for each issue]
    - Unsafe drinking water
    - Price of water and payment process
    - Distance of water sources (drinking and domestic water)
    - Duration of colleting water from main sources
    - Supply of water
36. Gender based concern about natural environment
    - Water salinity
    - Water pollution
    - Soil salinity
    - Tidal flooding
    - Occupational variations

D. Differential impacts of water related risks and hazards based on gender (women-men)

37. Nature of water related hazards affecting your locality based on gender role
    - Floods, cyclones, salinity intrusions, sea level rise, tidal flooding, storm surge, water logging, drainage congestion, river erosion, rainfall variability
38. How do these natural hazards and water related risks affect the livelihood based on gender variations

E. Gender-based alternative adaptation options to water risks and decision making

39. Gender-based adaptation mechanism with water related natural hazards [Involvement of both women and men in adaptation and variation of adaptation]

- Doing alternative small business
- Involving in handicrafts [vanity bag making, sweetmeat packet making, mat making]
- Involving in pig rearing
- Pigeon rearing
- Livestock rearing
- Involving in crab fattening
- Duck rearing
- Reducing food consumption
- Cultivating salinity tolerant vegetables/gardening
- Cultivating crops through floating garden
- Poly cultivation (combining paddy, shrimp and fin-fish in different seasons)
- Problems/challenges faced by the households
- Suggest at least top three recommendations to solve these types of problems

40. Preservation techniques of water used by the households in your locality in terms of gender
    - Suggest at least top three recommendations to solve these types of problems
41. Purification process of drinking water [Engagement of both women and men at each step]
42. Rainwater harvesting process and gender-based participation in your locality
    - Process of rainwater harvesting
    - Involvement of both women and men
    - Challenges faced by the households while harvesting rainwater
    - Suggest at least top three recommendations to solve these types of problems
43. Storage of water and participation family members
    - How do the households preserve water? Who is preserving water at your locality?

- Preservation processes of water based on gender[plastic tank, plastic barrels/dram, plastic bottles, ferro cement tank, aluminum pitcher, mud pitcher]
- Challenges faced by the households in your locality
- Suggest at least top three recommendations to solve these types of problems

44. Measures taken by the household for adaptation to water risks [domestic water, irrigation, and shrimp culture] **[please ask specific question who has taken which measures in terms of gender roles for both women and men]**
    - Installation of deep/shallow tube-well
    - Piped water system [new/expansion]
    - Water vending [new/expansion]
    - Rain water harvesting
    - Public pond excavation
    - Installation of pond sand filter (PSF)
    - Managed aquifer recharge
    - Problems/challenges faced by the households
    - Suggest at least top three recommendations to solve these types of problems
45. Involvement/participation of both women and men in installing water sources
    - Labor and gender roles
    - Cash
    - Materials and types
    - Space and land
46. Installation of new water related infrastructure at household **[please ask about to what extent these new water related infrastructures are gender friendly]**
47. Decision making to installing the new water related infrastructure in your locality
    - Who have played the key role and how the decision have been taken [any consultation between husband and wife]
    - Types of decision [how have women provided their decision?]

- Problems faced at the time of taking decision
- Suggest at least top three recommendations for making amiable atmosphere at household for decision making in your locality

48. Water management process at the community level in your locality

- Any water management group at the community level
- Members of these groups [women, men, adults, elderly, children, PWDs, and pregnant women]
- Types of groups and roles in water related risks management
- Challenges in managing water sources
- Suggest at least top three recommendations for consoling water risk.

25. Policy regarding water security in your locality

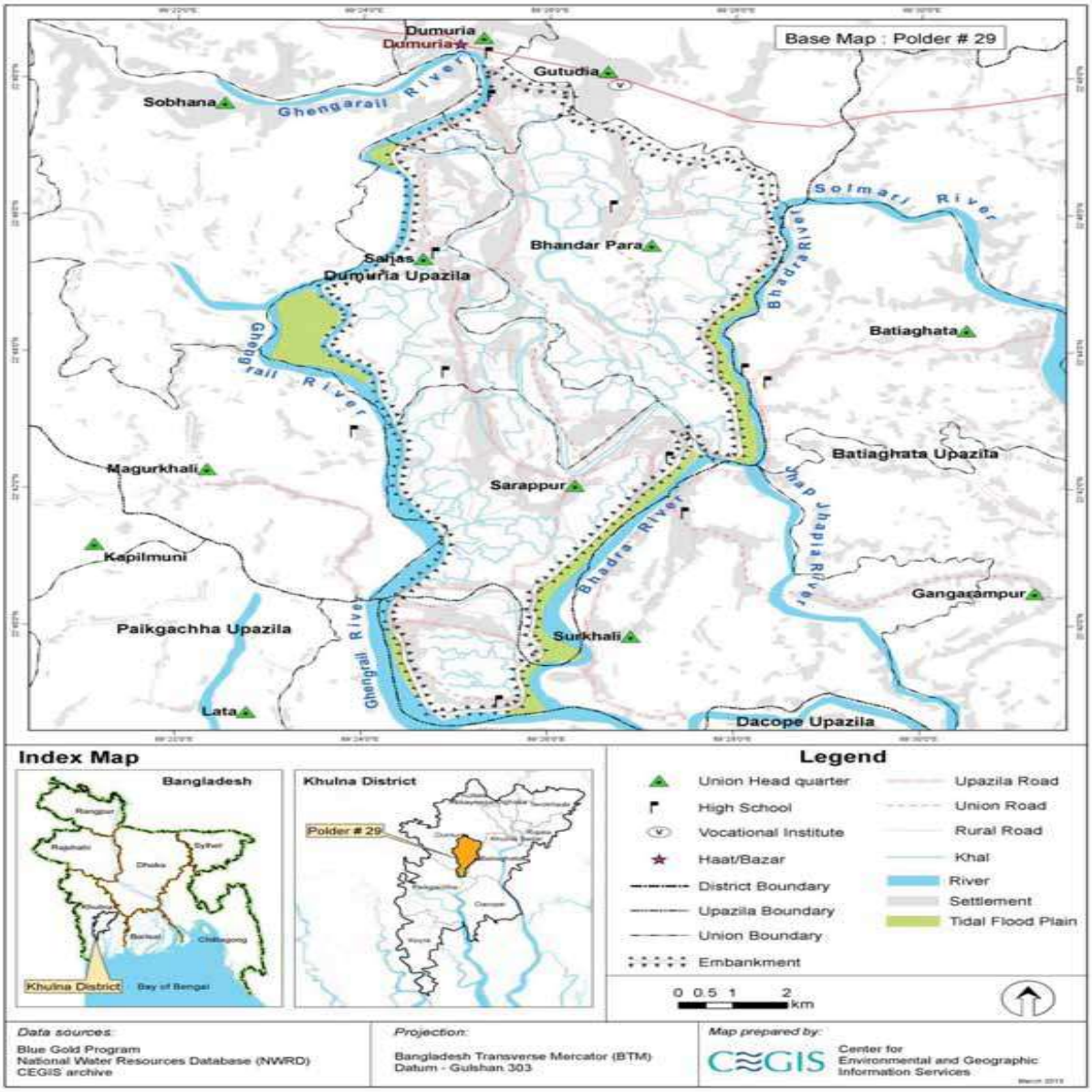
- Government intiatives (policy formulation, interventions, solutions)
- Non-Government initiatives (policy formulation, interventions, solutions)

- What new interventions are taken by the government?

- Over the time if they look any variation or not
-Are these techniques/interventions successful or not?
- Water related policy making is important or not
-Suggest at least top three recommendations for policy making of water related issues.

Appendix 5: Maps and risk profile

The study was carried out in 'Polder 29' located in Khulna District of the coastal region of Bangladesh.[5] Basically, 7930 hector[6] is the total area of Polder 29 (BWDB, 2016).



Map-5: Base Map of Polder 29 (Source: BWBD, 2016)

[5]Upazila: Bhandarpara, Dumuria, Sahas and part of Surkhali Union of Bataghata upazila and Sarappur Unions of Dumuria upazila.

[6]1 Hector=2.47 Acre or 7.5 Bigha

Table-44: Risk Profile developed by REACH

Mouza	Total households	Phase 1 (10 %)	Phase 2 (25 %)	Risk profile	Drinking water stress	Water logging	Erosion	Soil Salinity	Sanitation	Asset	Cropping intensity
Bhandarpara Union											
Bakultala	92	5		Moderate							
Banda	476	17		Low							
Banda Raghunatpur	7			Low							
Barabhandha				Low							
Bhandar Para	462	23		Low							
BrittiKanaidanga	3			Low							
ChakAngarkata				Low							
ChakChatraghona				Low							
ChakSonadanga	21	1		Low							
Dakshin Mahal	84	4		Low							
Dhanibunia	198	11		Moderate							
Ghona	196	18		Low							
GhonaTaltala	153			Low							
Hajibunia	201	10		Low							
Hula		1		Low							
Jabra	96	5		Low							
Kharibunia	161	8		Low							
Kusarhula	50	3		Low							
Lahaidanda	182	10		Low							
Maikhali	126	7		Low							
Nalghona				Low							
Orabunia	86	4		Low							
Pakhirbadal				Low							
Perikhali	92	5		Low							
Podekhali	6			Moderate							
PurbaAndharManik	9			Low							
PurbaKanaidanga	11			Low							
PurbaKanchan Nagar	40	3		Moderate							
Rajibpur	94	5		Low							
Rajnagar	87	4		Low							
Sitarampur				Low							
Talian	27	1		Low							
Taltala	6	8		Moderate							
Telikhali	283	14		Moderate							

Ula	823	41		Low							
Dumuria Union											
AraziSajiara	826	7		Low							
Dumuria	1867	94		Low							
Sahas Union											
Kamalpur	481	7		Low							
Tiabunia	107			Low							
Baghdari	74	1		High							
Bhagabatipur		5		Low							
Char Kapalidanga		2		Low							
Charchari	99	7	13	Low							
Chhota Banda	25	35	145	Low							
Dighalia	66	2		High							
Gajendrapur	**726**	**10**		**Moderate**							
Golaimari	13	18	61	High							
Kagaji Para	204	3		Low							
Kapalidanga	306	12		Moderate							
Kazir Hula	60			Moderate							
Kharsanda	245	18		Moderate							
Khutakhali	8			Moderate							
Kukhia	358	5		Low							
Lashmipur		28		Low							
Latabunia	104	82		Moderate							
Noakhati	565			Moderate							
Sahas	1617	7		Low							
Tengramari				Low							
Sarappur Union											
Akra	**193**	**19**	**39**	**High**							
Asannagar	74	4		Moderate							
Bahir Akra	93	9	19	High							
BazeaftiBhulbaria	16	1		Low							
Bhulbaria	277	14	55	Moderate							
BrittiBhulbaria	373	37	75	High							
Chandgarh	**195**	**20**	**39**	**High**							
Jaliakhali	91	10	18	High							
Jhaltala	67	3		Moderate							
Kalikapur	1317	67	263	Low							
KalikapurBadhurg		1		Low							

hachha											
Keakhali	64	4		Low							
Ratankhali	68	3	14	Moderate							
Sarappur	1047	69		Moderate							
Taiabpur	243	12	49	Moderate							
Surkhali Union											
Bara Aria	426	43	85	High							
Kodla	195	20	39	High							
Mathbari	52	5		High							
Ruhitmara	31	6		Moderate							
Sambhunagar	105	19	21	Moderate							
Sundar Mahal	**659**	**68**	**132**	**High**							

Legend	
	High risk
	Moderate risk
	Low risk
	No data

* Source: Adopted from REACH Methods Manual, 2018

Appendix 6: Photographs

Picture- 5: Seasonal drought in Chandgarh

Picture-6: Women as water collectors in Akra and Sundar Mahal

Picture-7: Iron in shallow tubewell in Chandgarh

Picture-8: Women involvement in different activities

Picture-9: Water preservation system in Akra

Picture-10: Loss of property and crop lands due to river erosion in Chandgarh

Picture-11: The Impacts of river erosion in polder 29

Picture-12: FGD participants, Gajendrapur

Picture-13: FGD participants, Akra

Picture-14: Case study, Chandgarh, Female-headed Households

Dhaka University Institutional Repository

Picture-15: Case Study, Sundar Mahal, Female-headed households

Picture-16: FGD participants, Sundar Mahal (Female)

Dhaka University Institutional Repository

Picture-17: FGD participants, Sundar Mahal (Male)