A Feminist Perspective of the Differentiated Impacts of Climate Change, Adaptation and Women's Roles in Coastal Agriculture in Bangladesh

BY

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Abstract

This thesis research, conducted in Kaliganj Upazila, Satkhira District, Bangladesh, aims to i) identify the key factors driving differentiated climate change impacts on various income groups, particularly women; ii) examine local agricultural adaptation strategies with a focus on women's engagement; and iii) explore the challenges women face in adapting to climate change in agriculture. A mixed-methods approach, using a feminist lens, was employed and data collection involved surveys, focus group discussions (FGDs), key informant interviews (KIIs), and participant observations Data were analyzed using Microsoft Excel and thematic categorization, and presented through tables, graphs, and descriptive narration. The findings reveal that women, minorities, and lower socioeconomic groups experience adverse impacts of climate change disproportionately, which are exacerbated by systemic gender disparities and existing social inequalities related to age and minority status. The study highlights the cyclical relationship between climate change and gender inequality, where one reinforces the other. It also identifies coastal agricultural adaptation strategies, such as alternate income sources, salt- and drought-tolerant crops, hybrid high-yielding crops, and rainwater harvesting. Women's critical role in agriculture is emphasized, while revealing barriers such as limited land rights, wage gaps, gender norms, lack of gender-sensitive technologies, and restricted access to resources. The study also underscores the significance of external social factors in shaping farmers' adaptive capacity. Recommendations include providing gender-sensitive disaster shelters, accessible credit facilities and agricultural interventions, and creating awareness programs to address gender and social disparities. The study also calls for gender-responsive and inclusive adaptation policies, fostering women and minorities' participation in decision-making, and ensuring access to education and resources for adaptive capacity.

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Contributions of Authors Statement

This thesis written by Alvira Farheen Ria, is also the result of the collective support and contributions of those mentioned in the Acknowledgement above, as well as many others who, though not explicitly named, have had a meaningful impact on her academic and personal journey.

Dedication

This thesis is dedicated to the hardworking coastal communities of Satkhira, who were willing to share their valuable time and deeply personal stories for this research. It is also dedicated to my parents, who have been my biggest source of motivation throughout my academic journey and did not let me drown.

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CHAPTER 1

Introduction

1.1 Background and the Context

Bangladesh is a deltaic country situated in the lower catchment area of the Ganges, Brahmaputra, and Meghna Rivers, with the Bay of Bengal on the South—placing it in a geographically vulnerable position (Alam et al., 2019). Ranking 7th on the Global Watch's Climate Risk Index 2021, Bangladesh is recognized worldwide as one of the countries most threatened by climate change impacts (Eckstein et al., 2021). Given its low-lying geographical location in the Ganges–Brahmaputra Delta, it has been predicted that with every 1-m rise in sea level, 11% to 18% of the country's land could be submerged (Shariot-Ullah, 2024). As a result of climate change, it is also expected that Bangladesh would experience an annual increase of 74 mm in rainfall between 2040 and 2059 (Mahmud et al., 2021). Moreover, between the period of 1976 and 2019, on average, the temperature has gone up by 0.5°C and, by 2050, it is expected to rise by about 1.5°C (Mahmud et al., 2021).

The coastal regions of Bangladesh, making up nearly 32% of its land, are the most sensitive to climate change impacts (Ahmed & Eklund, 2021). Consisting of 19 districts, the coastal zones are flat and low lying, and comprise canals, estuarine areas, and wide rivers, making the land exceptionally prone to flooding from sea surges (Alam et al., 2019). Moreover, the coastal regions are densely populated, more income poor, and have higher rates of illiteracy and landlessness than the other parts of the country (Ahmed & Eklund, 2021). Rural coastal inhabitants are also highly dependent on natural resources and rely heavily on climate-sensitive sources of income like agriculture and fisheries. This makes them more vulnerable to the impacts of climate change, and less likely to adapt to the consequences and damage left behind from disasters (Alam et al., 2019).

Extreme climatic events in the Bay of Bengal have increased both in frequency and intensity, often making their way to the coastal areas of Bangladesh (Chowdhury et al., 2021). In the past 14 years alone, the region has experienced 9 major cyclonic events: Cyclone Mahasen and Cyclone Vyaru in 2013; followed by Cyclone Komen in 2015 and Cyclone Roanu in 2016; Cyclone Fani and Cyclone Bulbul in 2019; Cyclone Amphan in 2020; Cyclone Yaas in 2021 (Rabbani et al., 2021); and, most recently, Cyclone Remal in 2024—all of which have left long-

lasting devastation in the coastal regions. According to a report by the Internal Displacement Monitoring Centre (IDMC), in the year 2019, 1.7 million people had to evacuate from 23 districts of Bangladesh due to Cyclone Fani, and most of these evacuees were from coastal areas (cited in Hadi et al., 2021). In 2020, 2.6 million people in coastal zones were affected by Cyclone Amphan, which destroyed 55,767 houses, 76 kilometres of embankments, and 440 kilometres of roads (Hadi et al., 2021). Only a year later, Cyclone Yaas hit the coastal zones, affecting nearly 1.3 million people; damaging 26,000 houses; and breaching embankments and affecting 39% of croplands and 3,599 hectares of prawn and pisciculture areas (International Federation of Red Cross and Red Crescent Societies [IFRC], 2021).

A survey conducted by the Comprehensive Disaster Management Programme (CDMP) II in 2014 on the natural hazards–induced displacement of people in 14 coastal districts revealed that 12 % of people were permanently displaced because of climate issues, while 46% faced temporary displacement, and 29% were swinging between being permanently and temporarily displaced (CDMP II, 2014). Ishtiaque and Nazem (2017) also determined that flood-affected coastal populations experienced a 70% decline in their income, while those affected by river erosion experienced an 89% decrease in income, and that this drop in income played a role in influencing these people to migrate to urban areas.

Coastal regions also suffer from slow-onset impacts of climate change like salinity intrusion, precipitation changes, land erosion, and temperature changes (Ahmed & Eklund, 2021). As a result of these impacts, coastal people are subjected to loss of assets and livelihoods, food insecurity, scarcity of water, as well as various health-related consequences (Mohiuddin et al., 2021). In their study, Hasan and Kumar (2021) observed that from 1970 to 2017, coastal areas in Bangladesh have experienced an increase of 0.35 °C in temperature and 579 mm of precipitation. The study also noted that climate stresses and shocks during the same period have resulted in crop yield losses of 2.75%, with coastal regions having a 2.54% greater crop loss rate than the mainland due to natural disasters that had taken place (Hasan & Kumar, 2021). Furthermore, according to data from the Soil Resource Development Institute (SRDI) in Bangladesh in 2010, the rate land affected by salinity in Bangladesh is increasing at 146 km^2/year, with nearly 37% of the country's coastal regions being affected by salinity (cited in Jalal et al., 2021).

Climate change impacts have resulted in major land use changes in coastal areas, where people are now more involved in saline aquaculture activities like shrimp or rice–shrimp farming that is, in turn, detrimental for the environment and makes salinity intrusion worse (Hoque et al., 2019). According to the Bangladesh Forest Department, land for shrimp culture went up from 140,000 ha in 2000 to 258,000 ha in 2019 (Jalal et al., 2021), which has affected crop production. The increasing salinity intrusion from anthropogenic activities and rising sea levels has led to the extinction of some significant local varieties of rice previously grown in coastal regions, such as *Kalojira, Njirsail* and *Boran* (Islam et al., 2015). Additionally, the production of sugarcane, jute, and wheat have been impacted and are no longer grown in coastal areas due to soil salinization (Rahman & Uddin, 2021). The lack of water availability and grazing land is also affecting livestock in coastal zones, with animals falling sick after drinking poor quality water and not getting enough nutrients. This in turn is affecting the livelihood of coastal people as these animals have lower draught power and milk production capabilities (Hossain et al., 2016).

Coastal people also suffer from many health issues related to climate change impacts. Disasters like floods or tidal surges can contaminate groundwater and surface water and damage water infrastructure, which coastal people rely on. This leaves them more exposed to climate change–related waterborne diseases such as diarrhea, cholera, and skin and eye conditions, as well as hypertension associated with drinking saline water (Abedin et al., 2019). According to Hoque (2009), around 30 million people are deprived of potable water in coastal regions of Bangladesh and 15 million people rely on saline groundwater sources for drinking water (cited in Hossain et al., 2021). In these coastal regions, the acceptable threshold for salinity in groundwater is at 1000 ppm—much greater than the 600 ppm threshold permitted for the rest of Bangladesh (Roman et al., 2021).

Both immediate and slow-onset impacts of climate change have significant consequences on the food security, health, income generation, agricultural production, and water availability of coastal populations, often exacerbating existing socioeconomic challenges faced by marginalized groups in the communities such as the disabled, elderly, children, minority groups, and women (Rabbani, et al., 2018; Reggers, 2019). Moreover, men and women have different attributes regarding climate change impacts and may have different needs for adaptation interventions that are often overlooked (Alston, 2014). Women are also more likely to suffer from climate change–

related health impacts like nutritional deficiencies and food insecurity, skin diseases, respiratory issues, and cardiovascular issues (Sorensen et al., 2018; Yadav & Lal, 2018).

Women in rural areas of developing countries, like Bangladesh, are considerably disadvantaged as they have low socioeconomic standing and limited access to land, assets, finances, and resources. Prevailing societal gender norms, gendered division of labour, political and cultural barriers, and women's limited involvement in decision-making processes also contribute to their vulnerability (Reggers, 2019). These factors also influence their ability to cope with climate change impacts, often keeping them in a cycle of poverty and worsening existing gender inequalities (Eastin, 2018; Reggers, 2019). In some cases, climate change adaptation interventions can also be gender blind and exacerbate existing gender disparities.

This phenomenon of people experiencing disproportionate impacts of climate change due to existing social, historical, economic, and institutional inequalities is known as "differentiated impacts of climate change" (Field et al., 2014). Research has found that women often bear a substantial burden of the climate change consequences, especially due to gender inequalities that are pervasive in society (Alhassan et al., 2019; Eastin, 2018; Rao et al., 2017). These issues are worse when other marginalizing factors—such as age and minority religious backgrounds and/or ethnic backgrounds—come into play, which is defined as "intersectionality". Intersectionality calls into consideration the intersectional socioeconomic, cultural, religious, and ethnic identities of an individual, along with institutional discrimination and power dynamics in societies which contribute to people's state of vulnerability (Kaijser & Kronsell, 2014). When referring to socioeconomic groups, it implies a group's economic and social background, which is generally determined by factors like social status, income, education, and occupation (Conway et al., 2019; Villalba, 2014).[1]These socioeconomic factors often influence people's health, environment, living conditions, and how they experience and adapt to climate change.

It is also important to note that women perform multiple important roles in society that place them in a position to contribute directly to the adaptation and mitigation plans of climate change through their knowledge, experiences, household responsibilities, and participation in income-generating activities (Ministry of Environment and Forestry [MoEF], 2013). Women in coastal zones are also often involved in various agricultural activities and targeted for many climate change adaptation intervention programs (Schulenburg et al., 2017). When given the right support, women can be powerful agents in climate change adaptation strategies (Khalil et

al., 2016). Unfortunately, despite their considerable contributions, women are [1]often invisible in the agriculture sector (particularly in Bangladesh) and agricultural adaptation interventions and projects are not always gender responsive (Rola-Rubzen et al., 2020).

[1]In the context of Bangladesh, considering practicality and data constraints, Fida et al. (2024) defined the lower class as households earning less than 12,900 BDT (<106.14 USD); the middle class as those earning between 12,900 and 21,500 BDT (106.14–176.91 USD); and the upper class as households earning more than 21,500 BDT (176.91 USD). This was based on the country's median household income published in the Household Income and Expenditure Survey (2023) by the Bangladesh Bureau of Statistics. The stratification system used is recognized internationally, where the lower class is defined as earning less than 75% of the median income, the middle class earning between 75% and 125%, and the upper class earning more than 125% of the median income (Fidah et al., 2024).

In this study, household income was categorized as follows: low-income households (<10,000 BDT / <82.75 USD); middle-income households (10,000–20,000 BDT / 82.75–165.50 USD); and high-income households (>20,000 BDT / >165.50 USD). Although this classification is like that of Fida et al. (2024), the terminology and income thresholds differ slightly to reflect the local context. These categories were informed by consultations with local experts and IDRC's initial census survey.

1.2 Objectives and Research Questions

1.2.1 Objectives of the Research

Considering the above contexts, my study aims to understand the dynamics and the factors that cause pronounced climate change impacts on the marginalized groups in the coastal region of Satkhira, Bangladesh, with a focus on gender disparities. It also delves into women's contributions to local climate change adaptation activities, while exploring the innovative local agricultural technologies and methods that are currently being used in the region to cope with climate change impacts. The specific objectives of the study are to:

I. identify and explore the major factors responsible for differentiated climate change impacts on different income groups, with a particular focus on women;
II. examine agricultural adaptation technologies and methods that have evolved locally as a response to climate change impacts, particularly engaging women; and
III. determine the challenges and barriers faced by women in climate change adaptation to agriculture.

1.2.2 Research Questions

Table 1.1 outlines the research questions associated with my objectives that guided my studies.

Table 1. 1

Objectives and Corresponding Research Questions

	Objectives		Research Questions
I.	To identify and explore the major factors responsible for differentiated climate change impacts on different income groups, with a particular focus on women	i.	How are different income groups in coastal regions affected by climate change?
		ii.	Does climate change impact men and women differently?
		iii.	Why do certain income groups and women experience climate change differently than others?
		iv.	Do socioeconomic factors and gender intersect to influence how climate change is experienced?
II.	To examine agricultural adaptation technologies and methods that have evolved locally as a response to climate change impacts, particularly engaging women	i.	What climate change features affect agriculture in the study area?
		ii.	What kind of agricultural activities are women involved in?

Objectives		Research Questions	
III.	To determine the challenges and barriers faced by women in climate change adaptation to agriculture	iii.	What are the local adaptation measures/technology adopted by locals for agriculture?
		iv.	What kind of agricultural adaptation activities do women participate in?
		i.	What barriers/challenges do women face when taking up these adaptation activities?
		ii.	Do agricultural adaptation technology and measures benefit women and men the same way?

1.3 Methodological Overview

This research was part of a project funded by the International Development Research Centre (IDRC), titled "Scaling Climate Change Adaptation Knowledge and Technologies for Empowering Women, and Enhancing Social Equity and Disaster Resilience in Bangladesh (SAKTEE)," carried out in partnership with the Bangladesh Centre for Advanced Studies (BCAS). The study is guided by a pragmatic worldview and utilizes a mixed-methods approach, incorporating both quantitative and qualitative data collection techniques. These include key informant interviews (KIIs), focus group discussions (FGDs), surveys, and participant observations.

A total of 25 key informant interviews (KIIs) and nine focus group discussions (FGDs) were conducted in the Kaliganj sub-district (*upazila*) of Satkhira District (*zila*)—an area chosen due to its vulnerable geographical location, frequent exposure to disasters, salinity intrusion issues, and reliance on agriculture. A sample survey of 358 households and participant observations were also conducted. For the sample survey, 308 households were drawn randomly, using a sampling frame collected from a census survey conducted by BCAS in 2018, under the same IDRC project. Additionally, considering there was a very small number of female-headed households in the overall sample, a supplementary survey was conducted with 50 purposively selected female-headed households. The data were triangulated and thematically categorized for analysis. The survey data were also taken into consideration in the analysis.

I applied a feminist framework throughout the entire research process, alongside an intersectionality lens. Chapter Three is guided by Islam and Winkel's (2017) framework on climate change and social inequality and places a particular focus on capturing the emic perspective of the participants, as it addresses the first objective of this study. Chapter Four addresses the third and fourth objectives and is guided by Sen's (1993) *Capability Approach*. The specific frameworks (Islam & Winkel, 2017; Sen, 1993) adopted during presentation of the results are detailed in Chapters Three and Four. The philosophical views, research approach, methodology, and data analysis for the research is detailed in Chapter Two.

1.4 Organization of Thesis

The present thesis research aims to examine differentiated impacts of climate change, farmers' adaptation to such stresses and shocks, and women's roles in agriculture in coastal communities of Bangladesh. The first chapter is the introduction, which starts with a brief background, outlines objectives and research questions, and then describes the organization of the thesis. In Chapter Two, the research approach, field methods, data collection procedures, and data analysis are discussed. It also delves into detail on the feminist theory, which was the overarching lens used for the research. The outcomes from the study have been divided into two major chapters (Chapters Three and Four) based on my specific objectives, with separate results, discussions, and conclusions for each chapter. The thesis ends with Chapter Five, which includes a discussion of my findings and concluding remarks, focusing on the study as a whole.

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CHAPTER 2

Methodology

My research follows a mixed method approach involving the collection of both quantitative and qualitative data using a sample survey, key informant interviews (KIIs), focus group discussions (FGDs), and participant observations in Kaliganj sub-district (*upazila*) in Satkhira District (*zila*). Furthermore, a sample survey of 358 households was conducted for collecting the population-based sociodemographic and socioeconomic data. This sample survey was one of the components of the International Development Research Centre (IDRC) project titled "*Scaling climate change adaptation knowledge and technologies for empowering women, and to enhance social equity and disaster resilience in Bangladesh (SAKTEE)*", under which I conducted my thesis research. The IDRC project was carried out in collaboration with the Bangladesh Centre of Advanced Studies (BCAS) and took place between 2019 and 2022. The field work for my specific research topic was conducted in 2022 over six months (May to October). The research received ethical approval from the Joint Research Ethics Committee of the University of Manitoba (Canada) (Protocol # HE 2022-0206).

The field work involved three phases. Initially, the study and questionnaires were designed and tested, and then finalized. Then, along with a team of five enumerators from BCAS, I conducted a sample survey of 358 households using the KOBO survey software (which included 308 randomly selected households from a sampling frame and 50 purposively selected female-headed households). This survey data was then compiled and the FGD and KII questionnaires were revised based on the information obtained. This initial survey phase also helped to build rapport with locals and arrange meetings with key informants. In the third phase, my research assistant from BCAS and I conducted the KIIs and organized FGD sessions. Participant observations were noted in both phases of data collection.

2.1 Philosophical Worldview

Philosophical worldviews refer to the set of ideas that guide and underpin research (Creswell & Creswell, 2018). I approached this study from a *pragmatic worldview*, which places importance

on the research problem instead of focusing on the methods, and supports the use of every method that is appropriate for investigating the research questions in the most suitable way possible (Kaushik & Walsh, 2019). My research topic is complex, nuanced, and multidimensional, which is why I used a mixed method approach to obtain the most meaningful information that effectively answered my research questions. As pragmatism emphasizes the fact that people's experiences are shaped by dynamic and constantly evolving social, historical, political, and environmental contexts (Creswell & Creswell, 2018; Kaushik & Walsh, 201), it was a key belief guiding my study. The IDRC project that my research operated under also adheres to Canada's Feminist International Assistance Policy framework; the principles of which I followed in my research. Canada's Feminist International Assistance Policy framework is based on feminism, which is a world view that "values women and confronts systematic injustices based on gender" (Chinn & Wheeler, 1985, p.74).

2.2 Feminist Theoretical Framework

The feminist school of thought is rooted in the feminist movement, which originated in the late 19th and early 20th centuries, and developed in three major waves (Malinowska, 2020). *The feminist movement* is essentially an activist movement for social and political change with regard to women's rights. *The feminist theory* is a part of this massive movement, and deals with scholarship and learning that contributes to the feminism movement (Osmond & Thorne, 1993). The feminist historian Linda Gordon explained it as "an analysis of women's subordination for the purpose of figuring out how to change it" (Gordon, 1979, p. 107). Feminist theorists aim to build knowledge that will help to fight oppression and subordination that persists in society. The theory involves reassessing concepts, models, and methods used within and across different disciplines in academics and research, through a feminist lens (Osmond & Thorne, 1993).

While there are many types of feminist theories, they all agree on the fact that women as a group are deprived of certain privileges—although it varies to what extent and how. In general, four key aspects are emphasized in feminist theory: i) women and how they experience life; ii) acknowledgement of the fact that women tend to be oppressed or hold subordinate positions in society; iii) a goal to end such discrimination against women; and iv) consideration of the role of gender and gender relations in society on both women and men's lives (Osmond & Thorne, 1993). Feminist theorists often relate oppression to issues such as lack of access to education, financial

dependence, unequal political rights, disproportionate labour burdens, and lack of autonomy over one's sexuality and body (Lay & Daly, 2007). They also acknowledge that gender itself is not the basis of repression; rather it is one of the factors that contribute to social divisions in society, interacting with other factors like socioeconomic class, ethnicity, age, disability, and sexual orientation (Osmond & Thorne, 1993).

The three major established branches of feminist theory are Liberal Feminism, Marxist/Socialist Feminism, and Radical Feminism. *Marxist and Socialist Feminism* are derived from the Marxist theoretical framework, where Marxist feminists introduced women into Marx's social structure of capitalism, emphasizing the important role of housewives in the economy. They brought to light the significance of the unpaid household work done by women that contributed to the capitalists' and proletariats' lives and maintained the next generation (Lorber, 1997). Both Marxist and Socialist feminists identified family as one of the major exploitative and oppressive factors in women's lives. For instance, if women were housewives, they were dependent financially on men, but if they worked outside, they were still expected to fulfill household duties. Marxist and Socialist Feminism are very similar, but with one exception—socialist feminists believe that along with the capitalist society and economic system in place, other factors such as race, gender, sexual orientation, and age interact simultaneously and result in oppression (Potter, 2001).

Liberal Feminism, often termed '*mainstream feminism*,' is based on the world views of liberalism and progressivism. According to Liberal feminism, differences between men and women attributed to their biological sex are insignificant and should not deprive women of participating in society. It advocates for equal treatment of men and women, especially in educational and workspaces. Liberal feminists focus mainly on the gender discrimination related issues that take place in society, such as unbalanced job markets, difference in pay scales, and the lack of authoritative positions held by women in institutions (Lorber, 1997; Tong & Botts, 2018). *Radical feminists* emphasize the role of patriarchy on women's oppression in their everyday lives. They believe that there is a fundamental way of thinking in society that suggests women are inferior and different, and that men hold authoritative power over women. Radical feminism addresses issues such as sexual freedom and reproductive rights, sexual harassment, violence, and women's bodily integrity (Osmond & Thorne, 1993).

Another branch of feminist theory relevant to this research on the impacts of climate change is the 'Feminist Standpoint Theory'. *The standpoint theory* on its own refers to people's social positioning and emphasizes the daily life experiences of marginalized groups in research. It builds on the notion that subordinate or less powerful groups in society experience different realities than others (Swigonski, 1993). On a similar vein, *feminist standpoint theorists* believe that women are a marginalized group of people, and their unique perspectives are significant in knowledge building and politics. People who set agendas for policies and research usually hold 'hegemonic power'. *Hegemony* refers to how there are some existing assumptions in society that everybody takes for granted, without asking any questions (Lorber, 1997). Standpoint feminists believe that women have different experiences in life than men, and their perspectives need to be heard in research and policy making. According to standpoint feminism, although it is assumed that scientific research is neutral, objective, and applicable to everyone, in reality, scientific knowledge is subjective and based mostly on 'masculine' knowledge (Lorber, 1997).

The concept of intersectionality, which deals with understanding how power structures evolve and interact, and evolved from the feminist theory, is also an important lens for climate change issues. The thoughts behind intersectionality originated in *Black Feminism* which emphasized how people's race, gender, and class intersect simultaneously to shape their experiences with discrimination. The term was later mainstreamed by Black Feminist Kimberlé Williams Crenshaw (a legal scholar and one of the founders of Critical Race Theory), who used it as a metaphor to explain how it was inadequate to tackle systems of oppression in isolation, focusing on only one factor and not considering the other identities that make people vulnerable to oppression (Carastathis, 2014). Currently the concept of *intersectionality* refers to the "intersection between gender, race and other categories of difference in individual lives, social practices, institutional arrangements, and cultural ideologies and the outcomes of these interactions in terms of power" (Davis, 2008, p.68). In the context of climate change, it gives insight into varying extents of people's experiences, vulnerabilities, and ability to adapt to climate change resulting from their positions in power structures and social categorizations (Kaijser & Kronsell, 2014).

Research based on feminist theory is attentive of gender relations, and how cultural, historical, and economic processes—as well as political institutes and women's own self-worth—can contribute to oppression (Lay & Daly, 2007). When research applies a '*feminist approach'*, it

essentially means that the study is being conducted following the values and beliefs of feminist theories. This involves including feminist principles in every step of the research process—from selecting a research question, deciding on methodology and making data collection decisions, to analyzing the data, describing the results, and finally, what is done with those results. Originating from the feminist movement in 1970, according to Lather (1998), feminist research emphasizes on the fact that gender is a social construct (cited in Phillips, 2015). This type of methodology aims to conduct research that is beneficial to the cause of gender inequality, and highlights the diversity of women's perspectives and experiences, which otherwise tend to be ignored. Feminist research also gives importance to existing research biases, societal hierarchies, and reflexivity of the researcher (Wilson, 2023). It pays particular attention to research ethics, societal hierarchies, research biases, and how the research will contribute to the bigger picture of the feminist agenda (Parry, 2020; Wilson, 2023). In such types of research, accurately bringing out both the respondents' experiences and the researcher's 'reflexivity' is important. *Reflexivity* refers to researchers being transparent and aware of their own worldviews and critically reflecting on how their perspectives and positions could affect the research process (Parry, 2020).

In the context of climate change, its effects, and community responses to cope with and adapt to them in Bangladesh, my proposed research applies the feminist theoretical framework with the orientation elaborated above. It has been stressed by feminist researchers that climate change literature often emphasizes women in developing countries as being helpless victims, whereas in reality, women are also responsive agents who can be significant resources in climate change adaptation. Moreover, climate change adaptation research has largely been dominated by technological fixes, without taking into account the complex social, political, and cultural processes that contribute to its impacts, and whether these fixes are equitable (Tschakert, & Machado, 2012).

Critics may argue that a feminist lens focuses 'too much on gender' and lacks neutrality and objectivity in research. However, climate change impacts are not gender neutral, and it is well established that women face disproportionate impacts of climate change due to societal disparities and have limited capacities to adapt, which makes it a double burden for them. As the slogan of the Bali Climate Conference in 2007 rightfully stated, there is "No climate justice without gender justice". Moreover, the Committee on the Elimination of All Forms of Discrimination Against Women (CEDAW) has even called climate change a human rights issue for women, emphasizing

how women in developing countries in particular experience threats to their rights as a result of climate change (Levy & Patz, 2015). I personally believe that researchers should not take a general standpoint by ignoring this reality. However, it should be noted that by adopting feminist principles, my research not only focused on gender, but also on other independent factors that build context—such as class, ethnicity, economic standing, and the interplay between historical, cultural, and social processes of power and gender relations. Thus, my research benefitted greatly from the adoption of a feminist theory, which led to a nuanced and thorough process of knowledge co-generation with women on the ground in coastal Bangladesh communities, which will ultimately contribute to creating more effective solutions for climate change impacts that do not discriminate against any groups.

2.3 Research Approach

The study takes a *mixed method approach*, which is research that "combines elements of qualitative and quantitative research approaches (e. g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration" (Johnson et al., 2007, p.123). There are many advantages of the adoption of a mixed method approach, including the fact that it supports interdisciplinary and cross-sectional research, allowing researchers to conduct studies with more than one paradigm/worldview in mind. Mixed method studies often explore answers to questions that cannot be obtained by applying quantitative or qualitative designs on their own and provide a thorough understanding of the research problem with substantial evidence.

When using both qualitative and quantitative designs, the strengths of each make up for the limitations of the other (Guest & Fleming, 2015). These factors led me to choose a mixed method design for my research, since it explores issues regarding gender disparities and differentiated impacts of climate change, that have a wide range of interdisciplinary dimensions associated with factors ranging from social, political and economic to scientific, environmental and health related aspects. A mixed method approach gave an in-depth perspective of these interrelated and complex factors responsible for differentiated climate change impacts through a gendered lens, and helped me to better understand the role of women in local adaptation technology for climate change impacts on agriculture.

Our study used a feminist approach for all steps of the research process – from planning and data collection to analysis and interpretation. Following a feminist theoretical framework with a focus on intersectionality lens provided our research with the tools and perspectives needed to gain insight on factors driving the disproportionate impacts of climate change. Moreover, rather than just acknowledging that women are vulnerable, the feminist approach and intersectionality lens improved our understanding of the complex and interrelated multiple factors that make women more vulnerable to climate change.

2.3.1 Emic Perspective

For the specific research questions explored in Chapter Three, my study focused on bringing forth the emic perspective of participants. The *emic* and *etic* approaches in research originated from the field of anthropology and were originally theorized by Pike (1967) as two ways to understand sounds of language— 'phonemic' being the native speaker perspectives, and 'phonetic' being the researcher/non-native speaker perspectives (cited in Berry, 1999). More recently, emic and etic approaches are used by social science researchers to understand cultures, societies, and their concepts and practices. The emic approach refers to 'insider perspectives and the etic approach refers to 'outsider/observer perspectives' (Whitaker, 2017).

Etic researchers take a generalized pattern approach to understand cultures using theories and hypotheses, while emic researchers are more focused on context, nuances, and individual insider accounts of topics being studied (Berry, 1999; Whitaker, 2017). Although it is impossible to completely label a study in one polarized direction, the data collected from this study was focused more on the emic perspective of participants impacted by climate change. While both etic and emic approaches contribute to understanding the whole picture of complex and interconnected social topics such as climate change impacts, the emic lens is highlighted in this study to bring forth identification of problems experienced by participants from a nuanced and lived perspective, regardless of the general expected trends of climate change impacts in the coastal areas.

2.4 Study Area

This research was carried out in the Kaliganj sub-district *(upazila)* within the Satkhira District *(zila)* of Bangladesh. Satkhira, covering an area of 3,817.29 km^2, is situated in the coastal

region of southwestern Bangladesh, positioned between latitudes 21º36' and 22º54' north and longitudes 88º54' and 89º20' east (Figure 2.1). It is bordered by the Jessore district in the north, by Khulna to the east, the Bay of Bengal to the south, and India to the west (BBS [Bangladesh Burearu of Satistics], 2013). The district is highly vulnerable to climate change impacts, including frequent and severe storm surges and cyclones, salinity intrusion, and rising sea levels. Data from 2006 to 2015 indicate a rising trend in annual mean temperatures, alongside increasingly erratic rainfall patterns, characterized by a greater number of dry days, even during the typically rainy monsoon seasons (Rabbani et al., 2021).

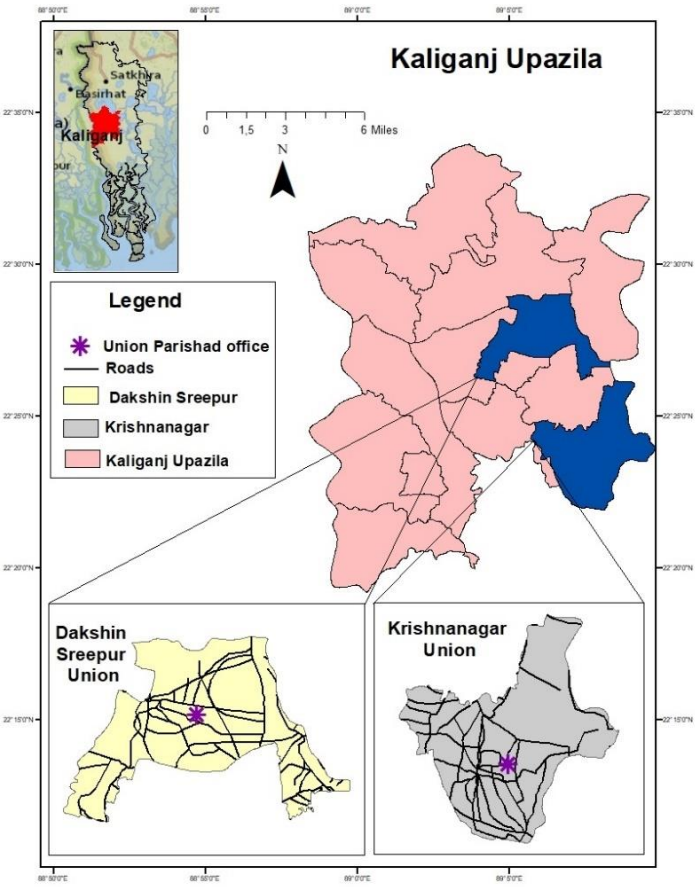
Satkhira District has been chosen as the study area because of its geographical and socioeconomic vulnerability to climate change impacts, frequent exposure to cyclones, and the region's heavy dependence on agriculture and fishing (which are extremely sensitive to climate change). The major livelihood in rural Satkhira is agriculture, with 62.56% of its inhabitants involved in the sector (Rahman & Ferdous, 2019). Other main sources of income include shrimp farming, fisheries, and forestry, with 1534.88 km^2 of the district's area consisting of mangrove forests that are a part of the Sundarbans. Data from 2006 to 2015 indicate a rise in annual average temperatures and increasingly erratic rainfall patterns, with more days without rain occurring even during monsoon seasons (Rabbani et al., 2021). Satkhira has a multidimensional poverty rate of 23.42 % and its extreme poverty headcount is 9.3%. Literacy rates are at 52.07%, with a female literacy rate of 48.15% and a higher male literacy rate of 56.11% (BBS, 2013). Furthermore, Satkhira is among the eight districts in Bangladesh identified as having "high gender disparity" according to the Gender Related Development Index, a ranking developed by the Centre for Policy Diaogue (CPD) and the United Nations Population Fund (UNFPA) (CPD, 2002).

Kaliganj *Upazila* (sub-district) was specifically selected for the study based on expert consultations due to its geographical and socioeconomic vulnerability to climate change, frequently experienced cyclones, exposure to salinity intrusion, and the region's heavy reliance on agriculture. The sub-district's ease of accessibility also played an important role in its selection. Kaliganj Upazila spans an area of 333.78 km^2 and comprises 12 unions and 254 villages. It is bounded by Shyamnagar Upazila to the south, Assasuni Upazila to the east, Debhata and Assasuni Upazilas to the north, and West Bengal, India to the west (BBS, 2013; Pitol & Sharmin, 2020). Shyamnagar, which is adjacent to Kaliganj, covers a larger area of 1,968.23 km^2, and includes 13 unions and 218 villages. It is surrounded by Kaliganj and Assasuni Upazilas to the north, the

Sundarbans and the Bay of Bengal to the south, Koyra and Assasuni Upazilas to the east, and West Bengal, India, to the west (BBS, 2013) (See Figure 2.1).

Figure 2.1

Location Map of Kaliganj, Satkhira



Note: Map by Mahjabin (2024)

2.5 Methods of Inquiry

2.5.1 Key Informant Interviews

Key informant interviews (KIIs) are in-depth interviews with experts on a certain topic, or with community members who have special knowledge on the topic being researched (Taylor & Blake, 2015). In this study, I conducted a total of 25 KIIs for in-depth inquiries and contextual investigation, keeping the balance of diverse top-down level perspectives and grassroots level experiences in mind, as well as the possibility of data saturation. These participants were selected

based on reputed organizations working in the community, relevant government departments for the sectors being investigated, and local leaders from the community. The KIIs were conducted with (i) eight government officials from relevant ministries, (ii) four community leaders, iii) two representatives of the agricultural market (seed dealers and shopkeepers), (iii) seven NGO workers associated with agriculture, disaster, and gender issues, (vi) two informants working with minority and ethnic communities, and (vii) two community members from each minority religion in the area (Christianity and Hinduism). A semi-structured guideline was used for these interviews, and the interviewees' names and designations were kept confidential throughout the thesis. The questionnaires took around 40 minutes and were open ended, addressing topics such as climate change impacts, gender inequality situation in the area, adaptation to climate change, and recommendations for the area's issues. The KIIs helped me obtain rich and detailed qualitative data about climate change related issues in the area and the nuanced social, cultural, and political processes that contribute to these issues and differentiated impacts. It also gave me an idea about the implementation of policies and external adaptation interventions related to climate change.

2.5.2 Focus Group Discussions

Focus group discussions (FGDs) involve facilitating discussions among a group of six to ten purposively selected people with a major shared characteristic, regarding a topic. In FGD sessions, emphasis is placed on the dynamics, interaction, and participation of the participants. FGDs are a beneficial tool for exploring various perspectives on a topic from people belonging to a diverse range of backgrounds, and understanding nuanced power relations in a social setting (Krueger, 2014; Powell & Single, 1996). For this research, I conducted nine FGD sessions in Satkhira consisting of 7 to 8 purposively selected participants based on their occupation and gender. The FGDs helped me obtain qualitative data on the complex factors that contribute to differentiated impacts of climate change, what kind of barriers and challenges people face toward adapting to those impacts, and what community members need, especially from a gendered perspective. It also gave me insight into local power structures and relations, participatory exclusion processes, and sensitive sociocultural attributes. The FGDs were conducted with i) farmers and agricultural workers, ii) fishermen and women involved in fishing, iii) people representing all other occupations in the area other than agriculture and fishing, and iv) minority communities, keeping in mind the possibility of data saturation. I conducted separate FGDs with

only women under all the group categories, except for the sessions with “people of other livelihoods”, which involved transport workers, barbers, shoe repairers, retail workers, tea sellers, and chicken and goat farmers. This was intended to create a comfortable environment for women to open up, and because many women were involved informally with the agricultural and fishing livelihoods. The number of FGD sessions is shown in Table 2.1. Please see Appendix G for pictures taken during the FGD sessions.

Table 2. 1

Breakdown of Focus Group Discussion Sampling

FGD Participants	FGD Type by Gender	No. of FGDs
Farmers and Agricultural Workers	Both Sexes	2
	Only Women	2
Fishing Activities	Only Men (fishermen)	1
	Only Women	1
All other occupations	Both Sexes	1
Minority Groups	Both Sexes	1
	Only Women	1
Total		9

2.5.3 Participant Observation

Observations can be used as data collection methods to understand the interaction between people and get a grasp of how things work or are organized in a setting (Kawulich, 2012). For my study, I used the participant observation method, which is an in situ qualitative data collection method whereby researchers interact with target populations through participation and observation of their activities, to get required data (Guest et al., 2013). I observed the agricultural workers and farmers in the area to note the type of agricultural work they do, and what adaptation technology and local innovative methods they are currently using.

Through these observations of their activities, I gained insight into how women and men interact in these settings and whether women face visible challenges. During this process, I also asked some informal questions to understand if agricultural adaptation technology is easy to use for women. Before proceeding with the participant observations, I had to build rapport with the community members so they were comfortable with me observing their activities, and let them know about my research and intentions.

2.5.4 Sample Survey

A sample survey is conducted to collect data from a portion of a targeted population, who are a representative sample of the targeted population for a study. It allows researchers to infer and generalize information about the background targeted population (Kelley, 2003). For my study, my team of enumerators (from BCAS) and I conducted a survey of 358 households (i.e., Primary Sampling Unit), interviewing household heads to inquire into the concerned issues of the research topic. The survey results provided demographic and socioeconomic details of the study area. In the absence of the household head, another household member who had appropriate knowledge of the required information was interviewed. The sample survey gave me an overview of agricultural activities, climate change impacts, and overall sense of the gendered labour division in the study area. The survey also allowed me to assess how households are being affected by climate change, and which groups of people are generally most affected from a tangible, 'loss and damage' lens.

The interviews were conducted with 308 randomly selected households, that could either be male- or female-headed, from two villages in Kaliganj (Berakhali and Dakshin Sreepur). From these villages, 205 participants were from Dakshin Sreepur and 153 from Berakhali. In the 308 randomly selected households, there were 292 male-headed households and 16 female-headed households, who were interviewed face-to-face. I used the census data from the initial census survey of the IDRC project (conducted in 2018) to find a list of participants, that is, the sampling frame—for this sampling survey. I also conducted a supplementary survey with 50 female-headed households. The supplementary survey ensured that data was collected from female-headed households, as there might not have been a significant number of female-headed households compared to the number of male-headed households in the rural area.

2.6 Data Analysis

The data were analyzed by thematically categorizing my qualitative data to identify common trends and patterns regarding my research questions. I also used the socioeconomic data from the sample survey and supplementary survey to support my analysis.

Data analysis for the study was completed in three parts. First, the sample survey responses were checked for errors and then analyzed using Microsoft Excel. The key findings were presented through numerical data in the form of tabulation, charts, and graphs. The variables include socioeconomic attributes (e.g., income, livelihoods, ethnicity, religion) and gender, while the dependent variables are climate change impacts (e.g., damages and losses, changes in working hours), adaptation responses (e.g., whether respondents went to shelters, whether they adopted agricultural adaptation technology) and barriers to adaptation (e.g., whether a specific gender or group with lower socioeconomic standing faced more obstacles in adapting).

In some cases, there are multiple independent or explanatory variables that have a relationship with a dependent variable—for instance, a woman from a poor socioeconomic background who is also from a minority religion may experience more obstacles to accessing climate change adaptation technology.

For the qualitative data, the FGD and KII responses were transcribed directly from Bengali to English and presented descriptively under thematic categories, as well as presented in tables. The notes and pictures collected from the observations were also included in the qualitative data analysis. In the final stage of the analysis, findings from both the qualitative data and the sample survey were integrated to present an overall discussion.

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CHAPTER 3

Differentiated Impacts of Climate Change and the Perceived Cycle of Social Disparities: Women's Struggles in Coastal Areas of Bangladesh

Abstract

This chapter examines the differentiated impacts of climate change, with a focus on gender disparities and intersectional inequalities affecting women in Kaliganj Upazila (sub-district), Satkhira district of Bangladesh. The study used a mixed-method design, with data collected using focus group discussions (FGDs), key informant interviews (KIIs) and participant observations, also supported by a sample survey. Results show that women, minorities, and people of lower socioeconomic status bear a greater burden from climate change impacts, which are multiplied with other overlapping vulnerability factors such as old age. Existing social inequalities, gender disparities, systemic and institutional discrimination, varying belief systems, and poverty play a significant role in exacerbating climate change impacts. Moreover, climate change and gender inequality are found to be positively correlated with each other and often results in a perpetual cycle of inequality. Based on the findings, introducing accessible and inclusive disaster shelters, programs that empower women and minorities, accessible credit facilities for income generation, and awareness programs on gender disparities and climate change impacts are recommended.

KEYWORDS: differentiated climate change impacts, gender-differentiated climate change impacts, women, gender inequality, social inequality, Bangladesh

3.1 Introduction

Climate change is a pressing issue in rural coastal regions of Bangladesh, with certain disadvantaged and marginalized groups of people facing disproportionate adverse impacts. However, climate change does not differentiate between men and women, socioeconomic classes or ethnicity. Rather, factors such as gender, class, ethnicity, age, and disability—along with

social relations, institutes, and political processes—influence how people experience and respond to climate change impacts and to what extent they are impacted. In the rural coastal regions of Bangladesh, women are some of the most vulnerable groups experiencing differentiated impacts of climate change due to existing societal gender inequalities and overlapping factors such as poverty, marginalization, and low socioeconomic standing. Most climate change interventions and policies do not address these issues sufficiently (Reggers, 2019).

The World Meteorological Organization (WMO, 2019) identified rural communities, the elderly, disabled, widowed women, and women who are pregnant as most impacted by changes related to climate in the regions of Asia, Africa, and the Pacific. According to their findings, both genders suffer from similar losses in assets and livelihoods due to climate change impacts, but other impacts are heavily gendered. Women bear burdens like additional workload, sexual and gender-based violence, and early marriages, while men suffer from issues such as livelihood related migration, alcohol abuse from stress, and increased risk of death as rescue workers. Carr et al. (2024) emphasizes how a decrease in precipitation can add to women's existing problems with water scarcity all over the world. Their study predicts that under a high emissions scenario, by 2050, global warming will increase women's time for water collection by 30% globally.

Literature also reveals that climate change increases existing gender-based health inequalities in low- and middle-income countries (Desai & Zhang, 2021; Sorensen et al., 2018). Women are likely to have higher mortality and morbidity rates and nutritional deficiencies due to climate change impacts. Pregnant women, in particular, are susceptible to health issues such as increased risk of malaria, hypertension, pre-eclampsia, and negative reproductive outcomes (Sorensen et al., 2018). Another study by the United Nations Development Programme (UNDP,2018) conducted in Africa found that women were experiencing greater impacts of climate change compared to men with regard to adverse effects on income, food and water insecurity, and intensified conflicts surrounding land and resources (cited in Adeola et al., 2023).

Marginalized groups like indigenous communities, ethnic communities, and minority religious communities are also extremely vulnerable to climate change due to their reliance on nature, social disparities and lack of representation in decision making (Baird, 2008). Singh (2023) notes that in India, women from backgrounds of lower caste and social status experience aggravated impacts of climate change especially due to their subdued positions in the "rural power structure", and the location of their housing in risky places such as low-lying areas and

village outskirts (p. 81). Phuong et al. (2023) highlights how minority households in Vietnam have climate-vulnerable livelihoods because of poverty, and how this results in the communities being stuck in poverty traps.

Although differentiated impacts of climate change have been established in existing literature, there is not enough evidence that compares the burden of impacts between groups of people in society. While it is acknowledged that the marginalized communities and women in particular are extremely vulnerable to climate change, and there are numerous studies on the gendered impacts of climate change, there is still a dearth of literature on the disproportionate impacts of climate change on women and how intersectionality and existing inequalities play a role in these exacerbated effects. As Kaijser and Kronsell (2014) note, the disproportionate impacts of climate change on women are usually approached from a binary "gender–climate change" perspective. However, in reality, external societal factors, overlapping vulnerabilities, and gender disparities together act as multipliers of the threat of climate change for women.

Satkhira, a coastal district in Bangladesh, is considered highly vulnerable to climate risks. Due to its vulnerable geographic location, recurrent exposure to cyclones, less than ideal socioeconomic conditions, existing social inequalities, and climate-dependent livelihoods, the study area experiences the brunt of climate change impacts (see 2.4 for details). The primary purpose of this study is to examine differentiated impacts of climate change on the marginalized groups of the coastal region of Kaliganj, Satkhira, with a focus on gender disparities and intersectional identities. The specific objectives are to i) identify and explore the major factors responsible for differentiated climate change impacts on socioeconomic groups with a particular focus on women; and ii) to assess the relationship of gender inequalities and climate change, with a focus on elderly and minority women.

3.2 Key Concepts and Terms

3.2.1 Differentiated Vulnerabilities and Impacts of Climate Change

Differentiated impacts of climate change refers to how, because of pervasive historical and institutional inequalities in society, as well as biophysical vulnerabilities, certain groups of people experience adverse climate change impacts more intensely than others, bearing a disproportionate amount of the burden. It also denotes how climate change impacts can add on to existing issues faced by already disadvantaged people and have incremental effects that

aggravate their adversities in life (UNFCCC, 2019). The Intergovermental Panel on Climate Change (IPCC) recognizes these differentiated impacts of climate change, stating that due to pre-existing multidimensional inequalities in society, people have different degrees of vulnerability, exposure, and adaptation responses to climate change (Field et al., 2014). *Vulnerability* to climate change refers to "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC, 2007, p. 89). Vulnerability can be seen as "a function of exposure, sensitivity and adaptive capacity", and is a multidimensional process that is influenced by social, economic, and political factors (Thomas et al., 2019, p. 2). *Exposure* refers to when people, their assets, their livelihoods, and their socioeconomic and cultural properties are present in a location or situation that may be impacted by climate change. *Sensitivity* is described as the extent of climate change impacts on a system and *adaptive capacity* is considered the ability to cope and adapt with negative climate change impacts (Jerin et al., 2023).

Poverty is a major contributing factor to climate change vulnerability. In addition to the financial aspect, poverty encompasses various interconnected dimensions, including economic, social, political, health, environmental, and seasonal factors, all of which reinforce one another (Gweshengwe & Hassan, 2020). For example, the poor are more likely to live in high-risk areas with housing constructed from weak materials (Thomas et al., 2019). They also tend to suffer greater losses compared to the wealthy, especially when these losses are considered relative to their already limited assets (Hallegate & Rozenberg, 2017). Moreover, rich people can diversify their assets, whereas rural poor people have more unstable climate sensitive assets such livestock and crops (Islam & Winkel, 2017). The poor also often lack access to financial services and social safety nets that could help them recover from climate change–related disasters (Hallegate & Rozenberg, 2017).

The World Bank refers to *poverty* by a universal poverty line indicator, which is currently $2.50 per day, based on the most recent global purchasing power parity (PPP) exchange rates calculated in 2017 (Jolliffe et al., 2022). National poverty lines are calculated differently, with low- and middle-income countries often using a minimum income needed for optimal nutrition and non-food basic items to determine their specific poverty thresholds (Jolliffe & Prydz, 2019). Bangladesh uses the Cost of Basic Needs (CBN) method to assess their national poverty rates, with an upper and lower line. According to the most recent Household Income and Economic

Survey published in 2022, 18.7 % of the population in Bangladesh is poor, with a 20.5 % poverty rate in rural areas and 14.7 % in urban areas, based on the country's upper poverty lines (BBS, 2023).

Gender is also a significant determinant of vulnerability, with numerous studies identifying women as being more vulnerable to climate change than men, in most situations (Alhassan et al., 2019; Eastin, 2018; Flatø et al., 2017; Rao et al., 2017; Yadav & Lal, 2018). This gender-based vulnerability is not inherently based on sex, and arises from the social and cultural expectations and roles assigned for men and women. Factors such as lack of access to resources, limited decision-making power, and cultural and social gender norms also contribute to this vulnerability, keeping women at a disadvantaged position and limiting their opportunities to adapt and cope to climate change impacts (Alston, 2014). Apart from income and gender, other factors such as disability, age, and cultural backgrounds can also influence vulnerability to climate change. For instance, vulnerabilities can multiply if people are from minority religious backgrounds, due to their low social standing and systematic discrimination from privileged socioeconomic groups (Chisty et al., 2021). Feminist research in particular has brought to light the gender-differentiated impacts of climate change and how intersectional identities lead to layers of vulnerability for women (Alston; 2014; Arora-Jonsson, 2011; Tuana, 2015).

3.2.2 Intersectionality

Intersectionality is a concept embedded in feminist theory, which was initially introduced to represent women of colour when pursuing equity and inclusiveness in the political and legal spheres of society (Garcia & Tschakert, 2022) (see 2.2, p. 24 for details). Davis (2008) defines intersectionality as "the interaction between gender, race and other categories of difference in individual lives, social practices, institutional arrangements, and cultural ideologies and the outcomes of these interactions in terms of power" (p. 68). In the climate change arena, the concept of intersectionality addresses the compounded vulnerabilities from different identities and power relations, and how they influence climate change impacts and adaptation among certain vulnerable groups (Kaijser & Kronsell, 2014). The intersectional lens is increasingly being used to better understand the differentiated experiences of climate change in a nuanced manner, taking into consideration various systems of oppression and social intersections instead

of focusing only on singular inequalities (Assaduzzaman et al., 2023; Djoudi et al., 2016; Garcia & Tschakert, 2022; Walker et al., 2019).

3.2.3 Inequality and Climate Change

Inequality refers to disparities in resources, opportunities, and treatment among individuals or groups within society. These inequalities manifest in various forms, such as economic, racial, ethnic, geographical, gender based, health based, disability based and age-based inequalities. Based on literature reviewed, it can be assumed that inequality and climate change impact have a negative relationship (Paglialunga et al., 2022; Pérez-Peña et al., 2021). Diffenbaugh and Burke (2019) found that low-income countries face many challenges when adapting to climate change, which in turn also increases their poverty levels. On a similar note, Cevik and Jalles (2023) highlighted that income inequality leads to greater vulnerability to climate change, and that climate change has a significant effect on the income distribution of developing countries, compared to developed countries.

Research has revealed that most climate change impact assessments tend to overlook the role of inequality and social disaggregation and emphasize short-term financial benefits and losses (Sanchez, 2018)**.** While there have been a few studies that investigated the specific relationship between climate change and inequality, they tend to focus on economic aspects. Most of the studies also tend to take a general approach of comparison among different countries, rather than looking at "within country inequalities". Islam and Winkel (2017) addressed the latter and proposed a framework for the United Nations Department of Economic and Social Affairs (DESA) to assess such inequalities on a local level in the context of climate change. They referred to the relationship between income inequality and climate change as "a vicious cycle", arguing that existing income inequality worsens climate change impacts on vulnerable households and results in greater income inequality.

Models like the livelihood vulnerability index are popularly used for understanding climate change impacts in terms of unequal distribution of wealth, income, and assets. These vulnerability models are largely one-dimensional, overemphasizing on economic indicators. They often overlook people's capability to cope and adapt to climate risks, and ignore the interconnectedness of vulnerability to the multiple other dimensions of well-being. They also often lack consideration of structural and systemic inequalities such as gender and caste that lead

to uneven power dynamics and unequal access to resources (Cappelli, 2021). While there have been numerous studies on gender-based vulnerability to climate change, they have emphasized on the burden faced by women as if they are victims only due to their gender. The research does not adequately address the role of gender inequalities in society that lead to such greater burdens for women. Furthermore, there is a lack of research examining caste and ethnic inequality within countries and how these identities may overlap with other vulnerable identities.

3.3 Conceptual Framework

This present study uses a feminist approach with an intersectional lens to understand the disproportionate impacts of climate change and the factors responsible for them, based on real-life experiences of marginalized groups. The feminist movement is essentially an activist movement for social and political change with regard to women's rights and equal status. Feminist research aims to build knowledge that will help to fight oppression and subordination that persists in society (Osmond & Thorne, 1993) (See 2.2 for details).

By adopting feminist principles, my research not only focusses on gender, but also on other independent factors which build context such as class, ethnicity, economic standing, and the interplay between historical, cultural, and social processes of power and gender relations. Feminist research also pays particular attention to bringing out both the respondents' experiences and the researcher's 'reflexivity'. *Reflexivity* refers to researchers being transparent and aware of their own worldviews and critically reflecting on how their own perspectives and positions could affect the research process (Parry, 2020). The feminist approach has been used by many researchers studying gendered impacts of climate change and its disproportionate consequences. However, most of this research leans toward a theoretical and philosophical approach, rather than field-based empirical investigations from a feminist lens.

According to Zoloth (2017), climate change is a concerning issue for feminists because it results in adverse effects on women's opportunities, reproductive rights, and well-being, which are important elements of the feminist philosophy. On a similar vein, Husaini and Davies (2022) argue that climate change policies tend to be gender blind in Bangladesh, which is evident in the fact that the topic of "Access to Sexual and Reproductive Health Rights (SRHR)" is not addressed in the country's climate change framework, despite this dimension of women's rights being significantly impacted by climate change. To address gender and climate-related issues, Sultana (2013) calls

upon the need for insights from the feminist geography and political ecology perspectives to better understand nuances and complexities of the diverse perceptions, responses, and coping abilities among different groups of people. Gay-Antaki (2020) also emphasizes on the importance of assessing structural inequalities and understanding that women cannot be treated as homogenous groups in the context of climate change. Israel & Sachs (2012) sheds light on the fact that climate change discussions are typically technology and science oriented, and viewed from a capitalist, colonialist, and patriarchal perspective. Similarly, Tuana (2015) discusses how climate change discourse, policies, and knowledge itself is often based on subtle gendered constructions. Although these biases are not as evident as direct differential impacts of climate change, they affect how climate change issues are understood and addressed. The existing literature therefore highlights the need for feminist discourses on climate change and the lack of feminist approaches to collecting empirical evidence on the disproportionate impacts of climate change and their association with gender inequalities.

To explore the relationship between gender inequality and climate change, my study draws upon the framework by Islam and Winkel (2017), which demonstrates the perpetual cycle of income inequality and climate change. It focusses upon three main factors that contribute to aggravation of inequality in society: a) the increased exposure of vulnerable groups to climate change impacts, b) their increased likelihood of suffering from the damage of climate change impacts, and c) their decreased coping and recovering abilities from the damage.

Islam and Winkel's (2017) Framework depicts the differentiated impacts of climate change from an income perspective and how the compounded vulnerabilities of the poor make climate change a chronic stressor that needs to be addressed (Figure 3.1). It emphasizes "within country" inequalities, has clearly delineated concepts of vulnerability dimensions with socioeconomic factors, and is flexible and adaptable for local and context-specific cases. However, although Islam and Winkel (2017) acknowledge intersectionality, their framework does not go into the necessary depth with an intersectional analysis on vulnerabilities of overlapping social identities (e.g., gender, caste, race, income). It also has a limited focus on physical and mental health-related dimensions of vulnerability. My study attempts to integrate these factors with the feminist and intersectionality lens, and adopts Islam and Winkel's framework as a foundational platform to understand the relationship between gender inequality and climate change impacts. I also added minority status in this modified framework. Figure 3.1

demonstrates the conceptual framework developed for this chapter, titled ‘Cycle of Gender Inequality and Climate Change Impact (CGICCI)’.

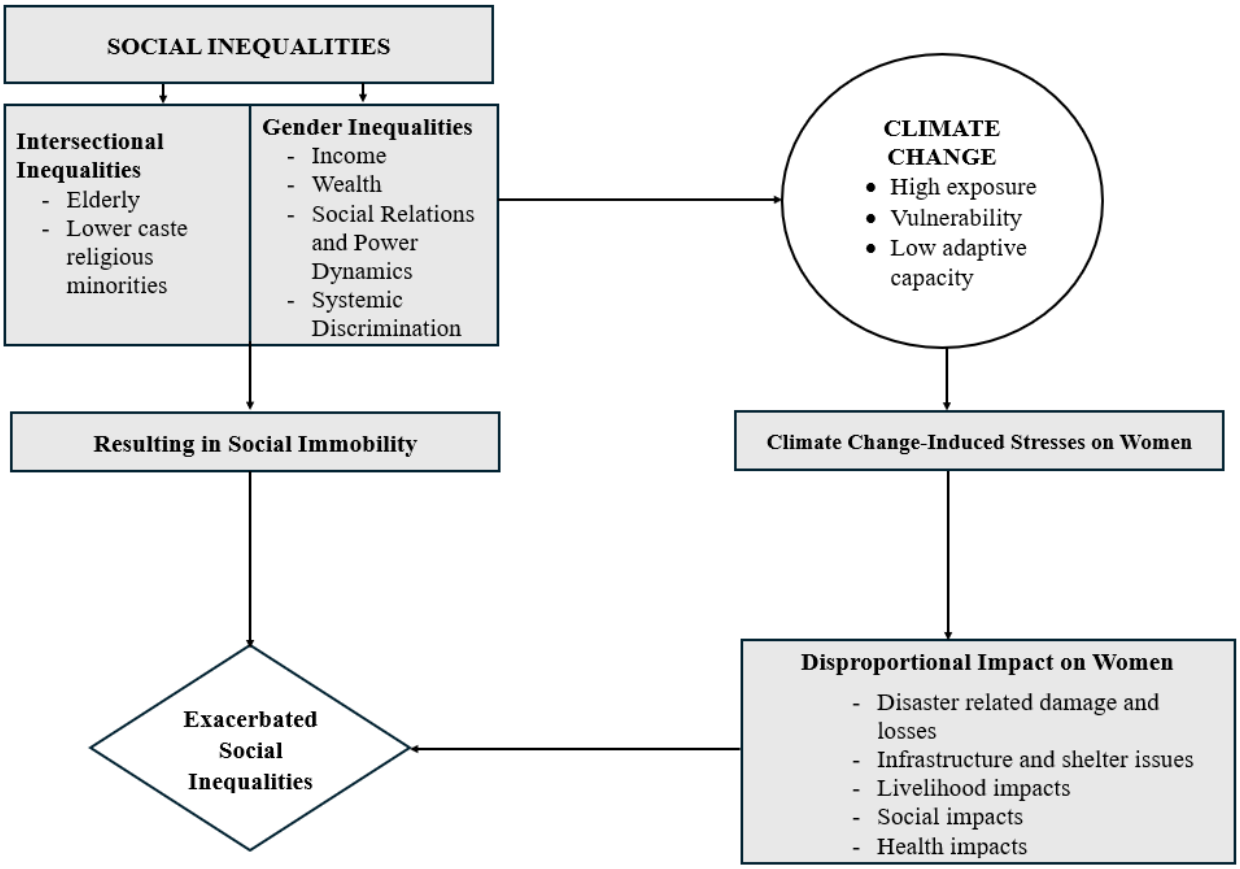
In the CGICCI framework (Figure 3.1), I demonstrate that gender inequality presents in society in the form of disparities in Income, Wealth, Social Relations and Power Dynamics, and Systemic Discrimination. The major issues identified for each type of gender inequality are listed as follows:

I. Income Inequality—Pay Gap, Occupational Immobility, and Unequal Division of Labour
II. Wealth Inequality—Lack of Assets and Unequal Land Rights
III. Social Relations and Power Dynamics—Gender Norms, Cultural Expectations, Religious Regulations, and Decision-Making Power
IV. Systemic Discrimination—Non-inclusive Infrastructure, Complex Official Procedures, and Limited Access to Collective Resources.

These gender inequalities along with intersectional inequalities (such as old age and minority backgrounds) lead to higher exposure and vulnerability, and reduced ability to cope and adapt to climate change impacts. These outcomes are seen in women experiencing disproportionate impacts of climate change. The impacts of climate change have been broadly categorized as i) disaster-related damage and losses; ii) infrastructure and shelter issues; iii) livelihood impacts; iv) social impacts; and v) health impacts. The impacts identified are a consequence of both direct climate change impacts, and the inability to adapt to those climate change impacts. Thus, I posit that, the differentiated impacts of climate change that occur due to gender inequalities exacerbate the existing gender inequalities even further. In this framework, I grouped gender inequalities and intersectional inequalities under social inequalities. The exacerbated gender and intersectional inequalities again lead to higher exposure and vulnerability to climate change, and reduced adaptive capacity for women. Therefore, the relationship between gender inequality and climate change impacts is correlated and creates an inequality trap over generations. It is difficult for women and marginalized communities to free themselves from this perpetual cycle, and they are unable to improve their socioeconomic status, resulting in social immobility (Figure 3.1). *Social immobility* refers to people advancing in the social hierarchy through factors such as increases in income, better living conditions, higher education, occupation changes, and rural-to-urban area migration (Ellis et al., 2018; Kaelble, 2015).

Figure 3.1

Cycle of Gender Inequality and Climate Change Impacts—A Conceptual Framework



Source: Adopted from Islam & Winkel (2017)

3.4 Results

This section starts with a presentation of the socioeconomic characteristics of the respondents to provide context for the findings. The findings of the study are then discussed through a lens of disproportionate impacts of climate change experienced by different groups, divided into 3 major categories: i) Issues of Climate Change–Related Disasters; ii) Impact of Climate Change and Adaptation on Livelihood of Community Members; and iv) Social and Health Impacts of Climate Change. Finally, based on these findings and additional observations, and guided by the CGICCI framework, a summarized table depicting how gender inequality and intersectionality influences exposure, vulnerability and adaptive capacity to climate change is presented.

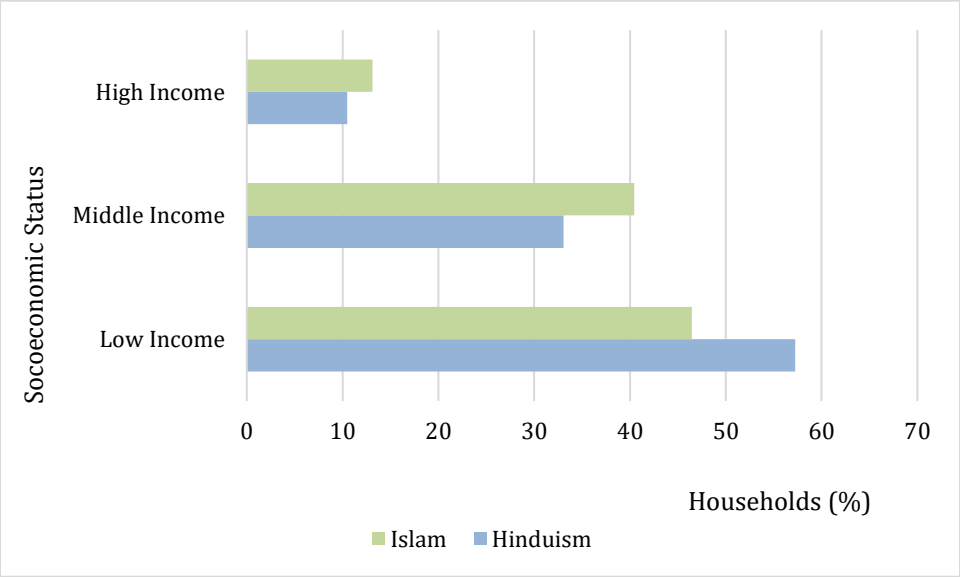
3.4.1 Socioeconomic Characteristics of Respondents

In this study, from the total 308 randomly selected households, 50.6 % (156) of the households were low income, 37.3 % (115) were middle income and 12% (15) were high income. Most of the households (183, or 59.4%) were Muslim and 40.6 % (125) were Hindu. Of the total 308 participants, 292 (94.8%) were male-headed households, while 16 (5.2%) were female-headed households.

There was also a supplementary survey conducted with 50 female-headed households who were also interviewed. For gender-based analyses, I compared the data from the 292 male-headed households and 50 supplementary female-headed households.

Figure 3.2

Comparison of Household Socioeconomic Status and Religion (n=308)



In the sample survey, compared to Muslim households, a greater proportion of Hindu households were low income (57.3%) while only 10.5 % could be categorized as high income (Figure 3.2). Furthermore, from the 50 supplementary female-headed households, the majority (72 %) belonged to the low-income socioeconomic status, whereas only 2 % were higher income (Figure 3.3). This data reveals a trend where households headed by females and following the minority religion of Hinduism in the area tend to belong to lower socioeconomic status.

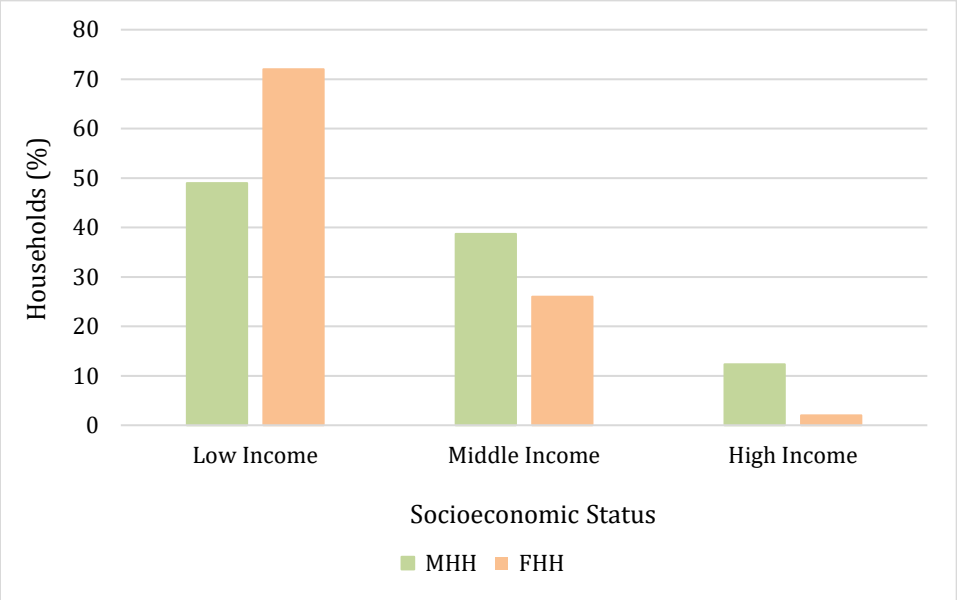
In the study area, the sample survey results of the 308 households reveal that common income sources were daily labour (64.9 %), agriculture (42.9%), and livestock rearing (32.5 %), followed by fisheries (23.1 %), vegetable/homestead gardening (20.1 %), and others (49.4%)—which includes income sources like rickshaw driving, crab collection, etc. The livelihood pattern of the respondents based on their household socioeconomic characteristics is demonstrated in Figure 3.4. Although they were also involved in agriculture, livestock rearing, and vegetable gardening to some extent, high-income households were also involved with business (29.7%), service (24.3%), land mortgaging and selling (16.2%), and bank interest (5.4%), which low-income households were not participating in. It is evident that households belonging to lower socioeconomic status in the study area were more involved with climate sensitive and natural

resource–related sources of income like daily labour (77.6%), livestock rearing (34%), fisheries (32.1%), and agriculture (25.6%) (Figure 3.4).

Figure 3.3

Comparison of Household Socioeconomic Status and Gender of Head

*Total male headed households (*n* = 292), Total female headed households (*n* = 50)

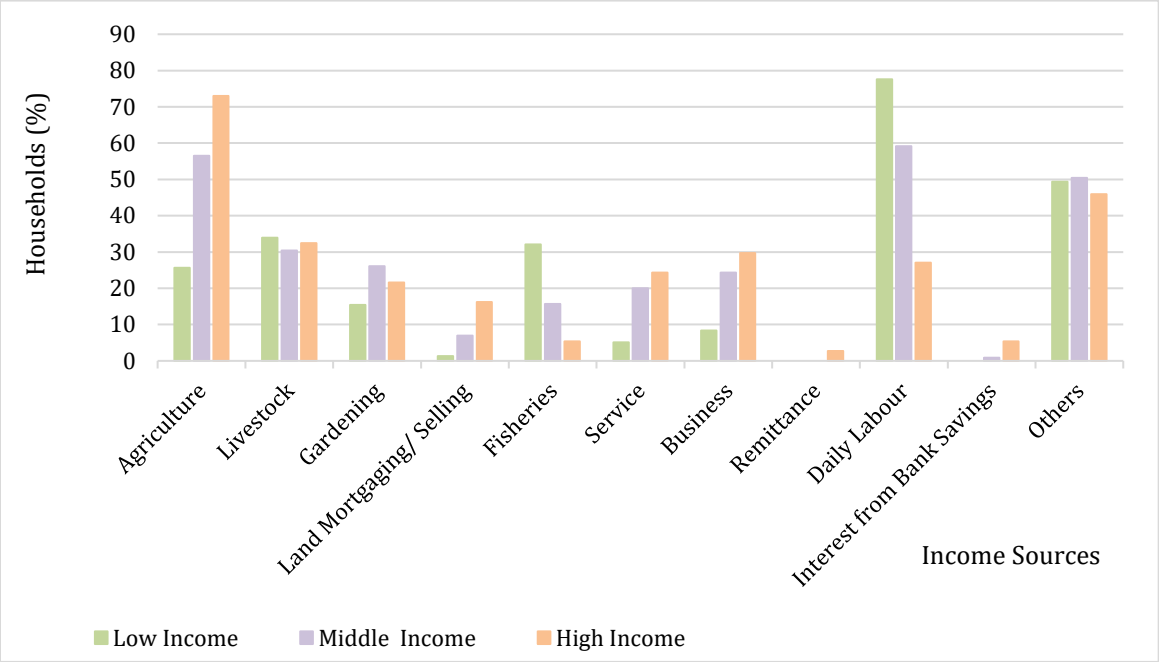


Popular sources of income for the 292 male-headed households were daily labour (64.4%), agriculture (42.8%), livestock rearing (32.2%), and fisheries (23.3%). The 50 female-headed households were mostly involved in daily labour (70%), livestock rearing (32%), and agriculture (14%) (Figure 3.5).

Figure 3.4

Comparison of Income Sources and Socioeconomic Status

*Total household number (*n* = 308), total low-income households (*n* = 156), total middle-income households (*n* =115), total high-income households (*n* = 37)

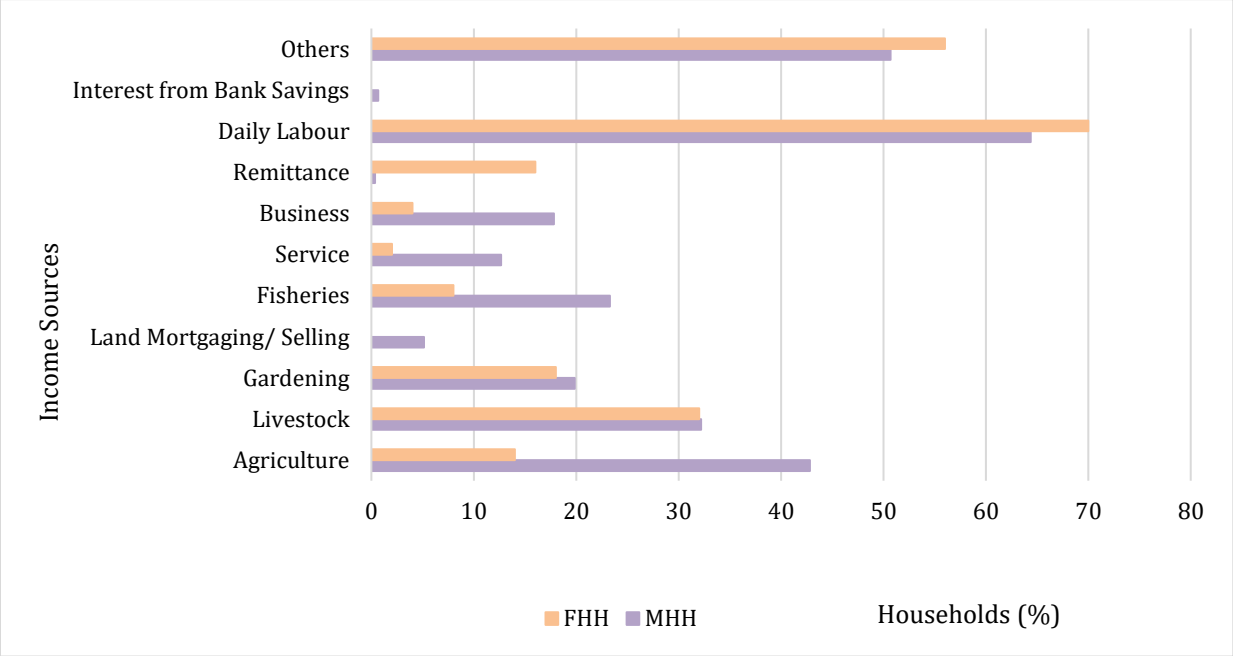


It should be noted that daily labour involves working in agricultural labour, and less women received income directly from their own agricultural production. Rather, they worked as agricultural labourers in other people's fields and earned a wage. No female-headed households were involved in land mortgaging/selling or earned income from bank interest, but 16% earned an income from remittance, which was much higher than male-headed households. This can be attributed to the fact that men going away to earn and send back remittance would leave their wives in charge of the household, which were the female-headed households making up the supplementary survey.

Figure 3.5

Comparison of Income Sources and Gender of Household Head

*Total male-headed households (*n* = 292), Total female-headed households (*n* = 50)



3.4.2 Issues of Climate Change–Related Disasters

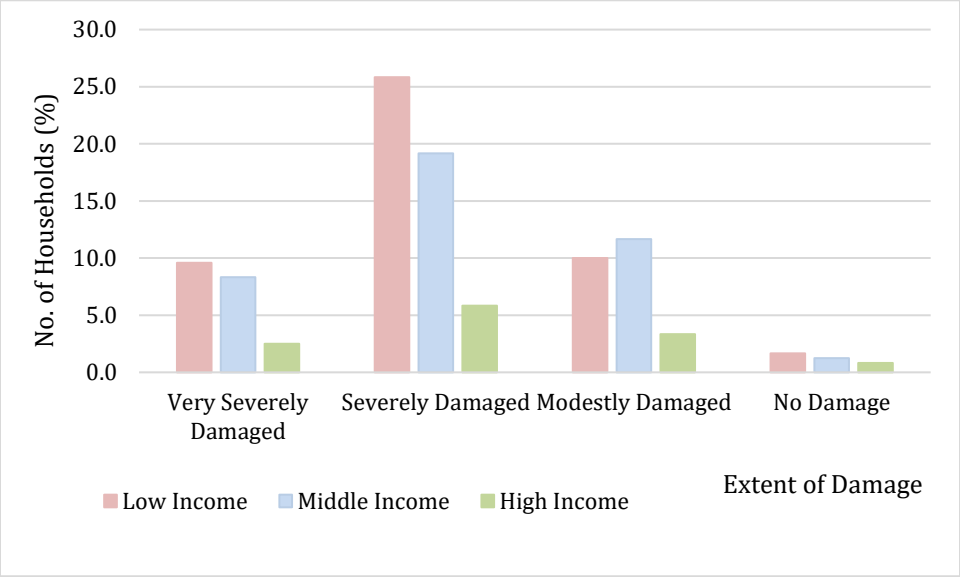
Damage and Losses

The sample survey revealed that in the past 20 years, low-income households had been experiencing very severe (9.6 %) to severe damage (24.8 %) from cyclones, while high-income households were impacted comparatively less (Figure 3.6). When assessing the damage caused by Cyclone Amphan in 2020, poor households were affected the most compared to middle- and high-income households. From those responses regarding the types of damage caused by the cyclone, 55.3% of low-income households experienced the destruction of their houses, 54.8% experienced damage to toilet facilities, 54.9% experienced power supply issues, 56.3% had damaged water sources, and 52.9 % experienced disruption in fuel for cooking, which was greater than damages experienced by high income households (Table 3.1). Furthermore, out of the 130 households that borrowed money to recover from the damage and losses from Cyclone

Amphan, 63% were low income, 53% were middle income and only 11 % were from a high socioeconomic status (Figure 3.7) Also, data on the two major cyclones, Sidr (2007) and Aila (2009), that occurred in the study area revealed that poor households took much longer to recover than high-income households (Table 3.2). It also showed that people took less time to recover from Cyclone Aila (2009) compared to Cyclone Sidr (2007). When comparing the responses of the randomly selected male-headed households with the purposively selected female-headed households who had experienced the major events of cyclones Aila and Sidr in the area, it is apparent that the duration of recovery from both cyclone impacts was very similar.

Figure 3.6

Experience and Perception of Cyclone Impacts on Households of Different Socioeconomic Status
*Total responses (*n* = 240)



Note: Chart shows the distribution of varying magnitudes of cyclone impact experienced in the last 20 years by socioeconomic categories.

Table 3.1

Distribution of Damage Caused by Cyclone Amphan by Socioeconomic Categories (n=308)

Type of Damage	Low Income (%)	Middle Income (%)	High Income (%)
Houses (n=235)	55.3	36.6	7.7
Toilet Facilities (n=157)	54.8	37.6	7.0
Power Supply Systems (n=215)	54.9	37.7	7.0
Water Sources (n=16)	56.3	31.3	6.3
Fuel Sources for Cooking (n=104)	52.9	37.5	8.7

Figure 3.7

Comparison of Different Socioeconomic Groups who had to Borrow Money to Recover from Cyclone Amphan

*Total responses (*n* = 130)

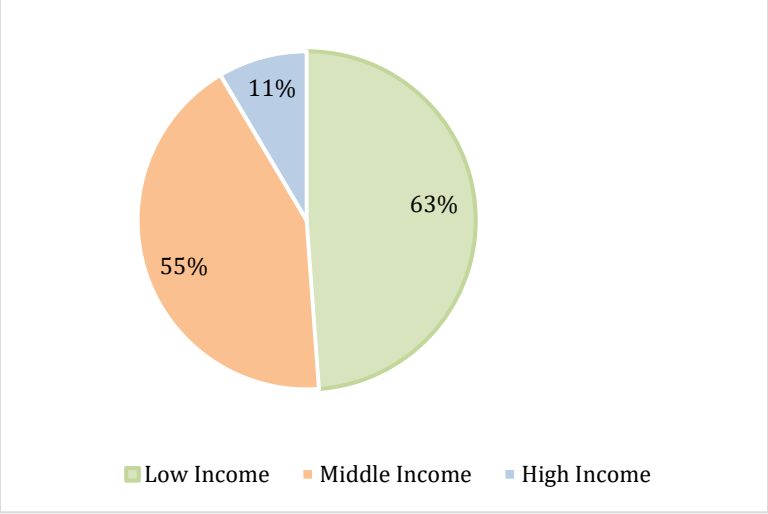


Table 3.2

Distribution of Days Taken to Recover from Cyclones by Socioeconomic Categories (n=308)

No. of Days to Recover	Sidr (2007)			Aila (2009)		
	Low Income (%)	Middle Income (%)	High Income (%)	Low Income (%)	Middle Income (%)	High Income (%)
1 to 5	53.9	36.3	9.8	53.3	35.9	10.8
6 to 19	25	50	25	55.5	33.3	11.1
20 to 90	80	20	0	70	30	0
240 to 365	33.3	66.7	0	50	25	25

Table 3.3

Distribution of Days Taken to Recover from Cyclones by Gender of Household Head

No. of Days to Recover	Sidr (2007)		Aila (2009)	
	MHH (%) n=105	FHH (%) n=13	MHH (%) n=245	FHH (%) n=44
1 to 5	90.5	92.3	86.5	88.6
6 to 19	3.8	0.0	9.0	9.1
20 to 90	3.8	7.7	3.3	2.3
240 to 365	1.9	0.0	1.2	0.0

Infrastructure and Shelter-Related Issues

The sample survey data of the 308 households reveal that very few respondents (15.3%) moved to and took shelter in the last three years during floods, or during the major Cyclones Amphan in 2020 and Yaas in 2021. Among male-headed households, 84.2% (246 out of 292

respondents) stated that they did not go and 94% (47 out of 50) of the female-headed households also revealed the same.

Figure 3.8 depicts the reasons stated by the 308 randomly selected households for not going to shelters, and Table 3.4 compares this data between the 292 male-headed households and 50 female-headed households. It was revealed that 151 out of the 308 households did not need to go to shelters because their area was not in immediate danger, and 83 households took shelter in a structurally sound building near their houses—such as a neighbour's house, school, union parishad, or mosque. Some other common responses included 37 households stating that the shelters were too far away and 13 households stating that they avoided the shelters because they were too crowded (Figure 3.8). A similar trend was also found when comparing the reasoning behind not going to shelters based on the household heads (Table 3.4). It should be noted that more female-headed households who responded went to a neighbouring structurally sound building compared to male-headed households.

Figure 3.8

Reasons for not Going to Shelters During Major Disasters in the Last 3 Years (n = 261)

*Multiple Responses Possible

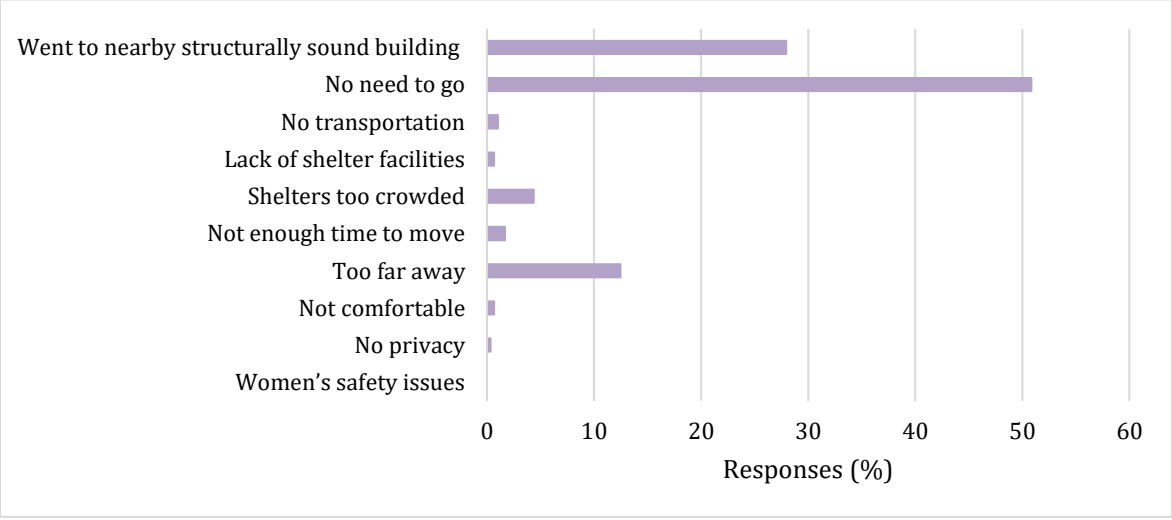


Table 3.4

Comparison of Reasons for not Going to Shelters During Disasters in the Last Three Years Between Male and Female Headed Households

*n is based on households who did not go to shelter, multiple responses possible

Reasons Stated *Multiple Responses	No. of MHH n=246	No. of FHH n=47
Women's safety issues	1	1
No privacy	1	1
Not comfortable	2	0
Too far away	36	7
Not enough time to move	5	1
Shelters too crowded	13	2
Lack of shelter facilities	2	0
No transportation	3	1
Not in immediate danger, so did not leave	141	26
Went to structurally sound building nearby	1	15

The qualitative data from FGDs and KIIs revealed more elaborate information on the issues surrounding shelters. It was found that arranging transport to shelters is difficult, especially for the disabled, the elderly, and pregnant women and sometimes reaching the shelters itself can be dangerous due to broken trees, damaged roads, and risky weather conditions. Moreover, some people were hesitant to leave their assets and houses behind, especially in the case of women, who also did not want to go anywhere without their husband's permission. While men are usually outdoors and move to shelters immediately, women are expected to manage the elderly relatives and their kids and organize all their supplies before going to the shelter. Regarding this topic, a key informant who volunteers to get people to the shelters during disasters, elicited that:

> *"They (women at home) have their mother in-law, father in-law, ill members of the family…. so how will they leave them behind? If there is no man present, it is difficult to*

bring them to the shelter. Women also don't want to leave their house behind. They say 'If I die, I will die here'. In our village, they are very attached to their house."

Our FGD and KII participants also revealed that shelters are not inclusive or secure, which plays a part in people's reluctance to move. One of the major issues is the lack of privacy and separate bathrooms for men and women in the shelters. This is especially an issue for women who wear abayas (a robe worn by Muslim women as a cover) or hijabs (hair covering for Muslim women) for religious reasons, as well as those who are conservative and prefer not to be around men outside of their own families. Sometimes men and boys at the shelters stare at the women from windows, which makes them uncomfortable. This is awkward for new mothers breastfeeding their babies. Sometimes, the men take pictures to post on their social media about the state of the cyclone and shelters, without the consent of women, which adds to their uneasiness. A key informant, who volunteers in such shelters, revealed that even female volunteers themselves sometimes get eve-teased when trying to get supplies during such conditions. However, when respondents of the survey were asked about the security of women in these shelters, it seemed to be a topic of hesitation. From the 75 respondents who responded out of the 308 households 1.3% perceived the shelters as extremely safe, 17.3% rated the shelters as moderately safe, 2.7 % said they were unsafe and 78.7% said they did not know. This was different from the information revealed in the focus group discussion and personal discussions with respondents, which was probably because there was more than one person present during the survey, and survey participants were not comfortable answering.

The shelters also lack the facilities, comfort, or specific support systems that everybody needs, due to the lack of resources, funds and manpower. For example, during disasters often water and electricity supplies get interrupted, and arranging food and resources like candles and torches is difficult. Elderly people need help to move and to use the bathroom, but there is no such support. The lack of water and light in the bathroom is difficult for women and girls on their period. People may forget to bring hygiene items like pads and period rags, and there is usually none available at the shelters. There is also no place to discard the pads or wash the period rags.

Among the 292 randomly selected male-headed households, 15.75% (46 out of 292) went to shelters, and among the 50 purposively selected female-headed households, it was only 6% (3 out of 50). Figure 3.8 reveals which facilities were available and unavailable at these shelters, based on the responses of those who had took refuge there during recent disasters.

The most noted lacking services revealed by the sample survey respondents include the lack of sanitary napkins for women (78.7%%), accessible pathways for the disabled (76.6%), shelter for livestock (80.4%), and the absence of gender-separated bathrooms (55.3%). On the other hand, the commonly available facilities at the shelters were food arrangement (93%), safe drinking water (93.5%), hygiene facilities (75%), running water (73.5%), communication services (72.1%), medical resources (71.7%) and health care aid for pregnancies (65%) (Figure 3.9).

According to a key informant at the Ministry of Disaster Management and Relief, there are 16 official cyclone shelters in Kaliganj, but currently during disasters, 120 shelters are used. Extra shelters are usually provided by schools and Madrasas (Islamic schools) that have structural stability, in addition to the 16 cyclone shelters. Although it is agreed that everyone must face some level of discomfort during disasters, these specific problems in the makeshift shelters demotivate people from going to shelters. However, the new cyclone shelters being built since 2017 are designed to have necessary facilities such as kitchens, ramps, gender disaggregated rooms, rainwater harvesting facilities, and space for livestock.

Figure 3.9

Perception of Availability of Shelter Services (n=308)

The perception of the availability (and likewise, the unavailability) of gender separated rooms at shelters resulted in almost equal responses in both categories, with 53.1% selecting that they were satisfied with the facility. This can be attributed to the fact that there are different types of local shelters (apart from the official shelters) that may or may not have designated separate areas for men and women, depending on their size, designs, number of people present, and other contextual factors.

Figure 3.10 and Figure 3.11 present the satisfaction level of the 308 respondents regarding the aforementioned services (both regarded as commonly available and mostly unavailable). These data are presented based on only the responses from those who stated that these facilities were available in the shelter they took refuge in. Figure 3.10 shows that most respondents were satisfied with the available facilities. Figure 3.11 reveals that most respondents who had access to the less common facility of gender separated bathrooms were satisfied with them, but most were not satisfied with the accessible pathways designed for people with disabilities. Respondents were somewhat satisfied regarding their access to places for their livestock and, regarding sanitary napkins, an equal number of "somewhat satisfied" and "not satisfied" responses were found.

Figure 3.10

Satisfaction Regarding Commonly Available Facilities at Shelters (n=308)

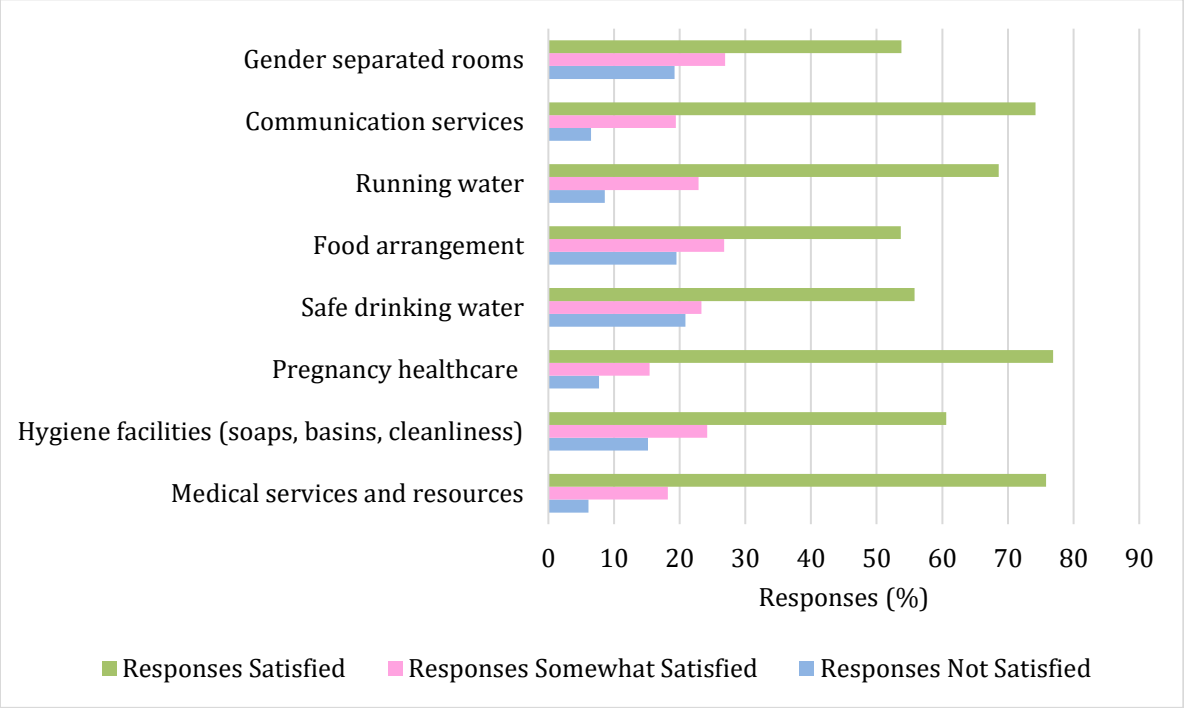
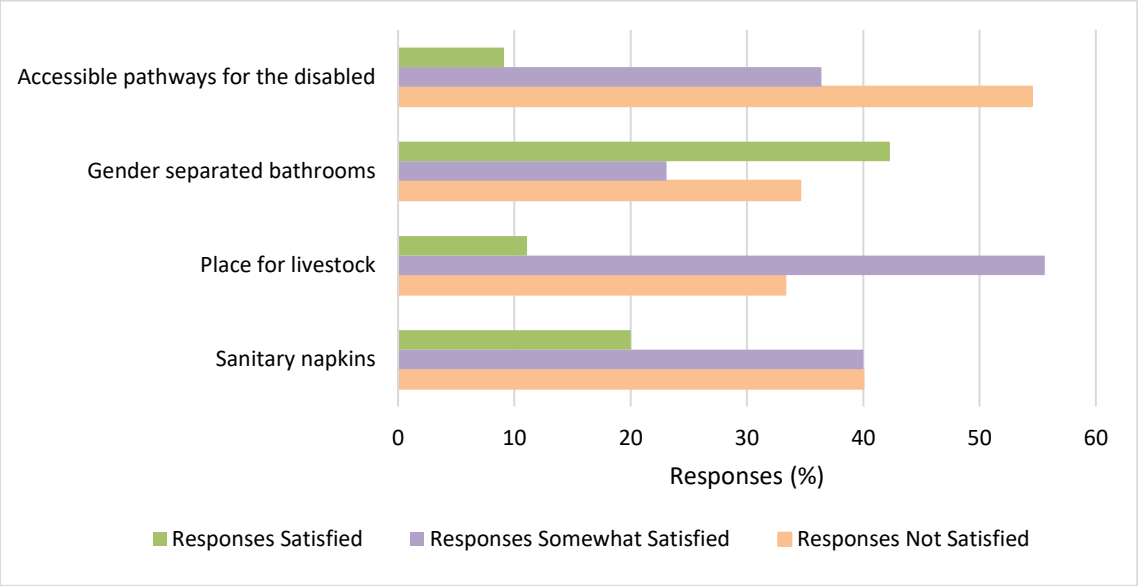


Figure 3.11

Satisfaction Regarding Less Commonly Available Facilities at Shelters (n=308)



Overall, the empirical data suggests that the poor, disabled, elderly, and women in the community tend to suffer significantly during disasters in terms of damage and losses as well as with respect to issues related to shelter and infrastructure. As per key informants, disaster management authorities and local organizations in the area are actively making efforts to address the problems faced by disadvantaged people. There are many programs targeting inequality and the disproportionate impacts of disasters like *Kabi Kha* (*Kaajer Binimoy Khawa*), where affected people work on infrastructure building in exchange for food, and *Kabi Ta (Kaajer Binimoy Taka),* where affected people work on infrastructure building in exchange for food. There are also programs like *VGF* (Vulnerable Group Feeding) which involve the distribution of necessary items and money for families who are disadvantaged, and provision of disaster resilient homes for landless and homeless people (of which 400 have been given since 2017). In these programs, to ensure gender inclusivity, it is compulsory to have 33% women recipients from the total allotted funds, and in the case of VGF, the quota for women is higher, at 70%. However, when talking to locals, many people revealed that sometimes there is corruption in the distribution process and not all the disadvantaged families receive this help.

3.4.3 Impact of Climate Change and Adaptation on Livelihood of Community Members

According to key informants associated with the Ministry of Agriculture, Ministry of Fisheries and Livestock, and Ministry of Disaster Management and Relief, the study area experiences climate-related hazards such as salinity intrusion, frequent cyclones, erratic rainfall patterns, altered duration of seasons, heatwaves, and even issues such as hailstorms, fogs, hightides, and flooding. This area is generally known to be one of the most vulnerable to climate change in recent years, and the changing weather patterns have also been observed by the local people. Such climate change impacts can have a major impact on coastal populations' livelihoods, specifically in agriculture, fisheries, and livestock rearing, which are sensitive to weather and dependent on natural resources.

Agriculture is the most climate sensitive means of livelihood, and seasonal changes and weather extremes can have severe adverse impacts on production and people's income. The study area suffered from periods of drought, as well as excessive rain, humidity changes, and temperature changes. As a result of these climate extremes, crop yield is often lower, and farmers face considerable losses. To adapt to climate change impacts like the lack of rainwater, farmers have to buy water to irrigate their lands, which is very expensive. Farmers have also started to skip planting in certain dry seasons. Respondents from the FGDS explained how excessive rain can also be a problem, with no pathways to reach the fields, making it difficult to plant and harvest crops. If problems like this arise in one season, they get delayed in planting for the next season as well.

The outcomes of the KIIs, FGDs and observations confirmed that agriculture is a major livelihood means for the poor, but not much for the rich. The rich or "big farmers" are the ones who have large plots and lease these plots out to smaller farmers from poor backgrounds and those involved in agricultural labour. The "big farmers' often have multiple streams of income and are more involved with shrimp farming. Hence, it is the smaller farmers that suffer more directly from the impacts of climate change in agriculture than others. A key informant explained:

> *"Poor farmers work directly with agriculture. They plant seeds, gather crops, maintain costs, give crops to the landowners and also keep crops for themselves. Rich people do very little agricultural work. In some cases, the landowner pays only an amount of money per year as rent and all the costs are borne by the poor farmer. In other cases, both bear the costs and both get the crop, but majority of the labour work is done by the poor farmers."*

Climate change impacts on agriculture also affect the availability of fodder for cattle, with many cattle in the area now having stunted growth, according to villagers. Moreover, drinking saline water also gives cows diarrhea. Therefore, people are compelled to opt for buying fresh water, along with fodder for their livestock, which is expensive. This can be a major burden to arrange for poor households. Changes in temperature can also cause poultry and livestock to become sick and die. Moreover, excessive heat and rain can increase the number of mosquitoes that bite cows and cause strokes in chickens. It is usually women in the households who are primarily responsible for livestock rearing, and it is often the primary source of income for widowed women, single mothers, and religious minorities.

The survey results and qualitative data also revealed that since changes in weather make agriculture a risky livelihood, coastal populations have been diversifying their livelihoods and venturing into other forms of income earning. Shrimp farming and day labour work are such two popular work streams, which are not stable income sources, but considered a better option for locals than agricultural activities which are extremely sensitive to climate change impacts. However, due to existing gender norms and societal positions, the rich and poor, as well as men and women, do not have the same experience with this livelihood diversification. In fact, these livelihoods are also affected by climate change impacts. For instance, the survey results indicated that labour work (46.7%), agriculture (14.3%), and shrimp farming (12.1%) were some of the most significantly affected livelihood sectors by Cyclone Amphan in 2019 (Figure 3.12). Fish and shrimp are sensitive to temperature, pH, and humidity changes, and they need to be maintained carefully. Excessive rainfall and waterlogging are also some major issues that affect fisheries. Key informants from the Ministry of Fisheries and Livestock and local representatives of fishing communities explained that when sweet and saltwater mix, it affects the different fish habitats and, since the water enclosures are not connected to rivers, there is no way for the water to drain out.

Figure 3.12

Income Sources Impacted by Cyclone Amphan (n = 308)

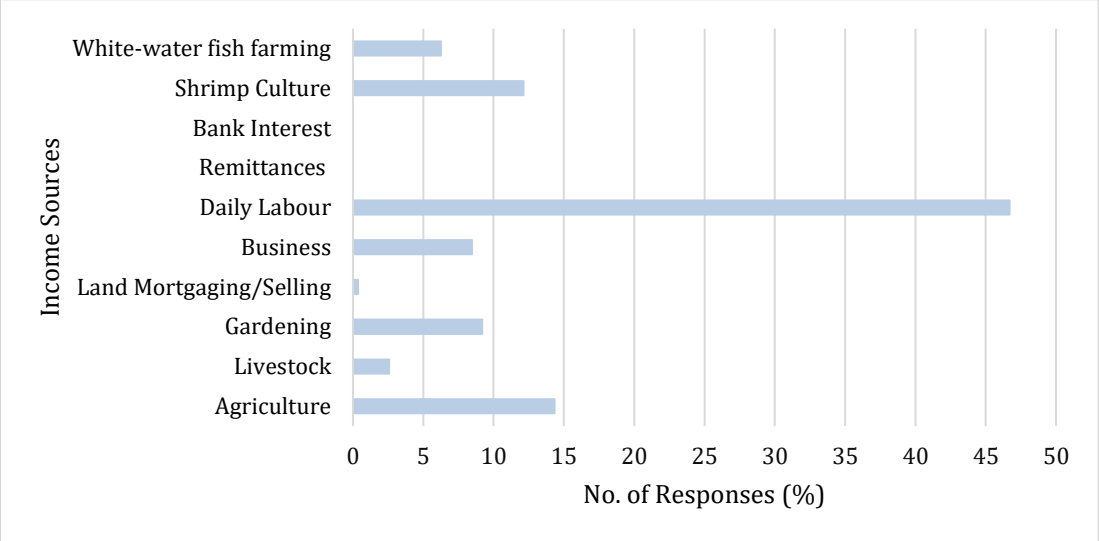
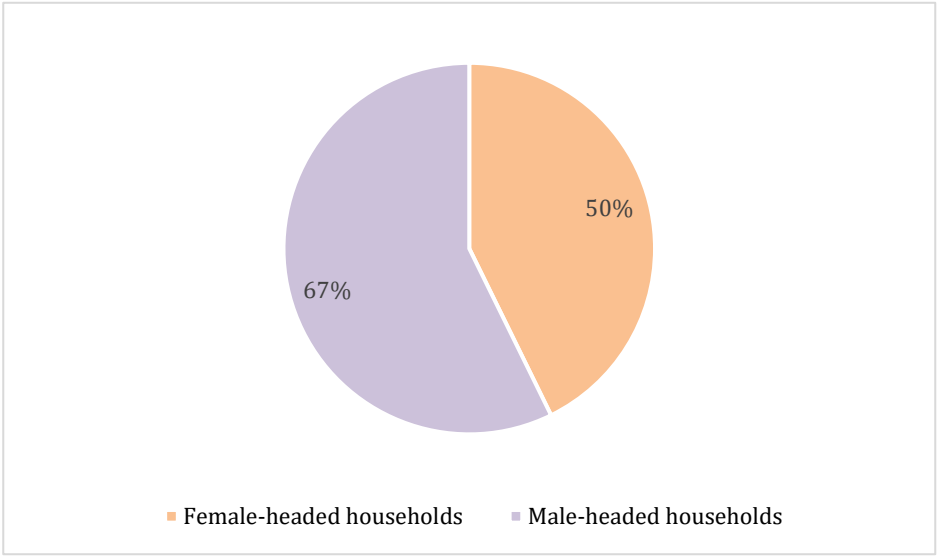


Figure 3.13

Household Income Sources Affected by Cyclone Amphan—Comparison by Gender of Household Head

*Male-headed households (*n* = 292), Female-headed households (*n* = 50)



When comparing impacts on income sources, more male-headed households (67%) were adversely impacted than female-headed households (50%) by Cyclone Amphan in 2020 (Figure 3.13). Their responses are further elaborated in Table 3.5, which reveals a similar impact trend as seen in the cases of 308 households, with unemployment in daily labour hiring being the most common response regarding adverse impacts. However, it should be noted that more female-headed households (72%) earned an income from daily labour and livestock than male-headed households (daily labour at 60.7% and livestock rearing at 12%). This was perhaps because women are more dependent on daily labour work and livestock for income. Moreover, when it comes to labour work, women are most likely unable to travel as freely during cyclones, and given less work opportunities than men during such times. The data also revealed that male-headed households experienced impacts from Cyclone Amphan on income sources involving business, and mortgaging and selling, and white-water fish farming, whereas none of the female-headed households reported on these sectors.

Table 3.5

Comparison of Income Sources Affected by Cyclone Amphan Based on Gender of Household Heads

Income Sources	FHH (%) n=25	MHH (%) n=196
Daily Labour	72	60.7
Agriculture	16	19.4
Livestock Rearing	12	3.1
Homestead Gardening	8	12.8
Shrimp Culture	8	16.8
Business	0	11.7
White-Water Fish Farming	0	8.2
Land Mortgaging/Selling	0	0.5

When discussing labour work, it implies doing physical work for a specific wage, for a wide range of sectors such as agriculture, shrimp farming, and construction. There are some direct impacts of climate change that affect people, such as disasters leading to loss of jobs, and excessive heat and salinity intrusion affecting workers' health. However, there are some societal issues that add to the impacts of climate change issues in the area. In this study, it was found from FGDs that women (especially the elderly) do not get the same opportunities to work or earn as much money as men. While men can work 7 days per week, women might only get called for 3 to 4 days because of the nature of the job, women's limited mobility, and societal norms that prevent them from performing the same tasks as men. Women may also choose to work limited hours because of household chores and responsibilities, which is a disadvantage if they are the sole income earner in their household. It was also found that most men in the study area leave for 6 months to work at brick kilns in surrounding areas or India, where they earn around Tk. 1 to 1.5 lakh for the time period (US $ 839.5 to $1259 for 6 months), and return home to their families for the rest of the year to earn their income in other ways. However, in the case of women, in the rare occasions that they do migrate, it is only to work as a cook in the brick kilns, or to Saudi Arabia or Dhaka city for permanent work as a household helper.

There is also a major gender pay gap issue in the study area for the local labour force, making it difficult to cope with the economic impacts of climate change and related disasters for women. For daily labour work, men get Tk. 500 (US $ 4.18) and women get Tk. 300 (US $ 2.51). This is because it is believed men are stronger, can carry heavier loads and are faster at certain tasks than women. However, key informants working at NGOs that deal with such social issues, as well as key informants associated with the Ministry of Agriculture and Ministry of Ministry of Women and Children Affairs, have stated that men and women have different skill sets that should be acknowledged, and pay should be adjusted accordingly. In fact, in many cases, there may even be no difference in task load or speed, yet there is a gender pay gap. An example of this is the essential task of cleaning algae from shrimp ponds in shrimp farming, where men labourers get Tk. 300 (US $ 2.51), yet women labourers get Tk. 200 (US $ 1.67). When asked about the reason for this particular pay gap, a few women believed it was because men were faster. Some also thought that while unfair, it was the set wage and, if they protest, some other woman labourer would take up the job.

3.4.4 Social and Health Impacts of Climate Change

Access to Water

KII and FGD respondents highlight how availability of water is a major problem for people in the region as it is contaminated with iron, arsenic, and salinity intrusion. The lack of water availability is particularly problematic for women because they are the ones who have to deal with water-related tasks such as cooking and washing dishes and clothes. One of the FGD respondents explained, *"All our plates and glasses get damaged by the water. The colours of our saris are ruined, and the blouses cannot be worn outside if washed. Ofcourse our dishes are not clean enough to our liking; we just make do to get by."*

High-income households can afford to buy water, but this becomes a burden for middle-income and poor households, who often rely on free water distributed from hand pumps from neighbouring houses or other community sources. Water in the study areas usually costs Tk. 0.25 to 0.5 per liter, and it takes Tk. 5 to 10 for delivery, depending on the location. In another community, it was revealed that one drum of water would be 30 liters, and would cost around Tk. 30 to Tk. 35 (US 0.25 cents to 0.31 cents). This drum would only last a family for 3 days at maximum. Collecting water is a major time-consuming activity in villages, for which women are mostly responsible. When men do fetch water, they use bicycles or motorbikes, but women and girls walk with water

pots on their heads and waists. While younger girls may occasionally use cycles, this is rare—and older women never use such modes of transport as it is considered inappropriate (See Figure 3.14 and 3.15). One of the female respondents shared how walking with water pots for long distances can be difficult:

> *"It is painful to carry water pots on our waists. The hand becomes numb, the legs hurt. I think going and coming back with the water takes around an hour. Then again if there is a lot of people there it might even take 1.5 hours."*

Figure 3.14

Man Going to Collect Water on a Bicycle

Source: Photo taken by the author with consent during the field work (September 23rd, 2022, Kaliganj).

Usually, groups of women and girls walk together to collect water, and this is often a social activity. However, it also gives a chance for men to harass and catcall young girls. When asked about the problems faced during water collection specific to women, one of the participants of an FGD said:

Of course, we face problems! We are older women so nobody says anything. But if they (boys and men) see younger girls they wink at them and say many types of things. My daughter told me 'Mom, a boy said all this to me!' She used to go in the mornings to collect water but now she goes in the afternoon to avoid them."

When the stock of water in their household is about to finish, people sometimes borrow from their neighbours. They also rely heavily on rainwater collection during monsoon months, which they use for many purposes (See Figure 3.16). However, rainwater for drinking is not suitable for everyone due to health reactions. Women also tend to drink less and prioritize their husbands if there is not enough water. One woman explained:

"Right now, we are drinking rainwater. But my man gets allergies when he drinks rainwater, so I drink it. If there is no rainwater, then I have the tap water. You know, women can bear a lot of discomfort, but men cannot bear the same discomfort in many cases."

Figure 3.15

A Woman Carrying a Water Pot on her Waist to the Water Filling Location

Source: Photo taken by the author with consent during the field work (September 23rd, 2022, Kaliganj).

Figure 3.16

Rainwater Harvesting

Source: Photo taken by the author during the field work (September 23rd, 2022, Kaliganj).

Domestic Issues

Climate change–related disasters and weather changes can have some indirect, reverberating impacts on people's relationships at home. One of these impacts includes limited food when there is lower income or less production of crops. Women participants in the FGDs disclosed that during such times of financial hardship and food scarcity, women tend to sacrifice and let their husbands eat whatever little food there is. One of the participants said, "*We have to give the good food to the man of the house—the husband first, then the kids and then we come last"*. Other participants agreed, with another respondent explaining her specific coping strategy when there is limited food in the house:

> *"During those times, we cook potatoes in greater amounts. We give a bit more to the men and we eat a little less. Also, for instance, if there is less rice right now, I might just drink two glasses of water so I don't have to eat as much rice."*

When asked about why men are prioritized in such instances, the participants believed that their husbands needed to be given better quality and more food because they work harder and are outside all day for long hours without any rest, whereas women work at home and can at least sit

down. It should be noted that the participants also stated that food is distributed equally between men and women most of the time when there is no scarcity.

An outcome of an FGD with women, as well as some KIIs, brought to light the domestic violence and arguments resulting indirectly from climate change impacts on livelihood and income. According to a key informant who works closely with these communities for women's empowerment and faces domestic violence herself, when finances are impacted during difficult situations like disasters and climate change–related shocks, men become more aggressive and are in bad moods. She explained:

> *"When men start earning less and cannot manage the household, conflict arises between the husband and the wife. Sometimes, men look at it as entertainment, a way to relax. They think at least this is how I can reduce my frustration and anger. The girls in our community are also used to this kind of behaviour."*

Such scenarios were also specifically mentioned by several women respondents in FGD sessions (i.e., labourers and crab collectors). These women usually participate in these activities to help their husbands earn extra income for the household. In addition to working outside, women also have to complete household chores that men do not help with, and time management becomes an issue. A respondent explained, *"As women, we have to work outside and at home as well. Men don't have to come home and cook or do the dishes. There is so much work to do in the house."* Moreover, if husbands come home to see incomplete household chores and late meals, they often use bad language toward their wives, and in some cases even beat them. One female respondent explained how her husband does not understand that she also works all day, saying:

> *"I go in the morning to do labour work. I also have to maintain the livestock and the pond. Then I have many tasks like doing the dishes and cooking and cleaning. When my husband comes home, he says, 'You still have not finished cooking?" You are so late. What have you been doing all day?'"*

When asked to further elaborate on arguments and violence at home, another female respondent said, *"Of course we get beatings and thrashings! We suffer there (at work), and we suffer here (at home) too".* Other participants agreed, with one of them explaining that when she tells her husband that the food is being served late because she also just returned from work like he did, the husband says, *"How much money did you even earn today?"* Such behaviour was common in most households, with another respondent sharing that men tell women *"Women don't*

face any problems at all. Men face all the problems". It is important to note that this was a sensitive topic that took women some time to open up about. However, once they started discussing the topic, they complained lightly about the husbands' behaviour and speaking about the situations with humour and sarcasm. From personal observations and their attitude toward the topic, it seemed like this was a normalized part of life and shared experience among women in the community.

Health Issues

Key informants discussed how washing clothes and dishes constantly with salt water can have serious adverse health impacts like rashes and skin diseases on women's hands. Women in the villages use rags instead of pads or tampons, which they wash regularly to reuse. A key informant who works with women in the communities revealed, *"During their periods, women have to wash their rags with salty water, which is why they get several diseases like urine infection"*.

Women participants from FGDs also shared how they are exposed to health problems from their livelihood choices. Many women participate in crab collection and fishing for an extra source of income to deal with the financial impacts of climate change and contribute to household expenses. While men fish with bigger nets in groups for bigger catches, women stand directly in the water, submerging half their bodies and catch fish and crabs with their hands or small traps.

Labour work like clearing algae from ponds and shrimp enclosures is also popular among women, where they stay in the water for hours. When doing these activities, they come in direct contact with dirty and salty water which can cause many skin diseases and itchiness in exposed areas, as well as urine infections. This can be particularly problematic when women are going through their periods. One of the focus group respondents explained *"Our skin itches, there are infections, white discharge and we experience burning in those areas. During periods, we try not to go, but if we do, we remove the period clothes (rags) and then go directly into the water"*. All the participants agreed with this information, with some of them saying they had to visit the doctor. One of the respondents said, *"The doctors tell us not to do this kind of work and that we are getting infections because of it. But if we don't do this work, how will we eat?"*

Some key informants who work with these local communities regularly also explained that the impacts of climate change can be indirectly linked to a long chain of social issues that affect

women negatively. For example, nutritional deficiencies affect girls' periods and make them irregular. Issues like this can lead to fertility problems and divorce later on. Moreover, the effects of living in areas where salinity is high in the water and air on women's physical health can have many other indirect impacts. As an example, a key informant associated with an NGO working with women's issues in the area shared:

> *"We get skin diseases; we get darker skin tone and our hair falls off because of the salt. Women suffer from itching, period issues, high blood pressure leading to more miscarriages and venereal diseases. If they are suffering from all this, husbands won't stay with them for long. This is an open secret—the husband will get married again, hit their wives and behave badly with them."*

According to other government and NGO-associated key informants, in the study area, the climate change–induced stresses and shocks constrain livelihood options and reduce income. Consequently, men often migrate to other area of the country or even to India. In many cases, they may not return and ultimately start new families in the place they are working, therefore leaving their old families to fend for themselves. The women left behind are often not self-dependent and face harassment from society and other men.

Child marriage was also brought up in discussions in relation to climate change. When respondents were asked about the minimum age of marriage of girls in the area, they all said 18 years, while it was 22 for boys. The legal age of marriage in Bangladesh is 18 years, and several efforts are made by organizations to stop early marriage. However, upon observation, it could be seen that many young girls below the age of 18 were married quite early and had babies. According to a key informant, early marriage is a common coping strategy among families in disaster prone areas, where disasters can be a security issue for young girls. She explained:

> *"When there is a disaster, fathers and mothers feel helpless. We don't have electricity and cyclone shelters are not gender friendly and girls often get harassed, so people don't want their daughters there. Since the parents know disasters can happen any time, they want to get their daughters married off early. It is always at the back of their heads since it's always occurring, so if they can, they try to marry off their daughters."*

3.4.5 Exclusion of Religious Minorities and Impact of Climate Change

Based on information from FGD sessions, KIIs, and personal observations, it was found that in Kaliganj, Christians and lower-caste Hindu communities such as the Rishi and Dalit communities are minorities who face continuous marginalization. They tend to stick to their traditional work, which is often low wage occupations, such as producing bamboo products and handicrafts (*bash bet er kaaj*), shoe repairing, hairdressing, wage labour, and goat rearing. These communities find it difficult to move away from these occupations as they do not have enough capital, or skills to start something new. Sometimes, it can also be a generational skill that people don't want to abandon. For instance, while there were both Muslim and Hindu fishermen, it was observed that Hindu fishermen belonged to a certain caste, which only practised fishing as their main occupation for generations. Making bamboo products and handicrafts were also one such caste-specific skill passed down several generations.

It is important to note that various facets of livelihoods are impacted by climate change, including bamboo business and production, as it requires a lot of space outdoors and input from nature (See Figure 3.17). Usually, men collect, cut, and sell the bamboo, while women do the sewing. When the weather gets too hot, they cannot produce products at the same rate. When there is considerable rain, the men involved in bamboo handicrafts for livelihoods have to buy bamboo at higher prices from the market, instead of collecting it. Moreover, weather changes and resulting agricultural trends affect the demand for their products. An FGD with a Christian community in the area (where many were converts from the Hindu Rishi caste) discussed how they rely heavily on bamboo handicrafts for income, producing items like baskets for crop collection and bamboo barriers and bridges (*baadh*) between shrimp enclosures and ponds (See Figure 3.18). The bamboo products are usually bought by sellers who come to their locality to sell them in the market. While the community would get more money if they were able to sell it in the market themselves, they do not have the money to even go to the market or pay the taxes for renting a shop there. Moreover, they do not want to take the risk of not selling any items, as they need immediate cash to buy food for their family.

Figure 3.17

Lower-Caste Hindu Man Working on a Bamboo Product (Bash Bet er Kaaj)

Source: Photo taken with consent by the author during the field work (September 25th, 2022, Kaliganj).

Figure 3.18

Bamboo Product Made and Sold by the Rishi Community

Source: Photo taken by the author during the field work (September 25th, 2022, Kaliganj).

The community's other popular income streams including hairdressing for men, open van drivers, and livestock rearing are also impacted by weather changes. For instance, people travel less during severe weather or foggy cold weather. They also do not go outdoors as much when it is extremely hot. Moreover, most men from the area migrate seasonally and this reduces demand for haircuts. Another major issue the community mentioned was the impact of heat and cold on their livestock. Cows cannot be kept outdoors during rain, and because agricultural outputs are low, the cost of cow feed also increases, not to mention the fact that animals are often very sensitive to temperature.

In an FGD, it was revealed that these communities want to change their income streams, but find it impossible to do so. One respondent stated:

> *"We have to change our type of work and we need investment and assets to change it. We are trying. Do you think we really want to remain like this for the rest of our lives? We are vulnerable and we continue to be vulnerable. We have seen our ancestors had nothing and we also don't have anyone to give us support."*

For these communities, it is more difficult to get larger loans to cope with the impacts of climate change on their livelihood and move away from the cycle of poverty. These people usually do not have many assets or land to their name, which banks and loan lenders often have as a requirement. Regarding this issue, a respondent explained:

> *"If I want to take a higher loan above Taka 30,000 (US $251.62), I would have to get a blank cheque and a stamp from a bank. How am I supposed to get those? The organizations take these in case I cannot pay back the loan with interest. The blank cheque will have my sign but I won't know what they will write there. I don't have any money at all in the bank. If I cannot give the money back, these organizations can then use that blank cheque to file a case and get the money through the bank."*

From the FGD sessions, it was also evident that the lack of support and investment opportunities were preventing the communities from expanding their income sources beyond what they know. They were earning day to day in order to survive and did not have the capability to set up sustainable sources of income. As a result, they were dependent on other people constantly, and stuck in a cycle of poverty. A respondent shared:

> *"We raise someone else's chickens. They buy the chickens, food, and medicine because don't have the money to buy all that. They take cost of expenses and give us the profit. It*

is profitable for the owners because they buy chickens and other necessary items at bulk and for lower prices, but cut the normal rates from us. We cannot sell the chicken either, and if we do it has to be at the owners' rate. For instance, I could sell the chicken for Taka 240 (US$ 2.01), but the owner wants to sell it at 200, just as long as his basic costs are covered. Even if there is a loss when chickens die, we have to give them that money."

Although it is true that minority communities get some advantages and help from the government in the form of subsidies, many of them are not even aware of these opportunities. For instance, the Rishi community is entitled to get the old age subsidy starting from the age of 50—a much lower eligibility age compared to other citizens. However, people rarely claim this subsidy. It is also important to note that women in these minority Hindu communities are not encouraged to work, unless they are compelled to do so. The key informant interviews and discussions with participants revealed that often, the Hindu minority women in the area are not given their rightful ownership to property and do not usually receive any assets from their father's side. In these communities, it was also observed that girls were typically married off at an early age and discouraged from pursuing higher education.

A key informant associated with NGOs that work with these communities, as well as a local representative from the community, discussed how education is free for children from Rishi families and scholarships are available for them. However, kids rarely continue school and are more interested in earning a living immediately and getting married early. A key informant involved with the local school said that sometimes students from lower-caste families may be teased and asked to sit at the back of the class because they are from the Rishi community. When these students complain to teachers, the teachers do not take action either. These issues can also discourage children from religious minority backgrounds from attending school. When asked if such behaviour still continues today, she said:

"Of course, there is still some discrimination that takes place. My daughter had a friend in grade 5 who was a sweeper's daughter and they used to sit together in class. Everyone would ask my daughter why she sits next to a sweeper's girl, and even the teachers would come and complain to me about it. We don't treat these people the same in our society. We don't even let the cleaning staff sit on chairs."

From this study, it was also observed that climate change impacts like salinity intrusion and lack of water availability were aggravated by some resource conflicts between dominant

communities and religious minorities. For instance, results of the FGD sessions found that one of the communities used to live on free government given land (*khaas land*) but the pathway that was privately owned was suddenly off limits to them when that land was sold to new private owners. As a result, they could no longer walk on those roads and had to move to a new settlement. A similar problem was discussed in another village, where the Hindu communities had limited access to the main roads as their houses are secluded and located on the inside of the village. Thus, in order to collect water, the Hindu locals have to walk through the pathways within the Muslim households, whereas the Muslim households can just use the main roads. A respondent explained how this can cause arguments while doing something as harmless as collecting water, stating:

> *"They (the men from Muslim households) say walking with an empty water pot is unlucky and curse us for it. In our village there is a saying that if a man is going out to earn and a woman walks by with an empty pot, then his earnings won't be good that day. They (Muslim women) don't have to cross our homes but we have to cross their homes to collect water, so they get mad at us about seeing us before they go to work."*

Conflicts with water body sharing and exclusion of minority groups was seen in two different villages. For instance, in one of the villages, a pond the Hindu community once shared with other villagers was no longer accessible to them after a Mosque (known locally as *Masjid*) was constructed. A respondent in an FGD explained:

> *"We can't bathe in that pond anymore because of the Masjid. They say that our bangles and vermilion (shakha and shidur—both important symbolic elements of Hindu religion worn by women) will get washed in the water and ruin the Muslims' prayer and ablution. Other people can go there but we cannot."* Another respondent added, *"The people in the area say they will not go to the Masjid if we go there, so the Masjid committee also tells us not to go there. They say 'Don't come to our Masjid. Our religion will get ruined because of you. The environment of the Masjid will get ruined'."*

The focus group respondents revealed that they are often forced to take baths in the surrounding shrimp enclosures (*ghers*) or canals (*khals),* which are also privately owned by others and where they are also not welcome. These bodies of water are dirty, saline, and often have fertilizers and other chemicals, resulting in skin diseases upon contact. These issues with water and bathing are particularly difficult for women, especially during menstruation. A respondent shared:

> "*We hide and take baths in the shrimp enclosures. We get a lot of skin diseases from there. Our skin gets itchy because they breed fish there and throw fertilizer in there. The doctor told us not to bathe in open water bodies. When we have our period, we try not to go there and use the water from the tube well. But this tube well water is also not good as it has a lot of iron. If we wash our clothes/rags in that water, they get stained. If we use those clothes we start itching and swell up in our private areas."*

The respondents shared how it is time-consuming to take baths and find an appropriate time when the shrimp enclosure is empty, since they are guarded by men *(chowkidaars)*. Sometimes they get caught taking baths and are scolded as well. One of the respondents shared, *"When they see us, they say we are shameless. We are ruining the fish. They ask, 'Don't you feel any shame? You are not supposed to be in the water!'"* From observations, it was obvious that the bathing issue was a major problem, as it was discussed by everybody. All the women and children also had arms covered with rashes and skin disease, and their local doctor had specifically told them it was because of the water they were bathing in. This was confirmed by the doctor when he was also contacted about the issue. A similar problem was also observed in a neighbouring village, where the Hindu Rishi community were not allowed to sit on the stairs of the shared ponds, or bathe at the same time as Muslims. The FGD session respondents revealed that there were always arguments taking place and it was a frustrating experience for them.

It is important to note that the minority groups stated that there is no other discrimination taking place, except for the conflicts with water and road issues. However, it was obvious that there was a subtle separation between the minority lower-caste Hindu locals and the higher-caste Hindus and Muslims in the village. The communities even had different names within the village called "Muchi Para", which means the "Cobbler Area". This was supposedly because of the communities' traditional occupations related to shoemaking, which even though many did not continue, they were still known for this occupation. This was common in other areas as well, with certain lower-caste Hindu communities being called "Rishi Para". In both Hindu communities that were visited, the minority lower-caste Hindus lived in secluded areas with broken roads and weak structural housing, and were difficult to reach. Open defecation was observed in those areas, as well as a dirty environment and muddy, water puddles everywhere. These communities are isolated from both Muslims and higher-caste Hindu communities and experience subtle forms of discrimination.

Based on my observations, three tables depicting how existing climate change inequalities influence exposure, vulnerability, and adaptive capacity to climate change impacts have been presented (See Appendix A) and the findings have been summarized in Table 3.3 and 3.4. It was found that in all categories, gender disparities led to greater exposure and vulnerability and reduced adaptive capacity for women than men, therefore resulting in greater climate change impacts. These impacts in turn affect women's rights, physical and mental well-being, economic security, and social positions, thereby increasing gender disparities (Table 3.6 and 3.7)

Table 3.6

Existing Gender Inequalities Leading to Greater Exposure and Vulnerability to Climate Change Impacts, Lower Adaptive Capacity and Exacerbating Gender Disparities

Dimensions of Gender Inequality	**Nature of Inequality**	**Greater Exposure**	**Greater Vulnerability**	**Greater Adaptive Capacity**	**Remarks (Effect on Gender Disparities)**
Access to Income	• Pay Gap • Occupational Immobility • Unequal Division of Labour	Women Sometimes men in case of certain types of livelihoods	Women	Men	Leads to greater income inequality for women.
Wealth	• Lack of Assets • Unequal Land Rights	Women	Women	Men	Leads to greater wealth inequality for women.

Dimensions of Gender Inequality	**Nature of Inequality**	**Greater Exposure**	**Greater Vulnerability**	**Greater Adaptive Capacity**	**Remarks (Effect on Gender Disparities)**
Social Relations and Power Dynamics	• Gender Norms • Cultural Expectations • Religious Regulations • Decision-making Power	Women Sometimes men in case of certain gender norm–related responsibilities	Women	Men Sometimes women in case of networking for knowledge	Leads to lower social standing and limited decision-making power for women.
Institutional Discrimination	• Non-inclusive Infrastructure • Complex Official procedures • Limited access to collective resources	Women	Women	Men	Leads to greater risk to safety, and income and wealth inequality for women. Works as barriers for women's empowerment.

Table 3.7

Overlapping Intersectional (Elderly and Minority) Identities to Gender Inequality

Intersectional Identity	Nature of Inequality	Greater Exposure	Higher Vulnerability	Lower Adaptive Capacity	Remarks (Effects on Social Disparities)
Elderly	• Physical Immobility • Occupational Immobility • Limited Decision-making Power • Non-inclusive Infrastructure • Complex Official Procedures	Elderly women *Sometimes elderly men in case of certain types of livelihoods and gendered responsibilities	Elderly women	Elderly women	Elderly are more exposed and vulnerable to climate change, and have lower adaptive capacity than others. Elderly women suffer from additional gender-related inequalities along with age disparities. Leads to more income and wealth inequality and low social standing.

Intersectional Identity	**Nature of Inequality**	**Greater Exposure**	**Higher Vulnerability**	**Lower Adaptive Capacity**	**Remarks (Effects on Social Disparities)**
Minority	• Occupational Immobility • Limited Decision-making Power • Non-inclusive Infrastructure • Complex Official Procedures • Lack of Representation	Minority women *Sometimes elderly men in case of certain types of livelihoods and gendered responsibilities	Minority women	Minority men	Minorities are more exposed and vulnerable to climate change, and have lower adaptive capacity than others. Minority women suffer from additional gender-related inequalities along with social disparities. Elderly minority women suffer the most from gender, social, and age-related disparities. Leads to more income and wealth inequality, low social standing and marginalization.

**See Appendix A for elaborated tables*

3.5 Discussion

3.5.1 Greater Burden of Climate Change Impacts on Poor, Lower-Caste Religious

The results of this study offer evidence of lower socioeconomic groups, women, and minorities experiencing disproportionate impacts of climate change, starting from disaster-related struggles and consequences on livelihoods, to social and health issues. This adds to the existing literature discussing how certain groups have greater vulnerability to climate change and therefore experience a greater burden of its impacts (Coirolo & Rahman, 2014; Gentle et al., 2014; Islam & Winkel, 2017; Thomas et al., 2019). Moreover, women and minorities were found to be more vulnerable to climate, with women from all communities facing greater climate change impacts than men in their communities—which is similar to findings from existing literature such as Goh (2012), Dube et al. (2017), Xenarios et al. (2017), Sardar and Bhaduri (2022), and Jain et al. (2023).

It should be noted that most of the Hindu religion and female-headed households in the study area were poor. These poor households experienced greater damage to their houses during disasters, most likely because they lived in low-value, risky areas prone to climate-related issues like erosion, landslides, flooding, etc. They also lived in housing made of weak infrastructure and lacking basic facilities, which makes their situation during disasters worse. Furthermore, it was found that poor households took longer duration to recover from previous disasters, which is likely because of their limited finances and assets, and hand-to-mouth lifestyles. Due to their dire economic condition, it is also difficult to take loans to recover, especially for minorities from lower-caste Hindu religions, as they lack the ability to provide collateral. This creates a perpetual cycle of vulnerability, whereby the poor households from minority backgrounds cannot improve their position in society and are kept in their state of poverty due to institutional discrimination. Loans have been identified as a positive influence on adaptive capacity in South Asian countries like Pakistan (Qazlbash et al., 2021). However, as Batung et al. (2022) explains, the design of formal credit institutions, especially under the private sector, are largely focused on profits—which reinforces social stratification as they ultimately do not benefit the poor.

Along with impacts on health, livelihood, and assets, women were found to face additional reverberating impacts such as increased risk of harassment, domestic abuse, child marriage, dropping out of school, time-poverty, as well as mental health issues. These issues have long-term consequences that affect their quality of life, autonomy, and future prospects—all

of which are important for a person's overall well-being. Minorities also deal with existing inequalities such as limited income opportunities, low education, and poor living conditions when compared to other communities. These factors, along with discrimination against the marginalized, and social taboos relating to the caste system, amplify the impacts of climate change. Therefore, climate change can be seen as an aggravating factor for all types of social inequality.

A key finding in this study was that due to their low social standing and lack of power, minorities are often the victims of resource conflicts and are deprived of equal access to public resources. In fact, Sovacool (2018) highlighted how in Bangladesh, even adaptation projects and policies may exclude minorities and worsen their conditions. Also, due to limited water supplies, absence of basic hygiene facilities, and difficulty accessing resources, some minorities suffer twice as much from water-related climate change issues. A study by Shohel et al. (2024) echoed similar findings, sharing that minority Munda and Rajbanshee indigenous communities in southern coastal regions struggle to arrange safe water when affected by salinity intrusion, due to the high cost. Durrani et al. (2024) discusses how climate change impacts in general result in escalated competition for resources for countries, which is evident in the transboundary river water–sharing issues between India and Pakistan and India and China. Such climate change–related resource conflicts are more intense in African regions like Sudan and Nigeria (Folami et al., 2013), which not only suffer from international water conflicts, but also from internal water scarcities within communities (Selby & Hoffman, 2014). Ruettinger (2011) explains how local water conflicts are a globally common phenomenon, which is being exacerbated by climate change impacts. He asserted that the marginalized communities are often the worst sufferers and that these conflicts hiding behind water issues run much deeper on a societal level.

3.5.2 Women's Climate Change–Related Problems Magnified by Intersectional Inequalities and Contextual Vulnerabilities

Intersectional Inequalities

My research found that intersectionality is a significant factor in the context of climate change–related gendered vulnerabilities. Existing gender inequalities are exacerbated by other vulnerable identities like being elderly and belonging to a lower-caste religious minority group.

This is supported by existing literature, but more at the theoretical level than through empirical case studies (Djoudi et al., 2016; Godfrey, 2012; Versey, 2021). My study also identified that generally, the most vulnerable populations (when all other nuanced contexts and external factors are assumed to be the same) in coastal regions are elderly women from minority backgrounds.

My study revealed that women experience greater discomfort than men at shelters, but elderly women face even more severe problems. Their limited mobility, existing physical issues, illnesses, and need for support add to their struggles with the lack of gender-inclusive facilities at the shelters. Another example of the added burdens of climate change in my study was seen in the minority communities suffering from resource conflicts. Women tend to endure more hardship due to the lack of water availability as they are responsible for water collection and water-related household chores. In these cases, minority women suffer the most. Women from poor households belonging to lower-caste Hindu minorities cannot use resources freely and need to follow the rules set by the dominant religious community members who are usually in charge of the water supply.

Notably, rural women are given limited land rights, which affects their decision-making power within the household and in the community. It also keeps them in a financially insecure and unstable position. In addition, women from Hindu lower-caste minorities have even more limited land rights due to their cultural norms, limited assets, and state of poverty. These women are at the lowest position in society and are the most underrepresented during policy-making processes, so their problems are rarely addressed. The lack of empowerment, autonomy, and decision making make women more vulnerable to climate change and reduces their ability to take appropriate decisions for coping with its impacts.

The study by Asaduzzaman et al. (2023) observed similar patterns, revealing that women from both ethnic and non-ethnic backgrounds were more vulnerable to climate change impacts than men in rural coastal regions. However, researchers of this study also emphasized that vulnerability is always context specific. In their study, Munda women in the area were empowered by working beside men and earning money from both off-farm and agriculture sectors. Many ethnic households were also female headed and had greater decision-making power within their household, compared to non-ethnic women. However, in the community, ethnic women still had lower social standing than non-ethnic women and were excluded from collective decision-making processes (Asaduzzaman et al., 2023). A study by Ahmed and

Eklund (2021) also found that despite being the majority, compared to Hindu women, Muslim women in their study area were less likely to receive first-hand climate change adaptation–related information from agricultural extension agents due to their religious restrictions on speaking with men. According to Ashrafuzzaman et al. (2022), who explored intersectionality and gender inequality in the context of climate change, women's empowerment (which plays a vital role in reducing vulnerability and improving gender inequality) depends on a number of contextual factors such as social class, caste, religion, cultural values, education, and social and economic freedom.

This link between intersectionality, gender, and disproportionate climate change impacts was examined in other countries as well. For instance, Phuong et al. (2023) found that poor Co Tu ethnic minority households in Vietnam, especially those headed by women, had lower climate resilience ability compared to the Kinh majority households. The study by Khan et al. (2024) on the Kalash Indigenous community of Northern Pakistan shed light on how indigenous women are more exposed to physical and sexual violence when they are displaced due to climate change–induced disasters. Similarly, in Nepal, Dalit women have been found to experience disproportionate impacts of climate change due to the groups' climate-sensitive traditional occupations, women's roles and activities being intertwined with natural resources like collection of water and agricultural products, and the exclusion of the Dalit community from communication modes (Khadka et al., 2022).

Importance of Context when Considering Gendered Vulnerabilities

The findings of this study revealed some context-specific cases of gender empowerment and vulnerability, and in some scenarios, they were complex in nature as there were both positive and negative aspects for women. This was evident in poor households and female-headed households where women were working as wage labourers. Based on conversations with locals, it was obvious that these women only did so because there was no other option—that is, they were widowed, had no male household members, or depended on the dual income to survive. It was observed that poor households often have less restrictions for women, whereas women in high-income households tend to stay home and have limited mobility, with greater expectations of seclusion of women (*purdah*). Another such example is when women are often given more loans from NGOs than men, which empowers them to invest in income-earning initiatives, make

climate smart decisions and invest in their children's education. However, while the initiatives are helpful, it was revealed that men often took out loans in their wives' names for personal purposes, or to marry off their daughters. This raises the question of whether the solutions and interventions in place for climate change adaptation and aid are genuinely helping women in a transformative manner, or whether gender inequalities manage to creep in behind the face of "empowerment". In similar context, Bain et al. (2018) states that women in Uganda who often participate on building dairy livestock assets may be considered "weak winners" under the guise of achieving empowerment. This was due to the added labour which resulted in time poverty, especially for women in poor households who could not hire herdsmen.

In my study, it was also revealed that men would migrate for better livelihood opportunities as a coping strategy to support their families. Research has revealed that as men migrate for work, women are left with an increased work burden as they have to fulfill all the man's responsibilities like managing finances and land, as well as stocking up on food and taking care of their children (Naz, 2023). However, it should also be noted that in these scenarios, some women in this study felt more empowered and independent as they were handling everything. Thus, empowerment is largely contextual and subjective. Regarding gendered labour work and climate change impacts, existing literature is not always negative. For instance, Shayegh and Dasgupta (2022) predict a reduction in availability of low-skilled labour in high climate change impact exposure sectors and a subsequent increase in job opportunities for women in South Africa.

This study recognizes that it is not always women who are most vulnerable to climate change compared to men, although based on our findings, that is generally the case. There are context-specific situations where men may be more vulnerable to climate change impacts, especially when factors such as social status, wealth, age, and minority background come into play. In the study area, I found that men suffered from physical health issues, mental health issues, financial burdens, and livelihood-related issues due to climate change impacts. I also found that in some cases men may have greater exposure to climate change impacts through their societal roles, livelihoods, and labour-intensive responsibilities.

Another important finding was that men from Hindu lower-caste minorities or poor households, as well as elderly men, were more vulnerable to climate change impacts than women who were from dominant religion communities or richer households, and younger in age. This

aligns with Sovacool (2018)'s study that describes how upper-caste Hindu women are at a higher advantage than lower-caste Hindu men in Bangladesh as they have more financial stability to cope. These women also do not partake in manual labour, but the lower-caste men have to do the physical work in adaptation interventions such as digging canals, or planting crops and levees, that ultimately benefit all members of the community.

On a similar note, a study by Khan et al. (2022) highlighted how masculinities and cultural roles of manhood and gender norms create immense pressure on men and affect their mental health when they are unable to fulfill their responsibilities as household heads. Nagel and Lies (2022) also point out that firefighters and rescue workers associated with climate induced-disasters are often men, which increases their exposure. They argue that research for disproportionate gendered climate change impacts mostly focuses on women, while leaving men out of the discussion. When climate change is framed as a women's issue, this shifts the responsibility away from men, masculinities, and their role in addressing gender gaps.

3.5.3 The Role of Social Construct, Internal Beliefs, and Institutional Discrimination in Disproportionate Impacts of Climate Change

A major finding of the study is that social constructs, internal belief systems, and institutionalized discrimination are significant drivers of disproportionate impacts of climate change. In some cases, social expectations and gender norms dictate women's behaviour and compel them to bear certain situations resulting from climate change impacts. An example of such behaviour includes saving food for the husbands and kids while eating less themselves during scarcity. Another such example lies in women's unwillingness to leave for shelters during disasters due to their caretaking responsibilities toward the elderly. Other examples can also be seen in South Asia, such as how restrictive traditional clothes for rural women and norms against women learning how to swim add to their vulnerabilities during disasters. In addition, societal norms and lack of transport options limit women's mobility and require chaperoning by men, which often prevents them from seeking medical care or shelters from disasters (Sultana, 2022). In Ethiopia, climate-induced water scarcity leads to girls skipping school to help out with water collection. Moreover, girls and women in Ethiopia are often expected to be docile and have limited decision-making power, which affects their responses to climate change impacts (Devonald et al., 2024).

This study highlighted that internal belief systems conditioned in women (as well as lower-caste Hindu minorities) themselves that place them at a lower social standing can serve as obstacles in their empowerment and aggravate the impacts of climate change. For example, despite doing the same work for algae removal, many women truly believed that they deserved to be paid less wages compared to men because they are weaker and slower as a gender. These behaviours due to gender constructs and norms can harm women and increase their vulnerability from climate-related issues. Zafrullah (2019) also notes the patriarchal system in Bangladesh encourages women to hand over their wages to the men/head of the family. In some cases, the men of the household may even be the ones collecting the women labourer's wages from the employers, which ultimately gives them more control.

Furthermore, stories about beatings and verbal abuse from husbands were shared with humour, as if it is a normal part of life. The way these topics were discussed, and the women's annoyed but accepting attitude toward these issues, indicate that they have been preconditioned from a young age and over generations to think in a way that men in their life have certain rights over them. Similar findings were revealed in studies by Rezwana and Pain (2021) and Memon (2020), where they explored how the instances of gender-based violence may increase due to climate change impacts. In fact, in South Asia, research has found that an aggravated trend in domestic violence occurs when household crops, income, and food security are adversely affected by climate variations (Malivel et al., 2024).

As for minorities, apart from the evident societal discrimination and state of poverty, they seem to have some inherent beliefs about themselves that prevented them from leaving their generational low-income livelihoods. These communities did not see any benefit of educating their kids beyond primary school, as they need the children to participate in income generation, and the social taboo against their children add to their hesitation toward educating them further. They also marry their girls off at a young age so as to minimize the financial burden, especially when they know climate change–related disasters are a possibility in their area. All these factors relating to their own beliefs and values also contribute to their disadvantaged position in society and amplify the impacts of climate change. They also contribute to increasing social and gender inequality over generations, as these norms and thought processes are taught to children as well.

This study also revealed that many institutional processes and infrastructure are not inclusive of women and minorities. For instance, not only do shelters lack gender-friendly

facilities, but the process of registering for subsidies and benefits that could help with coping with climate change impacts and disasters are also quite complex and require people to be present physically at government offices, which are often at the center of a major town. It is therefore difficult for women, especially those who are widowed or do not have any male members in their household, to travel all the way to the center and complete the required paperwork. Financial institutes such as banks also make it difficult for minorities to take out loans, Moreover, nobody invests in their businesses as they are considered risky due to their lack of land, assets, and collateral. Thus, they are forced to continue with their typical low-income livelihoods. They are also sometimes exploited in the market, as people pay them less than the set price for their products since they know these minorities have no other options for income. Moreover, despite some beneficial governments policies in place, very few are aware of these opportunities and want to avoid complex procedures where they need too many documents.

In some cases, adaptation projects themselves may even be exclusionary, where marginalized stakeholders like women may have little access to resources or participation in decision making. Adaptation projects may worsen social and income inequality and disempower women or minorities. Tanjeela and Rutherford (2018) describe a phenomenon known as ‘entrenchment’, which occurs when projects and policies often follow typical gender stereotypes and are unknowingly gender biased and non-inclusive, excluding women and minorities from power and decision-making positions in their communities. They also reveal that most projects in Bangladesh do not accommodate women of all economic and cultural backgrounds.

3.5.4 Patriarchy Driving Differentiated Impacts of Climate Change

This study found that patriarchy contributes substantially to the differentiated impacts of climate change by reinforcing gender inequalities that influence how different groups experience and respond to climate change impacts. Based on the different historical definitions, patriarchy can be succinctly described as “a male domination system over women, which creates social inequalities, discrimination, and injustice” by placing women in inferior positions in society and men in positions of power (Hoque, 2021, p.1). Similar to my findings, Onwutuebe (2019), argues that power differentials and gender inequalities can be attributed to patriarchal norms in society, and that when climate change is added to the equation, it acts as a “threat multiplier” for women,

creating an unbalanced vulnerability for women. Altogether, these factors marginalize women in society and further amplify gender disparities.

In patriarchal societies, women are often assigned to roles that are more directly linked to the environment, such as caregiving, arranging food, and water collection, while men control finances, decision-making and access to resources. This division of labour means that when climate change leads to resource scarcity or climate stress such as water shortages, crop failures, or natural disasters, women are more likely to be more affected due to their societal vulnerabilities. Their limited access to education, land, and economic opportunities also constrains their ability to adapt to climate change, leaving them more vulnerable to its effects. This restricted access, according to Koomson (2023), can be attributed to the domination of men over resources, institutions, and services.

Patriarchal systems also often lead to the marginalization of women in climate policy discussions, decision-making processes, and traditionally designed institutes. This is particularly evident in rural regions, where women are encouraged to avoid the public sphere and expected to remain subordinate. Abdullahi et al. (2023) points out that women's lack of time due to their household responsibilities can also prevent their participation in meetings and decision-making processes, as it was revealed in his study in Somalia. There is a lack of female representation in decision making and leadership roles that translates to women's specific needs and knowledge being overlooked in climate adaptation strategies. As a result, climate policies and interventions tend to be less inclusive and less effective in addressing the needs of those most affected by climate change. Rather, climate change projects and policies tend to favour top-down, male-dominated governance structures. Additionally, rural women tend to have lower levels of education and skills compared to men, which hinders their ability to obtain important positions in society. This disparity is not a result of inherent biological differences, but rather the product of patriarchal norms and gender inequalities that restrict women's access to education and skill development (Djoudi et al., 2016). Women from marginalized communities face even greater barriers to reach respected and well-off positions in the community, as they struggle with not only gender-based discrimination but also additional exclusions based on ethnicity, minority status, or religion (Arya, 2020; Thapa et al, 2021).

The exclusion of women in decision-making roles and public platforms keeps them confined at a lower position in society and allows patriarchal norms to continue. On that note,

Semujju (2014) points out that girls tend to follow elderly women and other females in their surroundings, which plays a role in perpetuating patriarchal gender biases. Thus, if no females in a community have significant public facing and decision-making roles, it will most likely be the norm for future generations of women as well, unless there is some external intervention such as education or awareness. Moreover, in the few cases where women do partake in important public roles in society, my study observed that they themselves tend to follow and believe in pre-conditioned patriarchal norms. These scenarios are "passive psychic acceptance" of discrimination, which Koomson (2023) explains as women's subtle approval and conformity to patriarchal norms in society without any opposition (p. 265). This behaviour also discourages other women from questioning the system and perpetuates gender biases from a young age, embedding gender inequalities in society and conditioning women to act in ways that reinforce their beliefs of being subordinate to men.

3.5.5 Climate Change Impacts Perpetuating a Vicious Cycle of Gender Inequality

As per the observations, it was found that existing gender inequalities have an impact on exposure, vulnerability, and adaptive capacity to climate change. These inequalities often result in negative outcomes for women in all three mentioned aspects. The increased exposure and vulnerability, as well as the lower adaptive capacity, in turn reinforces the gender and other social inequalities in society. As a result, there is a perpetual cycle of inequality that keeps women as well as other vulnerable groups like minorities and elderly at a disadvantaged position. Since climate change is a chronic stressor, it adds to the difficulties of these groups and exacerbates social inequalities. These impacts are often felt throughout generations of families, making it impossible to leave the cycle. This is because they are constantly struggling to meet basic needs and recover from the impacts of climate change, leaving no resources, funds, and time for improvement in other aspects of their lives that may help with empowerment.
In fact, researchers like Atrey (2023) and Sidun and Gibbons (2024) describe these gender-differentiated impacts of climate change as a human right issues for women.

Cappelli (2021) highlighted a two-way relationship for broader social inequality among countries and climate change and discussed how countries with higher inequality experience more damage from climate-induced natural disasters, while also increasing their social inequalities and vulnerability to future disasters. The author coined the process as a "disaster inequality trap" for countries already suffering from high inequality. Our findings point to a

similar pattern on a "within country" level, revealing that gender inequality can be both an independent and dependent variable in the context of climate change impacts. There is a two-way relationship where gender inequality amplifies climate change impacts and climate change impacts reinforce gender inequalities. The fact that gender inequality worsens climate change has been discussed by a growing body of literature (Atrey, 2023; Hailemariam et al., 2023; Otzelberger, 2014; Tschakert & Machado, 2012). The opposite has also been explored, where it was found climate shocks and disasters themselves impact gender inequality negatively by reducing women's rights (Eastin, 2018).

3.5.6 Limitations and Contributions

While my study adopted a feminist lens, and attempted to view both genders' climate change–related issues from an objective point, data from men was still lacking due to the scope, time limits, and cultural issues that dictated men's presentation of themselves. Moreover, although a mixed study, the interpretation and analysis relied more heavily on qualitative data as they offered more insights. There was also a strong focus on emic perspectives, and I was unable to triangulate data from organizations and government sources to verify and compare realities. The focus on the emic lens, limited quantitative data on gendered climate change impacts, and the exploration of on only two intersectional identities overlapping with gender (minority backgrounds and old age) gives a partial picture of gender-differentiated impacts of climate change in the coastal region. Furthermore, a small-scale study on two unions from Satkhira does not allow for generalizing about the entire coastal region, as there may be other important contextual differences related to geography, socioeconomic demographics, and resource availability.

However, it is important to note that the present study makes a much-needed contribution to the feminist literature on differentiated impacts of climate change and the link between gender inequality and climate change impacts. It fills the gap in comprehensive knowledge on the various social, institutional, and gender disparity–related driving forces behind disproportionate climate change impacts that are faced by marginalized groups, which are often not taken into account in policies and interventions. The feminist approach used with an intersectional lens provides a focus on broader social inequalities, while also bringing forth women's voices and realities. Moreover, the emic perspective sheds light on the reality experienced by marginalized

groups, despite national claims of gender-responsive adaptation and policies. While it is true that the Government of Bangladesh has adopted a gender-sensitive approach to dealing with climate change impacts, it does not always translate to planning and implementation, as nuanced contexts, biased institutional designs, and internal beliefs that play a significant role in coping and adapting to climate change impacts are often overlooked.

3.6 Conclusion

Satkhira District is one of the regions in Bangladesh most vulnerable to climate change impacts like cyclones and salinity intrusion. Moreover, the unions chosen for the present study are heavily reliant on agriculture and fishing, and generally represent the livelihoods of the country's coastal region, as well as its socioeconomic conditions. Therefore, this research aimed to explore the differentiated impacts of climate change in these areas of Satkhira, with a special focus on women, and determine the major drivers behind these differentiated impacts. In doing so, the study also aimed to understand the relationship between gender inequality and climate change.

Based on the findings, it is clear that women bear a disproportionate burden of climate change impacts and the major driving forces behind this include existing gender inequalities, poverty, social constructs, inherent beliefs, intersectional inequalities, and deeply embedded institutional discrimination in our society. It was also found that not only does gender inequality increase vulnerability to climate change impacts, but that these climate change impacts also reinforce gender inequality.

In terms of recommendations, this study revealed that there is a need for intersectional analyses and awareness of inherent and societal biases in climate change impact assessments and design and implementation of climate change adaptation policies and projects. Shelters need to be made more inclusive and accessible, and minorities and women need to be represented in public platforms and positions of power so their issues can be heard and addressed. Furthermore, loans should be made accessible for minorities, the poor, and other disadvantaged groups, without the need for collateral, in order to uplift the marginalized in the community and give them a chance to get out of the inequality cycle.

Issues like the gender pay gap also need to be tackled on both government and local levels. As well, women's contribution to the household, society, and economy needs to be recognized. A crucial step in doing so is introducing awareness programs that teach the

importance of equality and education and how social expectations, inherent belief systems, and gender norms keep vulnerable people at a disadvantage and constant cycle of inequality. It would benefit both climate change adaptation and social and income equality if development initiatives target empowering women and minorities through education, livelihood opportunities, and inclusive infrastructure and processes, while keeping the changing climate and its impacts in mind.

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CHAPTER 4

Agricultural Adaptation to Climate Change Impacts and the Undervalued Role of Women in Farming: An Application of the Capability Lens

Abstract

This chapter investigates the local agricultural climate adaptation strategies being undertaken in the coastal region of Kaliganj, Satkhira. It explores the role of women in agriculture and identifies that the lack of land rights, gender wage gap, gender norms, lack of gender-friendly technology, absence of skill building, and limited access to resources work as barriers against women farmers' adaptation to climate change impacts. Data were gathered through a mixed method approach using focus group discussions (FGDs), key informant interviews (KIIs), participant observations, and supported by a sample survey. The study was conducted using a gendered lens on the capability approach, focusing on the agriculture sector. Findings reveal that farmers' abilities to adapt to climate change are largely dependent on external social influences. These external social influences also play a significant role in determining the positive and negative outcomes of adaptation actions, as well as who is benefitting and losing out from these actions. The study recommends a gender-sensitive and inclusive approach to planning, implementing, and designing adaptation policies and projects and the provision of loans, education, and important decision-making positions in community for the empowerment of women farmers.

KEYWORDS: agricultural adaptation, climate change, women farmers, female labour, adaptation technology, adaptation strategies, agriculture

4.1 Introduction

Agriculture is one of the most sensitive sectors to climate change because it is directly dependent on climatic factors such as seasonal temperature and rainfall. This sector is particularly important for developing countries, where economies rely on farming and crop production and the countries do not have sufficient resources to recover from climate change impacts. Bangladesh is one such agro-economy–based developing country, where 43% of the population is employed by the sector (BBS, 2017) and nearly 84% of its rural population has a direct or indirect dependence on agriculture (Rezvi, 2018). The country's food system is dependent on agricultural yield, which is being affected by climate change impacts like flooding, droughts, erratic rainfall, and salinity intrusion. According to the general equilibrium model developed by Banerjee et al. (2015), climate change is predicted to reduce agricultural output in Bangladesh by 1.23% by 2030, increasing import dependence by 1.52%, and reducing total caloric consumption by 17%.

Coastal regions in Bangladesh experience not only the rapid onset climate change impacts like floods, cyclones, and tropical storms, but also the slow-onset impacts like temperature changes, precipitation changes, and salinity intrusion (Deb & Haque, 2017; Mirza, 2011). These impacts in turn have significant consequences on the food security, income generation, agricultural production, and availability of water supply of coastal populations, often exacerbating existing socioeconomic challenges (Rabbani, et al., 2018; Reggers, 2019). Rural coastal inhabitants are also highly dependent on natural resources and rely heavily on climate-sensitive sources of income like agriculture and fisheries. This makes them more vulnerable to the impacts of climate change, and less likely to adapt to the consequences and damage left behind from disasters (Alam et al., 2018).

Women are significant contributors to the agriculture sector in Bangladesh, making up 64.8% of the country's farm work force (Manusher Jonne Foundation [MJF], 2020). In rural areas, their agricultural responsibilities usually involve post- and pre-harvest tasks such as drying, thrashing, grading, storage, and preservation (Mondal et al., 2019; Naz et al., 2023). Women in coastal zones also participate in various local climate change adaptation activities, such as sandbar cropping, hydroponic agriculture, variety crop cultivation, and the use of salinity and drought-tolerant seeds (Schulenburg et al., 2017). For instance, in Gabura, Satkhira District in Bangladesh, it was found that with the help from NGO programs, women were involved in innovative adaptation practices, such as tower method farming, sac/bag cultivation, composite farming

system, *macha* method (cultivation on the platform), and production of organic fertilizer, which helped their households successfully deal with soil salinity (Khalil et al., 2016). Adaptation interventions targeting poor women often involve them in alternative income-generation activities such as rearing poultry and caring for livestock, managing nurseries, agro-entrepreneurship, homestead gardening, and weaving mats made of reeds (Mondal et al., 2019; Naz et al., 2018; Sovacool, 2018). It has also been established that women can be powerful agents in climate change adaptation strategies as members of local social networks, and with their rich repository for local knowledge (Khalil et al., 2016).

Despite their fundamental role in the agriculture sector, women remain invisible and underacknowledged through social and cultural discrimination of women farmers, wage gaps, gender-blind adaptation projects and technologies, and gender inequalities in land rights, institutions, and decision making. While this is widely acknowledged, there is not enough literature of nuanced and contextual situations and obstacles faced by women in the agriculture. Moreover, there is limited work on local agricultural adaptation measures, strategies, and innovations that are being used in low- and middle-income countries (LMICs) and what role women play in these processes, especially in Bangladesh. Keeping this background in mind, my study aims to i) examine agricultural adaptation technologies and methods that have evolved locally as a response to climate change impacts, and the role women have played in them; and ii) determine the challenges and barriers faced by women in climate change adaptation to agriculture.

4.2 Conceptual Considerations

4.2.1 Defining Adaptation, Adaptation Technology and Agriculture

Adaptation to climate change is defined by the IPCC as "adjustment in natural or human systems in response to actual or expected climate stimuli or their effects which moderates harm or exploits beneficial opportunities" (IPCC, 2007, p.6). Adaptation action for climate change can be categorized as autonomous or reactive actions, and planned or anticipatory (proactive) actions. *Autonomous or reactive adaptive actions* tend to be spontaneous and dynamic, focusing on immediate solutions for localized issues, usually taken by climate change–impacted people themselves. On the other hand, *planned or anticipatory adaptive action*s tend to be planned large-scale measures based on specific goals, that are usually introduced by external forces like the government and private organizations helping people (Rahman & Hickey, 2019). According to the

IPCC (2000), *technology* in the context of climate change is "a piece of equipment, technique, practical knowledge or skills for performing a particular activity" (cited in Klein, 2005, p. 3). The United Nations Framework Convention on Climate Change (UNFCCC) refers to *adaptation technology* as "the application of technology in order to reduce the vulnerability, or enhance the resilience, of a natural or human system to the impacts of climate change" (UNFCCC, 2005, p.5). Technology can be characterized as 'hard', which refers to things or equipment that have been manufactured, or 'soft', which refers to the knowledge generation necessary for designing, manufacturing, and using hard technology (Olhoff, 2014).

Generally, the agriculture sector is considered to encompass activities and issues relating to crop production and processing, livestock rearing, and fishing that may take place in farms or natural habitats (International Labour Organization [ILO], 2020). It can be categorized into six sub-sectors, namely i) Food crops; ii) Tree crops; iii) Vegetables and herbs; iv) Livestock and poultry; v) Fisheries and aquaculture; vi) Non-traditional agriculture (herbs and snail, apiary, and mushroom farming; and vii) The agricultural value chain (inputs, production, processing, and marketing) (International Labour Organization [ILO], 2020). However, in Bangladesh, the Ministry of Agriculture does not fulfill functions regarding livestock, poultry, fisheries, and aquaculture and consider them as separate sectors under the Ministry of Fisheries and Livestock. Keeping this context in mind, as well as my study scope, I applied the term to refer to issues and activities related to food crops, tree crops, vegetables and herbs, and the agricultural value chain.

4.2.2 Agricultural Adaptation

South Asian countries in general have adopted drought- and flood-tolerant crops, disease- and pest-resistant crops, and changed farming practices, such as planting crops with shorter cycles, crop rotation practices and late/early planting (Bhatta et al., 2017). For soil management, adaptation practices such as zero tillage, tree and hedgerow planting in semi-arid regions, and contour plowing and vegetation covers in coastal regions are commonly practised (Aryal et al., 2019). Other measures like agroforestry, conservation agriculture, and diversification of income are also popular adaptation strategies in these regions (Aryal et al., 2019). Similar strategies are also practised in Africa and in other regions of Asia. A notable adaptation technique used in Nepal involves 'plastic tunnels' wherein farmers have been growing vegetables and crops to protect them

from heavy rainfall or inappropriate temperatures, and to promote farming using scarce resources. This technology was adopted from developed countries but simplified for use by Nepalese farmers who construct the framework using bamboo or galvanized iron pipes and cover it with silpaulin plastic. They also add controlled pesticides and use drip irrigation in the tunnels (Diwakar et al., 2021).

Another local strategy called *zaï* is used in Burkina Faso in which crops are grown in hand-dug pits and organic matter is added to the pit to create fertile conditions and attract termites that help the soil. The pit also allows better water filtration into the soil from runoff water (Lèye et al., 2021). Some countries in West Africa also use a technique called 'stone bunds' or 'contour lines', which involves placing stones closely along the natural contours of the land to slow the flow of run-off water, which limits erosion and allows better infiltration of water into the soil (Partey et al., 2018). In the Philippines, farmers have been adopting the Alternate Wetting and Drying method for rice production in saline areas. Instead of keeping the rice fields constantly submerged in water as the tradition calls, there are 'non-flood' periods before irrigation are applied to save water, while still allowing the rice roots to have enough water to continue growing (Rejesus et al., 2011).

As for Bangladesh, some common agriculture-related adaptation practices in coastal regions include increased use of irrigation water, water harvesting, hydroponics, changing farmland to aquaculture, using up savings, borrowing money from family and friends, limiting food consumption, and seeking support from the government and NGOs (Delaporte & Maurel, 2018; Aryal et al., 2020). Planned adaptation in the country has been implemented primarily through three types of interventions: i) hard infrastructure such as embankments, sluice gates, and drainage systems; ii) soft adaptation actions that focus on locally feasible options such as alternate livelihood options and land use practices; and iii) building institutional capacity (Rahman & Hickey, 2019).

Beyond such planned and policy driven interventions, there are also many local adaptation strategies taken up by the affected rural communities (Rahman & Hickey, 2019). For instance, in areas of Bangladesh that are prone to floods and waterlogging, farmers have been using floating gardens or *Baira* to grow vegetables and crops. This involves raised bed farming on banana rafts, with layers of soil and easily available decomposed weeds and water hyacinths used to supply nutrients for the plants. This practice is used more often now as an adaptation measure for climate

change impacts, as it is not only a low-cost measure, but also allows farmers to have a steady source of food and income (Salman et al., 2018). Some villages in Bangladesh have also been practising rainwater harvesting for many years. Plastic sheets are placed on the roof and water collected from rainfall is stored in clay pots, which is used for cooking as well as farming (Khalil et al., 2016). This rainwater harvesting technique has been encouraged by NGOs and the government as a locally viable adaptation strategy as well, with organizations constructing storage structures in villages for this purpose (Hossain et al., 2016). Farmers also use a traditional *Sorjan* method of farming to deal with salinity intrusion, where ridges and furrows are alternately created in soil. Crops are grown on the ridges and water concentrates in the furrows, with salt from the ridges leaching into the furrows when it rains. The furrows are used for crops that can be grown in submerged and saline conditions or for fish cultivation (Gopalakrishnan et al., 2019).

While adaptation strategies have been useful for farmers, Bhatta et al. (2017) reported that they do not always yield equal benefits for all. In most cases, only bigger landholders have the resources to implement interventions. For instance, equipment needed for zero tillage, laser land levelling, and rotavators cannot be afforded by poorer farmers without external funding. There is also the issue of limited awareness and training, and increased workload for women. Another study by Fenton et al. (2017) revealed how converting agricultural land toward aquaculture as an adaptation measure also has undertones of inequality. Often the land of poor households is converted and rented out to wealthier households, who reap the benefits of aquaculture since they have the resources for the conversion, which the poor lack (Fenton et al., 2017). Sovacool (2018) had similar findings, stating that adaptation action in Bangladesh can be highly political, with climate change interventions being considerably exclusionary during planning and implementation stages, often entrenching existing social inequalities and aggravating situations for the poor.

4.2.3 Gender-Inclusive Agricultural Adaptation

Men and women differ in their perceptions of climate change and choice of adaptation strategies, and also in their access to resources, finances, and knowledge related to adaptation. Patriarchal societal norms, gender roles, traditions, and institutional discrimination also influence the different requirements and behaviours of men and women. Recent literature acknowledges these gender biases in agricultural adaptation in the climate change context, and calls for more gender-inclusive projects and implementation approaches, and proposes gender mainstreaming for

agricultural technology and adaptation policies (Hidrobo et al., 2024; Njuki et al., 2024; Rola-Rubzen et al., 2020;).

Studies have found men and women take on different adaptation strategies, with many cases where adaptation is lower or limited in women than men (Assan et al., 2020; Jost et al., 2015). This gendered difference in adaptation is attributed to the social, financial, institutional, and cultural barriers faced by women (Mersha & Laerhoven, 2016). Women and men tend to have different perceptions of climate change, and these perceptions can influence how they choose to adapt to climate change. These perceptions also arise from the fact that women tend to have less access to climate information or response strategies (Bryan et al., 2018). Women also tend to face considerable obstacles when responding to climate change impacts. They have limited access to agricultural assets like livestock, land, farm equipment, fertilizers, agrochemicals, and seeds, compared to men (Bessah et al., 2021). This lack of access to assets and their limited decision-making power and agency affects their ability to take up agricultural technologies that could help them to adapt to climate change (Cholo et al., 2020). Jost et al. (2015) also found that smallholder women farmers in Ghana, Uganda and Bangladesh face financial barriers and lack of access to resources, with men being dominant recipients of information and extension services and in control of household technology.

Clark et al. (2022) argue that there is a lack of complex gender-based analysis of climate change vulnerabilities, which often results in discriminatory power dynamics and gender inequalities to be reinforced through climate change adaptation interventions and discussions. In some cases, adaptation projects may even be exclusionary, where marginalized stakeholders like women may have little access to resources or participation in decision making. Adaptation projects may also worsen social and income inequality and disempower women or minorities, a phenomenon known as ‘entrenchment’. For instance, Sovacool (2018) points out that although Bangladesh implements many climate change projects targeting the empowerment of women, there have been cases of power play and exclusionary adaptation planning, with ethnic or religious minorities and women often left out of key decision-making processes in these projects. Adaptation and its related projects often also follow typical gender stereotypes and are unknowingly gender biased, limiting women to existing gender norms and excluding them from powerful and decision-making positions in their communities. In some cases, these projects may

not accommodate women of diverse economic and cultural backgrounds (Tanjeela & Rutherford, 2018).

Women in Bangladesh have significantly limited land rights and decision-making powers related to agricultural practices in comparison to men. The amount of land owned by women (if any) also tends to be smaller than men's and can be insufficient for them to introduce climate smart technology (Sugden et al., 2014). Jost et al. (2015) noted that in Bangladesh, even though both men and women in households take part in farming, the definition of a farmer under the government is the "one who owns land". Zafrullah (2019) observed that in Rangpur and Thakurgaon districts of Bangladesh, women do not get acknowledged for the work they do in their fields. Due to the effects of the patriarchal system, women also cannot keep the income from agriculture and tend to hand it over to the men/head of the family.

Moreover, there is a pay gap between men and women labourers, and the men of the household are the ones collecting the women labourer's wages from the employers, which ultimately gives them more control. The study also revealed that sometimes irrigation technology was not easy for women to use in northern regions of Bangladesh as they needed help from men to get the machine started. Moreover, a study by CARE [Cooperative for Assistance and Relief Everywhere] found that although women were targeted specifically for climate-based adaptation projects, the number of women dealing with saline-tolerant paddy varieties was still low. It has also been observed that women faced barriers in adaptation as they were too shy to communicate with irrigation providers and marketplace suppliers providing fertilizers and pesticides (cited in Ahmed et al., 2017).

Although emerging research is addressing the gender issues in climate change and agricultural adaptation research, some gaps in knowledge remain. Israel and Sachs (2012) point out that climate change discussions are often dominated by a technological and scientific focus, framed within capitalist, colonial, and patriarchal structures. Huyer (2016) states that there is limited understanding of the type of adaptation support needed by women farmers. There is also a lack of understanding of how social and gender inequalities influence the ways in which impoverished men and women react to the effects of climate change on agriculture, as well as the specific support female farmers require to adjust to these changes. There is also a need for gender-based analysis of adaptation practices, and more in-depth studies on the extent of access to and control of agricultural resources between men and women and their specific roles in agricultural

processes (Huyer, 2016). According to Tuana (2015), climate change discourse, policies, and knowledge are frequently shaped by subtle gendered assumptions. Kristjanson et al. (2017) mirrors these findings, stating that women will continue to be neglected if policy and project designs themselves do not address the gendered differences in needs and access to adaptation resources and support. Chanana-Nag & Aggarwal (2020) argue that while there is multiple emerging literature on gender and climate change adaptation, there is still a dearth of such studies in the agricultural context. On a similar note, Davidson (2016) points out that research in the arena tends to lean toward women's vulnerability barriers to adaptation. While this is important information that needs to be explored, it also tends to keep women as victims, undermining their roles in the agriculture sector and ignoring their knowledge and contributions to climate change adaptation strategies (cited in Huyer & Partey, 2020).

4.3 Conceptual Framework: The Capability Approach

This study draws upon Amartya Sen's (1993) capability approach to present how capabilities influence agricultural adaptation, and how external societal influences play a significant role in the extent of impacts experienced, people's adaptive capacities, as well as the outcomes of their adaptive actions—all through a gendered lens (Figure 4.1). The capability approach posits that people have certain *capabilities* (abilities or opportunities) that help them reach/perform *functionings* (achievements, state, or actions) (Clark, 2005). According to Brackel (2021), this approach was established by Sen to suggest an alternative to the criticized normative, informational, and utilitarian approaches taken by justice models and cost-benefit analyses of that era. Sen argued for a more people-centric approach, focusing on human agency and the availability of resources, rather than resource distribution. Sen kept the concept of capabilities open ended, allowing them to be selected based on context (Robeyns, 2006). However, Nussbaum, who developed the capability approach further addressing critiques of Sen's concept being too subjective, developed a set list of basic capabilities, that includes "(i) life, (ii) bodily health, (iii) bodily integrity, (iv) senses, imagination and thought, (v) emotions, (vi) practical reason (vii) affiliation, (viii) other species, (ix) play, (x) control over ones' environment" (Brackel, 2021, p. 5).

The capability approach is commonly used for development agendas, welfare economics, and to study social and political processes. More recently, it is also being used as a lens for climate change adaptation research (Byskov, 2024; Cappelli, 2023; Ekoh et al., 2023) as it allows

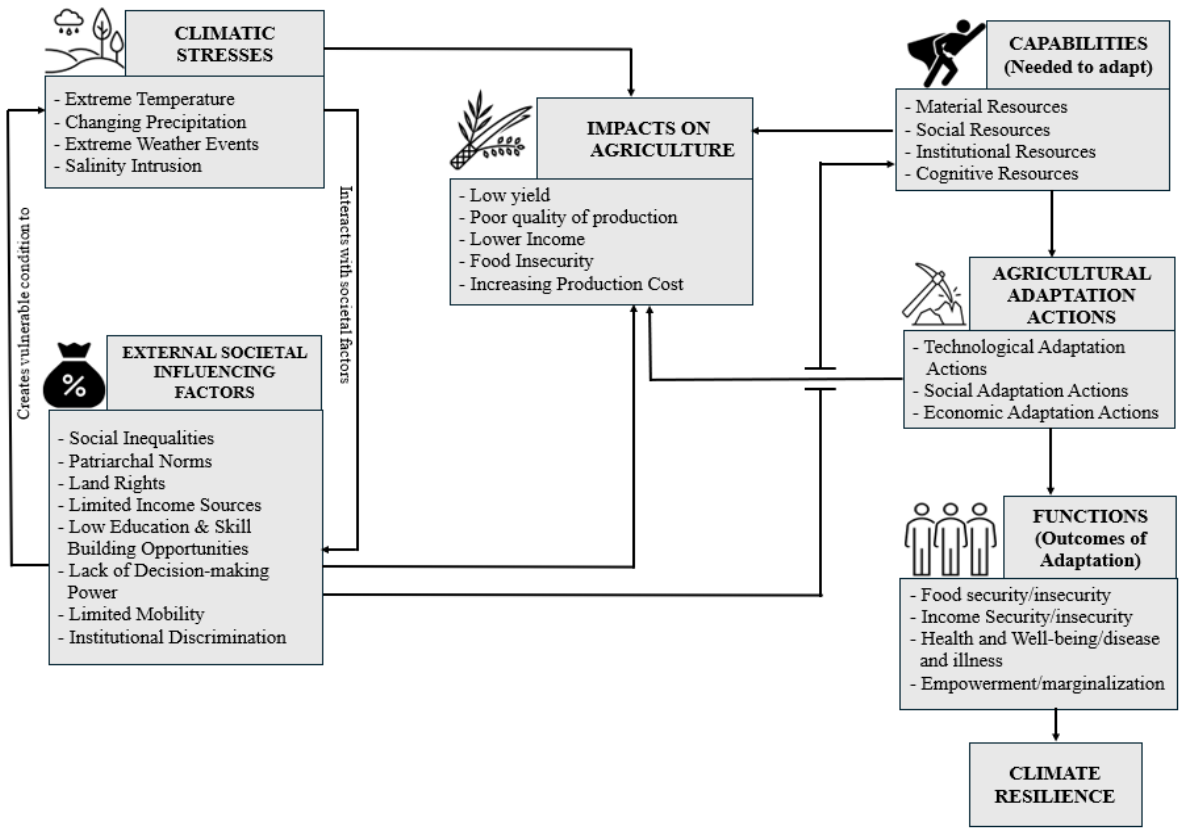
nuanced understandings of intrinsic values being impacted by climate change and how structural inequalities can shape people's access to resources that enable them to adapt to the impacts (Robeyns, 2006). My study followed Sen's original approach, deciding on the capabilities based on the local and agriculture sector–specific contexts. I chose this framework as it is flexible and allowed me to incorporate contextual and societal factors (Brackel, 2021) like gender inequalities, while tailoring it to the rural agricultural scenario.

In this framework (Figure 4.1), I identify that climate stresses like temperature and precipitation changes, salinity intrusion, and frequent natural disasters impact the agriculture sector in multiple ways, such as i) Low Yield, ii) Poor Quality Production, iii) Lower Income for agricultural workers and farmers, iv) Food Insecurity, v) Increase in Pest and Insects, and vi) Increase in Expenses for agricultural production. I posit that these impacts experienced by the agricultural sector are not only an outcome of climate stresses alone; rather they are a compounded effect of external influences in combination with climate stresses. The external societal influences identified in this study were i) Inequalities, ii) Patriarchal Norms, iii) Land Rights, iv) Limited Income Sources, v) Low Education/Skill Building Opportunities, vi) Lack of Decision-making and Bargaining Power, vii) Limited Mobility, and viii) Institutional Discrimination. While there are many types of social inequalities, biases, and discriminations, I used a gender lens when analyzing these external influences, therefore focusing on gender biases and inequalities.

I categorized agricultural climate change adaptation actions in three groups: i) Technological, ii) Social, and iii) Economic. In order to carry out these actions, people require 'capabilities' such as material, social, institutional, and cognitive resources, which are also heavily dependent on the aforementioned external societal influences. When adaptation actions are carried out, I propose that it leads to outcomes (referred to as 'functions') that generally improve people's quality of life. The major climate change adaptation outcomes of the agricultural sector in particular that I identified are Food Security, Income Security, Health and Well-being, and Empowerment. Here, the external influences again play an important role in whether the adaptation actions will lead to these positive outcomes and, ultimately, climate resilience.

Figure 4.1

Capability Approach for Understanding the Links between Climate Stresses, External Societal Influences, Agricultural Adaptation Actions, and Adaptation Outcomes



Note: Adopted from Sen (1993)

4.4 Results

4.4.1 Socioeconomic Characteristics of Study Participants

In the study area, from the sample survey of 308 households, the most common income sources were daily labour (64.9 %), agriculture (42.9%), and livestock rearing (32.5 %), followed by fisheries (23.1 %) and vegetable/homestead gardening (20.1 %). The agriculture sector is an important income source for the coastal populations and is very sensitive to climate change impacts. In this research, I considered crop cultivation and growing vegetables (homestead gardening) under agriculture. Moreover, it should be noted that daily labour (the most popular income source for both men and woman in the area) often involves agricultural work for other farmers' land. Therefore, I also included daily agriculture-related labour when referring to the agricultural sector.

Fisheries, daily labour, and livestock were popular sources of income for poor households in the study area, while crop cultivation and homestead gardening were more popular for middle-income households (Figure 3.2). As per my observations, this is because middle-income households owned land, albeit small amounts, to cultivate their own crops and vegetables, whereas poor households worked on other people's land. However, overall, crop cultivation and homestead gardening were more common among poor and middle-income households, compared to high-income households (Figure 3.2).

Middle- and high-income households were more involved with the service sector, business, renting/selling land, and interest from bank savings than poor households (Figure 3.2). These sectors do not involve manual labour and require a certain level of education and skill that low-income households may lack. On the other hand, remittance is a popular income source for middle-income households but is not a common source of income for the rich. My observations revealed that since high-income households have assets and wealth, they do not need a running stream of income or require migrating for generating essential income. They prefer to stay in their inherited land and can live on their generational wealth.

Among the 50 female-headed households in this study, most were involved in daily labour (70%) and livestock rearing (32%), followed by homestead gardening (18%) and agriculture (14%) (Figure 3.3). Also, female-headed households earned more than male-headed

households from remittances. However, compared to female-headed households, more male-headed households were involved in businesses, the service sector, and renting/selling land (Figure 3.3).

The low levels of involvement of female-headed households in these sectors indicate lower wages and greater poverty among female-headed households. This was also backed by the fact that a greater number of female-headed households in this study belonged to the low-income category (72%) compared to male-headed households (49%), who were mostly in the middle- and high-income categories (Figure 3.3).

4.4.2 Agricultural Adaptation to Climate Change Impacts

The study area suffers significantly from cyclones, with 78.6 % of the 308 survey participants stating that they had been adversely impacted by at least one in the past 20 years. These cyclones not only destroy infrastructure, but also damage crops and shrimp enclosures and cause loss of livestock and other assets. However, other than these cyclone disasters, there are also some slow-onset impacts of climate change that make it a chronic stressor for this area. Irregular rainfall, droughts, shifts in temperature and humidity, saltwater intrusion, and alterations in seasonal patterns contribute to crop failures and decreased agricultural productivity, as this is a climate-sensitive livelihood. Another problem mentioned was excessive rain for short durations, which floods fields and ruins crops, as well as causing overflow of water in shrimp enclosures and loss of farmed shrimp. In the study area, all the 308 households revealed that they have been noticing changes in the climate of the area. Figure 4.2 shows that the most noticeable changes experienced and/or perceived by the respondents were higher temperatures, shorter winter seasons, decreased rainfall, frequent thunderstorms, higher salinity, and unpredictable seasonal changes. Similar results were found when comparing the perspectives of female- and male-headed households.

Figure 4.2

Climate Change Trends Experienced and/or Perceived by Community Members (n=308)

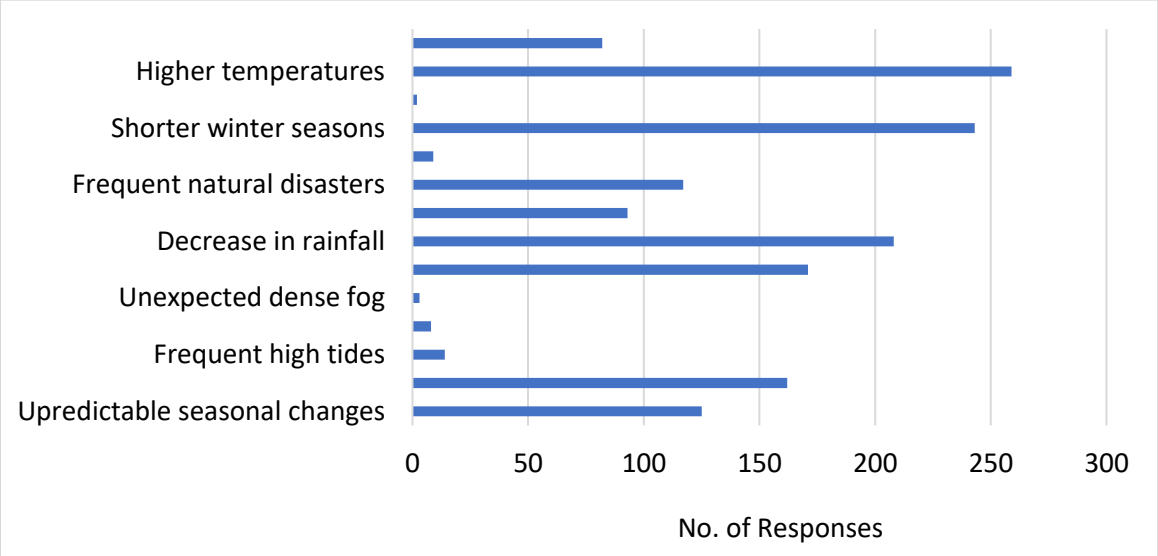


Table 4.1

Gender-Based Comparison of Climate Change Trends Experienced and/or Perceived by Community Members

Perceived Changes in Climate *Multiple Response Possible	Total no. of responses (*n* =308)	No. of FHH Responding (*n*=50)	No. of MHH Responding (*n*=292)
Extreme heatwaves	82	6	77
High temperatures	259	44	245
Shorter winter seasons	243	35	229
Longer winter seasons	9	2	9
Frequent natural disasters	117	14	107
Excessive rainfall for a shorter period	93	15	91

Perceived Changes in Climate *Multiple Response Possible	Total no. of responses (*n* =308)	No. of FHH Responding (*n*=50)	No. of MHH Responding (*n*=292)
Decrease in rainfall	208	42	200
Frequent thunderstorms	171	31	164
Unexpected dense fog	3	23	3
Observing increasing in hailstorms	8	0	8
Frequent high tides	14	23	14
Higher salinity	162	19	156
Unpredictable seasonal changes (e.g. late monsoon)	125	23	118

For many years, based on the climate of the region, people have planted crops and strategized an efficient farming process according to seasonal patterns. However, the current unpredictability of seasons is affecting farmers as they have to adapt to the changes. For example, when there is less rain in the Aush season (July to August), and the weather is dry, salinity in water increases. Thus, in this season, very few farmers now grow crops and vegetables. The lack of rainfall makes it difficult to water crops, and irrigation from other sources is too expensive. Even if they do cultivate crops, by the time it is collection time, there is too much rain and it becomes a huge hassle to walk through wet fields, delaying preparation for the next season in the process.

Some of these climate change impact issues are also exacerbated by human activities in the area. For instance, according to a key informant associated with the Ministry of Disaster Management and Relief, dams and embankments are not repaired as often as they should be, which is why they are weak and break easily, causing increased salinity intrusion. He also pointed out that corruption, lack of accountability, and absence of new technology are playing a significant role in preventing and tackling impacts of disasters. Moreover, the increasing shrimp farming in the area, which is itself an adaptation strategy, has made soil salinity worse. Shrimp

farming involves bringing in sea water through canals as shrimp cultivation needs brackish water. This increases the soil salinity of the area and affects surrounding farmland soil as well. Moreover, shrimp farming involves less labour than agriculture, so the more popular this adaptation strategy becomes, employment opportunities for daily labourers also decrease.

Tackling the issues of low yields and damage to crops resulting from climate change impacts leads to reduced income, more losses, and heightened expenses related to irrigation and agricultural inputs like high-yield seeds, fertilizers, pesticides, etc. Many farmers find themselves increasingly dependent on purchasing rice and vegetables, whereas before they could eat what they produced. In fact, when crop yields are affected, there is also a reduction in supply of food for livestock, which people then have to buy from the market. To manage these financial challenges, many farmers resorted to taking loans, while others were found to migrate for six months each year to work in brick kilns, which offer higher wages than farming. Additionally, it was observed that some farmers have turned to shrimp farming to adapt, which is ideal for saline conditions and provides economic advantages.

Irrigation, Water storage, and Rainwater harvesting

The lack of water availability is a major issue in the coastal areas. Not only is drinking water scarce, but sometimes droughts and lack of rainfall during planting season can affect farming and livestock as well. To tackle issues with water scarcity, the locals utilize shallow tube wells, pumps, pond water, and rainwater harvesting for irrigation (See Figure 4.3, 4.4 and 4.5). Some also dig large pits near their fields or have manmade ponds nearby to collect rainwater for irrigation. Irrigation also helps with flushing out salt from soil, which is usually affected by salinity intrusion in coastal regions. The sample survey revealed that 151 out of 308 households (49%) in the area involved with agriculture used irrigation as an adaptation technique. The most common irrigation sources in the area were water pumps (86 %), followed by water from shallow tube wells (19%) and rainwater harvesting (13%) (Figure 4.6).

Figure 4.3

Rainwater Harvesting for Irrigation

Source: Photo taken by the author during the field work (September 17th, 2022, Kaliganj)

Figure 4.4

Pond Used to Collect Rainwater Used for Irrigation

Source: Photo taken by the author during the field work (September 17th, 2022, Kaliganj)

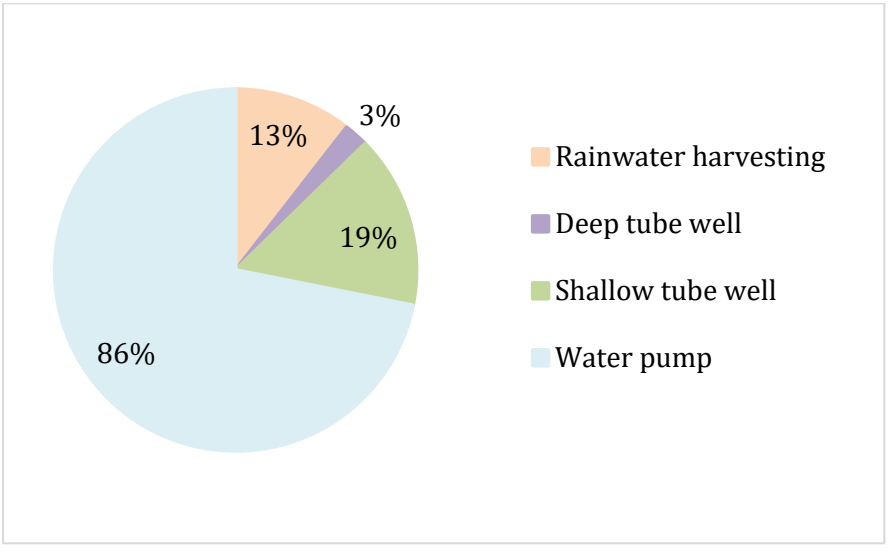
Figure 4.5

Irrigation Machine

Source: Photo taken by the author during the field work (September 15th, 2022, Kaliganj)

Figure 4.6

Distribution (%) of Irrigation Sources (n=308)



Salt-and Drought-Tolerant Crops, Hybrid High-Yielding Crops

Many crop varieties have also been introduced to help farmers adapt to climate change impacts. Farmers use salt-tolerant crop varieties such as BRRI 67 (tolerance 8 dS/m), BINA Dhan 10 (tolerance 10-12 dS/m), and BRRI 47 (tolerance 6 dS/m), waterlogging-resistant varieties like BRRI Dhan 52, BRRI Dhan 85, and BRRI Dhan 51, as well as high-yield options such as BRRI Dhan 22 and BRRI Dhan 33. They also choose hybrid fast-growing crops and rice seeds, like BRRI Dhan 49 and BINA Dhan 7, to take advantage of the short periods of lower soil salinity in the area. Furthermore, locals plant salt-tolerant fruits such as tamarind (*tetul*), hog plum *(amra*) and Indian gooseberry (*amlok*i) as well as Sesbania plant (*dhaincha*), which is known to reduce salt content in soil and acts as fertilizer. Planting schedules may also be adjusted based on seasonal forecasts, with farmers utilizing early maturing seeds like BRRI Dhan 22 and BRRI Dhan 33 to mitigate flood risks.

Local Technologies and Strategies

The study revealed some local technologies and strategies that help locals cope with the impacts of climate change. For instance, to mitigate waterlogging during floods, farmers implement local drainage systems and adopt raised bed farming, which facilitates better water flow. One of the common strategies observed was the “line sowing” method, which involves planting in lines in the soil while keep space between the crops (See Figure 4.7). This allows farmers to use less water for irrigation, drain out excess rainfall and makes it easier to get rid of rotten leaves. Another popular strategy for planting is the "Machan" method, where vegetables are cultivated on bamboo structures elevated above other crops, preventing them from being in contact with excess water during flooding, and thus also optimizing space (See Figure 4.8).

Figure 4.7

Line Soiling

Source: Photo taken by the author during the field work (September 17th, 2022, Kaliganj)

Figure 4.8

Machan Method

Source: Photo taken by the author during the field work (September 17th, 2022, Kaliganj)

A different approach known as the "Sac Method" (*Bosta method*) was also observed in the study area, involving growing vegetables and ginger in bags filled with soil and fertilizer, which can easily fit in small areas (See Figure 4.9) To save space and increase their agricultural output, locals also grow vegetables which can handle salinity such as tomatoes, gourds, and taro root, alongside the beds of the shrimp enclosures (*ghers*). Some individuals cultivate vegetables like pumpkins as well as gourds on their thatched rooftops, and some add compost on top of soil so that salt is absorbed and reduced from soil (See Figure 4.10). These strategies are crucial as climate change leads to land loss and degradation, allowing locals to maximize yield and available cultivable space, generate additional income, and ensure food security.

Figure 4.9

Sac Method (Bosta method)

Source: Photo taken by the author during the field work (September 17th, 2022, Kaliganj)

Figure 4.10

Rooftop Gardening

Source: Photo taken by the author during the field work (September 15th, 2022, Kaliganj)

Key informants as well as locals also discussed the issue of increasing pests and insects due to changes in seasons and environmental conditions from climate change. This is harmful for crops, and to tackle the issue, farmers use more insecticides and pesticides which are not only bad for crops, but also add to their expenses for adaptation. However, many local farmers also use a natural strategy to get rid of the pests. They use a system call “Perching/T system” (*daal perching*) which involves a perch made of sticks in the shape of a “T”, where birds can rest and eat the pests and insects. This perch is usually placed a week after seeds are transplanted. Some locals also used pheromone traps to kill insects, which was introduced to them by agricultural extension agents. Another method called “yellow sticky paper” (*holud kaath*) is also common, which involves placing a sticky paper with natural chemicals that attracts the insects (See Figure 4.11).

Figure 4.11

Using Pheromone to Keep Away Insects and Pests

Source: Photo taken by the author during the field work (September 17th, 2022, Kaliganj)

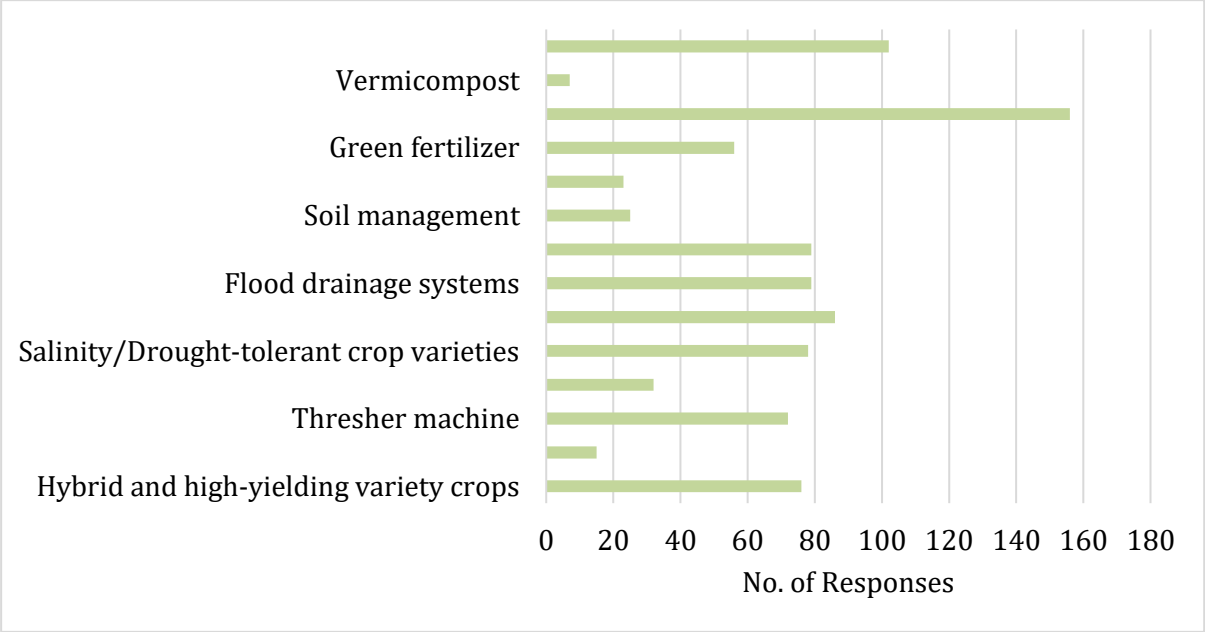
In the study area, a popularly discussed practice was to add sugar to the soil when it becomes too dry and saline, which farmers believed, when added along with gypsum, significantly improves their crop health. However, key informants from research organizations suggested that the perceived improvements may be attributed to other factors, such as gypsum application, rainfall, or irrigation, as adding sugar does not scientifically benefit the soil. On that note, some seed dealers said that farmers often follow their own beliefs, what their neighbours do and what previous generations practised, ignoring advice from the seed dealers and Department of Agriculture Extension (DAE) personnel. However, farmers themselves discussed how they were not satisfied with the help or advice they were receiving from different agencies and it was evident that they wanted more knowledge on agricultural adaptation.

Along with the irrigation methods described previously, some common agricultural adaptation strategies used by the locals in the area were using fertilizers, pesticides, and

insecticides, plough machines, agro-advisory services and information, sluice gates, cultivating salinity/drought-tolerant crop varieties, local level embankments, flood drainage systems, and cultivating hybrid and high-yielding variety crops (HYV) (Figure 4.12). As per Table 4.2, for both male-headed households and female-headed households, the use of fertilizers, pesticides, and insecticides were the most common strategy used. The type of strategies and technologies used were greatly influenced by ease of use (41.8%), availability of technology (25.4 %), and economic ability (10%) (Figure 4.13).

Figure 4.12

Distribution of Responses Regarding Commonly Used Adaptation Strategies



*Multiple responses possible, *n* = 308

Table 4.2

Gender-Based Comparison of Commonly Used Agricultural Adaptation Strategies

Types of Adaptation Strategies Used *Multiple Responses Possible	No. of Responses by FHH (n=50)	No. of Responses by MHH (n=292)
Hybrid and high-yielding variety crops	5	71
Plough Machine	7	95
Vermicompost	0	7
Fertilizers, pesticides, and insecticides	15	141
Green fertilizer	3	53
Integrated farm management	2	21
Soil management	5	20
Salinity/Drought-tolerant crop varieties	5	73
Local embankments	5	74
Flood drainage systems	5	74
Sluice gates	5	81
Crop rotation practices and changing cropping patterns	3	57
Agro-advisory services and information	9	92
Agricultural credit or loan	1	31
Thresher machine	4	68
Subsidies from NGOs or Government Organizations	0	15

Figure 4.13

Distribution (%) of Factors Influencing Decisions on Using Adaptation Strategies (n=308)

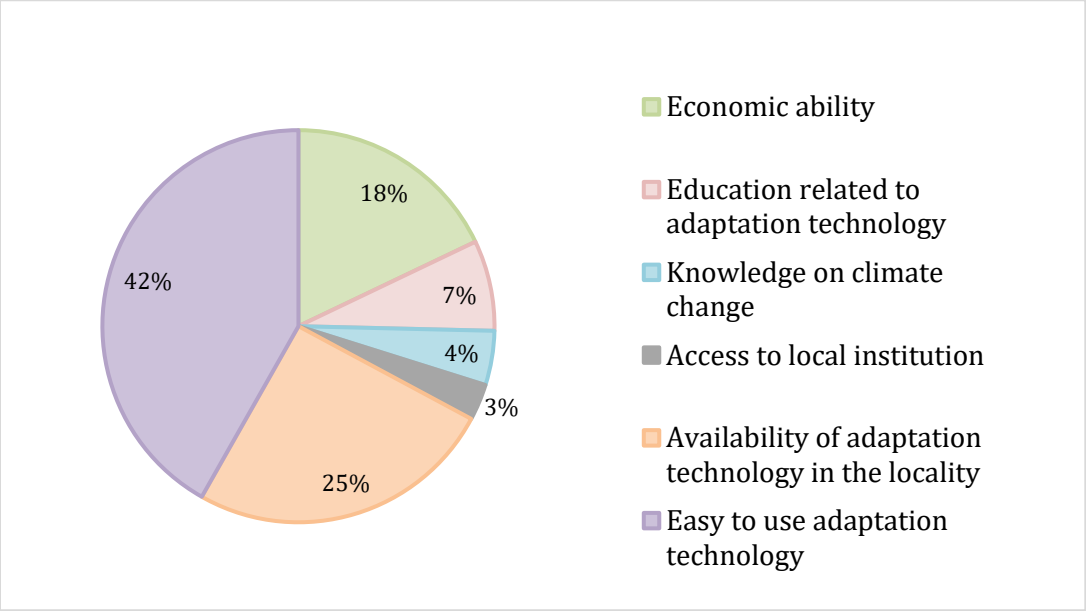


Table 4.4 presents the participants' perceptions regarding accessibility, affordability, and ease of different adaptation strategies, while Figures 4.13, 4.14 and 4.15 show a breakdown of their answers in details. The results reveal that flood drainage systems, green fertilizers, and integrated farm management are the most accessible, affordable, and easy to use, and therefore are the most preferred adaptation options. On the other hand, plough machines are the least accessible, most expensive, and difficult to use (Table 4.3). As a result, some farmers rent the plough machine from richer households to use on their land. Hybrid and HYV (High-Yield Variety) seeds are also a common strategy and, according to key informants, one of the most effective agricultural adaptation strategies for climate change impacts that the government organizations regularly disseminate on a national scale. Research organizations like BRRI (Bangladesh Rice Research Institute), BARI (Bangladesh Agricultural Research Institute), and BINA (Bangladesh Institute of Nuclear Agriculture) are always developing new varieties that can provide high yield in the changing climates. However, my study revealed that although Hybrid and HYV seeds and salt/drought-tolerant crops are accessible and easy to use for locals (as well as useful), they are quite expensive.

Table 4.3

Participants' Perception of Most and Least Accessible, Affordable and Easy-to-Use Adaptation Technology in the Community

	Most	Least
Accessible	Integrated farm management, Flood drainage system, Green fertilizer	Plough machine
Affordable	Local embankment, Integrated farm management, Flood drainage system, green fertilizer	Plough machine, Hybrid and HYV seeds, Salinity/drought-tolerant seeds
Easy-to-Use	Integrated farm management, Crop rotation and cropping patterns, Local embankment	Plough machine

Note: Based on Figure 4.13, 4.14 and 4.15, FGDs and participant observations

Figure 4.14

Accessibility to Adaptation Strategies (n=308)

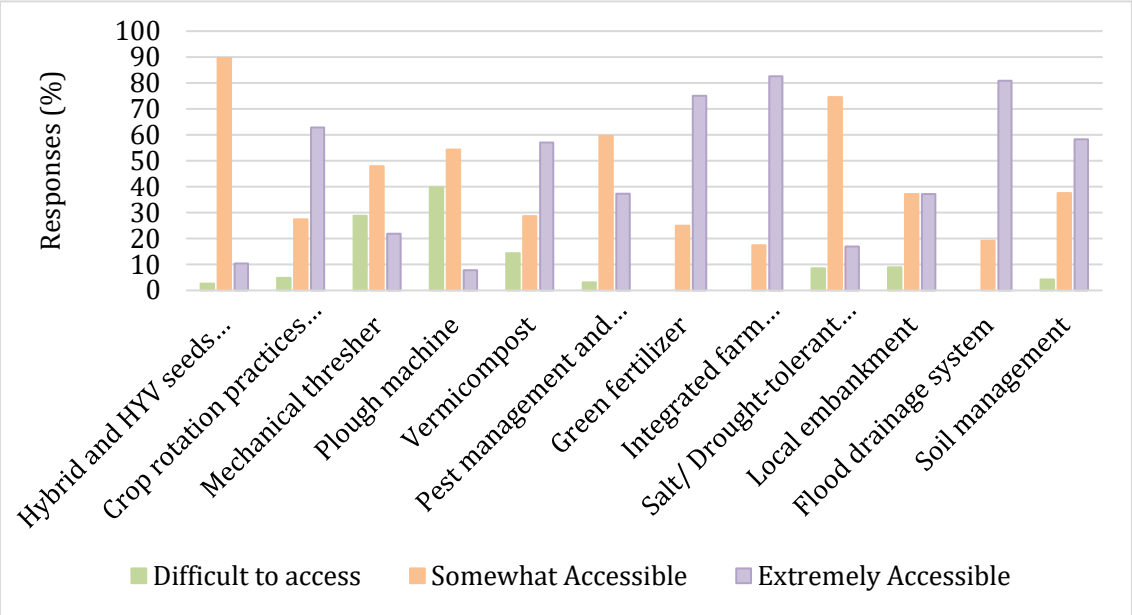


Figure 4.15

Affordability of Adaptation Strategies (n=308)

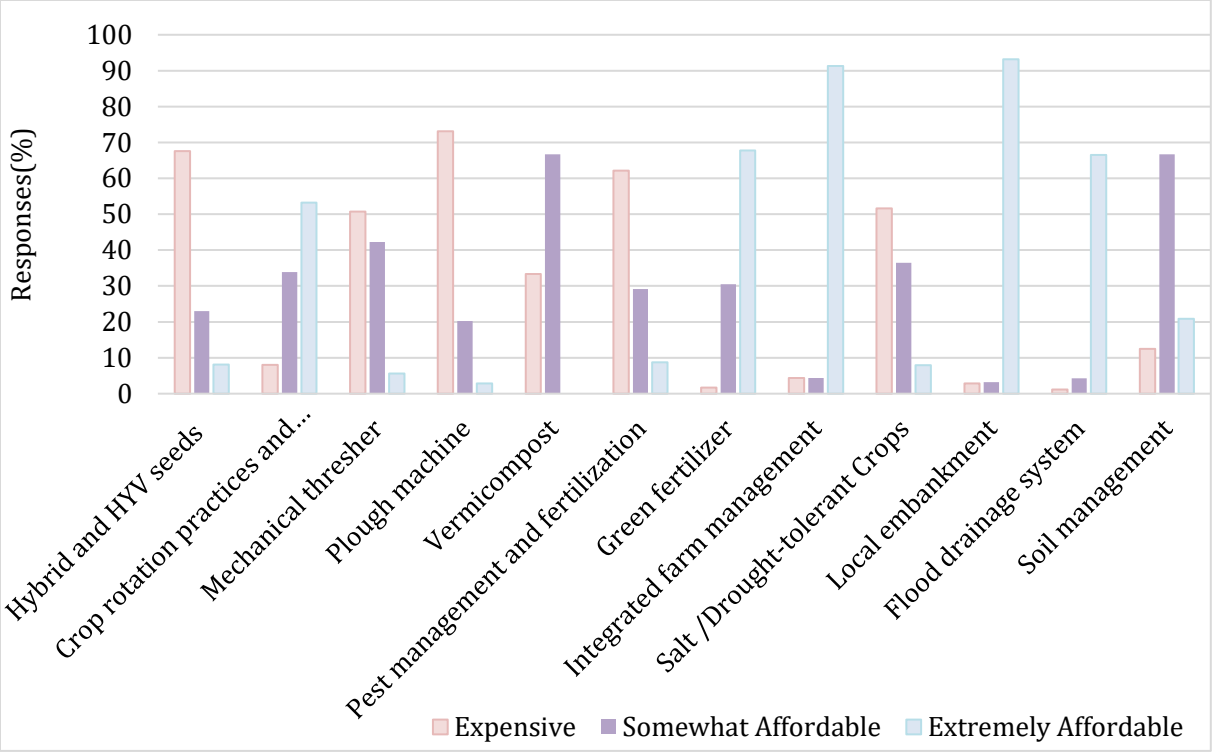
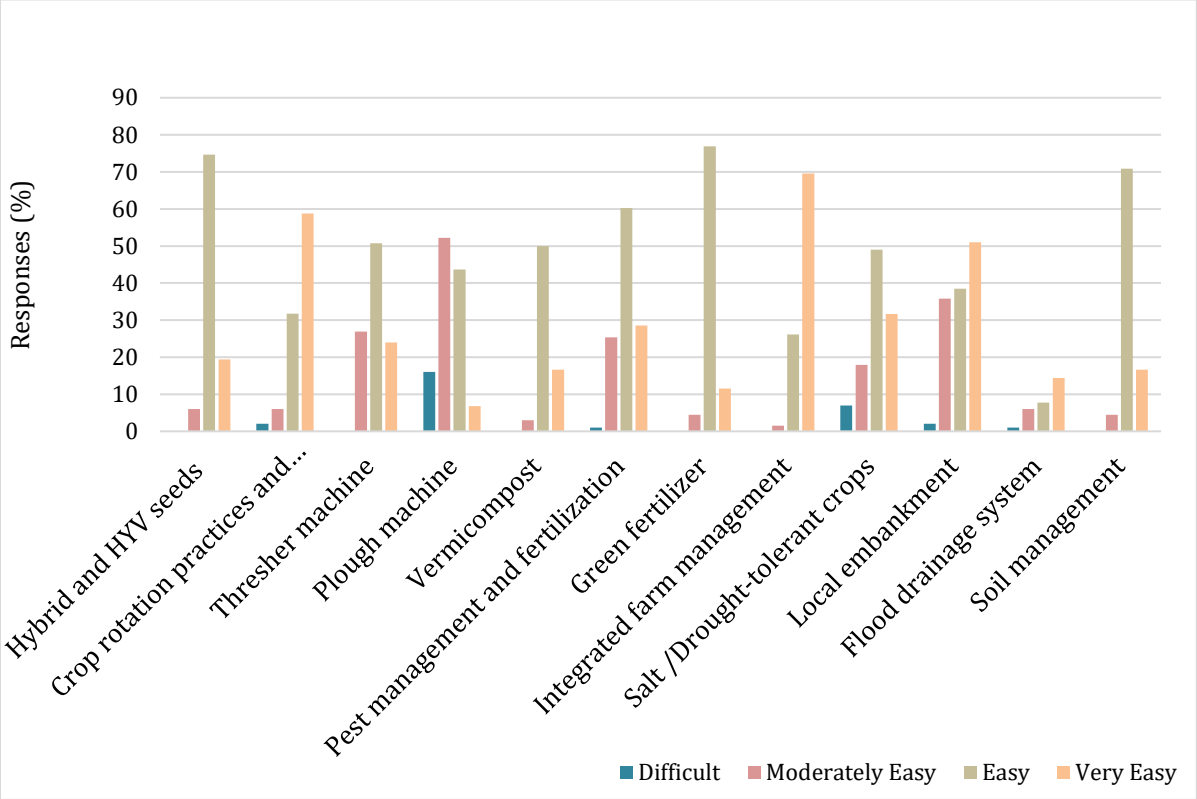


Figure 4.16

Ease of Use of Adaptation Strategies (n=308)



When comparing between male-headed households and female-headed households, it is seen that that male-headed households had greater access to most adaptation technology, especially the plough machines, thresher machines, vermicompost, salt/drought-tolerant crops, and pesticides, fertilizers and insecticides (Table 4.4). This may be attributed to women's limited mobility and access to markets. Table 4.5 shows that both female-headed households and male-headed households found certain adaptation strategies like High-Yielding Variety (HYV) and short-variety crops; fertilizers, pesticides and insecticides; and salinity/drought-tolerant crops to be expensive. Table 4.6 shows a trend where male-headed households find a wide range of adaptation technology as easy to use, which is not the case for female-headed households.

Table 4.4

Gender-Based Comparison of Accessibility to Adaptation Strategies

*Male-headed households (MHH) (*n* = 292), Female-headed households (FHH) (*n* = 50)

Adaptation Strategies	No. of Responses from FHH (*n* = 50)			No. of Responses from MHH (*n* = 292)		
	Extremely Accessible	Somewhat Accessible	Difficult to Access	Extremely Accessible	Somewhat Accessible	Difficult to Access
High-yielding and short-variety crops	1	5	0	7	0	2
Thresher machine	1	1	2	15	33	19
Plough machine	0	5	3	38	50	8
Vermicompost	0	0	0	4	2	1
Fertilizers, pesticides, and insecticides	4	10	1	52	85	4
Green fertilizer	2	1	0	39	14	0
Integrated farm management	1	1	0	18	3	0
Soil management	2	2	0	11	7	1
Salinity-tolerant crop varieties	0	4	1	14	54	6
Drought-tolerant crop varieties		3	1	7	45	11

Adaptation Strategies	No. of Responses from FHH (n = 50)			No. of Responses from MHH (n = 292)		
	Extremely Accessible	Somewhat Accessible	Difficult to Access	Extremely Accessible	Somewhat Accessible	Difficult to Access
Local embankment	19	20	3	106	76	20
Flood drainage system	13	15	19	127	26	4
Crop rotation practices and changing cropping patterns	0	2	1	38	14	2

Table 4.5

Gender-Based Comparison of Affordability of Adaptation Strategies

*Male-headed households (MHH) (*n* = 292), Female-headed households (FHH) (*n* = 50)

Adaptation Strategies	No. of Responses from FHH			No. of Responses from MHH		
	Extremely Affordable	Somewhat Affordable	Expensive	Extremely Affordable	Somewhat Affordable	Expensive
High-yielding and short-variety crops	1	1	4	5	16	51
Thresher machine	0	1	3	4	28	34
Plough machine	0	3	5	3	18	74
Vermicompost	0	0	0	2	4	0
Fertilizers, pesticides, and insecticides	1	6	8	10	40	91
Green fertilizer	3	0	0	33	18	1
Integrated farm management	2	0	0	19	1	1
Soil management	1	2	1	4	13	2
Salinity-tolerant crop varieties	0	0	5	5	23	45
Drought-tolerant crop varieties	0	0	3	5	25	31

Adaptation Strategies	No. of Responses from FHH			No. of Responses from MHH		
	Extremely Affordable	Somewhat Affordable	Expensive	Extremely Affordable	Somewhat Affordable	Expensive
Local embankment	41	1	0	179	7	6
Flood drainage system	24	1	0	2	9	4
Crop rotation practices and changing cropping patterns	1	1	1	31	19	6

Table 4.6

Gender-Based Comparison of Ease of Use of Adaptation Strategies

*Male-headed households (MHH) (*n* = 292), Female-headed households (FHH) (*n* = 50)

Adaptation Strategies	No. of Responses from FHH			No. of Responses from MHH		
	Easy to Use/Set Up	Moderately Easy to Use/ Set Up	Difficult	Easy to Use/Set Up	Moderately Easy to Use	Difficult
High-yielding and short-variety crops	6	0	0	67	4	0
Thresher machine	1	3	0	51	15	0
Plough machine	1	3	2	49	32	14
Vermicompost	0	0	0	4	2	0
Fertilizers, pesticides, and insecticides	12	3	0	126	14	1
Organic fertilizer	3	0	0	49	3	0
Integrated farm management	2	0	0	20	1	0
Soil management	4	0	0	16	3	0
Salinity-tolerant crop varieties	4	0	1	62	7	4

Adaptation Strategies	No. of Responses from FHH			No. of Responses from MHH		
	Easy to Use/Set Up	Moderately Easy to Use/ Set Up	Difficult	Easy to Use/Set Up	Moderately Easy to Use	Difficult
Drought-tolerant crop varieties	0	0	3	52	5	1
Local embankment	37	3	1	172	21	1
Flood drainage system	23	2	0	147	7	1
Crop rotation practices and changing cropping patterns	2	0	1	53	4	1

Influence of Land Ownership, Social Power, and Socioeconomic Status

It should be noted that rich households find it easier to adapt to climate changes impacts, and can recover more easily than poor households from climate change–related losses. Farmers are categorized by the government based on land ownership (Table 4.7), and this influences what kind of demonstrations, subsidies, and technology they receive. Rich households and big farmers with more land were often selected to receive agricultural technology, while poor households and small, marginal, and landless farmers do not have the same opportunities because of lack of cultivable land as well as limited influence and power in society. Sometimes the rich households may not be as involved with agriculture as others but still receive greater benefits, which give them a disproportionate advantage for income and adaptation.

Table 4.7

Farmers' Official Categorization by Land Ownership

Farmer Category	**Land Ownership (acres)**
Big Farmers/*Boro Krishok*	7.50 and above (3.04 ha and above)
Medium Farmers/*Majhari Krishok*	2.50 to 7.49 (1.01 ha to 3.03 ha)
Small Farmers/*Choto Krishok*	1.50 to 2.49 (0.607 ha to 1.00 ha)
Marginal Farmers	0.50 to 1.49 (0.202 ha to 0.603 ha)
Landless Farmers	Up to 0.49 (up to 0.198 ha)

Note: Based on key informant interviews

4.4.3 Women's Role in Agricultural Adaptation and Challenges Faced

Women actively participate in agriculture, either by working alongside their husbands on family-owned or rented farmland (*borga jomi*), or as paid labourers. Their tasks commonly include transplanting, weeding, thinning, managing water drainage, winnowing, drying grains, and packaging produce (See Figure 4.17). Some women also applying fertilizer to vegetable gardens and prepare seedbeds for sowing seeds. When women help their husbands, it reduces the

agricultural labour costs for households that would otherwise be an extra expense (See Figure 4.18). Furthermore, women are often involved in homestead gardening where they grow vegetables and fruits that can serve as a food source as well as an additional income for their household, along with making pickles, selling eggs and poultry, and livestock rearing.

Figure 4.17

Women Working as Agricultural Labourers and Farmers

Source: Top photo taken during fieldwork and bottom photo taken by field guide Abdullah, associated with the Mission Mohila Unnayon Sangstha, with consents (August 20th, 2022; September 16th, 2023, Kaliganj).

Figure 4.18

Women Working Alongside their Farmer Husbands

Source: Top photo taken during field work and bottom photo taken by field guide Abdullah, associated with the Mission Mohila Unnayon Sangstha, with consents (August 16th, 2023, Kaliganj).

Table 4.8 presents some specific climate change adaptation techniques and women's involvement in these activities, as well as the source of information for these techniques, based on information obtained focus group discussions, key informant interviews, and participant observations. From the data, it was found that use of irrigation and fertilizers, pesticides, and insecticides were the most popular adaptation technique adapted by households in the area, both of which women were deeply involved in. Furthermore, flood drainage systems, embankments, and using salinity/drought-tolerant crop varieties were also common techniques that women were involved with. However, women rarely participated in adaptation strategies that involved technology or heavy equipment.

Table 4.8

Common Agricultural Adaptation Techniques, Women's Involvement and Source of Information

Adaptation Technique	Involvement of Women	Information Source
Crop rotation practices and changing cropping pattern	Yes	Fellow farmers, Seed dealers, NGOs, DAE
Flood drainage system	Yes	DAE, fellow farmers, BADC
Local embankment	No	DAE, NGOs, fellow farmers
Salt/Drought-tolerant crop varieties	Yes	Seed dealers, DAE, Research Institutes, BRRI, BARI, BADC
Integrated farm management	Yes	NGOs, DAE, SRDI, BRRI, BARI
Green fertilizer	Yes	NGOs, DAE
Pest management and fertilization	Yes	Fellow farmers, Seed dealers, NGOs, DAE
Vermicompost	Yes	NGOs, DAE

Adaptation Technique	Involvement of Women	Information Source
Plough machine	No	Fellow farmers, NGOs, DAE, BADC
Thresher machine	Yes	Fellow farmers, NGOs, DAE
Hybrid and HYV seeds	Yes	Fellow farmers, Seed dealers, DAE
Irrigation Methods	Yes	Fellow farmers, NGOs, DAE, BADC, WDB

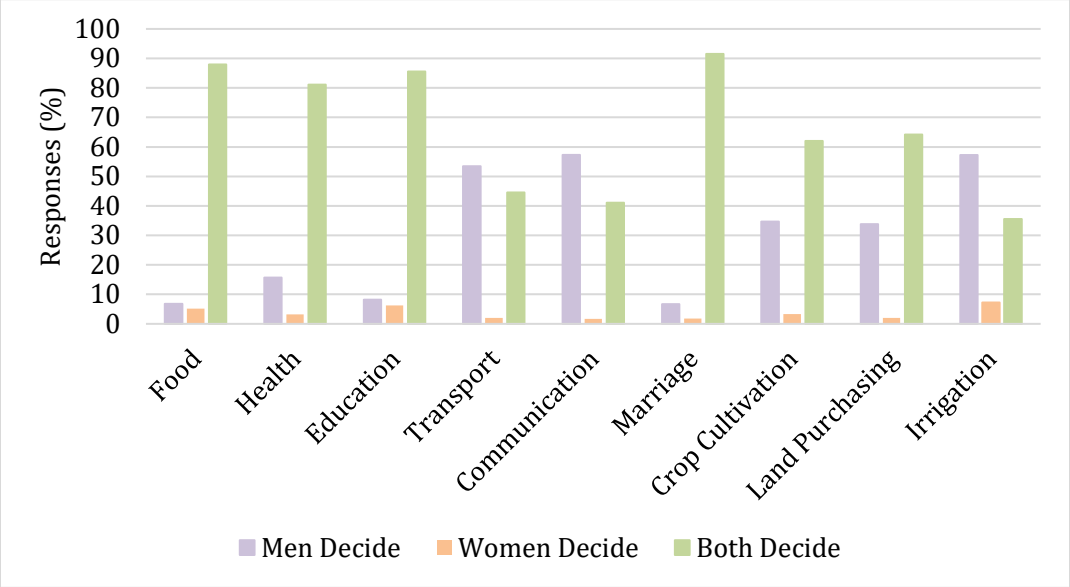
Note: DAE—Department of Agricultural Extension, WDB—Water Development Board, SRDI—Soil Resource Development Institute, BADC—Bangladesh Agricultural Development Corporation, WDB—Water Development Board, NGO—Non-Government Organizations, HYV—High-Yielding Variety; Table developed from focus group discussions, key informant interviews and participant observations.

It is also important to note that loans from NGOs and government programs are easily accessible to women, and they are often given more benefits than men in these situations to empower them and address gender inequality in rural areas. These loans allow women to play a crucial role in adapting to climate change impacts, particularly in agriculture. Additionally, women's income-generating activities, such as pickle-making and livestock rearing, serve as effective adaptation strategies for additional sources of income. This financial support allows households to invest in adaptation strategies and helps them tackle the economic losses from climate change impacts. The accessibility to loans elevates women's position in the household, and their decision-making power also improves.

Gender based decision-making power is significant when understanding gender-differentiated adaptation strategies as men and women may have different perceptions and abilities regarding adaptation. In the survey, it was found that men had greater decision-making power in the household regarding the use of irrigation technology, while both men and women had significant decision-making power for crop cultivation and harvesting, as well as land purchasing (Figure 4.19). As per observations, women have a say in land purchasing as loans are usually taken from financial institutions under their names to buy land. Women also decide on what to cultivate and harvest along with their partners as they are heavily involved in agriculture. On the other hand, using irrigation technology is a big expense and technical solution more suitable for men by design, which is why the decision to use such technology is usually taken by men. In the case of other aspects of their daily lives, men had greater decision-making power regarding transport and communication, while both men and women had decision-making power regarding food, health, education, and marriage-related issues in their household. Women overall had less decision-making power compared to men in all aspects.

Figure 4.19

Gender Based Comparison of Decision Making in Each Sampled Household (n=308)



4.4.4 Challenges Faced by Women in Agricultural Adaptation

Gender Disparities—Social Norms, Wage Gaps, and Limited Land Rights

In the study area, female agricultural wage labourers earn around Tk. 300 (approximately 2.92 USD), which is significantly less than their male counterparts, who earn Tk. 500–600 (4.87–5.84 USD) for the same hours of work. This wage disparity is often attributed to the belief that men can complete tasks more quickly and handle physically demanding jobs. However, even for jobs with similar effort like algae removal, women are paid less than men.

Women are also not acknowledged for household work or even their income-earning activities, and often suffer from time poverty. Women's earnings are equally important for the household as men as they provide additional finances for supporting the family and children's educations, savings, climate change adaptation and emergencies, along with daily costs. In fact in the study area, among the women who worked for a living, 55.9% contributed their entire income to their households. However, despite doing the same work, they receive less pay and they also get little time to themselves compared to men, as they are also responsible for childcare and household chores. Being unable to fulfill all their responsibilities may also result in increasing domestic disputes and, in some cases, domestic violence.

Moreover, although there are many women working on farmlands, they are never acknowledged as "farmers" because of their limited land rights. This is due to patriarchal inheritance laws that involve a lion's share of wealth being passed onto sons. This is especially problematic for widows whose husbands have passed away and have no sons, as the husband's land is given to male members of extended families instead of the wives. This often leaves widows powerless and landless, living in poverty.

My study revealed that in the study area, out of the 50 purposively selected female-headed households, 92% owned land, whereas out of the 292 randomly selected male-headed households, 98.3% owned land. Among the 16 randomly selected female-headed households, all of them also owned land. However, it should be noted that the majority of female-headed households owned homestead land but male-headed households owned more land of varying types, especially those related to agriculture like cultivable land (33.8% for MHH vs 23.99 for FHH) and ponds for fisheries (18.1% for MHH and 4.3% for FHH). Male-headed households also overall owned more shared cropped land and mortgaged land (Figure 4.19).

The results also revealed that all farmers received a "farmer identity card" (*Krishi Card*) from the government that allowed them to be recognized based on land ownership, which no women in the area possessed. This card is sometimes used to receive government aid such as receiving monitory help, training, and farming technology. Furthermore, it is difficult for women-headed households to access these services when there are no men in the household. This is because the government offices are located in the towns, require long distance travelling and going back and forth to different government officials, as well as complicated paperwork. It should also be noted that organizations distributing agricultural technology, aid, and input feel it is safer to target men in terms of getting their desired output and investment returns. From observations and conversations with women agricultural labourers, it was found that wearing women's traditional clothing (sari) makes it difficult to work in the fields and many women preferred to wear the more flexible salwar kameez (another traditional clothing that younger girls wear which is less constricting) (See Figure 4.21). Some women revealed that sometimes men passing by may eve tease them or comment on why they are working in fields. In Bishnopur in particular, a few women revealed that they sometimes wear pants and shirts while working on the field. They wear these untraditional western clothes because such clothes are easier to work in, and they can change out of them when done with farm work. This is not a common practice

and was only seen among a handful of women who were actively participating in agriculture, beyond labour work.

Figure 4.20

Comparison of Land Ownership and Gender of Household Head

*Male-headed households (*n* = 287), Female-headed households (*n*= 46)

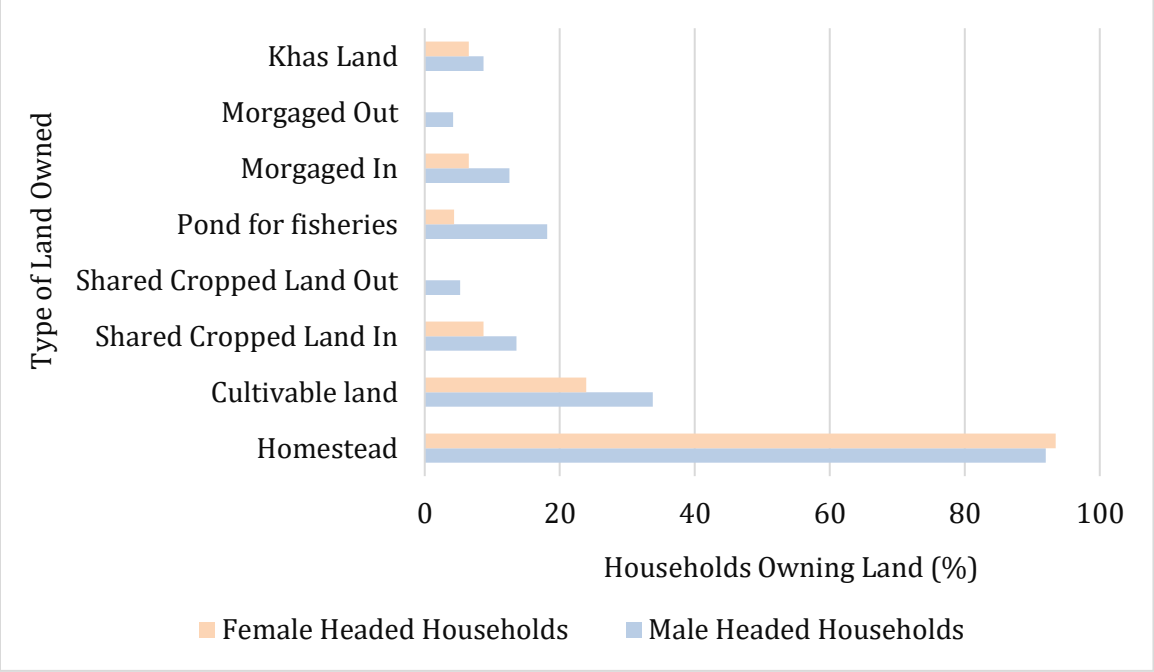


Figure 4.21

Woman Wearing Flexible Salwar Kameez Attire When Working

Source: Photo taken by field guide Abdullah, associated with the Mission Mohila Unnayon Sangstha, with consent (March 14th, 2023, Kaliganj).

Limited Access to Resources

Our sample survey results revealed that out of 292 randomly selected male-headed households and 50 purposively selected female-headed households, the majority of the respondents (80.5 MHH and 66% FHH) believed that men in their community have better access to agricultural adaptation and irrigation resources (Figure 4.22).

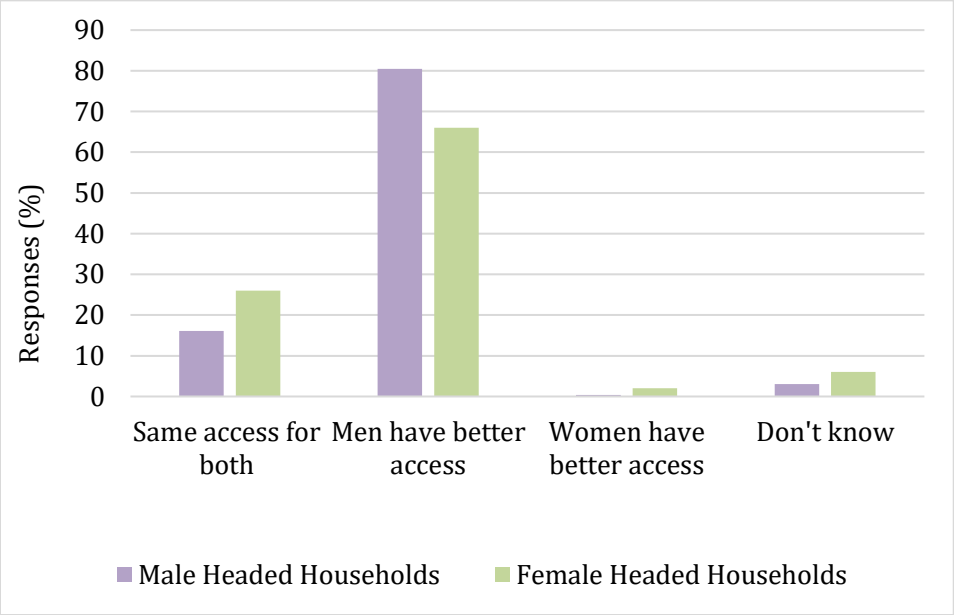
When men are absent in a household, women tend to ask neighbours to buy seeds and agricultural resources from the market, instead of going out to the market themselves. My observations also revealed that the majority of women did not go to markets for agricultural resources or household needs, and in the rare instances that they did, most would wear *burkahs* or cover their heads with a scarf. There were few women observed in public places in the villages and towns, which locals revealed were due to religious and cultural reasons and to avoid eve teasing. However, in some cases, if husbands are too busy or absent, wives involved in agriculture do come to the seed shops. In the shops, women sometimes feel uncomfortable waiting in line, and speaking up amongst men. Shopkeepers also do not converse for long with women or want to share as much information as they usually would with men. It should be noted

that these women, along with others seen in the markets and town centers, were most likely going to work or selling goods and often belonged to poor households, and were not viewed positively by women and men from higher social classes/rich households.

Figure 4.22

Perception of Gendered Access to Agricultural and Irrigation Resources based on Gender of Household Head

Male-headed households (*n* = 292), Female-headed households (*n* = 50)



It was also found from the survey that among the 50 purposively selected female-headed households, 80 % said they had female household members who owned cellphones, but among the ones that did, 72% did not have access to internet on the device. In the 292 randomly selected male-headed households, 72.9% said they had female household members who owned cellphones, but among them, 61.3% had no access to the internet. Access to a phone and internet connection is an important communication and knowledge-sharing tool, and plays an important role in women's autonomy, independence, and access to adaptation resources and knowledge on available assistance.

Lack of Gender-Friendly Technology

The agricultural machinery available is often not designed with women in mind. A government representative noted that this oversight is common in the design of such equipment. For instance, spraying machines require carrying a 15-litre chemical mix on the back, which is too heavy for many women, especially the elderly who also participate in agricultural labour (See Figure 4.23). Operating irrigation pumps, especially those that require oil, can also be challenging. While simpler devices, like meter irrigation machines that only need a switch to operate, are more accessible, they are also pricier and require more electricity. Additionally, power tillers and crop-cutting machines demand both skill and strength to use effectively (See Figures 4.24 and 4.25). Although some gender-friendly tools exist, like the Japanese weed cutter, many farmers prefer to have family members perform the tasks rather than invest in these tools. Some poor households may not have electric power lines and this too affects their choice in technology.

Knowledge on adaptation technology is not widespread among women, and it is also difficult to access and afford such technology for female-headed households involved in agriculture. There is very little external financial assistance to adapt these technologies, as well as limited awareness on new technology in the community. In the study, only 10% of the 50 purposively selected female-headed households and 2.7% of the 292 randomly selected male-headed households were receiving such financial assistance from NGOs and government organizations for agricultural adaptation. The few households that did receive training, demos, and financial help are often ones with connections to organizations.

Figure 4.23

Women Operating Different Types of Spray Machines

Source: Photos taken during fieldwork with consent (September 16th, 2023, Kaliganj).

Figure 4.24

Thresher Machine

Source: Photo taken during fieldwork by local field guide Abdullah, associated with the NGO ‘Mission Mohila Unnayan Sangstha’, with consent (August 20th, 2023, Kaliganj).

Figure 4.25

Tractor: Difficult to Operate for Women

Source: Photo taken during fieldwork by local field guide Abdullah, associated with the NGO 'Mission Mohila Unnayan Sangstha', with consent (June 12th, 2023, Kaliganj).

Lack of Skill Building

Key informants indicated that government workshops typically require 30 to 33% mandatory female participation. However, from our survey it was found that only 5% of households were aware of government-sponsored agricultural and skills training programs aimed at women. While some women in the community were selected as lead farmers and acted as local points of contact for resource distribution and training in agriculture, actual attendance in trainings and meetings often falls short of these quotas. Women's names may be registered in the workshops, but men frequently attend in their place. This trend may stem from a lack of interest among women, the burden of household responsibilities, and the perception that men would benefit more from the training. A key informant associated with the Ministry of Agriculture revealed that it is difficult to gather women, but sometimes farmers' wives attend the meetings to pass information to their husbands. The key informant also discussed how women take longer time to understand topics in the meetings and do not ask questions to clarify confusions, which discourages the workshop holders from inviting women as they think it won't be useful. It should also be noted that training programs aimed at women tend to focus only on socially acceptable income-generating activities like for women (like IGAs) and post-harvest processes, rather than providing agricultural skills and technical knowledge. Another factor discussed by key

informants was the fact that girls in the household rarely went onto pursue higher studies and were married off young, often even having to drop out of school. Thus, low literacy rates among women also makes skill building difficult. However, this may also be the case for men, who have to drop out early in school to help earn incomes for their families.

4.4.5 Capabilities and Adaptation Outcomes through a Gendered Lens

My study highlighted that capabilities of people in the agricultural sector are shaped by external societal factors such as Social inequalities, Patriarchal norms, lack of Land Rights, Limited Income Sources, Low Education/Skill Building opportunities, Lack of decision-making and bargaining Power, Limited mobility, and Institutional discrimination. The findings reveal that compared to men, more external societal factors influence women's capabilities negatively, affecting their ability to adapt. This not only prevents them from achieving functioning and reaching a state of well-being, but may also worsen their existing states (Table 4.9). I also found that adaptation activities may have both positive and negative effects on well-being outcomes/functioning, and this is significantly affected by the mentioned external social factors. Table 4.10 presents some examples of positive and negative outcomes based on my observations and qualitative data.

Table 4.9

External Societal Factors and their Impact on Men and Women's Capabilities to Adapt

Capabilities	Examples	Impact of External Societal Factors on Women's Capabilities		Impact of External Societal Factors on Men's Capabilities	
		Negative	Positive	Negative	Positive
Material resources	Money, land, assets, technology	Lack of land rights, poor quality and small land ownership, inaccessible technology, limited income options	Greater likelihood of owning gold and receiving loans	More difficult to obtain loans, lack of savings and gold assets	Greater land rights, higher quality and size of land, easily accessible technology, diverse income options
Social resources	Community groups, neighbours, friends, family	Limited participation in community activities, limited mobility, lack of access to communication devices	Good neighbourhood networking	Some income sources may limit socializing time	Involved in community and religious activities, free to move, access to communication devices
Institutional resources	GOs, NGOs, Markets, Banks	Complex procedures, long distance travelling, lack of gender friendly facilities, gender roles limiting women's presence in public	Easier for women to obtain loans, Many NGOs and GOs available to help with women's issues	Loans might be more difficult to access	Ease of mobility, public presence, infrastructure designed for men, agricultural extension services and support

Capabilities	Examples	Impact of External Societal Factors on Women's Capabilities		Impact of External Societal Factors on Men's Capabilities	
		Negative	Positive	Negative	Positive
Cognitive resources	Information, skills, education, training	Limited schooling, lack of awareness and knowledge of agriculture, unable to use technology, unable to access training	Scholarships available especially for women, skill building targeted at women, traditional knowledge base on agriculture	Boys may drop out of school early to earn incomes; men may not have enough time for skill building as they are the breadwinners	Access to education, training and skill building workshops, knowledge sharing from other farmers and seed dealers, access to Internet and phones

Table 4.10

Examples of Positive and Negative Outcomes of Adaptation Strategies in the Community

Outcomes	Women		Men	
	Positive	**Negative**	**Positive**	**Negative**
Food security	Homestead gardening, livestock rearing can increase food supply	Women prioritizing men and children and eating less due to gender norms	Adaptation strategies improve yield of subsistence farming and food supply	Reduction of protein intake to control expenses may affect nutrition
Income security	Diversified income-earning opportunities improve finances	New adaptation technologies may lower demand for labour	Migration and diversified income opportunities improve finances	Shrimp farms do not require as many labourers as crop cultivation

Outcomes	Women		Men	
	Positive	**Negative**	**Positive**	**Negative**
Health and well-being	Adaptation strategies that improve crop production and therefore income allows more money to be spent on health issues and higher quality of life	More agricultural responsibilities and income opportunities may cause time poverty and a greater burden of work	Technology that reduces agricultural labour can improve their physical health	Burden of earning as breadwinner and heavy labour work during migration periods can affect health
Empowerment	Access to loans and income earning opportunities and training increase women's decision-making power	Work burden and pressure to earn affecting household chores household disputes	Adaptation innovations, strategies and community efforts motivate farmers; working with NGOs and GOs improves their social status	Selling off assets like land for adaptation may lower social status

4.5 Discussion

4.5.1 Women's Unacknowledged Role in Agriculture and Climate Change Adaptation

Contrary to popular belief of agriculture being a male-dominated field, this study found that both men and women in this study were heavily involved in agricultural activities. In fact, women often rely solely on agriculture whereas men have more sources of income. This is on par with existing literature which emphasizes women's notable roles in the agriculture sector related to food security, daily responsibilities, and livelihoods (Antriyandarti et al., 2024; Chandrakar et al., 2020). Research by the Food and Agricultural Organization of the United Nations (FAO, 2023) also states that women are often more dependent on agriculture as an income source than men. According to their report, 66% of women in Sub-Saharan Africa and 71% in Southern Asia are employed in agrifood systems, whereas for men in those regions, the statistics show 60% and 47% involvement, respectively (FAO, 2023).

My findings highlighted that women's role in agriculture is often minimized, and they are viewed only as extra helpers, farmer's wives, or agricultural labourers. The undermining of their role in agriculture is also evident through the fact that none of the women in the study area possessed a farmer identity card *(krishi card),* which is tied to landownership and often determined whether they were receiving monetary aid and other agricultural support from the government. This lack of recognition is a common phenomenon in other developing countries in Asia and Africa (Glazebrook et al., 2020; Raynolds, 2021).

I also found that women earn significantly less than men for agriculture labour work, although sometimes they have to put in twice as much labour as they may not be using technology. Globally, women in the agricultural sector earn 18.4% less than men on average (FAO, 2023). However, in this study I found a higher gender pay gap, with women earning 40% less than men for agricultural labour. This lower income makes it difficult for women to make up the losses related to climate change impacts and serves as an obstacle to adaptation to agriculture. Moreover, women partake in daily unpaid labour in their own homestead lands, help their husbands in the fields, and manage their household and caretaking responsibilities. All of these unacknowledged roles and responsibilities result in time poverty and difficulty managing their tasks, and often result in domestic problems. According to Hyde et al. (2020) such time poverty should be categorized as a women's rights issue as it can have adverse effects on

women’s health through poor food choices, delayed medical attention–seeking tendencies and lack of skill-building opportunities

4.5.2 Lack of Land Ownership

My findings indicate that land ownership influences farmers' livelihoods and adaptation significantly and functions as a criterion for governments to officially recognize farming livelihoods. It is also associated with the allocation of nationwide agricultural aid and resources. This practice inherently perpetuates discrimination, as wealthier and male-headed households possess greater landholdings compared to their less affluent counterparts. Additionally, the inheritance of land over generations further entrenches this inequality, providing already wealthy households with a sustained advantage. Although mechanisms such as renting and leasing exist to enable farmers with limited land access to engage in agricultural activities, the underlying inequalities intensify the adverse effects of climate change on smallholders and agricultural labourers. These marginalized farmers face heightened risks and have limited capacity to recover from, and adapt to, the impacts of climate change.

Naher and Karim (2023) highlight that the lack of access to land in South Asia affects agricultural production and access to other resources, like extension services and credits, negatively. Morsalin and Islam (2023) also report that landlessness creates constraints for seeking livelihood diversification options like livestock rearing, shrimp farming, fishing in ponds, and homestead gardening of vegetables and in-season fruits. In a similar vein, my study found that being landless makes it difficult to receive loans through official channels to recoup from climate-related losses as institutions do not want to take risks. In rural Bangladesh, land ownership contributes to economic and social well-being, and also functions as a symbol of power and status. Notably, women experience disproportionately lower levels of land rights and ownership compared to men. Despite the existence of legal frameworks intended to promote women’s land ownership, the reality is that very few possess formal titles (Enokenwa, 2022). According to the Bangladesh Bureau of Statistics (BBS, 2022), 32.04% of landowners are women, with Muslim women (34.26%) owning more land than women from Hindu and other religions (11.64%).

The women in the study area possessed less land than men, particularly cultivable land. This disparity inhibits women's ability to officially engage in agricultural activities and to be recognized as "farmers". Furthermore, the lack of land ownership keeps women at a subordinate

position within society, limiting their economic autonomy and preventing them from selling land to address financial needs arising from climate change impact. Those women who do hold titles often inherit smaller parcels of land that are typically of inferior quality and lower economic value. Moreover, women's agency over agricultural practices and production decisions related to the land they may own also tends to be limited. However, it should be noted that married women in the study area were playing an equal part in deciding about the production on land as well as buying and selling land. Some were also quite knowledgeable about agriculture, land, and farming requirements. This decision-making power can be attributed to two factors: i) the fact that agricultural loans are more easily available for women, giving them more power, and ii) women learn about agriculture from their husbands, neighbours, and employers as they are eager to improve their own farming knowledge.

A report by Oxfam (2023) reiterates our findings, that in Bangladesh, Nepal, and Sri Lanka, women had a lack of land tenure and limited decision-making surrounding land, which affected their ability to access support for climate adaptation as well as compensation for climate-related losses from the government. However, in Timor Leste, they found that formal land tenure was available to women and therefore women farmers were able to access government support (cited in Wickramaratne & De Silva, 2023). The Akter et al. (2017) study based on Myanmar, Thailand, Vietnam, and the Philippines found that although issues related to work loads and drudgery were common, in general, women assumed they had joint ownership of land, and therefore played an equal role in making selling and buying decisions regarding land, and had equal access to agricultural inputs. However, in most cases, land was still formally registered under the husband’s name or women were unaware of the legal tenure.

The authors attribute these results to the fact that women in Southeast Asia are more empowered than other regions in Asia, and because the region’s agriculture is mostly based on small-scale family rice farming which requires both wife and husband to work in the same fields together (Akter et al., 2017). It should also be noted that Christianity and Buddhism are the dominant religions in the countries studied. I therefore propose that geographical and local contextual differences must be considered when designing and implementing agricultural interventions, support, and policies.

4.5.3 Patriarchy as a Challenge for Women Farmers and Adaptation

Based on the literature and my findings, I draw the conclusion that patriarchal norms play a significant role in gender disparities in climate change–related agricultural adaptation. Moreover, patriarchal norms and societal perceptions of gender roles and responsibilities, as well as religious beliefs and cultural practices, play a significant role in the empowerment and recognition of women in agriculture, and how much climate support they are able to receive.

In the study area, women from higher socioeconomic status looked down upon working women from poor backgrounds who would go to the markets for resources and engage with men, due to religious and cultural notions of women's roles and behaviours. This is similar to Clark's (2023) findings, where women involved with agriculture in Nepal were often gossiped about and harassed by society for interacting with men in public regarding labour recruitment. Another study by Najjar et al. (2023) in Morocco revealed that it was considered shameful for husbands to allow their wives to work in fields. Working as agricultural wage labourers for young and unmarried women was also considered bad for their reputation, with many of them covering their faces when going out to work and leaving at dawn to avoid being seen. Sugden et al. (2014) further highlight how limited networking, discomfort with engaging men, and women's tendency to stay out of the public eye due to patriarchal norms often create obstacles for finding irrigation sources and agricultural inputs. However, while the working women in my study also mentioned these issues, they were also actively trying to improve their knowledge and access to resources to help increase their household income through agriculture.

Glazebrook et al. (2020) also explains that the lack of recognition of women's labour can be seen as "both a symptom and driver of bias" when it comes to the marginalization of women farmers (p.11). That is, since women are marginalized and face prejudice in our patriarchal societies, their work is not given as much importance. This non-recognition of their labour in turn reinforces the social disparities and discrimination faced by women.

Galiè et al. (2013) attributed the invisibility of women in agriculture to gender roles and norms in society. They also pointed out that women were considered as part of the agricultural livelihood as long as they maintained those gender boundaries. This study had similar findings, where women faced many restrictions with the type of agricultural work they were able to do, type of clothes to wear, hours they could work, and lack of mobility and access to markets.

However, at the same time, their agricultural income and labour was often necessary to run the household.

Research has shown that there has been an ongoing feminization of agriculture linked to climate change impacts. That is, when men migrate for alternate sources of income due to climate change impacts and other reasons, women are left behind to take up their agricultural responsibilities (Chhetri & Ghimire, 2023; Glazebrook et al., 2020; Satapathy, 2025). While this is generally empowering for women, it further adds to their workload and responsibilities. Pattnaik et al. (2018) proposes that this phenomenon should instead be called 'feminization of agrarian distress' as outmigration of men leads to heavy work burdens for women, which has negative effects on their well-being and empowerment, and exacerbates issues relating to time poverty.

4.5.4 Absence of Accessible and Inclusive Institutions, Markets, and Technology

Results of this study indicated that institutions, markets, and dissemination of information and resources were not gender responsive. The lack of access to markets and institutes also limits their access to agricultural aid and inputs, and limits women's networking and knowledge sharing. Moreover, accessing aid and relevant institutions for their agricultural issues is often riddled with complex processes, paperwork, and long-distance travelling which can discourage women, especially if there is no man to accompany them. These findings echoed the study by Manfre et al. (2013), which shared that women were engaging with informal and local-level networks like family and neighbours for agricultural purposes and information, whereas men were relying on formal institutions like government and non-government organizations.

I also found that the lack of representation of rural women in agricultural platforms, institutes, and decision-making roles results in policies and projects which are not gender sensitive, particularly during the implementation phase. Agricultural training and skill-building programs overlook women's challenges and do not have enough female participation, even though there are policies that promote gender inclusivity, such as the government requirement of having 33% women participation in most initiatives. Gender inclusivity goals are met superficially, while in reality, loopholes, corruption, and lack of accountability limit the transformative intentions of projects during implementation.

On a similar note, Rola-Rubzen et al. (2020) points out that agricultural research, development, and extension (RD & E) give more importance to productivity, often excluding

women when introducing new strategies and technologies. Even if women are included, there are no measures taken to address the knowledge gaps and limited access to agricultural inputs that may act as obstacles when adopting adaptation technology and strategies. Msosa (2022) explains that along with cultural obligations, the lack of sanitary facilities in markets, the expenses related to taxes, and even the market operating times that coincide with other household responsibilities serve as obstacles for women farmers' access to markets. A study in Uganda by Theeuwen et al. (2021) also found that due to non-inclusive institutions, women farmers find it difficult to sell their agricultural products and negotiate with buyers and sellers for better prices, which would often result in them being exploited.

This study indicated that popularity of adaptation strategies depended on accessibility, affordability and ease of use. However, many integral technologies were too expensive for the locals such as plough machines and drought- and salt-tolerant crops. I also found that both men and women participated in adaptation strategies, but adaptation technology was dominated by men, and women were limited to the labour heavy work. However, in some cases, women were equally capable of operating technology like the irrigation machines or the thresher machine, if given the opportunity, especially when there was a group tackling the task.

It should be noted that along with patriarchal, religious, and cultural beliefs of women's designated roles and responsibilities, and negative association with technology use, the agricultural adaptation technology itself is often designed with a gender bias. They are designed in such a way that only considers men's physique and abilities, which in some cases may be different from women's from a biological perspective. Moreover, technology is most often introduced to aid in men's agricultural tasks, rather than targeting women's tasks, which are already labour intensive and require efficiency.

Hidrobo et al. (2024) mirrors these findings, stating that agricultural technology is gender biased and prioritizes men's physical stature, preferences, and needs over women's. They further explain that labour-saving technology can benefit women in numerous ways by freeing up their time, reducing workload, and changing gender norms that associate women with only household chores. On that note, Khatri-Chhetri et al. (2020) also proposes that certain strategies like "transplanting, nutrient management, and sowing of crops, direct seeded rice (zero tillage and low tillage using machine) and green manuring (GM)" (p.37) should be introduced for adaptation as it has great potential in reducing women's agricultural drudgery.

Gonda (2016) suggests that one needs to go beyond simple assessments of the costs and benefits of technology to understand the association of cultural practices and gendered behaviours to such strategies. Theis et al. (2018) further points out that sometimes, the "right to use" technology also plays a role in the gendered adoption of strategies. For instance, they found that in Africa, men have the right to use mechanized irrigation methods, but women only have the right to use manual irrigation measures like buckets and cans. This right is not biological, but clearly stems from patriarchal norms and cultural beliefs. However, the same study also noted that women are limited to growing leafy vegetables that require less water whereas men in charge of greater water-requiring produce such as tomatoes and onions. Srestha et al. (2023) notes that mechanized technology is often considered the man's possession due to gender stereotypes and that women may also become more dependent on men if technology is used for agriculture. Along with gender-biased designs, household power dynamics, gender stereotypes, and lack of purchasing ability, women also have less access to training and skills building and communication and information dissemination services compared to men (Rola-Rubzen et al., 2020).

4.5.5 Limitations and Contributions

This study, conducted through a gendered lens, aimed to explore local agricultural adaptation strategies. A key emphasis was placed on participants' perceptions and the study was approached from a bottom-up perspective. One limitation of the study was that internal and external capabilities, as outlined in Sen's (1993) framework, were not treated as separate categories and internal capabilities were not given the same level of focus as external capabilities. Also, due to time and scope constraints, my ability to triangulate findings with data from governmental and organizational sources was limited. The study was also unable to adopt an in-depth intersectional approach, which is an important aspect to consider when assessing adaptation strategies, as men and women are not homogenous groups. Moreover, as the study was confined to two unions in Satkhira, its findings cannot be generalized to the entire coastal region, where variations in geography, socioeconomic status, and resource access may lead to different outcomes.

Nonetheless, the study makes a significant contribution to feminist scholarship on women's roles in agricultural adaptation. It helps fill a gap in understanding nuanced challenges faced by women which are often overlooked in policy making and interventions. This study also

contributes to the existing literature on local adaptation technologies and strategies specific to coastal zones. By using the capability approach and a feminist lens, the study assesses both availability of resources and opportunities for men and women from a human rights perspective, and considers both positive and negative outcomes of adaptation—instead of following the usual research trend of focusing on only the benefits. Moreover, it sheds light on and can act as a guide for addressing entrenched gender inequalities, social disparities, patriarchal norms, and institutional discrimination when designing adaptation

4.6 Conclusion

Coastal regions of Bangladesh including the District of Satkhira are heavily reliant on agriculture and have a significant number of women involved in the sector for income and subsistence. However, they often tend to be overlooked in terms of their agricultural contributions by the prevailing institutions. Moreover, there is a dearth of knowledge on currently existing local climate change adaptation strategies, and especially the role of women in those strategies. My study attempted to identify the local adaptation strategies in the agricultural sector of Kaliganj, Satkhira and assess women's contributions to the process. Furthermore, my study planned to understand the barriers faced by women in the process of adaptation to propose gender equitable policies and technologies.

This study found and categorized the adaptation strategies used into four groups: alternate sources of income; irrigation, water storage and rainwater harvesting; salt- and drought-tolerant crops and hybrid high-yielding crops; and local technologies and strategies. The study also shed light on the significant contributions of women in agriculture and identified some challenges they face in the adaptation process. Women experienced gender disparities in terms of social norms, wage gaps, limited land rights, and limited access to resources. Moreover, the agriculture sector does not design gender-friendly technology and excludes women from skill building and training. Lastly, this study revealed that capabilities are shaped by a set of external social influences, which also play a role in the positive and negative outcomes of adaptation actions.

Based on these results, I recommend mainstreaming of gender in climate change adaptation for agriculture, so that multiple goals of gender inequality, development, and adaptation can be met together, since there are already proven linkages and connections between each of the goals. Policies and projects from the initial phases need to be gender sensitive, while

implementation needs to be gender responsive with the goal of gender transformative success, which will lead to long-term sustainable benefits. Locals of all backgrounds should be included in agricultural extension programs and skill-building projects, making sure the implementation process is itself inclusive and easy to access. The provision of gender-friendly and drudgery-reducing technology, and solutions catering to specific needs, should be introduced—especially in the case of information dissemination and provision of agricultural support. Empowering women through easily accessible loans, income-earning opportunities, and education are significant for successful adaptation outcomes. Moreover, there needs to be better awareness regarding women's land rights and women should be recognized for their farming work, even in the absence of land ownership. Lastly, I recommend that women are encouraged to participate in leadership roles and activities, and are given important roles in society, to elevate their status and ensure they have a say in decision making regarding adaptation interventions, projects, and policies.

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CHAPTER 5

Discussion and Conclusion

5.1 Introduction

This study aimed to analyze the dynamics and factors driving the severe impacts of climate change on marginalized communities in the coastal region of Satkhira, Bangladesh, with a particular focus on gender disparities. It further examined the contributions of women to local climate change adaptation strategies and investigated the innovative agricultural technologies and practices being implemented in the region to address climate change challenges. The specific objectives of the study were to:

i. identify and explore the major factors responsible for differentiated climate change impacts on different income groups with a particular focus on women;
ii. examine agricultural adaptation technologies and methods that have evolved locally as a response to climate change impacts, particularly engaging women; and
iii. determine the challenges and barriers faced by women in climate change adaptation to agriculture.

The results from this study were presented in Chapter 3 and 4. Chapter 3 is associated with the first objective and Chapter 4 is associated with the third and fourth objectives. My research revealed that overall, women, elderly, and minorities (specifically lower-caste Hindu communities) are some of the most vulnerable communities to climate change in the rural coastal areas of Satkhira due to existing inequalities and low social status, which not only contributes to them experiencing disproportionate burdens of climate change, but also limits their ability to recover and adapt. These experiences are far worse when such vulnerable identities intersect, and ultimately, climate change acts as an aggravating factor for social inequality, keeping these groups stuck in a disadvantaged position. My study also found that although women play integral roles in climate change adaptation, they are not acknowledged for their contributions, and that there is a lack of inclusive climate change policies and implementation programs, which perpetuates the cycle of social disparities. Lastly, my research revealed that patriarchal norms, gender roles, and internal discriminatory belief systems play a significant role in the

differentiated impacts of climate change and adaptation capacities. This highlighted that there is a need for deeper changes in society through awareness and empowerment of women and minorities, in order to tackle climate change impacts.

This chapter provides an overview of the key findings and discussions from both chapters, along with policy recommendations. It also addresses the limitations and contributions of the research, offering suggestions for potential areas of future inquiry. The chapter concludes with the researcher's final reflections on the study.

5.2 Discussion

Climate change constitutes a major global challenge, with its impacts shaped by a range of factors, including gender, socioeconomic status, ethnicity, age, and disability. Additionally, social and political processes play a crucial role in determining how individuals experience climate change and their ability to respond to, and adapt to, its consequences. These processes lead to differentiated impacts of climate change, further exacerbating pre-existing social inequalities and gender disparities. While the gendered impacts of climate change are a global phenomenon, the burden of its impacts is experienced to a greater extent by women from low- and middle-income countries.

A study by Goh (2012) revealed how developing countries in particular have gendered impacts on economic resources. In these countries, women are already at a disadvantage in terms of land and asset ownership, and climate change impacts and related disasters create even greater losses for women compared to men. Glazebrooke et al. (2020) also assert that overall, women in the global South tend to suffer more from climate change compared to the global North. They also argue that most research on agriculture and climate change is focused on the global North, despite women in the South being heavily involved with food security. However, women in agriculture in those regions tend to be viewed merely as "involved in farming", as opposed to the perception of women being legitimate "farmers" in the global North (Glazebrooke et al., 2020).

In their study, Fatouros and Capetola (2021) found that deeply embedded societal gender norms and roles, prejudiced policies and practices that are biased toward men, and the underrepresentation of women in leadership roles within socioeconomic and political spheres are prevalent in low-income countries such as Bangladesh, India, Indonesia, Iran, Nigeria, the Philippines, Vanuatu, and Vietnam—and are significant contributors to women's higher

vulnerability to natural hazards, compared to men. Goodrich et al.'s (2019) study on the Hindu Kush Himalayan region (constituting Nepal and Bhutan and the mountainous areas of Afghanistan, Pakistan, China, India, Bangladesh, and Myanmar), also highlights the area's social stratifications based on gender, caste, ethnicity, and religion and the resulting power dynamics. Despite the diversity of beliefs and communities, the region has overarching patriarchal customs which exclude women and marginalized communities from society, limiting their access to resources and ability to adapt and cope with climate change impacts.

Africa is another developing region suffering from disproportionate climate change impacts, where women and the marginalized are often the biggest sufferers. Along with diverse ethnicities, the region has vastly different topographies and microclimatic conditions (Rao et al., 2017). Moreover, in regions like East Africa, additional issues such as societal volatility, war and famine are added to the mix and result in aggravated societal conflicts and disparities from climate change impacts (Abebe, 2014). Rao et al. (2017) also noted that women-headed households were common in the African region and in some cases, like in Northern Kenya, it was found that household chores were flexibly shared among men and women.

In Bangladesh, women in rural coastal areas are among the most vulnerable groups facing the severe effects of climate change. This vulnerability is intensified by existing gender inequalities and compounded by factors such as poverty, marginalization, and low socioeconomic status, which most climate change interventions and policies do not address sufficiently (Reggers, 2019). Moreover, women play crucial roles in the climate change adaptation process, particularly within the agriculture sector, and have unique, gender-specific needs that need to be considered when designing and implementing climate change adaptation technology, policies, and interventions (Khalil et al., 2016; Schulenburg et al., 2017).

Women remain a largely untapped potential in programs tackling climate change impacts and climate change interventions need to be more gender responsive. Moreover, climate change policies and activities and existing literature largely emphasize women being 'victims' of climate change rather than active agents in the fight against it (Reggers, 2019; Tanjeela & Rutherford, 2018), overlooking how women can be agents of adaptation and resilience. There is also an overall lack of comprehensive knowledge in the recent climate adaptation activities and technology used by locals in Bangladesh (Asian Development Bank [ADB], 2014), and the role of women in climate change adaptation practices.

While gender issues have been addressed in climate change adaptation policies of Bangladesh, gender sensitivity does not translate into the planning and implementation of climate change action. There is a lack of consideration of the differentiated impacts of climate change on women and how climate change adds to their ongoing socioeconomic adversities (Shabib & Khan, 2014). Knowledge on how gender relations and different backgrounds of women influence their experience with climate change is also limited. Furthermore, the current climate change research arena requires in-depth and nuanced evidence of the factors behind the differentiated impacts of climate change and adaptation in Bangladesh.

This study addresses the gaps in the existing literature regarding my research questions and contributes to the theoretical and practical knowledge on local agricultural climate change adaptation technology. It also provides insight on the role of women in climate change activities and the various social, institutional, and gender inequities that are faced by marginalized groups. This research draws upon feminist theories which acknowledge that gender itself is not the basis of oppression, rather it is one of the factors that contribute to social divisions, interacting with other factors such as socioeconomic class, ethnicity, age, and disability (Osmond & Thorne, 1993). Using a feminist lens makes researchers attentive of gender relations, and how cultural, historical, political, and economic processes, as well as women's own self-worth can contribute to oppression (Lay & Daley, 2007). Since my research explores the differentiated impacts of climate change and local agricultural climate change adaptation technologies, with a focus on women, gender relations, and socially equitable climate change action, a feminist worldview provided the guiding principles to obtain a comprehensive and perceptive understanding of these issues through a contextual process of knowledge generation. Thus, my contributions to this aspect of climate change literature will ultimately help to establish improved climate change resilience projects, policies, and frameworks that are gender responsive and inclusive for marginalized people.

5.3 Major Findings and Reflections

5.3.1 Women and Minorities Trapped in a Cycle of Inequality

The findings of my research indicate that women and minorities experience more severe outcomes from climate change impacts compared to other communities, particularly in relation to disaster-related losses, infrastructure issues, and livelihood, social, and health impacts. Furthermore, intersecting factors such as old age, disability, poverty, and lower social status can compound gender and ethnicity to create layered vulnerabilities, keeping these groups in a disadvantaged position. These compounded factors result in marginalized and disadvantaged groups having higher exposure to climate stresses, making them more susceptible to the impacts of climate change and leading to more significant losses compared to others. Besides, these groups typically have lower adaptive capacity due to existing inequalities and limitations in their capabilities.

My research findings reveal that not only do climate change impacts vary across different groups, but the outcomes of adaptation efforts are also disproportionate. The ability to adapt is heavily shaped by pre-existing social and gender inequalities, which influence the effectiveness of adaptation measures. Consequently, there are “winners” and “losers” in adaptation efforts, with disadvantaged groups losing more and having fewer resources to recover from climate-related shocks. However, this cycle can be mitigated through external support aimed at enhancing adaptive capacity. Interventions such as loans, skills training, financial and food aid, and improved early warning systems for disasters can help increase resilience and reduce vulnerability.

The root causes of vulnerability must also be addressed in order to create sustainable change. This can be achieved by implementing gender-inclusive institutional processes, promoting universal access to education, and enacting policies that aim to reduce social disparities. The interventions to reduce vulnerability require transformative societal changes, while measures to improve adaptive capacity benefit from both short-term and long-term actions. By addressing both the structural factors that create vulnerability and enhance adaptive capacity, the resilience of marginalized communities can be significantly strengthened.

5.3.2 Social Constructs, Internal Belief Systems, and Entrenched Inequalities in Daily Life Influence the Climate Change–Inequality Cycle and Capability to Adapt to Impacts

My research emphasizes the crucial role that social constructs, internal belief systems, and deeply embedded historical inequalities play in shaping the differentiated impacts of climate change. These societal frameworks influence how people experience climate crises, reinforcing systems of oppression through constructs like gender roles, social and religious hierarchies, and cultural values. Such constructs contribute to the unequal burdens that marginalized groups, particularly women, bear during climate events. Furthermore, subtle, embedded inequalities—such as unequal access to resources, political power, and social protection—intensify the effects of climate change, further entrenching the vulnerability of these groups in a cycle of disadvantages.

Internalized belief systems, particularly among women and marginalized communities, may either empower or hinder their responses to climate change. This presents an important consideration in the design of effective adaptation strategies, as people's capacity to act or adapt depends significantly on these beliefs. In some cases, even those most affected by climate change may unknowingly perpetuate societal structures that limit progress. Social constructs regarding "appropriate behaviour," often reinforced by those in higher social strata, can obstruct marginalized groups from overcoming their disadvantages. It is ultimately the elite or "upper classes" who benefit from maintaining these exclusionary cycles that restrict access to opportunities for certain groups.

To break these cycles, it is essential to challenge and transform these underlying systems. Empowering marginalized communities, and integrating gender equity and social justice into climate policies and actions is key to achieving meaningful change. This can be accomplished through transformative and sustainable interventions, such as raising awareness, ensuring access to education for children across all communities, providing job and income-generating opportunities for marginalized groups, and ensuring the active participation of women and minorities in decision-making roles. Additionally, it is important to ensure that efforts to support women do not inadvertently burden them with additional responsibilities that worsen their workloads or contribute to time poverty.

It is recommended that women should not be viewed merely as victims of climate change nor should they be expected to take on the role of "saviors". Rather, women and minorities are

integral members of society who deserve equal treatment and human rights. Therefore, climate change adaptation measures must include equitable support to address gender and social disparities while effectively responding to the challenges posed by climate change.

5.3.3 Need for Contextual Considerations and Inclusive and Gender-Sensitive Adaptation Policies and Action

The need for contextual considerations and inclusive, gender-sensitive adaptation policies and actions arise from the recognition that climate change impacts are experienced differently across various communities, and these disparities are often influenced by social, cultural, economic, and gender-based factors. Contextual considerations ensure that adaptation measures are tailored to the specific vulnerabilities, needs, and resources of local communities, thereby enhancing their effectiveness and sustainability. First, climate change does not affect all individuals or groups in the same way. Vulnerabilities are shaped by factors such as geography, socioeconomic status, cultural norms, and gender roles.

In Bangladesh, while gender and social equality are often incorporated into climate change and development policies, these issues are frequently treated as mere formalities rather than being addressed in substantive, impactful ways. The inclusion of mandatory quotas for women or marginalized groups, for example, is often implemented without sufficient transparency or accountability, which leads to ineffective and unsustainable outcomes. Moreover, women, the poor, and minorities are not a homogenous group, and their unique needs and challenges require context-specific solutions. A one-size-fits-all approach is inadequate, as marginalized communities have diverse backgrounds, resources, and vulnerabilities that must be acknowledged when designing climate adaptation strategies.

The objectives of addressing gender inequality, climate change adaptation, and development are closely intertwined. A negative impact in one area often exacerbates challenges in the others. For instance, issues such as the lack of appropriate shelters for women, limited mobility for women farmers working in the fields, social isolation among minorities, and inadequate infrastructure for accessing resources like water—such as poor road conditions—are frequently overlooked, yet they play a significant role in the success or failure of adaptation efforts. These nuanced concerns underscore the complexity of adaptation and highlight the need for more comprehensive, people-centered approaches.

While the focus of climate change adaptation is increasingly shifting from technical and scientific aspects to social dimensions, it remains crucial to strike a balance between these approaches. To achieve more inclusive, effective, and sustainable adaptation outcomes, it is essential that interventions not only incorporate technical innovations and economic strategies but also consider social power dynamics, political processes, accessibility, and the specific needs of different communities. The aim should be to create solutions that are accessible to all, recognize existing disparities, and effectively empower marginalized populations in the face of climate change.

Inclusive policies that account for diverse demographic factors, including age, disability, ethnicity, and economic status, are crucial in promoting equity in adaptation efforts. Excluding marginalized groups from the design and implementation of adaptation measures can exacerbate existing inequalities, further undermining their capacity to cope with and recover from climate impacts. Gender-sensitive adaptation policies specifically aim to empower women and other marginalized groups by addressing the power imbalances that limit their access to resources and opportunities. By integrating gender considerations into climate change adaptation, policies can help transform societal structures that perpetuate inequalities, thus fostering more resilient and adaptive communities. Therefore, incorporating contextual and gender-sensitive factors into adaptation policies is essential not only for improving the effectiveness of climate change responses but also for ensuring that these responses are just, equitable, and sustainable.

5.4 Policy Recommendations

Based on the study findings, I recommend the following policy interventions for consideration:

I. **Integrate Gender and Social Equality into Climate Adaptation Policies**: Climate adaptation strategies must be designed with a gender and social equality lens, recognizing the distinct vulnerabilities of marginalized groups such as women, indigenous populations, the elderly, and people with disabilities. Policies should ensure equal participation in decision-making and resource access, and the benefits of climate adaptation interventions. These include addressing power imbalances and ensuring that women and other marginalized groups have equal opportunities for capacity-building, leadership roles, and access to financial resources.

II. **Ensure Equitable Access to Resources and Financial Support**: Access to resources, including land, credit, and markets, must be equitable to reduce the vulnerabilities of marginalized communities. Financial support mechanisms, such as micro-loans and subsidies, should be made accessible to those who need them most, especially women and low-income groups, ensuring they can invest in climate-resilient practices. This also involves developing transparent, accountable systems for allocating financial resources, and easily accessible institutions and simpler process for accessing loans.

III. **Develop Locally Tailored Adaptation Strategies**: Climate change adaptation strategies should be context specific, taking into account the distinct needs and challenges of various communities.. Local knowledge and practices should be integrated into adaptation planning, ensuring that interventions are both feasible and effective in the given context. This includes addressing local water and agricultural issues, such as improving water access through rainwater harvesting or promoting drought-resistant crops, while considering the social and cultural norms that shape how these solutions are adopted.

IV. **Encourage Gender-Responsive Disaster Risk Management**: Disaster risk management systems must be gender-responsive, incorporating the needs and priorities of women, children, the elderly, and other marginalized groups. This includes ensuring that early warning systems are accessible to all and that evacuation plans consider gender-specific and age-specific needs, especially in shelters, for women and the elderly. Furthermore, women's voices should be included in disaster planning and response efforts.

V. **Promote Gender-Sensitive Agricultural and Technological Solutions**: Climate-resilient agricultural technologies and practices should be developed with a focus on gender inclusivity, addressing the specific needs of women farmers, who often face increased labour burdens and limited access to resources. Technologies that save time, improve crop yields, and reduce women’s physical labour in farming should be prioritized. Additionally, training and capacity-building efforts should be gender-responsive, providing women and marginalized groups with the necessary skills to implement and benefit from these technologies.

VI. **Enhance Public Awareness and Education**: Public awareness campaigns and educational programs should aim to raise understanding of the intersection of gender,

social inequality, and climate change. These programs should be inclusive, ensuring that marginalized groups are not excluded from important information and decision-making processes. This includes increasing educational access for girls and women and ensuring that communities are equipped with the knowledge to adapt to climate challenges.

5.5 Limitations of the Research

This research was conducted with well-meaning intentions and reflexivity, but there were some limitations that should be acknowledged. First, people in the area were aware that I was from the capital city Dhaka and a graduate student. Although all efforts were taken to build rapport with the communities over the 6-month field work period, and cultural norms such as dress codes and food habits were followed, some degree of power imbalance through the researcher–participant relationship may have existed. Furthermore, due to time and scope constraints, some relevant issues such as migration and human trafficking were not explored thoroughly. For the same reason, the ability to triangulate findings with data from governmental and organizational sources was also restricted.

While the study aimed to address both genders' climate change–related issues from a neutral perspective, data from men was limited due to scope and time limitations and due to men's hesitancy to share their personal problems, influenced by cultural factors. Moreover, the study's reliance on a partial set of intersectional identities (minority backgrounds and old age) and limited quantitative data on gendered climate change impacts offers only a fragmented understanding of the gender-differentiated effects in the coastal region.

The study was also conducted during a specific time period, which may have introduced a recency bias, potentially influencing participants' willingness to share issues that were more immediately relevant or pressing during that time. This limitation could have impacted the generalizability of the findings, as the issues reported may not reflect the full range of challenges faced throughout the year. Finally, being a small-scale study focused on only one union in Satkhira, the findings cannot be generalized to the entire coastal region, where geographical, socioeconomic, and resource-based variations may result in different outcomes.

5.6 Contributions of the Research

This research makes a significant contribution to feminist scholarship by addressing the differentiated impacts of climate change, particularly analyzing the link between gender

inequality and consequences of climate change. It fills a critical gap in understanding the social, institutional, and gender-related drivers of disproportionate climate impacts faced by marginalized groups, which are often neglected in policies and interventions. Using a feminist approach with an intersectional and emic lens, the study explores deep-rooted social inequalities while also bringing forth the voices and lived experiences of women and disadvantaged communities. Furthermore, the research adds to the literature on women's roles in agricultural adaptation and highlights their significant contributions to the sector, while also exploring the nuanced challenges women face which are often overlooked in policymaking. By integrating the capability approach and feminist theory, the research evaluates adaptation strategies and technologies, considering both positive and negative outcomes from a gendered and local perspective. Overall, the research highlights the limitations for the current approach in tackling climate change impacts, where the complexities of social and gender disparities, local contexts, institutional biases, and internal beliefs are frequently overlooked in planning and implementation. It ultimately aims to provides valuable insights for designing effective and inclusive climate adaptation policies, projects and interventions.

5.7 Future Areas of Research

There is a need for further research on gender-disaggregated data to better understand the specific vulnerabilities and adaptive capacities of men and women in climate-impacted regions, particularly in agriculture and other natural resource–dependent livelihoods. Future studies should explore the feasibility of agricultural technologies and interventions on a national scale, considering factors such as cost, accessibility, and ease of use, ensuring that they are tailored to the needs of diverse communities. Additionally, it would be valuable to investigate the role of men in supporting women's efforts to overcome climate change–related challenges, fostering a more collaborative approach to adaptation. Further research should expand the scope to include other livelihoods, such as fishing and livestock, that are closely linked to natural resources and agriculture and may be similarly affected by climate change. This holistic approach would contribute to a deeper understanding of the diverse impacts of climate change and help shape more inclusive, effective adaptation strategies. I also suggest that similar research should be conducted in other vulnerable regions of Bangladesh to help with generalization of the answers to my research questions.

5.8 Conclusion

My research explores the heightened vulnerability of Satkhira, a coastal region of Bangladesh, to climate change impacts such as cyclones and salinity intrusion. With agriculture and fishing as the primary livelihoods, the study underscores how these climate stressors disproportionately affect women and marginalized groups. The findings reveal that existing gender inequalities, poverty, and deeply-rooted social norms contribute significantly to this heightened vulnerability. Moreover, the adverse impacts of climate change exacerbate gender inequality, reinforcing the cycle of disadvantage for women and other marginalized communities.

My study also highlights the diverse adaptation strategies employed in Satkhira, including alternative income sources, irrigation, water storage and rainwater harvesting, salt- and drought-tolerant crops, and hybrid high-yielding crops. It shed light on the significant role women play in agriculture and the challenges they face—such as gender disparities, social norms, wage gaps, limited land rights, restricted access to resources, absence of gender-friendly technologies, and inadequate skill-building opportunities. The study also illustrates how external social influences shape the adaptive capacities of individuals and communities, affecting the overall outcomes of adaptation strategies.

The recommendations from this study stress the importance of adopting intersectional approaches in the design and implementation of climate adaptation policies, ensuring that the voices of women and minorities are heard and their specific needs are addressed. Key strategies include making shelters more inclusive, improving access to collateral-free loans, tackling the gender pay gap, and recognizing women's economic and social contributions. Additionally, awareness programs that challenge societal biases and promote education, equality, and women's empowerment are critical. By focusing on inclusive development initiatives—such as expanding education, livelihood opportunities, and accessible infrastructure—Bangladesh can better address both climate change adaptation and social equality, ultimately fostering more resilient and equitable communities.

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APPENDIX A

Detailed Tabulated Information for Summarized Tables 3.6 and 3.7

Table A1

Gender Inequality, Intersectionality, and Their Roles in Increasing Exposure to Climate Change

Dimensions of Gender Inequality	Nature of Inequality	Men	Women	Remarks
Access to Income	• Pay Gap • Occupational Immobility • Unequal Division of Labour	Laborious and outdoor tasks expose them to climatic disturbances and physical injuries	Paid less, limited to specific income-earning activities and work hours due to gender norms, limited mobility, and household responsibilities Less work opportunities due to limited education, skills, and access to labour market	Low income and less work opportunities keep women disadvantaged and dependent on climate-sensitive livelihoods.
Wealth	• Lack of Assets • Unequal Land Rights	More likely to sell their assets and paternal properties as household head	Possess fewer material assets and have limited land ownership than men due to patriarchal inheritance laws and social customs	Lack of wealth may expose women and men to poverty, lower living standards and less food supplies, and result in them living in weaker housing

Dimensions of Gender Inequality	Nature of Inequality	Men	Women	Remarks
				infrastructure which exposes them to impacts of climate change.
Social Relations and Power Dynamics	• Gender Norms • Culture • Religion • Decision-Making Power	Primary income earners responsible for ensuring household expenses are met, which forces them to look for any available work opportunities. This may expose them to climatic disturbances, physical injuries, and mental health issues	Responsible for water-related chores and firewood collection, which exposes them to salinity and climate disturbances Expected to manage household responsibilities, take care of children and elderly, cook, and clean—which makes it difficult to move to shelters during emergencies Expectations of women not mingling openly with men can prevent them from visiting shelters during disasters Women's low social status, submissive role in society, limited asset ownership,	Women's low decision-making power prevents them from making major decisions that may lower exposure to climate change impacts.

Dimensions of Gender Inequality	Nature of Inequality	Men	Women	Remarks
			and absence in politics and positions of power—as well as the lack of recognition of contribution to income-earning activities such as homestead gardening and crab collection—results in low decision-making power.	

Dimensions of Gender Inequality	Nature of Inequality	Men	Women	Remarks
Institutional Discrimination	• Non-inclusive Infrastructure • Complex Official Procedures • Limited Access to Collective Resources	Less access to NGO loans compared to women, which makes it difficult for them to invest in their livelihoods and housing infrastructure	Lack access to markets, technology, internet, and information due to social norms and complex institutional processes discouraging women from going outside and keeping them in ignorance Shelters lack gender-responsive facilities and have safety concerns, which discourages women from going to shelters during emergencies.	Women's limited access to resources and knowledge reduces their ability to take initiatives to prevent climate change exposure.

Dimensions of Gender Inequality	Nature of Inequality	Men	Women	Remarks
		Cannot work many hours or participate in physical labour, and are therefore not preferred for labour work opportunities Pre-existing health conditions cause higher exposure from climate-related health issues and physical injuries Absence of accessible and age-inclusive facilities in shelters, limited mobility, and travelling difficulties prevent them from going to shelters	Limited income-earning activities due to social norms and age-related physical weakness and immobility, in addition to gender pay gap and limited access to labour market Wealth and assets of their deceased husband is usually passed down to the son, and not the wife, due to patriarchal laws and customs—which results in wealth inequality and landlessness. Widowed elderly women often have limited decision-making ability as the son or son-in-law becomes the household head after their husband passes away Lack of age inclusive and accessible facilities as well as the absence of gender-friendly services, discourages them from going to shelters.	Elderly women and men are more exposed to climate stresses due to their age-related health issues and immobility. In addition to these issues, elderly women also suffer from gender discrimination which increases their exposure.

Dimensions of Gender Inequality	Nature of Inequality	Men	Women	Remarks
	Minority Status	Minorities stick to generational income-earning activities that are informal, low income, and labour intensive. Minorities like lower-caste Hindus lack land rights and have limited generational assets compared to the mainstream population. Live in social exclusion, in separate neighbourhoods that have poor infrastructure, sanitation facilities, and roads, which exposes them to health issues and affects mobility	Women from lower-caste Hindu minorities also stick to generational income-earning activities that are informal, low income, and labour intensive. On top of that, they get paid less than men. Due to their low literacy levels, trends of child marriage, and mobility-restricting culture for women, they have less income-earning opportunities. They are even less likely to inherit generational assets because their ancestors were also poor and women are rarely given their rightful ownership. Women belonging to the lower-caste of a minority religion struggle to access water resources for water-related chores due to resource conflicts.	Existing social taboos toward minority Hindus excludes them from social facilities and increases their exposure to climate change.

Table A2

Inequality, Intersectionality, and its Effects on Increasing Vulnerability to Climatic Shocks

Gender Inequality Dimensions	**Physical /Infrastructure Vulnerability**	**Economic Vulnerability**	**Sociopolitical Vulnerabilities**	**Health/Psychosocial Vulnerabilities**
Income—Pay Gap, Occupational Immobility, Unequal Division of Labour **Wealth**—Lack of Assets, Unequal Land Rights				
Men	*	*	*	Working in laborious and climate-sensitive outdoor jobs increases vulnerability to injuries and climate disturbances
Women	Income and wealth inequality increases likelihood of women living in areas with	Places women at greater risk of poverty, economic instability, financial debt, and insecurity	Keeps women at a lower social status in the community and within households	Lack of finances to spend on health and well-being, as they are struggling to meet the expenses for their basic needs

Gender Inequality Dimensions	Physical /Infrastructure Vulnerability	Economic Vulnerability	Sociopolitical Vulnerabilities	Health/Psychosocial Vulnerabilities
Women (continued)	weak housing and poor facilities	Reduces women's ability to save money and invest in asset building, livelihood, and education	Limited voice in political processes and decision making	Absence of wealth leads to insecurity, lower confidence, and mental health issues Keeps women at vulnerable position in their married household and increases risk of domestic and mental abuse

Social Expectations, Relations, and Power Dynamics—Gender Norms, Culture, Religion, Decision-making Power

Systemic Discrimination—Non-inclusive Infrastructure, Non-involvement in Politics, Limited Say in Policies, Complex Official Procedures, Limited Access to Collective Resources

Men	*	Not preferred for loans from NGOs, making it difficult for investments in livelihoods and infrastructure	*	Social expectations of being the head of the household responsible for the well-being of the entire family and finances of the household can be a mental burden

Gender Inequality Dimensions	Physical /Infrastructure Vulnerability	Economic Vulnerability	Sociopolitical Vulnerabilities	Health/Psychosocial Vulnerabilities
Women	Lesser decision-making power, low status, responsibilities for the elderly and children, and societal expectations of *purdah* makes it difficult for women to go to shelters The deficiency in gender-responsive facilities and safety concerns at shelters make women more vulnerable during disasters	Societal expectations of gender-appropriate tasks limit women's income-earning opportunities which reduces their income. This may result in women being more at risk of poverty, economic instability, financial debt, and insecurity The lack of access to markets, technology, and internet due to non-inclusive policies, processes, and infrastructure limits their income options and ability to build assets	Gender norms prevent women from taking up positions of power Limited say in political processes and decision making, which lowers their chances of improving their stance in society and asking for what they need	The household responsibilities along with additional income-earning tasks make time management difficult, which may lead to household conflicts and domestic violence. Resulting time poverty can also affect women's health and mental well-being Caretaking role and lower priority in households often cause women to drink less water and limit food intake; these may cause nutritional deficiencies and health issues, as well as may affect their mental well-being. Societal expectations and norms discouraging the use of bicycles for women, or fishing equipment, exposes them to

Gender Inequality Dimensions	Physical /Infrastructure Vulnerability	Economic Vulnerability	Sociopolitical Vulnerabilities	Health/Psychosocial Vulnerabilities
Women (continued)				physical injury and waterborne diseases Water-related chores and interaction with saline water, especially during menstruation, can cause health issues like itching and skin diseases as well as hygiene issues. The lack of gender-friendly shelters and risk of harassment affects well-being

Gender Inequality Dimensions	**Physical /Infrastructure Vulnerability**	**Economic Vulnerability**	**Sociopolitical Vulnerabilities**	**Health/Psychosocial Vulnerabilities**
Intersectionality—Elderly, Lower-Caste Religious Minorities				
Elderly				
Men	Absence of accessible pathways for elderly in shelters, and limited support staff to help them with mobility, causes difficulty for elderly at shelters	Physical incapability, limited mobility, and related income-inequality issues may result in elderly men being more at risk of poverty, economic instability, financial debt, and insecurity	Due to health issues, physical immobility and inability to contribute to household expenses, elderly men may have decreased decision-making power in their household and autonomy over their lives	Existing age-related health issues can make the elderly more vulnerable to health-related impacts of climate change like heat stress Physical incapabilities, immobility, and inability to contribute to household expenses may increase the risk of abuse and mistreatment from other household members

Gender Inequality Dimensions	Physical /Infrastructure Vulnerability	Economic Vulnerability	Sociopolitical Vulnerabilities	Health/Psychosocial Vulnerabilities
Women	Limited mobility, lack of age appropriate and accessible facilities, as well as the absence of gender-friendly services makes shelters a place of great discomfort for women	Gender-related income-inequality issues, illness, and limited mobility increases risk of poverty, economic instability, financial debt, and insecurity Social constructs, gender norms, and expectations from elderly limit their income opportunities and leave them financially vulnerable Discriminatory inheritance laws against elderly widowed women reduces ability to sell or buy assets, affecting their income and asset accumulation	Due to health issues, physical immobility, and inability to contribute to household expenses, elderly women often face decreased decision-making power The head of the household is often expected to be a man, so widowed elderly women may not be given the same respect or have autonomy over their lives	Water-related chores make elderly women more vulnerable to health issues related to salinity intrusion such as skin diseases, especially if they have pre-existing health issues. Lack of mobility, existing health issues, and injuries can make them more vulnerable to accidents during disasters Elderly women, especially women who are physically weak and immobile, and who have lower social status, are at increased risk of being abused by family members

Gender Inequality Dimensions	**Physical /Infrastructure Vulnerability**	**Economic Vulnerability**	**Sociopolitical Vulnerabilities**	**Health/Psychosocial Vulnerabilities**
Lower-Caste Religious Minorities				
Men	Social exclusion and residing in separate neighbourhoods that have poor infrastructure, sanitation facilities, and roads makes them more physically vulnerable to climate change disturbances. Poor roads also make it difficult for them to travel to shelters, especially during disasters	Generational low-income livelihoods, informal, and labour-intensive activities leave men from religious minorities at greater risk of poverty, economic instability, financial debt, and insecurity Lack of land rights and limited generational assets affects their ability to invest in better income-earning opportunities, take loans, and build assets.	Social exclusion, low social status, and systemic discrimination prevents men from lower-caste minority religions from holding positions of power or participating actively in politics or decision making Due to their lack of wealth and low social position, during conflicts regarding roads or public resources, they have very little bargaining power	The lack of access to clean water sources in their neighbourhoods affects their health and mental well-being Due to lack of bathing facilities and conflicts regarding public ponds, minorities have to bath in shrimp enclosures where the water is dirty and salty. This results in skin diseases. Social exclusion, discrimination, lack of access to basic necessities, poverty, and poor housing conditions as well as low social status can affect their mental well-being and result in low confidence and insecurity.

Gender Inequality Dimensions	Physical /Infrastructure Vulnerability	Economic Vulnerability	Sociopolitical Vulnerabilities	Health/Psychosocial Vulnerabilities
		Income and wealth inequality affects saving ability due to struggle to meet basic expenses		
Women	Social exclusion and residing in separate neighbourhoods that have poor infrastructure, sanitation facilities, and roads makes them physically vulnerable to climate change disturbances. Poor roads and limited mobilities also make it difficult for them to travel to shelters, and	Along with gender-related income-inequality issues, generational low-income livelihoods, informal, and labour-intensive activities leave women from religious minorities at even more risk of poverty, economic instability, financial debt, and insecurity Limited land rights and generational wealth affects ability to invest in better	Even less likely than men to hold positions of power or participate actively in politics or decision making Even more limited bargaining power than men due to gender discrimination as well as religious and caste discrimination Women also have very limited decision-making	Lack of access to clean water results in health issues. Water and food supply scarcity leads to women drinking and eating less, often resulting in nutritional deficiencies, health issues, and mental health issues The lack of bathing resources forces women to use shrimp enclosures, and as a result they suffer from health issues during their period, as well as UTIs, along with skin diseases. It also

Gender Inequality Dimensions	Physical /Infrastructure Vulnerability	Economic Vulnerability	Sociopolitical Vulnerabilities	Health/Psychosocial Vulnerabilities
	lack of gender-responsive facilities and safety concerns discourages them from going to shelters Lack of decision-making power and caretaking responsibility prevent them from going to the shelter	income-earning opportunities and building assets. Income and wealth inequality affects saving ability	power in their households	has a negative impact on their mental health Financial issues can leave women from such backgrounds at more risk of domestic violence and household arguments

Table A3

Gender Inequality, Intersectionality, and Decreasing Adaptive Capacity to Climate Change Impacts

Gender Inequality Dimensions	**Economic Capacity**	**Sociopolitical Capacity**	**Physical Capacity**
Income—Pay Gap, Occupational Immobility, Unequal Division of Labour **Wealth**—Lack of Assets, Unequal Land Rights			
Men	*	*	Men working in labour intensive and climate-sensitive outdoor jobs experiencing climate disturbances may have lower ability to cope and adapt due to health issues and injuries
Women	Lower income and limited wealth prevent ability to recover from climate change impacts like disasters that damage their houses, or major crop losses Cannot afford climate-smart technology or strategies, or to build	Poverty, and lack of financial capital and purchasing power, results in lower social status in the community and causes limited voice in political processes and decision making, that could affect their adaptive capacity and ability to voice concerns and needs	Lack of available finances for buying more food and water when there is scarcity in households, which impacts women because society at large prioritizes men and children Limited financial ability to treat injuries and health issues arising due to climate shocks

Gender Inequality Dimensions	Economic Capacity	Sociopolitical Capacity	Physical Capacity
	more disaster-resilient infrastructure No backup financial support to rely on during disasters and periods of unemployment		Lack of wealth limits their power in the household and autonomy over their lives, which may result in domestic violence and mental abuse
Women *(continued)*			Lack of wealth in women-headed households where they are the only income earners may cause women to marry off their daughters at an early age as a coping strategy for climate change Reduces their overall mental and physical well-being, which reduces their physical adaptive capacity

Gender Inequality Dimensions	Economic Capacity	Sociopolitical Capacity	Physical Capacity
Social Expectations, Relations, and Power Dynamics—Gender Norms, Culture, Religion, Decision-making Power			
Systemic Discrimination—Non-inclusive Infrastructure, Non-involvement in Politics, Limited Say in Policies, Complex Official procedures, Limited Access to Collective Resources			
Men	Preference for women over men when giving out NGO loans limits ability of men to invest in changes to their livelihood for adapting to climate change and recovering from climate-related disasters	*	The mental and physical burden of being the primary income earner of the household as a man may impact their physical adaptive capacity

Gender Inequality Dimensions	Economic Capacity	Sociopolitical Capacity	Physical Capacity
Intersectionality—Elderly, Lower-Caste Religious Minorities			
Elderly			
Men	Physical immobility, weakness, pre-existing health issues, and inability to earn income can lead to limited financial ability to cope, recover, and adapt to climate change impacts	Physical immobility, weakness, and inability to contribute to household expenses can lead to limited decision-making abilities that may affect their adaptive capacity	Absence of accessible pathways and help with mobility, as well as difficulty with travelling, discourages elderly men from going to shelters, thus affecting their physical adaptive capacity. Limited financial ability to treat injuries and health issues arising due to climate change disturbances and disasters
Women	Gender-related income inequality and wealth inequality, as well as physical immobility, weakness, pre-existing health issues, and inability to earn income can lead to limited	Gender norms, low position in society, lack of wealth, limited mobility, and physical incapability—as well as inability to contribute to household expenses—can lead to limited decision-	Absence of gender-responsive infrastructure and facilities, accessible pathways, and help with mobility discourages elderly women from going to shelters, thus affecting their physical

Gender Inequality Dimensions	Economic Capacity	Sociopolitical Capacity	Physical Capacity
	financial ability to cope, recover, and adapt to climate change impacts	making abilities that may affect their adaptive capacity Widowed elderly women in particular suffer from lack of autonomy due to discriminatory inheritance laws	adaptive capacity. Limited financial ability to treat injuries and health issues arising due to climate change disturbances and disasters Widowed elderly women in particular suffer the most in terms of mental health issues
Lower-Caste Minority Religions			
Men	The tendency to be involved in generational low-income earning, informal, and labour-intensive activities leave men from religious minorities with less financial ability to cope, recover, and adapt to climate change impacts The income inequality, along with lack of wealth, assets, and land	Social exclusion, low social status, and systemic discrimination prevents men from lower-caste minority religions from holding positions of power or participating actively in politics or decision making, which may affect their adaptive capacity. Due to their lack of wealth and low social position, during conflicts	The lack of access to clean water sources and bathing and hygiene facilities in their neighbourhoods affects their health and mental well-being, and overall physical adaptive capacity

Gender Inequality Dimensions	Economic Capacity	Sociopolitical Capacity	Physical Capacity
	rights also limits their ability to invest in adaptation technology and strategies	regarding roads or public resources, they have very little bargaining power, which also affects their adaptive capacity	
Women	The tendency to be involved in generational low-income earning, informal, and labour-intensive activities leave women from religious minorities with less financial ability to cope, recover, and adapt to climate change impacts	Social exclusion, low social status, and systemic discrimination prevents men from lower-caste minority religions from holding positions of power or participating actively in politics or decision making, which may affect their adaptive capacity.	The lack of access to clean water sources and bathing and hygiene facilities in their neighbourhoods affects their health and mental well-being, and overall physical adaptive capacity. This is particularly pronounced for females from lower class minority religions due to the risk of UTIs, menstruation issues, etc.
Women (continued)	The income inequality, along with lack of wealth, assets, and land rights also limits their ability to invest in adaptation technology and strategies.	Due to their lack of wealth and low social position, during conflicts regarding roads or public resources, they have very little bargaining power, which also affects their adaptive	The above-mentioned issues, along with gender-related vulnerabilities like time poverty, potential of domestic violence, and taboos surrounding menstrual issues can affect their physical as well as mental

Gender Inequality Dimensions	Economic Capacity	Sociopolitical Capacity	Physical Capacity
	This is more pronounced for females belonging to lower-caste minorities than males due to additional gender discrimination and social constructs.	capacity This is more pronounced for females belonging to lower-caste minorities than males due to additional gender discrimination and social constructs. Females belonging to lower-caste minorities also have limited decision-making abilities within their own households which affects their adaptive capacity.	health, which affects their overall physical adaptive capacity

Note: *No findings from data collection and observation

APPENDIX B

Research Ethics and Compliance from the University of Manitoba

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PROTOCOL APPROVAL

Effective: November 21, 2022 Expiry: November 20, 2023

Principal Investigator:	Alvira Ria
Advisor:	C. Emdad Haque
Protocol Number:	HE2022-0205
Protocol Title:	*Climate change impacts, responses and adaptation technologies in small-scale agriculture in coastal areas of Bangladesh: Gender and women's perspectives*

Andrea L Szwajcer, Chair, REB2

Research Ethics Board 2 has reviewed and approved the above research. The Human Ethics Office (HEO) is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*- TCPS 2 (2018).

This approval is subject to the following conditions:

i. Approval is granted for the research and purposes described in the protocol only.

ii. Any changes to the protocol or research materials must be approved by the HEO before implementation.

iii. Any deviations to the research or adverse events must be reported to the HEO immediately through an REB Event.

iv. This approval is valid for one year only. A Renewal Request must be submitted and approved prior to the above expiry date.

v. A Protocol Closure must be submitted to the HEO when the research is complete or if the research is terminated.

vi. The University of Manitoba may request to audit your research documentation to confirm compliance with this approved protocol, and with the UM *Ethics of Research Involving Humans*Ethics of Research Involving Humans policies and procedures.

APPENDIX C

TCPS 2 CORE Certification

PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE 2022

Certificate of Completion

This document certifies that

Alvira Ria

successfully completed the Course on Research Ethics based on the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2: CORE 2022)

Certificate # 0000816122 **21 May, 2022**

APPENDIX D

Household Survey Questionnaire

1. Unique Identification Number:
2. Name of Upazila:
3. Name of Union:
4. Name of Village**:**
5. Household Categories:
    - Male-headed Household
    - Women-headed Household
6. Household Socioeconomic Status:
    - Low income
    - Middle income
    - High income

7. Biological identity (sex/gender) of the household head:

    - Male
    - Female
    - Transgender

8.What is your (Respondent's) age?

9. How long you and your household/family have been living in this locality?

10. What is your religion?
    - Islam
    - Hinduism
    - Christianity
    - Buddhism
    - None
    - Others [Please specify] _____

11. What is your ethnicity?

- Bengali
- Chakma
- Tripura
- Garo
- Shawtal
- Marma
- Murang
- Mro
- Rakhaine
- Others [Please specify] _____

12. Who makes the most decisions on your household's expenditures on a daily basis?

Expenses	Men	Women
Food		
Health		
Education		
Transportation		
Communication (cell phone and internet)		
Crop cultivation and harvesting cost		
Land purchasing		
Marriage		

13. Does your household earn yearly from the following sources, including crop production, livestock, service, business, etc.?

- Agriculture (e.g., crops)
- Livestock (e.g., cows, goats)
- Gardening (e.g., vegetables)

- Land mortgage/selling land
- Fisheries Service
- Business
- Remittance
- Daily labour
- Interest from bank savings
- Others [Please specify] _____

Ownership of Assets

14. Does your household own any land?
    - Yes
    - No
15. If yes, what types of land does your household own?
    - Homestead land
    - Cultivable land
    - Shared cropped land in
    - Shared cropped land out
    - Pond for fisheries
    - Mortgaged in
    - Mortgaged out
    - Khas land
17. How many female members have land title in your household?
18. How much of land do female members own?
19. Do your female household members have any cell phone?

- Cell phone with internet
- Cell phone without internet
- No Cellphone

Disasters

20. Did your household members observe any noticeable change in weather/climate in recent decades (e.g., in the last 20 years)?
    - Yes
    - No
    - Don't know

21. If yes, what kind of changes did your household member observe? (Multiple choices)
    - Observing extreme heatwave
    - Feeling excessive temperature
    - Feeling extreme cold than earlier periods for a shorter period
    - Observing winter seasons becoming shorter
    - Winter seasons becoming longer than the previous time
    - Experiencing frequent natural disasters, such as flash floods, monsoon flood, hailstorms
    - Observing excessive rainfall for a shorter period
    - Observing a decrease trend in rainfall compared to previous years
    - Observing unpredictable changes in seasons, such as late monsoon
    - Unexpected dense fog during winter and other times
    - Observing increasing salinity in the water
    - Observing increasing hailstorms
    - Observing high tide thunderstorms
    - Others [Please specify] _____

21. Did your household need to borrow money due to cyclone Amphan or flash floods?

- Yes
- No

22. What were the sources of borrowed money? (multiple responses)

- Micro-finance institutions (NGOs)
- Bank
- Relatives/neighbours
- Local money lenders (*mohajons*)
- Government organizations
- Others [Please specify] _____

23. How severely did Cyclone Aila in 2009 impact your household assets? *For Satkhira

- Very severely damaged
- Severely damaged
- Modestly damaged
- No damage

Climate Change Adaptation

24. What was your (head) adaptation response to climate change in the last 20 years? (Multiple options)

- Increasing dependency on using technology
- Changing livelihood occupations

- Migrate to other places/abroad
- Storing more food and water
- Using local adaptation technics
- Others [Please specify

25. What types of technologies is your household using for water use other than drinking, including cooking, bathing, livestock? (Multiple options)

- Rainwater harvesting
- Deep tube well
- Shallow tube well
- Artificial aquifer tube well
- Pond sand filter
- Desalination
- Solar disinfection
- Managed aquifer recharge
- Household drinking water treatment
- Water purifier
- Pond Water
- Reverse osmosis plant
- Others [Please specify]

26. Is your household involved in irrigation?

- Yes
- No

27. What types of technologies is your household using for irrigation?
(Multiple options)

- Rainwater harvesting
- Deep tube well
- Shallow tube well
- Artificial aquifer tube well
- Pond sand filter

- Desalination
- Solar disinfection
- Managed aquifer recharge
- Using water pump
- Others [Please specify]_____

28. Who had taken the decision to adopt irrigation technologies?
    - Male
    - Female
    - Both

29. Which factors have influenced your household to adopt these technologies? (multiple responses)
    - Economic ability
    - Education related to adaptation technology
    - Knowledge on climate change
    - Access to local institution
    - Availability of adaptation technology in the locality
    - Easy to use adaptation technology
    - Others (specify)

30. What types of other technologies is your household using for reducing climate change impact on livelihoods? (Multiple options)

    - Climate-tolerant crops (e.g., high-yielding and short variety)
    - Floating agriculture
    - Mechanical thresher
    - Plough machine [Tractor]
    - Vermicompost
    - Using fertilizers, pesticides, and insecticides
    - Green fertilizer
    - Integrated farm management

- Soil management (e.g., biodigester)
- Cultivating salinity/drought-tolerant crop varieties
- Using sandbar cropping technology growing pumpkins
- Building embankment
- Flood drainage system
- Sluice gate
- Crop rotation practices and changing cropping pattern
- Early warning (Interactive Voice Response [IVR])
- Taking agro-advisory services and information
- Taking agricultural credit or loan
- Taking subsidies from NGOs or Government Organizations
- Others (specify)_____

31. Please rate to what degree you agree with these statements:

a. "The adopted technologies has increased my household income."

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

b. "The adopted technologies have increased my household food security."

- Strongly disagree
- Disagree
- Neutral
- Agree

- Strongly agree

c. "The adopted technologies have increased my household risks to climate disasters."

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

32. From which sources does your household receive information about adaptation technologies relating to climate change?

- Electric media (television/radio)
- Print media (newspaper)
- Agricultural extension officers (Government officials)
- Social media (digital sources)
- School/college/university
- Friends/family members
- Community members
- Local representative
- NGO officials
- Farming associations
- Private retailer/company
- Others [Please specify]_____

33. Does your household receive any financial assistance to adopt adaptation technologies?

- Yes
- No

34. Do your household members receive training and other technical assistance for maintenance?

- Yes
- No
- Don't know

35. If yes, from whom has your household received training and other technical assistance for maintenance? (multiple responses)

- Community leader
- Community members
- Local representative
- Bank
- Government
- NGO
- Friends/family
- Others [specify here]_____

Gender issues

36. How much of their income do working female household members contribute for household expenses?

- Entire income
- A certain portion
- Does not contribute

- Don't Know
- Not Applicable

37. If they contribute a certain portion of their income, what do they do with the rest of their earnings? (multiple options)

- Save in bank
- Save at home
- Spend on personal expenses
- Spend on education fees
- NGO/Insurance/Cooperative
- Don't know
- Not Applicable
- Others [Please specify]_____

38. Do your female household members take permission to go outside?

- Within the locality
- Outside the locality

39. Is there a community forum where women can voice their concerns about ongoing issues in the community?

- Yes
- No

40. Where do women in your locality socialize? (multiple options)

- Markets
- While collecting water/firewood
- At each other's houses
- Others [Please specify]

41. Did you go to a shelter in the last 3 years? (e.g., flood, Cyclone Amphan in 2020, Cyclone Yaas in 2021)
    - Yes
    - No

42. If you did not go to a shelter, what was the reason? (multiple options)
    - Women's safety issues
    - No privacy
    - Not comfortable
    - Too far away
    - Not enough time to move to a shelter
    - Shelters are too crowded
    - Inappropriate shelter facilities
    - No transportation to go to shelter
    - There was no need to go
    - Others [Please specify]

43. If you did go to a shelter, what kind of facilities/services did the shelter have?

Shelter Facilities	Satisfied	Somewhat Satisfied	Not Satisfied	Service not Available
Separate rooms for men and women				
Accessible pathways for disabled				
Separate bathrooms for men and women				
Place to keep livestock				
Communication services				

Hygiene products and facilities (soap, basins)				
Sanitary napkins for women				
Running water				
Food arrangement				
Safe drinking water				
Medical services/resources				
Healthcare aid for assisting pregnancies				
Women's security				

44. On a scale of 1 to 5, how secure (from harassment, violence) was the cyclone shelter for the female members?

- Extremely safe
- Moderately safe
- Neutral
- Unsafe
- Extremely unsafe

45. Are there any agricultural services /resources by the government departments targeted specifically toward women in your community? (multiple options)

- Skills training
- Training for using agricultural technology
- Subsidies
- Loans
- No access
- Others [Please specify]_____

46. How accessible are the following agricultural adaptation measures?

Adaptation Strategies	Extremely Accessible	Somewhat Accessible	Difficult to Access	Not Accessible
Agricultural adaptation measures:				
Climate-tolerant crops (e.g., high-yielding and short variety)				
Floating agriculture				
Mechanical thresher				
Plough machine [Tractor]				
Vermicompost				
Using fertilizers, pesticides, and insecticides				
Organic fertilizer				
Integrated farm management				
Soil management (e.g., biodigester)				
Cultivating salinity-tolerant crop varieties				
Cultivating drought-tolerant crop varieties				
Embankment				
Flood drainage system				
Sluice gate				
Crop rotation practices and changing cropping pattern				
Embankment				

47. How affordable are the following agricultural adaptation measures?

Adaptation Strategies	Extremely Affordable	Somewhat Affordable	Expensive	Not Affordable

Climate-tolerant crops (e.g., high-yielding and short variety)				
Floating agriculture				
Mechanical thresher				
Plough machine [Tractor]				
Vermicompost				
Using fertilizers, pesticides, and insecticides				
Organic fertilizer				
Organic Fertilizer				
Integrated farm management				
Soil management (e.g., biodigester)				
Cultivating salinity-tolerant crop varieties				
Cultivating drought-tolerant crop varieties				
Embankment				
Flood drainage system				
Sluice gate				
Crop rotation practices and changing cropping pattern				
Embankment				

48. How easy to use are these adaptation strategies?

Adaptation Strategies	Very Easy	Easy	Moderately Easy	Difficult
Climate-tolerant crops (e.g., high-yielding and short variety)				
Floating agriculture				
Mechanical thresher				
Plough machine [Tractor]				
Vermicompost				

Using fertilizers, pesticides, and insecticides				
Organic fertilizer				
Organic Fertilizer				
Integrated farm management				
Soil management (e.g., biodigester)				
Cultivating salinity-tolerant crop varieties				
Cultivating drought-tolerant crop varieties				
Embankment				
Flood drainage system				
Sluice gate				
Crop rotation practices and changing cropping pattern				
Embankment				

49. Do you think men and women in your community have the same level of access to these adaptation and irrigation technologies?

- Men have better access
- Women have better access
- Men and women have the same access
- Don't know

APPENDIX E

Key Informant Interview Question Guides

Key Informant Interview Guide I

Participants: Government officials, Community leaders, Committee Heads, NGO workers, and GO workers

Preamble

This is a guideline for the key informant interview for the study titled "Climate change impacts, responses and adaptation technologies in small-scale agriculture in coastal areas of Bangladesh: Gender and women's perspectives". The purpose of this research is to understand the dynamics and the factors that cause pronounced climate change impacts on the marginalized groups in the coastal region of Satkhira, Bangladesh, with a focus on gender disparities. It also aims to delve into women's contribution to local climate change adaptation activities while exploring the innovative local agricultural technologies and methods that are currently being used in the region to cope with climate change impacts. You will be asked the following questions regarding the research topic as you have consented to participating in the study as a key informant.

Section A: Satkhira and Climate Change Impacts

1. What are the main sources of income for the population in this community?
2. What are the ongoing climate change issues that people of this community are facing?
3. Who are some of the most affected groups to climate change in this community? Why?
4. Do political, cultural, religious, and socioeconomic factors influence how people experience these issues? Please explain
5. What are the long-term impacts of climate change on the people of this community?

Section B: Gender Inequality Scenario

6. What do you think about the gender disparity situation in this community?

   Prompts:

   - Education
   - Mobility
   - Access to healthcare

- Decision-making power

7. What role do women play in livelihood and income-generating activities in this community??
8. Is there a difference between wages/income earning for men and women?

Section C: Climate Change Impacts

9. Do women experience climate change impacts differently from men in this community? How?
   - Do you think women experience disproportionate impacts? Why
10. Do existing gender inequalities play a role in these differentiated impacts? Please explain how.
11. Do other political, cultural, religious, historical, and socioeconomic factors (caste, minority background, etc.) influence people's experience with climate change?

Section D: Adaptation and Climate Change

12. How do people adapt/cope with climate change impacts?
13. Do men and women use different coping and adaptation strategies? How? Why do they cope/adapt differently?
14. Is there a difference in how poor households adapt to climate change compared to others? How?
15. What difficulties do people usually face when adapting to/coping with climate change impacts? What difficulties do marginalized groups like the poor, ethnic, and minority communities and women in particular face?
16. What kind of external services/support do people receive for adaptation? Who provides these services/supports?
17. What difficulties do people usually face when accessing this external support/aid? What difficulties do Marginalized groups like the poor, ethnic, and minority communities and women in particular face?
18. What issues are faced by organizations when distributing this external support/aid? Is it difficult to reach certain targeted populations? Why?

Section E: Recommendations

19. What are your recommendations for tackling disproportionate impacts of climate change on women and marginalized groups?
20. How can climate change adaptation technology and interventions be more inclusive and gender responsive?

Key Informant Interview Guide II

Participants: Representatives of Minority Religions and Ethnic Groups

Preamble

This is a guideline for the key informant interview for the study titled "Climate change impacts, responses and adaptation technologies in small-scale agriculture in coastal areas of Bangladesh: Gender and women's perspectives". The purpose of this research is to understand the dynamics and the factors that cause pronounced climate change impacts on the marginalized groups in the coastal region of Satkhira, Bangladesh, with a focus on gender disparities. It also aims to delve into women's contribution to local climate change adaptation activities while exploring the innovative local agricultural technologies and methods that are currently being used in the region to cope with climate change impacts. You will be asked the following questions regarding the research topic as you have consented to participating in the study as a key informant.

Section A: Satkhira and Climate Change Impacts

1. What are the ongoing climate change issues that people in this community are facing?
2. Who are some of the most affect groups to climate change in this community? Why?
3. Do political, cultural, religious, and socioeconomic factors influence how people experience these issues? Please explain.

Section B: Inequality for Minority Religions and Ethnic Groups

4. What is the main source of income for this community?
5. Is there a difference in how this community is living in the area compared to others?

   Prompts:

   - Access to basic services
   - Treatment from others
   - Income disparity
   - Education

Section C: Gender Inequality

6. What is the gender disparity situation in this community?

   Prompts

   - Education
   - Mobility
   - Access to healthcare
   - Decision-making power

7. What role do women play in livelihood and income-generating activities in this community?
8. Is there a difference between wages for men and women?

Section C: Climate Change Impacts

9. Do women experience climate change differently from men in this community? How?
   - Do you think any socioeconomic impacts of climate change specifically harm women?
10. Do existing gender inequalities play a role in these differentiated impacts? Please explain how.
11. Do other political, cultural, religious, historical, and socioeconomic factors (caste, minority background, etc.) influence people's experience with climate change?

Section D: Adaptation and Climate Change

12. How do people in your community adapt/cope with climate change impacts? Is there a difference in how your community adapts/copes compared to others? Why?
13. Do men and women use different coping and adaptation strategies? How? Why do they cope/adapt differently? Who makes the decisions about what kind of adaptation/coping strategies are used in the household?
14. What difficulties do people in this community face when adapting to/coping with climate change impacts? What difficulties do women in particular face?
15. What do you think are the best local agricultural adaptation practices in this community? Why?
16. What kind of external services/support does this community receive for adaptation? Who provides these services/supports?
17. What difficulties do people usually face when accessing this external support/aid? What difficulties do women in particular face?
18. What issues are faced by organizations when distributing this external support/aid to this community?

Section E: Recommendations

19. What are your recommendations for tackling disproportionate impacts of climate change on women and marginalized groups?
20. How can climate change adaptation technology and interventions be more inclusive and gender responsive?

APPENDIX F

Focus Group Discussion Guide

Note: There will be three FGD groups—

Group 1: Farmers and Agricultural Workers (15 Questions: Section A + Section C)

Group 2: Fishermen (9 Questions: Section A + B)

Group 3: People with primary occupations other than in agriculture and fishing (9 Questions: Section A + B)

Section A: Climate Change Impacts (Applicable for all groups)

1. What climate-related issues have you faced while living in this area?

Examples:

- Frequent floods
- Frequent cyclones
- Waterlogging
- Salinity intrusion
- Increase in temperatures
- Excessive rainfall
- Lack of rainfall

2. How have these climate-related issues affected your life?

Examples:

- Agricultural yield
- Fishing catches
- Income
- Food intake
- Drinking water availability
- Diversified income
- Migration
- How many hours you work, how much effort you put in
- How far do you have to go for collecting water and foraging

3. Can you discuss some issues women and girls face which men do not, due to the problems we talked about so far? Please share examples or personal experiences.
   - Why do you think only this gender experiences these types of impacts?
4. Can you discuss what kind of climate change issues and problems men and boys in particular face that women and girls do not? Please share examples or personal experiences.
   - Why do you think only this gender experiences these types of impacts?
5. Can you discuss some climate change impacts that the poor, minorities, ethnic communities, and elderly experience with climate change? Please share examples or personal experiences.
   - Why do you think this specific group experiences these types of impacts?

Section B: Adaptation to Climate Change (Applicable for Only Group 2 and 3)

1. How do you cope/adapt to these climate change impacts? Please share some examples.
   Examples:
   - Did you have to diversify your income source?
   - Did you have to reduce spending—what household costs did you cut?
   - Did you have to eat less—how did you manage a lower food intake?
   - Did someone in your household migrate—what impact did this have on your life?
   - Did you make any changes in your occupation or the way you carry out your tasks? For example, fishing practices, change in routine, etc.

2. Did you receive any aid/support to adapt with these impacts?
   - What kind of aid/support?
   - Who provides these services/supports?
3. Do the poor, minority religions, and ethnic communities face any challenges in accessing this aid/support?
4. Do women face any challenges in accessing this aid/support?

Section B: Agricultural Adaptation (Only Applicable for Group 1)

1. What agricultural adaptation strategies and technologies do people in the area use for climate change impacts? Please give some examples
   - Who in the household decides which agricultural strategies or technology to use?
2. What difficulties do people usually face when implementing agricultural adaptation strategies or adaptation technologies for climate change? Please share some personal experiences or examples.
3. What difficulties do marginalized groups like the poor, elderly, minorities and ethnic communities in particular face when using agricultural adaptation strategies and technologies for climate change impacts?
4. What difficulties do women in particular face when using agricultural adaptation strategies and technologies for climate change impacts?

   Example:

   - Are climate change adaptation technologies easy to use and access for women?
   - Which ones are difficult to use/access? Why?
5. Which agricultural adaptation strategies and technologies do you think are the best to use in your area?
   i) Why? Please explain
   ii) Are they cost effective, easy to use?
   iii) Which strategies and technologies are easily accessible to everyone, including marginalized communities and women?
6. What kind of external services/support do people in this community receive for agricultural adaptation?
   i) Who provides these services/supports?
   ii) Where do people get information for this support?
   iii) What kind of difficulties do people experience when accessing these external services?
7. What difficulties do marginalized groups like the poor, elderly, ethnic, and minorities in particular face when accessing external support/aid?
8. What specific difficulties do women face when accessing these services and support?

APPENDIX G

Consent Form for FGD

UNIVERSITY OF MANITOBA

Natural Resources Institute
Clayton H. Riddell Faculty of Environment, Earth, and Resources

303-70 Dysart Road
Winnipeg, Manitoba
Canada R3T 2M6

Research Project Title: Climate change impacts, responses and adaptation technologies in small-scale agriculture in coastal areas of Bangladesh: Gender and women's perspectives

Principal Investigator: Alvira Farheen Ria, M.N.R.M Candidate
Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2.

Research Supervisor: Dr. C. Emdad Haque, Professor
Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2

Sponsor: International Development Research Centre (IDRC), University of Manitoba

You are invited to participate in a focus group discussion for this research study. This consent form is a part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. Please take your time to understand the consent form and feel free to ask the study staff to explain anything you do not understand.

Purpose of the research

I am a graduate student at the University of Manitoba in Canada and I am conducting my master's thesis research. The purpose of my research is to understand the dynamics and the factors that cause pronounced climate change impacts on the marginalized groups in the coastal region of Satkhira, Bangladesh, with a focus on gender disparities. My study also aims to delve into women's contribution to local climate change adaptation activities while exploring the innovative local agricultural technologies and methods that are currently being used in the region to cope with climate change impacts. The three specific objectives of this research are to:

i. identify and explore the major factors responsible for differentiated climate change impacts on socioeconomic groups with a particular focus on women;
ii. examine agricultural adaptation technologies and methods that have evolved locally as a response to climate change impacts, particularly engaging women; and
iii. determine the challenges and barriers faced by women in climate change adaptation to agriculture.

Study Procedure

Focus groups are discussions with a group of people who know something about the topic of interest and are used to find out people's thoughts and ideas about a specific topic. I am inviting you to participate in this focus group discussion (FGD) because as a community member in Satkhira, your life is impacted by climate change impacts and you may be taking adaptation or coping measures to deal with these impacts. The FGD will be conducted with a group of 6-10 participants and take around 1 hour 40 minutes. The discussion will take place in two sessions of 45 minutes and there will be a 10-minute break between the two sessions. The discussions will be moderated by the principal investigator (Alvira Farheen Ria). Notes will be taken and the discussion will also be recorded using an audio recorder.

Audio Recording

Since it is difficult to write notes down instantly and information may be missed, an audio of the discussion will be recorded, with participants' consent, for reviewing later. The recorder will be provided by the study staff and audio files will be saved in a secure database, which only the principal investigator (Alvira) and study supervisor (Dr. C. Emdad Haque) will have access to. The recorded audio will be transcribed by the principal investigator (Alvira), and participants will be referred to using codes, without revealing any identifying information in the transcripts.

Benefits

Participation in this focus group is voluntary and does not involve any monetary compensation. Being a participant of this focus group discussion may not directly benefit you in a tangible form, but your contribution will be highly appreciated and beneficial in understanding the disproportionate impacts of climate change in your community and current adaptation practices in agriculture. It will also help to create better climate change adaptation policies and interventions that are gender responsive and inclusive.

Potential Risks

There are no anticipated physical or mental risks to participants and the risks that may be present are no greater than the ones you experience in everyday life. If there are topics you do not feel comfortable talking about, please let me know and I will stop discussing it. Other participants will be asked to keep the information shared in the FGD private and will also be asked to sign an oath of confidentiality. But there is a minimal chance that participants may not maintain this confidentiality. Keeping this in mind, if there is something regarding the topics discussed that you want to share but cannot do so in front of others in the focus group, I encourage you to ask for an individual interview or time with the me (Alvira) to discuss the matter privately. Any information you share in this FGD that may identify you or anybody else will be changed and referred through codes in the transcription of the audio as well as in any presentation or report of the findings, to maintain confidentiality.

Privacy and confidentiality

We will do everything possible to keep your personal information confidential. Your name will not be used at all in the study records. If the results of this study are presented in a meeting, or published, nobody will be able to tell that you were in the study. Please note that although you will not be identified as the speaker, your words may be used to highlight a specific point. The collection and access to personal information will be in compliance with the provincial and federal privacy legislations.

In the focus group discussions, as anonymity cannot be maintained, we will need participants' understanding and consent that none of the names of the participants and contents of discussions will be revealed outside of the focus group discussions.

Audiotapes (to be obtained with consents from participants) of the group discussions will be transcribed and used to prepare a report. The audiotapes will be stored in a secure online database and typed notes will be kept for in a secure locked file cabinet my supervisor's (Dr. Emdad Haque) office at the Natural Resources Institute of the University of Manitoba. Only the discussion moderator (Alvira) and supervisor (Dr. C. Emdad Haque) will have access to them and know your name. After the 5 years, the notes and audiotapes will be removed and deleted. Furthermore, to ensure

privacy, all participants in the focus group discussion will be asked not to disclose anything discussed within the context of discussion and to sign an oath of confidentiality.

Withdrawal

You may decline to participate at any point throughout the discussion or decline to answer any question(s) during the discussion, without any negative consequences. You are only expected to answer according to the best of your knowledge, and if you do not know an answer or do not want to answer, we can skip those specific questions. You can withdraw your participation and information provided after the FGD is conducted as well, but please let me know by 30th October 2022.

Dissemination

The findings of the study will be disseminated in academic conferences and peer-reviewed journals, and the final thesis paper will be available at the University of Manitoba thesis repository MSpace (https://mspace.lib.umanitoba.ca). I will send you a summary of my findings if you wish to receive it. If you agree to receive a summary, then I will also need to collect your address. You can expect to receive this summary around March 2023.

Permission to Quote:

When writing the report or publishing this research, I may use direct quotes from this discussion. However, I will not use your name to quote what you said. I will use identifiers like "one female respondent" or "one farmer" to keep you anonymous.

Feedback

Upon completion of the focus group discussion, I will restate and summarize key facts and main ideas that you have discussed throughout the two sessions before turning the recorder off. I will request you to validate my interpretation of your statements. If you find any misinterpretation, please do not hesitate to share that with me.

Consent:

I am requesting you to indicate that you agree with the following items:

Yes ☐ No ☐	I agree that the researcher can use the audio voice recorder for this interview.
Yes ☐ No ☐	I have had a chance to ask questions and have received satisfactory answers to all of my questions.
Yes ☐ No ☐	I have understood and gone through all three pages of the consent form
Yes ☐ No ☐	I agree to participate in this research
Yes ☐ No ☐	I agree to be quoted directly if my name is not published (I remain anonymous
Yes ☐ No ☐	I want to receive a summary of the findings
Yes No	I will not reveal any name or content of discussion with anyone outside the focus group discussion

---------- **Provide for Signatures as Required:** ----------

Participant's Signature: _____ Date: _____

(day/month/year)

Participants Printed Name: _____

Participant's Address: _____
(Only required if participant wants to receive a summary of findings)

Researcher's Signature: _____ _____ Date: _____

(day/month/year)

Researcher's Printed Name: _____

Questions

If any questions come up during or after the study contact the principal investigator Alvira Farheen Ria at or the study's supervisor Dr. C. Emdad Haque.

For questions about your rights as a research participant, you may contact The University of Manitoba, Bannatyne Campus Research Ethics Board Office at (204) 789-3389 or email them at humanethics@umanitoba.ca.

APPENDIX H

Consent Form for KIIs

UNIVERSITY OF MANITOBA

Natural Resources Institute
Clayton H. Riddell Faculty of Environment, Earth, and Resources

303-70 Dysart Road
Winnipeg, Manitoba
Canada R3T 2M6

Research Project Title: Climate change impacts, responses and adaptation technologies in small-scale agriculture in coastal areas of Bangladesh: Gender and women's perspectives

Principal Investigator: Alvira Farheen Ria, M.N.R.M Candidate
Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2.

Research Supervisor: Dr. C. Emdad Haque, Professor
Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2

Sponsor: International Development Research Centre (IDRC), University of Manitoba

You are invited to participate in a key informant interview for this research study. This consent form, is a part of the process of informed consent. It will give you the basic idea of what the research is about and what your participation will involve. Please take your time to understand the consent form and feel free to ask the interviewer (Alvira) to explain anything you need further clarification for.

Purpose of the research

I am a graduate student at the University of Manitoba in Canada and I am conducting my master's thesis research. The purpose of my research is to understand the dynamics and the factors that cause pronounced climate change impacts on the marginalized groups in the coastal region of Satkhira, Bangladesh, with a focus on gender disparities. My study also aims to delve into women's contribution to local climate change adaptation activities while exploring the innovative local agricultural technologies and methods that are currently being used in the region to cope with climate change impacts. The three specific objectives of this research are to:

i. identify and explore the major factors responsible for differentiated climate change impacts on socioeconomic groups with a particular focus on women;
ii. examine agricultural adaptation technologies and methods that have evolved locally as a response to climate change impacts, particularly engaging women; and
iii. determine the challenges and barriers faced by women in climate change adaptation to agriculture.

Study Procedure

Key informant interviews (KIIs) are in-depth interviews with experts on a certain topic, or community members who have special knowledge on the topic being researched. I am conducting key informant interviews with government officials, non-government office (NGO) and government office workers, committee heads, community leaders and minority and ethnic community representatives to collect data for my research objectives.

I am inviting you to participate in this key informant interview because you have valuable knowledge on topics relevant to my research through your occupation, work and/or lived experiences, that will be helpful for my study. For this interview, I will ask a set of questions to get an idea of the socioeconomic situation in Satkhira and obtain information on disproportionate impacts of climate change and climate change adaptation strategies in Satkhira. I will also ask for recommendations and opinions on how to address these issues and improve adaptation policies and interventions. If you prefer, I can give you the set of questions beforehand for you to review.
The interview will take around 1 hour 10 minutes (70 minutes).

Audio Recording

Since it is difficult to write notes down instantly and information may be missed, an audio of the discussion will be recorded, with participants' consent, for reviewing later. The audio files will be saved in a secure database, which only the principal investigator (Alvira) and study supervisor (Dr. C. Emdad Haque) will have access to. The recorded audio will be transcribed by the principal investigator (Alvira), and interview participants will be referred to using codes, without revealing any identifying information in the transcripts.

Benefits

Participation in this interview is voluntary and does not involve any monetary compensation. Being a participant of this interview may not directly benefit you in a tangible form, but your contribution will be highly appreciated and beneficial in understanding the disproportionate impacts of climate change and current adaptation practices in Satkhira. It will also help to create better climate change adaptation policies and interventions that are gender responsive and inclusive.

Potential Risks

There are no anticipated physical or mental risks if you participate in this interview and the risks that may be present are no greater than the ones you experience in everyday life. If you do not feel comfortable talking about something, please let me know and I will skip the topic. Any information you discuss that may identify you or anybody else in this interview will be changed and referred to using codes in the transcription of the audio as well as in any presentation or report of the findings, to maintain this confidentiality.

Privacy and confidentiality

We will do everything possible to keep your personal information confidential. Your name will not be used at all in the study records. If the results of this study are presented in a meeting, or published, nobody will be able to tell that you were in the study. Please note that although you will not be identified as the speaker, your words may be used to highlight a specific point. The collection and access to personal information will be in compliance with provincial and federal privacy legislations. Audiotapes (to be obtained with consents from participants) of the interview will be transcribed and used to prepare a report. The audiotapes will be stored in a secure online database and typed notes will be kept for in a secure locked file cabinet my supervisor's (Dr. Emdad Haque) office at the Natural Resources Institute of the University of Manitoba. Only the discussion moderator (Alvira) and supervisor (Dr. C. Emdad Haque) will have access to them and know your name. After the 5 years, the notes and audiotapes will be removed and deleted.

Withdrawal

You may decline to participate at any point throughout the interview or decline to answer any question(s) during the discussion, without any negative consequences. You are only expected to answer according to the best of your knowledge, and if you do not know an answer or do not want to answer, we can skip those specific questions. You

can withdraw your participation and information provided after the interview is conducted as well, but please let me know by 30th October 2022.

Dissemination

The findings of the study will be disseminated in academic conferences and peer-reviewed journals, and the final thesis paper will be available on the thesis collection of the University of Manitoba repository MSpace (https://mspace.lib.umanitoba.ca). A copy of the master thesis or a summary of findings can also be made available to participants of this interview if requested, through email. You will most probably get these findings around March 2023.

Permission to Quote:

When writing the report or publishing this research, I may use direct quotes from this discussion. However, I will not use your name to quote what you said. I will use identifiers like "one female respondent" or "one farmer" to keep you anonymous.

Feedback

Upon completion of the focus group discussion, I will summarize key facts and main ideas that you have discussed throughout the interview. I will request you to validate my interpretation of your statements. If you find any misinterpretation, please do not hesitate to share that with me.

Consent:
I am requesting you to indicate whether you agree with the following items:

Yes ☐ No ☐	I agree that the researcher can use the audio voice recorder for this interview.
Yes ☐ No ☐	I have had a chance to ask questions and have received satisfactory answers to all of my questions.
Yes ☐ No ☐	I have understood and gone through all three pages of the consent form
Yes ☐ No ☐	I agree to participate in this research
Yes ☐ No ☐	I agree to be quoted directly if my name is not published (I remain anonymous
Yes ☐ No ☐	I want to receive a summary of the findings

---------- **Provide for Signatures as Required:** ----------

Participant's Signature: _____ Date: _____

Participant's Printed Name: _____ (day/month/year)

Participant's Email: _____
(Only required if participant wants to receive a summary of findings)

Researcher's Signature: _____ _____ Date: _____

Researcher's Printed Name: _____ (day/month/year)

Questions

If any questions come up during or after the study contact the principal investigator Alvira Farheen Ria the study's supervisor Dr. C. Emdad Haque.

For questions about your rights as a research participant, you may contact The University of Manitoba, Bannatyne Campus Research Ethics Board Office.

APPENDIX I

Consent Form for Surveys

UNIVERSITY OF MANITOBA

Natural Resources Institute
Clayton H. Riddell Faculty of Environment, Earth, and Resources

303-70 Dysart Road
Winnipeg, Manitoba
Canada R3T 2M6

Research Project Title: Climate change impacts, responses and adaptation technologies in small-scale agriculture in coastal areas of Bangladesh: Gender and women's perspectives

Principal Investigator: Alvira Farheen Ria, M.N.R.M Candidate
Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2.

Research Supervisor: Dr. C. Emdad Haque, Professor
Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2

Sponsor: International Development Research Centre (IDRC), University of Manitoba

You are invited to participate in a survey for this research study. This consent form, a copy of which will be left with you for your records and reference, is part of the process of informed consent. It will give you the basic idea of what the research is about and what your participation will involve. Please take your time to understand the consent form and feel free to ask the interviewer (Alvira) to explain anything you need further clarification for.

Purpose of the research

I am a graduate student at the University of Manitoba in Canada and I am conducting my master's thesis research. The purpose of my research is to understand the dynamics and the factors that cause pronounced climate change impacts on the marginalized groups in the coastal region of Satkhira, Bangladesh, with a focus on gender disparities. My study also aims to delve into women's contribution to local climate change adaptation activities while exploring the innovative local agricultural technologies and methods that are currently being used in the region to cope with climate change impacts. The three specific objectives of this research are to:

i. identify and explore the major factors responsible for differentiated climate change impacts on socioeconomic groups with a particular focus on women;
ii. examine agricultural adaptation technologies and methods that have evolved locally as a response to climate change impacts, particularly engaging women; and
iii. determine the challenges and barriers faced by women in climate change adaptation to agriculture.

Study Procedure

Surveys are used to get data on a large group of people, who are a representative sample of the targeted population for a study. I am conducting surveys with 350 households in Satkhira to obtain demographic and socioeconomic details of the study population and to get an overview on the agricultural activities, climate change impacts and an overall sense of climate change adaptation strategies in the study area.

I am inviting you to participate in this survey because as a community member in Satkhira, your life is impacted by climate change impacts and you may be taking adaptation measures to deal with these impacts. For this survey, I will ask a set of questions to get an idea of your socioeconomic situation, how climate change impacts are affecting your life and how you are adapting to these impacts. The survey will take around 90 minutes, and will be conducted at a time and place which is convenient for you. I will note down your answers on my questionnaire and also record the survey to verify answers later.

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Audio Recording

Since it is difficult to write notes down instantly and information may be missed, an audio of the discussion will be recorded, with participants' consent, for reviewing later. The audio files will be saved in a secure database, which only the principal investigator (Alvira) and study supervisor (Dr. C. Emdad Haque) will have access to. The recorded audio will be used to verify answers marked on the questionnaire during the survey by principal investigator (Alvira). Survey participants will be referred to using codes, without revealing any identifying information in the transcripts.

Benefits

Participation in this survey is voluntary and does not involve any monetary compensation. Being a participant of this survey may not directly benefit you in a tangible form, but your contribution will be highly appreciated and beneficial in understanding the disproportionate impacts of climate change and current adaptation practices in Satkhira. It will also help to create better climate change adaptation policies and interventions that are gender responsive and inclusive.

Potential Risks

There are no anticipated physical or mental risks if you participate in this survey and the risks that may be present are no greater than the ones you experience in everyday life. If you do not feel comfortable talking about something, please let me know and I will skip the topic. Please rest assured that the study staff are bound to maintain confidentiality. Any circumstances you discuss that may identify you in this survey will be changed in any presentation or report of the findings, to maintain this confidentiality.

Privacy and confidentiality

We will do everything possible to keep your personal information confidential. Your name will not be used at all in the study records, and your information will be referred to as codes. If the results of this study are presented in a meeting, or published, nobody will be able to tell that you were in the study. Please note that although you will not be identified as the speaker, your words may be used to highlight a specific point. The collection and access to personal information will be in compliance with the provincial and federal privacy legislations. The audiotapes (to be recorded with consents from participants) will be stored in a secure online database and typed notes will be kept for 5 years in

a secure locked file cabinet and office. After the 5 years, the notes and audiotapes will be removed and deleted. Only the interviewer (Alvira) and supervisor (Dr. C. Emdad Haque) will have access to them.

Withdrawal

You may decline to participate at any point throughout the survey or decline to answer any question(s) during the survey, without any negative consequences. You are only expected to answer according to the best of your knowledge, and if you do not know an answer or do not want to answer, we can skip those specific questions. You can withdraw your participation and information provided after the interview is conducted as well, but please let me know by November 2022.

Dissemination

The findings of the study will be disseminated in academic conferences and peer-reviewed journals, and the final thesis paper will be available on the thesis collection of the University of Manitoba repository MSpace (https://mspace.lib.umanitoba.ca).

Consent:

I am requesting you to indicate whether you agree with the following items:

Yes ☐ No ☐	I agree that the researcher can use the audio voice recorder for this interview.
Yes ☐ No ☐	I have had a chance to ask questions and have received satisfactory answers to all of my questions.
Yes ☐ No ☐	I have understood and gone through all three pages of the consent form
Yes ☐ No ☐	I agree to participate in this research

---------- **Provide for Signatures as Required:** ----------

Participant's Signature: _____ Date: _____ (day/month/year)

Participant's Printed Name: _____

Participant's Email: _____

(Required only if you wish to receive a copy of the thesis or summary of findings)

Questions

If any questions come up during or after the study contact the principal investigator Alvira Farheen Ria the study's supervisor Dr. C. Emdad Haque.

For questions about your rights as a research participant, you may contact The University of Manitoba, Bannatyne Campus Research Ethics Board Office.

Researcher's Signature: _____ _____ Date: _____ (day/month/year)

Researcher's Printed Name: _____

Questions

If any questions come up during or after the study contact the principal investigator Alvira Farheen Ria or the study's supervisor Dr. C. Emdad Haque.

For questions about your rights as a research participant, you may contact The University of Manitoba, Bannatyne Campus Research Ethics Board Office.

APPENDIX J

Additional Pictures for Context

Figure J.1

Focus Group Discussions

Figure J.2

Poor living conditions of lower socioeconomic households

Note: Open Latrine

Note: Women and girls washing dishes in dirty water

Note: Plastic covering edges and walls of mud houses to prevent salinity in the atmosphere from eroding the material