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**Research Title:** Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region

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**Date:** 17<sup>th</sup> January, 2025

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# **Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region**

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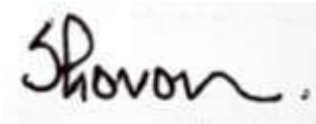
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**Department of Occupational and Environmental Health  
National Institute of Preventive and Social Medicine (NIPSOM)  
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## DECLARATION

The thesis entitled **Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region** is submitted to the faculty of Preventive and Social Medicine, Bangabandhu Sheikh Mujib Medical University (BSMMU) in partial fulfillment of degree of **Master of Public Health (MPH) in Occupational and Environmental Health** during the session 2022-2023. With the exception of quotation and references contained in published works which have all been identified and acknowledged, it is entirely an own work, and it has not been submitted either in part or whole for another degree elsewhere. The study was carried out at National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka 1212, Bangladesh.



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## CERTIFICATE

This is to certify that the thesis entitled **Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region** submitted by Shovon Chakraborty, student of **Master of Public Health (MPH) in Occupational and Environmental Health** session 2022-2023 to the faculty of Preventive and Social Medicine, Bangabandhu Sheikh Mujib Medical University (BSMMU) is a record of authentic research work. He carried out the research work under my direct supervision and guidance at National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka 1212, Bangladesh. The result embodied in this thesis has not been submitted elsewhere for the award of any other degree.



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The undersigned certify that, they have read and recommended to the faculty of Preventive and Social Medicine, Bangabandhu Sheikh Mujib Medical University (BSMMU), for acceptance of this thesis entitled **Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region** submitted by Shovon Chakraborty (Reg. No 22905070691301) in partial fulfillment for the requirement of the degree **Master of Public Health (MPH) in Occupational and Environmental Health** during the session 2022-2023. The study was carried out at National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka 1212, Bangladesh.

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## **Dedication**

**Dedicated to My Dearest Parents, and Sister**

**My Loving Wife and Beloved Daughter**

**All of My Respected Teachers**

**and My Close Friends**

**You are the pillars of my life, the guiding lights that have shaped me into who I am today. Your love, support, and teachings have been the foundation upon which I've built my dreams and aspirations.**

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## **LIST OF ABBREVIATIONS**

<b>Abbreviation</b>	<b>Full Meaning</b>
<b>BBS</b>	Bangladesh Bureau of Statistics
<b>BIWTC</b>	Bangladesh Inland Water Transport Corporation
<b>CFS</b>	Climatic Field School
<b>DCCEE</b>	Department of Climate Change, Energy, the Environment and water
<b>FAO</b>	Food and Agriculture Organization
<b>GDP</b>	Gross Domestic Product
<b>GNP</b>	Gross National Product
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>MPH</b>	Master of Public health
<b>NIPSOM</b>	National Institute of Preventive and Social Medicine
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change

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## **ABSTRACT**

Climate change poses a global threat, impacting various sectors, especially agriculture. The coastal zone of Bangladesh is possibly the most climate-vulnerable region globally. This study aimed to assess farmers' awareness and adaptation to climate change in the coastal region. Covering both male and female agricultural workers with over 10 years of residency in the coastal zone, this cross-sectional study utilized multi-stage sampling on Hatiya island. Quantitative and qualitative data were collected from a sample size of 414 respondents. Results revealed that 94.2% of the participants were male and 5.8% were female, the majority of the respondents (46.9%) were aged between 25 to 45 years, and 71.7% were illiterate or could only do a signature. About 19.3% of the total respondents had contact with local agricultural extension agents. Most of the farmers (77.3%) reported having exposure to mass media, and 79.75% of the total respondents had facilities to get information on weather forecasting. Majority of the participants, comprising 97.6%, had a high perception level of climate change, with only 2.4% holding a moderate perception. All of the farmer respondents (100%) indicated that they had employed at least one of the adaptive strategies. Most of the respondents (98.1%) changed crop types, while 98.6% shifted to drought/salinity-tolerant varieties, 89.9% adjusted planting dates, 99.5% increased the use of fertilizers and pesticides, and 99.8% increased the use of irrigation to cope with changing weather patterns. Certain variables demonstrated significant associations with farmers' adaptation strategies. An increased use of fertilizers and pesticides showed a highly significant positive association. Planting shade trees and adopting soil conservation measures positively correlated with adaptation practices. The insights of the Focus Group Discussion (FGD) were consistent with those of the study findings. These findings offer crucial insights into climate change adaptation, sustainable agriculture, and coastal development. The study advocates for a holistic policy approach, addressing the unique challenges faced by farmers in the southern coastal region of Bangladesh. This comprehensive strategy aims to strengthen agriculture's resilience and sustainability amidst evolving climate conditions.

# **CHAPTER I**

## **INTRODUCTION**

**1.1 Introduction**

**1.2 Justification**

**1.3 Research Question**

**1.4 Objectives**

**1.5 Objectives**

**1.6 Conceptual Framework**

**1.7 Operational Definition of Terms**

## **1.1 INTRODUCTION:**

Climate change is becoming an obvious and growing threat for the developing countries, and specially across the Asian region, it is anticipated to worsening the coming decades. The worldwide, environmental hazard of climate change is also a development issue. Because of their poor level of perception and adaptation, developing nations are the ones who suffer the most from the detrimental effects of climate-related disasters. By the middle of the twenty-first century, it is predicted that climate change will have a significant impact on food security worldwide. In South Asia, there will be the greatest concentration of individuals who lack access to food. All economic sectors are threatened by climate change, but the agriculture industry is particularly vulnerable (Abid *et al.*, 2015).

According to IPCC (Intergovernmental Panel on Climate Change), “climate change” is any change in the climate over time, whether it is brought on by natural variability or human action. Given that it affects all nations, established and developing alike, climate change has become a central topic of discussion and debate worldwide about development. One of the key factors affecting agriculture productivity is the climate. The United Nation and a number of state governments are concerned that climate change could jeopardize global food security. According to many studies, South Asian countries specially Bangladesh is particularly susceptible to the effects of climate change and is anticipated to experience harm to its cattle numbers, food and water security, agricultural production, and human health. In addition, agriculture is a major source of income for many people, particularly in rural and coastal regions, and the livelihoods of millions of people in Bangladesh are directly and seriously threatened by climate change. Therefore, the negative impacts and its ramifications are of greater concern to the governments of emerging nations (Raghuvanshi, Joshi and Ansari, 2018).

The challenge to the world’s food security posed by climate change is growing in size and complexity. The phenomenon is putting a strain on both human and environmental resources, making it difficult for resource-poor emerging nations like South Asia to maintain their social, economic, and ecological sustainability. These regions’ environmental resources are being negatively impacted by the resulting effects of these weather and climatic variations. Since the economic and social viability of these environments depends on agricultural productivities, integrated efforts are necessary to

ensure the resilience of their agriculture-based economies. According to the Food and Agriculture Organization (FAO, 2015), almost 50% of the total land area in the South Asian region is used for agricultural purposes; therefore, coordinated measures for the agricultural sector's resilience are essential (Amir *et al.*, 2020).

On the other hand, two-thirds of the world's population lives in these coastal regions of developing countries, which are the most sensitive to the effects of climate change and are already having catastrophic effects on way of life. According to the IPCC (2014), detrimental social effects are anticipated to worsen for this sizable portion of the coastal population, and climate change will make it more difficult for ecosystems to supply the services necessary for human well-being in the future (Kabir *et al.*, 2021).

The increasing population density, technological advancements, and corresponding lifestyle changes are each putting pressure on changes in land use and cover. These land use and cover changes are necessary to meet the rising housing and food demands in this highly populated area. The shrinkages in the forests and pastoral lands are occurring as a result of the land use and cover alterations. The effects of meteorological and climatic anomalies are being exacerbated by these deliberate and accidental disruptions of the natural equilibrium. As a result, the natural environment's resulting imbalances are making living and livelihood strategies in this region of the world more difficult. The hypotheses, which are based on simulation modelling methodologies, suggest that even a little increase in the earth's surface temperature will have a severe impact on the productivity and quality of cereal crops like wheat, rice, and maize, among others (Amir *et al.*, 2020).

Climate change has significantly impacted the productivity of the agriculture industry. Crop yields have been greatly diminished due to rising temperatures, unpredictable rainfall patterns, as well as the prevalence of diseases and pests. Despite the widespread discussion on climate change, many farmers at the local level have not taken any action and are nevertheless experiencing significant losses due to the intrinsic impacts of climate change (Mutunga, Charles and Patricia., 2017).

Small-scale farmers will be the ones who suffer the most from these corollaries. Their weak economic foundation, ignorance, and unpreparedness further limit their ability to handle these growing difficulties. Therefore, establishing context-based methods, corrective and remedial steps for the current environmental degradation are necessary.

These steps must be taken in order to lessen the impending effects of climate-related vulnerabilities for farming communities (Amir *et al.*, 2020).

In general, vulnerability refers to a person's or a group's diminished ability to deal with, resist, and recover from the effects of a natural or man-made hazard. The social, economic, and biophysical conditions of agricultural production are becoming more turbulent and unpredictable. The reason for this is that such production is increasingly being influenced by intricately intertwined contextual changes, such as a rise in resource scarcity, climate change, rising food demand, and governmental regulations. In detail, a system's vulnerability (at any scale) depends on how exposed it is to various risks, how sensitive it is to those risks, how well it can respond to those risks, how well it can adapt to them, and how well it can recover from their effects (Singh, 2020).

The production of agricultural products is now widely acknowledged to be significantly impacted by the changing environment and the farmers are known as most vulnerable group in aspects of negative effects of climatic change. However, there are significant regional differences in the distribution of the effects. Higher mean temperatures and longer growing seasons are expected to help agriculture in other countries located in temperate and arctic regions, but most countries located in tropical and subtropical climates are forecast to experience decreases in agricultural production (Tambo and Abdoulaye, 2013).

It is well acknowledged that one of the main issues influencing agriculture's productivity and people's quality of life is climate change. Farmers are disproportionately affected because they must constantly adapt to changing weather conditions. As a result of global warming and the ensuing climate change, extreme weather events such as floods, droughts, and powerful cyclonic storms are expected to happen more frequently and with increasing severity. Climate change is expected to reduce agricultural productivity in the tropics and raise worries about human security because of its direct and indirect effects on water resources, agriculture, coastal areas, and resource-dependent lifestyles, especially in Asian countries (IPCC, 2013). Climate change has caused flooding to disrupt food production in certain locations and increased frequency of droughts in other tropical countries (IPCC, 2007b). Asia's tropical and arid regions can be considered the most vulnerable to climate change due to the fact that

their populations are often faced with severe droughts and water shortages (Singh, 2020).

According to projections based on trends of food consumption and population growth, agricultural production would undoubtedly need to rise by at least 70% by 2050 to meet demand (FAO, 2005). Due to its rapid population expansion, South Asia is predicted to be severely hit. Because agriculture provides approximately 60% of the income for nearly 60% of the population in highly populated countries like Bangladesh and India, the effects of a changing climate on the sector would be felt most acutely there. It has been predicted that rice yields would decrease by 32–40% and wheat yield by 41–52% in India in the event of a 2.5–4.98C temperature increase. The GDP would decrease by 1.8% to 3.4% as a result (Singh, 2020).

Public perception of regional climate fluctuations is closely related to their beliefs about the significance and reality of climate change. One of the main reasons why people might not take actions to mitigate climate change or adapt accordingly has been identified as a lack of firsthand experience with its potential effects; in contrast, people who directly experience climate change would be more concerned and motivated to continue with sustainable behaviors. However, it is crucial to understand that observable effects of climate change offer chances for people to grow more certain about the truth of climate change, or whether past belief has a role in this. Through a process of motivated reasoning, certainty affects how the general public perceives things. It is also required to frame the indigenous knowledge and climate concerns of local residents so that transmission of modern scientific knowledge can be effectively planned (Ali *et al.*, 2020).

Although there is little scholarly research on how people perceive climate change, research done thus far suggests that people's opinions on environmental concerns and perceptions of climate change can be correlated with their experiences and physical surroundings. People who reside in low-lying coastal locations, for instance, have been identified as having a keen awareness of prospective threats in the future. There are some evidences that local residents' opinions and perceptions might be impacted by their experiences with disasters and environmental issues (Ali *et al.*, 2020).

Agriculture and climate change are connected processes. The sensitivity of the crop means that any change in the climate can result in large changes to the crop production.

Climate change may damage about 11% of the arable land in developing nations, which will result in a decrease in cereal production (FAO, 2005). South Asia would be severely affected by yield decreases brought on by climate variability and change. Extreme weather conditions like drought and heat waves, particularly during the growing season, may cause a drop in above-ground biomass, the extinction of tasty grass species, and significant nutrient loss (Ali *et al.*, 2020).

The economic and social survival of the majority of people in Asia, especially in South Asia, is negatively impacted by climate change, which shows up as changes in temperature and rainfall patterns. The most sensitive regions or industries to climate change are those that provide the main means of subsistence for rural poor people in Asia, such as forests, coastal zones, ecosystems, and agriculture (including agricultural production and animal husbandry). Food security and sustainable resource management continue to be seriously threatened by climate change (Sani and Chalchisa, 2016).

A significant portion of the South Asian population lives in utter poverty as a result of the agriculture sector's poor performance, rapid population expansion, and the negative effects of climate change. It is likely that the current trend will result in significant reductions in food security, worsening water security, an increase in animal and crop pests, and disease infestation, among other effects, if it continues to cause long-term changes in rainfall patterns and temperature that have significant impacts on agriculture (Sani and Chalchisa, 2016).

The effects of climate change on agricultural production are not the same in all parts of the world; low-latitude and developing nations are anticipated to suffer more as a result of their unfavorable geographical location, greater economic dependence on agriculture, and limited capacity to adapt to climate change. Both directly and indirectly, it has an impact on agricultural productivity and output. It has an impact on meteorological factors including temperature, solar radiation, rainfall, wind speed, and humidity, which directly affect agriculture. Indirectly, it has an impact on disease and insect outbreaks as well as favors the development of climate-related diseases like malaria, which have an impact on the workforce. Additionally demonstrated that climate change has an impact on the intricate relationships between crops and pathogens, increasing pest and disease outbreaks. In addition, different empirical studies have shown that while agriculture is the most vulnerable sector, other sectors in

the economy are also affected because of the induced effect from the agriculture sector. (Sani and Chalchisa, 2016).

Climate change affects agriculture and agriculture also affects climate change. The significant negative effects on food production, food security, and natural resources found all across the world are proof that climate and weather patterns change are already occurring. Climate change is likely to make it harder to reduce poverty and boost economic growth. It will also make problems that are already very bad even worse, especially in countries where climate-sensitive industries like agriculture are important to the economy (Acquah, 2011).

In addition to having a significant impact on agricultural production and food security for the farming community in particular, climate change has a significant negative impact on the livelihoods of the global community as a whole. It might negatively impact a number of biophysical and economic activities, including forestry, agriculture, water resources, human health, biodiversity, and animals. (Sani and Chalchisa, 2016).

Climate change's potential impact on Southeast Asia enjoys widespread renown. The region of Southeast Asia is experiencing an increase in the frequency, severity, and duration of extreme weather events due to climate change. These parts of the world have more tropical storms and warmer weather. Agricultural livelihoods in the world, especially in Southeast Asian nations, are expected to be negatively impacted by climate change. War and natural disasters have caused food crises in many countries, and other problems, like droughts and floods caused by climate change, are further undermining food security (Food and Agricultural Organization, 2008) (Mahaarcha, 2019).

The fact that climate change will adversely affect agriculture in the region has become a challenge for sustainable development on the continent. Bangladesh is one of the highly affected countries by climate change and has been ranked 7<sup>th</sup> extreme disaster risk prone country in the world as per the report from the Global Climate Risk Index 2021. Bangladesh is among the most climatically susceptible nations in the world because of its geographic location, topography, socioeconomic status, and reliance on agriculture. Although Bangladesh has historically been susceptible to natural disasters like floods and cyclones, climate change has not only induced and increased the severity of those risks but also had an impact on social and ecological systems by causing

changes in total rainfall, shifting rainfall seasons, rising temperatures and sudden changes in temperature, and an increase in salinity due to sea level rise. Particularly, Bangladesh's coastal region may be the most climatically sensitive area on earth. In this coastal region, climate change-related phenomena like droughts and sea level rise are expected to exacerbate indirect effects like salinity in the soil and water (Kabir *et al.*, 2021).

In different parts of the world, the effects of climate change would cause yields to decline by about 17%; Bangladesh's decline is predicted to be higher than the global average and could even reach 30%. Crop farming provides the majority of the food for nearly 150 million people lives in Bangladesh, accounts for about 19% of the country's gross domestic product (GDP), and employs roughly 48% of the labor force. In the coastal regions, which make up around 30% of the nation's total cultivable territory, agriculture is regarded as a necessary means of subsistence (there are 40 million coastal farmers). It is predicted that the yield of rice and wheat will decline by 28% and 68%, respectively, if the temperature rises by 1-2°C. Additionally, a rise of more than 3.5°C could result in the breakdown of society in the future (Kabir *et al.*, 2021).

Agriculture, food security, and the quality of life for any given population are all imperiled by climate change. One of the most weather-dependent industries, agriculture is particularly at risk from climate change because of its dependence on rain-fed farming, extreme poverty, poor human and physical capital, uneven land distribution, and insufficient infrastructure (Akanda and Howlader, 2015). Statistics shows that, agricultural sector contribute 11.63 percent of gross national product (GNP) in Bangladesh from 2011 to 2021. Although, during the post- independence era the food grain production quadrupled still Bangladesh continues to face a persistent challenge of feeding a growing population against a background of climatic uncertainties (Dhaka, Chayal and Poonia, 2010).

In another view, among the nations hit most by climate change, Bangladesh ranks high due to its low ability to adapt and its high vulnerability to devastating catastrophes. Agriculture is the backbone of Bangladesh's economy. Rural areas are home to 80% of those who rely on agriculture in some way, shape, or form. Since they form the backbone of the agricultural sector, farmers in Bangladesh are particularly at risk from natural disasters. (Abid *et al.*, 2015).

Bangladesh's coordinates are 88°01' to 92°42' East longitude and 20°34' to 26°38' North latitude. The nation's total area is 147,570 sq. km (BBS, 2012). With a coastal area of 47,211 square kilometers, or 32% of its total land area, Bangladesh is one of the most populous nations in the world. With a fairly low-lying flat region, Bangladesh's coastline is about 711 kilometers long. Among which, 62% of the ground is lower than three meters, and 86% is lower than five meters. Bangladesh's coastal region has 36.8 million residents in 2001. About 71% of the 6.85 million households are made up of agricultural laborers, small farmers, fishermen, and the urban poor (Ahmad, 2004). Every year, there are severe floods, cyclones, and tornadoes; in addition, crops are damaged by salinity and cold spells, which also claim lives. These are an early indication of the effects of global warming, researchers claimed that over 25 million people will become climate refugees due to sea level rise in the coming decades. The livelihoods of people living in the growing dangers of climate change have already had a detrimental effect on the ecologically sensitive coastal regions of Bangladesh, and it is also significantly impeding the progress of agriculture in Bangladesh and elsewhere. In these aspects, it is essential to know, how farmers perceive environmental change, how they adapt, what helps and what hinders them, or how to increase their capacity for adaptability (Akanda and Howlader, 2015).

Groundwater salinity is predicted to rise in coastal regions of Bangladesh, as a result of sea level rise. Furthermore, it's conceivable that cyclones and storm surges will occur more frequently. In order to reduce river flow and replenish ground water aquifers in Bangladesh, these complicated changes interact with other trends that are not directly resulting from climate change, particularly the impact of increased agricultural water extraction and potential negative water availability impacts from diverting rivers upstream in India. In terms of population, Bangladesh is the third most vulnerable country in the world to sea level rise, and it is in the top ten countries in terms of the proportion of its inhabitants who live in low-lying coastal areas. Bangladesh's sea level is predicted to rise by 10 cm, 25 cm, and 1 m, respectively, by the years 2020, 2050, and 2100, according to World Bank (2000). Sea level rise may cause up to 33 million people to lose their homes by 2050 and up to 43 million by 2080 (Akanda and Howlader, 2015).

Environmental hazards pose a significant threat to Bangladesh's coastline. Because of its location, a broad tidal floodplain that flows into the Bay of Bengal has long been

vulnerable to severe weather events like cyclones and prolonged monsoons. Climate change is expected to have the greatest impact on the coastal region of Bangladesh this century. Forecasts indicate that this will cause temperatures to rise and increase the frequency and severity of weather extremes. The current state of affairs is likely to deteriorate further. An estimated 18% of coastal land might be under water or used for brackish water farming by 2100, forcing 20-30 million people to relocate as a result of rising sea levels (WB 2013). In addition, problems with soil erosion, poor drainage, seawater intrusion, and insufficient freshwater for irrigation and human use are expected to intensify. On the other hand, Shrimp livelihood activities have contributed to the worsening of environmental conditions through the unsustainable exploitation of coastal resources. Already, two-thirds of the coastal belt's arable land has been adversely affected by salinity. Coastal farmers are stated to have low resilience because the bulk of them (84%) have small, semi-subsistence holdings, few resources, little mechanization, low adoption of stress-tolerant cultivars, and a great reliance on weather due to insufficient irrigation (Kabir and Alam, 2017).

A strategic policy is needed, according to the World Bank (2013), to protect coastal farming, resources, and ecosystems as well as to improve coastal populations' ability to adapt to climate change. This mirrors the widely accepted perspective on climate change vulnerability, where adaptation is frequently viewed as an official policy intervention or a carefully thought-out singular activity that mitigates harm or reaps benefits. The socio-political context of adaptation to climate change is: "Instead of conceptualizing adaptation as a policy process, independent from more general patterns of social change, we conceptualize adaptation as part and parcel of these processes of change." This implies that adaptation needs to be connected to the aspirations and activities of people and groups in society on a daily basis. In Bangladesh, research has concentrated on farm-level adaptation in the coastal, flood-prone, and drought-prone areas. Studies in coastal regions have concentrated on areas that are exposed to a lot of environmental risks (Kabir and Alam, 2017).

In this regard, understanding local agricultural practices and evaluating public perception of climate change are necessary before postulating workable adaption solutions (Abid *et al.*, 2018). Developing practical solutions also requires doing an examination of socioeconomic issues and identifying the channels via which information is shared among the stakeholders (Amir *et al.*, 2020).

Perceptions not only shape knowledge but knowledge also shapes perception. Therefore, how farmers perceive climate change has a significant impact on how they manage risks and uncertainties related to the climate and take specific actions by using coping mechanisms to lessen the negative effects of climate change on agriculture. It was suggested that specific interventions targeting the farming community as well as other stakeholders need to be performed to increase their preparedness to deal with its detrimental impact. Farmers' perception is the key to reducing the adverse impact of climate change on agriculture (Raghuvanshi, Joshi and Ansari, 2018).

Farmers will first notice changes in the climate and then devise practices to adapt to those observations. Similar to this, the viewpoints of the local population, their attitudes and behaviors regarding the climate, as well as their values and goals, are important factors in combating climate change (Mutunga, Charles and Patricia., 2017).

More and more people are starting to pay attention to how climate change is affecting farming. The topic of climate change has been receiving a lot of attention recently due to global warming, but many people still don't believe farmers can actually detect the changes in the weather that have already taken place (Dhaka, Chayal and Poonia, 2010).

The ability of a system to mobilize resources in response to stresses and shocks and to recover from them while maintaining essential functions is known as its adaptive capacity. It denotes the system's strengths, which might lessen the biophysical and or socioeconomic vulnerability brought on by climate change. Global attention has been focused on climate change adaptation due to an increase in extreme weather occurrences and growing trust in climate change projections. In order to lessen susceptibility and create farming systems that are robust to climate change, adaptation involves adjusting agricultural activity and management practices to the current or anticipated climatic conditions (Singh, 2020).

The threat posed by a changing climate to emerging nations is being more and more clear, and in Asia as a whole, it is expected to get worse over the next several decades. Since the majority of the world's population depends on agricultural production for food, human survival is largely dependent on agricultural land and its development. There is no denying the connection between agriculture and the changing environment, and in recent decades, climate change has had a negative impact on this industry. Climate disasters and weather extremes are expected to have a significant influence on

the farming sector and agricultural production (Gao *et al.*, 2022). Agriculture is the main source of income for most rural and urban residents in Bangladesh. To ensure national food security and rural communities' way of life, the agricultural industry may need to adjust to climate variability. Adapting rural households and communities' farming and livelihoods to climatic changes and variability, minimizing expected damages, and supporting them during unfavorable events reduces farm-level climate vulnerability. (Abid *et al.*, 2015).

Bangladeshi agriculture is heavily influenced by climate, which affects the economy and food output. Cyclones, floods, hailstorms, droughts, high winds, and extreme temperatures make farmers vulnerable and affect food security, regardless of production methods. Climate change harms agriculture, food security, water resources, and biodiversity, albeit the effects vary by region. Climate change affects cropping patterns, water availability, and agricultural productivity. The effects may be severe and need major farm management changes. The impact of climate change is significant to millions of poor Bangladeshis who depends on agriculture for food and income (Dhaka, Chayal and Poonia, 2010).

A faster warming, more frequent weather extremes, and altered precipitation patterns were all predicted by various climate models for Bangladesh. Droughts account for 60% of all economic losses brought on by natural disasters in Bangladesh. In addition to having an impact on Bangladesh's agricultural output, the country's shifting climatic circumstances also result in labor migration from rural to urban areas, primarily as a result of the growth of non-agricultural sectors. Climate change's decreased crop yield affects both the UN's sustainable development goals and food security. Mitigation and adaptation strategies are essential for Bangladesh's national food security to reduce the adverse effects of climate change. Because stable livelihoods are disrupted by climate change, smallholder farmers are most at risk. Small producers are seen as the fundamental implementers of agricultural system adjustments, helping to reduce their vulnerability and maintain their way of life and income (Gao *et al.*, 2022).

Climatic adaptation is a useful tool for reducing climatic vulnerability at the farm level since it helps rural households and communities lessen the negative effects of climate change. Climate change generally harms agriculture, but that some of this harm can be

partially countered by different adaption techniques at the farm level (Kumar and Sidana, 2018).

The ability of farming communities to adapt to changing weather conditions determines how much the agricultural industry is impacted by climate change. For effective policies to be developed to help the agricultural sector's successful adaptation, it is essential to have a greater knowledge of farmers' concerns and how they perceived climate change. Accurate knowledge of the kinds and degrees of adaptation strategies being used by farmers is also crucial. To adapt to climate change, it is therefore helpful to comprehend how farmers perceive changes and what influences their adaptive behavior (Kumar and Sidana, 2018).

Therefore, urgent adaptations are required now to deal with the changing climate. It is crucial to investigate and study farmers' perceptions of the problem in order to adapt to a changing climate and its severe effects. People's behavior can have an impact on their attitudes towards the environment, according to the theory of planned behavior, which is widely discussed in psychological and environmental research. People's perceptions of danger and their adaptive attitudes are closely related. Innovation in farming systems is heavily reliant on personal perception. The notion of protective motivation also highlights the connection, depending on farmers' perceptions, between their adaptive behavior and intention to adapt. Local farmers' adaptive behavior in the face of climate change is influenced by a variety of socioeconomic elements; recognizing these factors would help ratify policies that take the farmers' decision-making practices into account (Gao *et al.*, 2022).

According to the IPCC's (Intergovernmental Panel on Climate Change) definition of adaptation, it is the "adjustment of natural or human systems in response to actual or anticipated climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC 2007). Farmers have been impacted by climate change and have over time consistently reacted in different ways. It may be possible to help mitigate the effects of climate change by understanding these adaptation strategies and the obstacles to their implementation. Adaptation to climate change is also a two-step process that involves perceiving that climate is changing and then responding to changes through adaptation. (Tambo and Abdoulaye, 2012).

Although adaptation plans are often designed at the regional, national, and municipal levels, climate change is a transnational concern. Developing nations are where we see this trend more frequently. Adaptation to climate change is the process of making changes to natural or human systems in reaction to current or expected changes in the climate in order to lessen harm or take advantage of good opportunities (Mahaarcha, 2019).

It is anticipated that adaptations will occur and they are always viewed as essentially technical responses to the noted impacts (such as switching to alternative crops, implementing effective irrigation systems, or changing production systems). Instead of real measures that have been taken, the majority of these adaptations indicates potential or possible adaption measures. In fact, there is no proof that any of these adaption possibilities are practical, plausible, or even likely to materialize. They would also be impossible without thorough and exact information of the climatic conditions of the future (Shashidahra and Reddy, 2012).

The aim of adaptation is long-term resilience, to provide the conditions in which society and ecosystems are substantially able to mitigate the effects of climate change, such that any persistent effects beyond their coping ability remain within tolerable boundaries of risks. In order to lessen its harmful consequences, numerous countries have frequently pursued adaptation techniques. Given the centrality of agriculture in their economies and the lack of cash available for adaptation techniques, it is generally agreed that underdeveloped countries are more vulnerable to climate change than developed ones (Mahaarcha, 2019).

Due to an inefficient climate policy and Bangladesh's extremely low technological and financial capability for climate change adaptation, there is now very little help for the agriculture sector in terms of adjusting to the changing climate in that country. Adapting the agriculture industry to climatic changes requires a comprehensive national policy. According to research, some key elements of the adaptation strategy to climate change may include raising farmers' understanding, investing in new heat-tolerant varieties, crop insurance, raising society's awareness, and implementing protection programs (Abid *et al.*, 2015).

Minimizing the impacts of climate change requires perception and adaptation. Farmer's ability to perceive climate change is a key precondition for their choice of adaptation.

The adaptation to climate change requires that farmers must first perceive that climate has changed, then identify useful adaptations and implement necessary adaptation responses (Acquah, 2011).

Given the significance of adaptation strategies in response to climate change, it is beneficial to examine these strategies in a local context given the continued importance of the agricultural sector to the national economy and the likelihood that climate change will have a negative impact on it in the future. In order to understand the elements influencing the adoption of adaptation techniques, it is necessary to identify the tactics that Bangladeshi farmers employ in response to the ongoing and unpredictable changes in climatic occurrences. Therefore, one of the objectives of the current study is to identify socioeconomic factors that may have an impact on adaptive behavior (Mahaarcha, 2019).

However, adequate knowledge of the vulnerability status of farmers, the population's current awareness of their exposure to risks associated with climate change, the adaptation strategies employed, the capacity already in place for adaptation, and the perceived obstacles to adaptation are all necessary for the planning and implementation of any climate change policy. A critical and thorough analysis of the impact of climate change, farmers' perceptions of it, and their adaptations to it are required to address these problems and worries (Sani and Chalchisa, 2016).

The first step in preparing agriculture for climate change, is to perceiving climate unpredictability. For effective policies to be developed to help the agricultural sector's successful adaptation, it is essential to have a greater knowledge of farmers' concerns and how they view climate change. Additionally, it's crucial to be fully aware of the kinds and degrees to which farmers are utilizing adaptation strategies, as well as the necessity of making improvements to the current adaptation infrastructure and the barriers affecting adaptation to climate change. As a result, it is important for adaptation studies to comprehend how farmers interpret climatic changes and what influences determine how they respond to them (Abid *et al.*, 2015).

Numerous empirical findings supported the notion that a variety of institutional factors, including access to credit facilities, access to extension services, and off-farm income generating activities, as well as demographic factors, including gender, age of farmers, years of farming experience, household size, and years of education, were significant

determinants of climate change adaptation strategies (Sani and Chalchisa, 2016). Various social, economic, and environmental factors influence the adaptation strategies that farmers choose. The credibility of policies and their ability to address the difficulties that climate change is posing for farmers will ultimately be improved by this information. A variety of stakeholders, including those in the agricultural extension services, private welfare organizations, research, and policy fields, as well as local communities and farmers, will need to be included in the adaptation process (Abid *et al.*, 2015).

Farmers must use a variety of adaptation techniques to lessen the negative effects of climate change. From two different perspectives, adaptation to the negative effects of climate change can be seen: i) the awareness of the impact of climate change and their capacity to adapt to it; and ii) how adaptation can be thoughtfully planned and carried out to lessen the possibility of mal-adaptation (Sani and Chalchisa, 2016).

Despite the importance of studying how agriculture might adapt to changing climate conditions, particularly in coastal regions of Bangladesh, very little is known about this topic, according to the existing literature. This study intends to fill that knowledge vacuum by investigating how farmers of Bangladesh's southern coastal region view climate change and the many reactive adaptations they've implemented. The study's fundamental objectives are threefold, to learn how local farmers in Bangladesh's southern coastal region perceive climate change, to learn how these farmers have responded to these threats based on what they know and how they adopt it and to learn what factors are affecting the effective adoption of adaptation strategies.

## **1.2 JUSTIFICATION:**

Climate change is a global threat for all economic sectors particularly to the agricultural sector which influencing agricultural production, food security, biodiversity as a whole. Understanding on global climate and its changes is the prerequisite to take appropriate initiatives to combat with the climate change, which is also included in SDG goal 13. The world is experiencing anthropogenic-induced climate change, which has raised the earth's surface temperature by 0.85 °C in the last 100 years. By the end of the twenty-first century, it is expected to rise by at least 1.5 °C more (Intergovernmental Panel on Climate Change, IPCC, 2014). With recent warming, poverty and disadvantage have risen, and many communities should anticipate them to rise if average global temperatures rise by 1 to 1.5 degrees Celsius or more (IPCC, 2018). The likelihood of a transitory overshoot and the mitigation strategy chosen will determine the future dangers at 1.5 °C of global warming. In order to address climate change in an effective manner, the Intergovernmental Panel on Climate Change (IPCC, 2001) has recommended for integrating the potential impacts of climate change into national and local-level development planning by doing proper vulnerability assessment on perception of climate change and relevant adaptation strategies to combat the negative impacts of climate change. Bangladesh is one of the nation's most adversely impacted by climate change as a result of its high susceptibility to catastrophic events and poor capacity for adaptation. Bangladesh's economy is based primarily on agriculture. Statistics shows that, agricultural sector contribute 11.63 percent of gross domestic product (GDP) in Bangladesh from 2011 to 2021. Eighty percent of the people, who are either directly or indirectly dependent on agriculture, reside in rural areas. Farmers in Bangladesh are the main participants in agriculture and are more vulnerable to danger because of it. Larger risks are expected for many regions and systems for global warming at 1.5 °C, as compared to today, with adaptation required now and in near future. This study intends to find out, what is the farmers' perception about climate change and how they modify their farming practices in response to perceived climate change.

### **1.3 RESEARCH QUESTION:**

What is the farmers' level of perception and adaptation strategies towards climate change in southern coastal region?

## **1.4 RESEARCH OBJECTIVES:**

### **1.4.1 General Objective:**

To assess the farmers' level of perception and adaptation strategies towards climate change in southern coastal region.

### **1.4.2 Specific Objectives:**

1. To ascertain the farmers' level of perception towards climate change in southern coastal region.
2. To find out the adaptation strategies of farmers due to climate change in southern coastal region.
3. To identify farmers' work-related factors of farmers in southern coastal region.
4. To determine the socio-demographic characteristics of the respondents.

## **1.5 KEY VARIABLES:**

### **Socio-demographic variables:**

- Age (In complete years)
- Gender
- Religion
- Years of schooling
- Marital status
- Household size
- Household income
- Length of stay in residence (In complete years)
- Ownership of dwelling house

### **Work related factors related to farmers adaptation strategies:**

- Land size (in acres)
- Land ownership
- Years of agricultural experience
- Contacts with local agricultural extension agents
- Exposure to mass media
- Information on weather forecasting

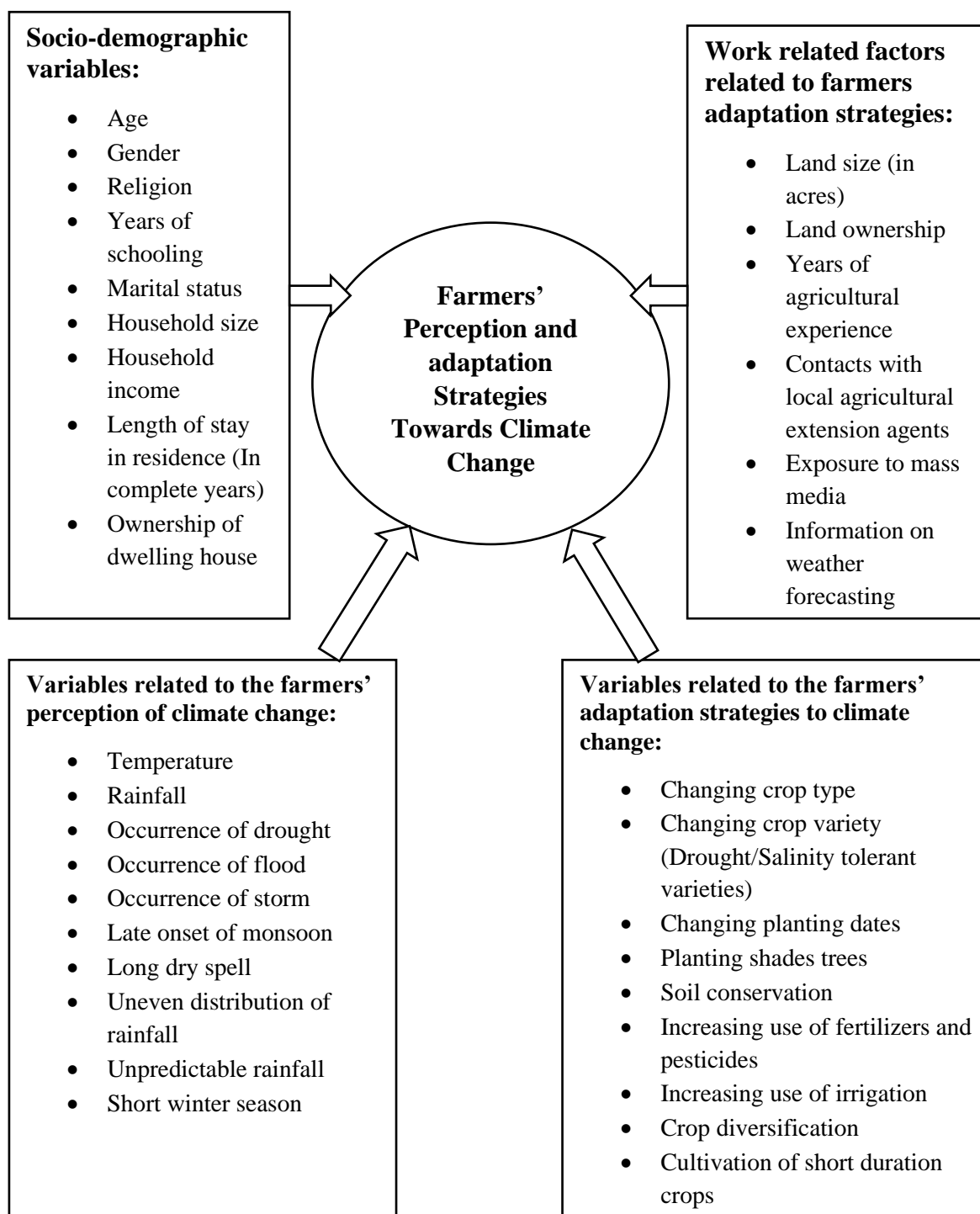
### **Variables related to the farmers' perception of climate change:**

- Temperature
- Rainfall
- Occurrence of drought
- Occurrence of flood
- Occurrence of storm
- Late onset of monsoon
- Long dry spell
- Uneven distribution of rainfall
- Unpredictable rainfall
- Short winter season

**Variables related to the farmers' adaptation strategies to climate change:**

- Changing crop type
- Changing crop variety (Drought/Salinity tolerant varieties)
- Changing planting dates
- Planting shades trees
- Soil conservation
- Increasing use of fertilizers and pesticides
- Increasing use of irrigation
- Crop diversification
- Cultivation of short duration crops

## 1.6 CONCEPTUAL FRAMEWORK:



## **1.7 OPERATIONAL DEFINITION OF TERMS:**

### **Farmers' Perceptions about Climate Change:**

In this study, farmers' perceptions about climate change were determined on the basis of respondents' opinions on temperature, rainfall, late onset of monsoons, long dry spells, occurrence of droughts, floods, or storms, uneven distribution of rainfall, unpredictable rainfall, short winter seasons, and long summer seasons.

### **Adaptation Strategies of Farmers Towards Climate Change:**

In this study, farmers adaptation strategies towards climate change were determined by participants opinions regarding changing crop type, changing crop variety, changing planting dates, planting shade trees, conserving soil, changing fertilizer, increasing use of irrigation, crop diversification, and cultivating short-lived crops.

**CHAPTER II**  
**LITERATURE REVIEW**

## **2.0 LITERATURE REVIEW:**

### **2.1 Climate change:**

The concept of climate change is not exclusively defined. The Intergovernmental Panel on Climate Change (IPCC) of the United Nations defines climate change as “Any change in climate over time, whether due to natural variability or as a result of human activity” (IPCC 2007, p.871). It is “a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer),” according to an older, more empirically based definition from the IPCC (IPCC 2001, p.788). Distinct from the IPCC definitions, the United Nations Framework Convention on Climate Change (UNFCCC) definition places greater emphasis on human activities as a contributing factor. Climate change may be defined as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (United Nations, 1992, p. 3). Australian Government’s DCCEE (Department of Climate Change, Energy, the Environment and water) in its website described Climate Change as ‘our climate is changing, largely due to the observed increases in human produced greenhouse gases. Greenhouse gases absorb heat from the sun in the atmosphere and reduce the amount of heat escaping into space. This extra heat has been found to be the primary cause of observed changes in the climate system over the 20<sup>th</sup> century’ (Rahman, 2013; Gao *et al.*, 2022).

The majority of studies defined climate change as changes in meteorological parameters, such as irregular seasonal patterns, more extreme and frequent weather events, higher variability in temperature and precipitation patterns, or an increase in sea level. (Apata *et al.*, 2009; Barnett, 2001; Deressa *et al.*, 2011; Mertz *et al.*, 2009; Schad *et al.*, 2012; Vedwan and Rhoades, 2001; Le Dang *et al.*, 2013). Climate change also may be described as any perceived change in overall climate, temperature, precipitation, rainfall, typhoon, drought, and/or floods by the farmers (Gao *et al.*, 2022).

## **2.2 Factors causing climate change:**

### **2.2.1 Greenhouse Gases:**

The primary driver of climate change, commonly known as the greenhouse effect, is believed to be greenhouse gases. They have high efficacy in retaining heat inside the atmosphere, thereby leading to the greenhouse effect. The earth's surface absorbs solar energy and then emits it back to the atmosphere as heat. Subsequently, as thermal energy is radiated into outer space, greenhouse gases selectively capture a portion of this energy. Subsequently, the heat is emitted by them either towards the Earth's surface, another molecule of greenhouse gas, or into space (The Greenhouse Effect). Scientists are primarily concerned about the release of CO<sub>2</sub>, as it accounts for around 75% of the total world emission of greenhouse gases. In the study "Methane leakage from evolving petroleum systems: Masses, rates and inferences for climate feedback" by L.A. Berbesi *et al.*, it is stated that the current warming trend is caused by a yearly rise in the levels of methane and CO<sub>2</sub> in the atmosphere (Berbesi *et al.*, 2014).

### **2.2.2 Nature Contributions:**

Volcanoes indeed contribute to climate change through the release of carbon dioxide (CO<sub>2</sub>). Nevertheless, the quantity of CO<sub>2</sub> they discharge is rather insignificant when compared to the volume of CO<sub>2</sub> being emitted by human activities. According to the NASA, the average annual emission of CO<sub>2</sub> from volcanoes ranges from 130 to 230 million tons. Nevertheless, through the combustion of fossil fuels, individuals emit an excessive amount of over 100 times, or 26 billion tons, of carbon dioxide (CO<sub>2</sub>) into the Earth's atmosphere annually (Kaddo, 2016).

### **2.2.3 Human Contributions:**

Scientists claimed that human activities have a significant contribution to climate change due to our reliance on fossil fuels for meeting our energy requirements. The combustion of fossil fuels is a significant driver of climate change, leading to the release of greenhouse gases such as carbon dioxide (CO<sub>2</sub>), methane, and other gases into the atmosphere. As per the Australian Greenhouse Office, around 80% of the world's energy requirements are met by fossil fuels, including oil, coal, and natural gas. Consequently, the heavy reliance on fossil fuels poses significant challenges in transitioning to alternative energy sources. The emission of greenhouse gases has experienced a significant surge since the industrial revolution, primarily due to the

combustion of fossil fuels for energy, agriculture, industrial processes, and transportation (Ecological Impacts of Climate Change) (Kaddo, 2016).

### **2.3 Effects of climate change:**

Significant effects of climate change are anticipated for the global economy and in general, for a wide range of human endeavors. Any discussion of mitigation or adaptation strategies must begin with an estimate of the effects of climate change. Policymakers must understand the cost of inaction and how the cost of mitigation strategies compares to the benefit of acting in order to determine whether action is necessary and to set the target. Among many of the effects of climate change, the significant consequences of climate change are:

#### ***2.3.1 Global warming:***

An estimated 0.7°C has already been added to the temperature since pre-industrial levels. The extent to which temperature rises are caused by anthropogenic greenhouse gas emissions is still up for debate. On the other hand, the most recent research in this field, as reported in the Intergovernmental Panel on Climate Change's 2007 report, indicates that human activity is responsible for over 90% of the observed increase in global average temperatures since the mid-20<sup>th</sup> century (Jamet and Corfee-Morlot, 2009).

#### ***2.3.2 Ozone layer depletion:***

Ozone layer depletion refers to a gradual and consistent decrease of approximately 4% per decade in the overall amount of ozone in the Earth's stratosphere, specifically in the ozone layer, since the late 1970s. This decline is projected to have health consequences, such as an increased risk of various types of cancer, as well as contribute to the occurrence of extreme weather events like desertification and drought (Rahman, 2013).

#### ***2.3.3 An increase in natural disasters:***

Climate change affects precipitation patterns, storm frequency and severity, and the frequency and intensity of droughts and floods in addition to global warming. Furthermore, two of the main irreversible risks associated with climate change are thought to be the widespread melting of the Greenland and West Antarctic ice sheets, which would imply a significant rise in sea level, and changes in the thermohaline circulation (THC)<sup>3</sup>, the global circulation of the oceans driven by density (Kaddo, 2016).

#### **2.3.4 Health hazards:**

The decline in health is one of the most significant effects of climate change that is anticipated. Given that estimations are not entirely complete, its size might be underestimated. Only a few diseases' worth of additional deaths has been estimated in relation to rising temperatures (malaria, cardiovascular mortality linked to heat and cold, and respiratory mortality connected to heat). Furthermore, little is known about how climate change may indirectly affect health through changes in air quality, food availability, water availability, or conflicts brought on by these changes (Jamet and Corfee-Morlot, 2009).

#### **2.3.5 Sea level rise:**

Significant Sea level rise and catastrophic occurrences that affect migration and the capital stock are potential consequences of climate change. Greenland saw an annual ice loss of 150 km<sup>3</sup> to 250 km<sup>3</sup> from 2002 to 2006, while Antarctica lost approximately 152 km<sup>3</sup> of ice between 2002 and 2005. However, this is contributing to the subsequent issue of sea level rise (Rahman, 2013).

#### **2.3.6 Damage of infrastructure:**

Infrastructure damage is predicted as a result of climate change; however, adaptation measures can partially mitigate this impact.

#### **2.3.7 Loss of biodiversity:**

The environment and biodiversity would suffer from climate change as well, though these consequences are not yet fully understood.

#### **2.3.8 Effects in agriculture:**

The precise manifestation of the influence of climate change on agriculture remains ambiguous, particularly in the case of modest temperature rises. The primary challenges in assessing this impact stem from inadequate understanding of the correlation between climate change and precipitation. Moreover, there are ongoing discussions regarding the occurrence of CO<sub>2</sub> fertilization. This refers to the idea that higher levels of CO<sub>2</sub> in the atmosphere can stimulate photosynthesis, leading to increased plant growth and improved carbon absorption. This phenomenon has the potential to alleviate or even counterbalance the adverse effects of climate change in the agriculture and forestry industries. Notwithstanding these limitations, projections indicate that climate change would decrease overall agricultural output in the majority of countries (for Central and Eastern Europe and certain Asian countries) if no adaptation measures are taken.

However, the negative effects could be mitigated through adaptation efforts (Jamet and Corfee-Morlot, 2009).

### **2.3.9 Ocean Acidification and Warming Oceans:**

Since 1750, the Earth's oceans have experienced a continuous rise in CO<sub>2</sub> levels, with an annual increase of approximately 2 billion tons. This rise has resulted in a 30% increase in ocean acidity. However, the uppermost 700 m (about 2300 ft) of the ocean has experienced a temperature increase of 0.16 °C since 1969, primarily as a result of absorbing additional heat from the Earth. These two alterations are highly likely to result in significant upheaval or devastation in marine habitats (Rahman, 2013).

### **2.3.10 Change in energy consumption and the availability of water resources:**

Climate change has the potential to either raise or lower energy consumption and the availability of water resources, as well as the demand for them. The impact is anticipated to exhibit a significant regional dependency, with warmer regions seeing a more pronounced negative effect compared to cooler parts (Jamet and Corfee-Morlot, 2009).

## **2.4 Effects of climate change in Bangladesh:**

It is a fact that climate change is occurring, and it is predicted to have a major effect on Bangladesh's economy by increasing the frequency of extreme weather events like floods and droughts as well as altering patterns of rainfall. Because Bangladesh's agriculture depends so heavily on natural water supplies, it is especially vulnerable to additional climate change. Therefore, in order to lessen these adverse effects of climate change, appropriate adaptation techniques are crucial (Abid *et al.*, 2015).

According to the Intergovernmental Panel on Climate Change (IPCC), extreme weather events that cause flooding, severe water shortages, and temperature swings will continue to affect developing nations like Bangladesh in the ensuing decades. The two most urgent expected effects of climate change are weather variability and sea level rise, with estimates of a 0.6 °C shift in global temperature, a 2% to 3% increase in precipitation in tropical latitudes, and a 3% drop in precipitation in subtropical regions by the 20<sup>th</sup> century. Global temperatures are expected to rise by 1.4 °C to 5.8 °C by the end of the twenty-first century, according to scenarios. Sea level rose by 10 to 25 millimeters during the 20<sup>th</sup> century, and forecasts indicate that it will increase by another 20 to 90 centimeters over the 21<sup>st</sup> century. In a similar vein, empirical models predicting an extension and intensification of precipitation periods, particularly in the Indian/South Asian subsystem of the Asian-Australian Monsoon, which were

mentioned in the latest IPCC report. Not only are land areas becoming inundated due to rising sea levels and greater precipitation a concerning consequence of global climate change, but drought occurrences have also been noted in the literature that the IPCC evaluated and reported on. Roughly 2.7 million hectares of land in Bangladesh alone were at risk of yearly drought in the last decades of the 20<sup>th</sup> century, with a 10% chance that 41%–50% of the nation would experience drought in any given year. These numbers are expected to rise in terms of both the geographic scope and the intensity of events. The Indian/South Asian summer monsoon subsystem is known to have undergone abrupt shifts, giving rise to prolonged and intense droughts, which is crucial information for this study. The 2013 IPCC report presents key findings from its investigations about the South Asian region under global climate change models: “normal” monsoon seasons are viewed as less frequent, resulting in uncertainty about the extremes that the region would experience (Uddin, Bokelmann, and Entsminger, 2014).

Climate change predictions might have a serious impact on nations that rely heavily on agriculture for their livelihoods, leading to food shortages among other issues. Thus, a range of adaptation techniques will be needed by those whose livelihoods depend on farming in order to lessen the adverse consequences of climate change and preserve agricultural families’ means of subsistence. To meet the targets of the Millennium Development Goals, various contemporary technologies have been created and implemented at the farm level. Using heat and drought resistant cultivars and scheduling planting adjustments are two specific adaptation tactics to the effects of climate change. New cultivars have also been chosen and implemented for the same goals. Other climate change adaptation tactics that farms have implemented include increased irrigation, fertilizer use, conservation of soil and water, and diversification into non-farm industries (Uddin, Bokelmann, and Entsminger, 2014).

It seems unlikely that climate change impacts will lessen in the future, despite numerous efforts at the international, national, and local levels (IPCC 2014). Planning and adaptation to climate change benefit greatly from an awareness of the implications as well as the perspectives of farmers and townspeople (Deressa *et al.*, 2011). Engaging farmers in the process of identifying and comprehending the factors that influence adaptation to climate change at the local level is crucial. This can help the decision-makers to grasp local climate issues and ensure that appropriate policy interventions are made (Kabir, Roy and Hossain, 2021).

## **2.5 Impacts of climate change in agricultural sector of Bangladesh:**

Due to its geographical location, Bangladesh is thought to be among the nations, most susceptible to the effects of climate change and environmental degradation. The base productivity of agricultural activities is impacted by these changes in average temperature and precipitation, which also affects the risk management strategies and yield expectations that farmers face. In addition, the area is frequently hit by climate related natural disasters. From 1974 to 2007, Bangladesh was afflicted by roughly 174 occurrences including cyclones, floods, and droughts. These natural catastrophes have negatively impacted agriculture and its output in ways that have also had a significant negative impact on farming operations and the whole national economy. As an illustration, cyclones affect Bangladesh roughly every three years, severely harming the nation's people, infrastructure, and crops. Cyclones killed 500,000 people in 1970 and 140,000 in 1991. The government of Bangladesh estimated that Cyclone Sidr had caused significant destruction and loss to the nation's assets, infrastructure, and productivity. Specifically, the agricultural sector suffered losses valued at US \$438 million, or nearly 95% of the total losses to all sectors. Global climate change is expected to have an impact on the frequency and intensity of these climate-related natural disaster events, exacerbating the baseline effects on agricultural production that are predicted by global climate change models (Uddin, Bokelmann, and Entsminger, 2014).

According to the number of people who live in low-lying coastal areas, where farming and fishing is the main professions, Bangladesh has been listed as the third most vulnerable country in the world to the effects of rising sea levels. Bangladesh also ranks among the top ten countries in terms of the percentage of the population that lives in these areas. In 2001, 36.8 million people lived in Bangladesh's coastline region. Of the 6.85 million households, 71 percent are made up of agricultural laborer, small farmers, fishermen, and the impoverished in urban areas. Every year, there are severe floods, cyclones, and tornadoes; salinity and cold spells cause crop damage and fatalities. Experts claimed that these are early indications of the effects of global warming. Over 25 million people will become climate refugees in the next few decades due to sea level rise (Climate Change Cell, 2007). Bangladesh is among the most at-risk nations in the world for natural disasters, according to UNFCCC (2005) (Howlader and Akanda, 2015).

## **2.6 Perception of Climate Change and Types of Adaptation Strategies to Climate Change:**

The process of gathering and interpreting information from one's surroundings is referred to as perception. Farmers must first recognize that the climate is changing before identifying and putting into practice any helpful modifications. Perception is the first step towards adaptation to climate change. Howlader *et al.*, (2015), found that most of the same factors that affect farmers' perceptions also affect adaptation to climate change. Farmers who progressively learn about climate change will also gradually learn about the most effective ways to adapt to it. Three methods are available to farmers to learn about the best possibilities for adaptation: (1) learning by doing; (2) learning by copying; and (3) learning from instruction. Therefore, it is necessary to record farmers' perceptions of climate change since they are believed to have an impact on agricultural production performance relative to other factors. In order to address the needs of this significant group of stakeholders in the agricultural development system, it is necessary for this research to evaluate the farmers' opinions of the consequences of climate change on coastal agriculture (Howlader and Akanda, 2015).

The world's physical and social systems are able to adapt to climate change. These reactions could be planned adaptation techniques or inadvertent, spontaneous shifts. Adaptation is the process of controlling the risk that climatic variability and change has brought. Private and public sector adaptation strategies can be used to categorize climate change adaptation efforts. Actions made by non-state entities like farmers, communities, or organizations are referred to as private adaptation strategies. The private adaptation techniques are cropping rotation, crop calendar adjustments, irrigation system modifications, and cropping technology selections etc. (Bruin, 2011). Governments of all stripes can participate in public adaptation by setting up organizations and infrastructure to lessen the adverse consequences of climate change. The development of additional irrigation infrastructure, transportation or storage facilities, land use planning, and property rights are a few examples of public adaptation measures (Mahaarcha, 2019).

In the community, adaptation might take the form of shared information and cooperative action, or it can happen at the individual level through a shift in behavior. "Household level behavior that aim to avoid the physical and financial impacts imposed by climate exacerbated hazards" is the definition of adaptation at the individual/household level (Wilson *et al.*, 2020). A vast amount of empirical research

on the adoption of sustainable intensification practices in sub-Saharan Africa, has focused on understanding the determinants of a shift in practice, for example, the adoption of an innovative farm practice. Farmers' successful adoption of new practices can be influenced by a number of factors, including as the unique qualities of their farms and the practice's attribute (Amadou *et al.*, 2022).

Adaption tactics can be either proactive or reactive. While proactive adaptation methods are implemented in advance of climate change, reactive adaptation techniques deal with the effects of climate change after they have already occurred. Controlling soil erosion, building irrigation dams, enhancing soil fertility, using superior cultivars, and adjusting planting and harvesting dates are examples of reactive adaptation techniques. The creation of resistant cultivars, scientific advancement, tax and incentive legislation, and research are examples of proactive adaptation tactics (Bryan *et al.*, 2009).

It is often acknowledged that the two main obstacles to adaptation are socioeconomic considerations and resource limitations (Bryan *et al.*, 2009; Deressa *et al.*, 2009; Francisco *et al.*, 2011). According to Bryan *et al.*, (2009), these obstacles include a lack of access to credit, land, and information; financial constraints and a lack of knowledge about adaptive measures and timely information on extreme climate events. Thus, it is suggested that increased access to technology, agricultural assets, markets, loans, extension, and farmland can improve farmers' ability to adapt. The degree of belief in climate variability, risk perception and perceived adaptive capacity, spiritual dimensions like denial, wishful thinking, and fatalism and personal perceived risk are just a few examples of the cognitive and psychological barriers to adaptation. Regarding the cognitive and informational obstacles to adaptation, there are four points of view (IPCC 2007). First, because of social and personal beliefs, experiences, and other contextual elements, people's interpretations of information are more significant in the adaptation process than the material itself. Second, variables including risk experience, trade-offs between risks, and confidence in others impact perceptions of the risks associated with climatic variability and adaptive responses. Third, the true constraints are oftentimes perceptions of vulnerability and adaptability rather than actual ones. Finally, adaptive action is not motivated by appealing to guilt and dread. These obstacles may lead to either maladaptive or adaptive behavior (IPCC 2007). Maladaptation can take two forms: incorrect adaptation that inadvertently exacerbates

the harm caused by climate variability, or avoidant responses (wishful thinking, denial, or fatalism) (Grothmann and Patt 2005). While there have been indications of cognitive and psychological hurdles, there is still a lack of attention of these elements as factors that influence the adaptation process. Seldom has the integration of socio-economic and psychological obstacles to farmers' adaptation been explored, especially in the setting of Southeast Asia (Le-Dang *et al.*, 2013).

### **2.7 Factors related to the social and demographic characteristics for perception of climate change and adaptation strategies towards climate change:**

Considering the growing threats of climate change, in addition to mitigation strategies, it is highly and equally critical to understand the socio-demographic determinants of climate adaptation in order to develop climate adaptation policies. Farmers adopt these adaptations mostly autonomously rather than on the advice of government. In Kabir, Roy, and Hossain's questionnaire survey from 2021, half of the respondents (n = 60, 50%) were between the ages of 31 and 50, and the majority (53.33%) had less than 21 years of farming experience. About 63% of people made farming their primary occupation, with half (50.83%) being full-time farmers. 35% of the respondents were small farmers, while 43.33% of the respondents were marginal farmers. The respondents' average annual income ranged from BDT (Bangladeshi taka) 102,733 ± 39,595 while their average monthly expenses ranged from BDT 3,001 to 9,000 (about 70%, n=84). Nearly 37% of the respondents (n=44) had loans from local community-based organizations, NGOs, and banks (Kabir, Roy and Hossain,2021).

Mahaarcha, (2019) conducted a study in kanchangiri, a large province located in the western part of Thailand. In this study he investigated the factors influencing farmers adaptation strategies to climate change. sample size was 364. The sample had a mean age of 51 years and that there were more women than men. Approximately 85% of them were married, and the sample's average years of education were 6.7 years, or roughly how long it takes to complete basic school. Four persons lived in each household on average. Heads of households made up two thirds of the sample. The average household income each month was 12765 bath (about 365 US dollars), and over 83% of the sample had access to financing from outside their homes to explore opportunities in agricultural labor. Over 80% of the samples had agricultural land, with an average household having 8.4 acres of land for agriculture. The average number of years spent working in

agriculture was 26. Agricultural agents were contacted by over 75% of the farmers (Mahaarcha, 2019).

According to Gao et al. (2022), the following ten elements have a major impact on farmers' adaptations: the farmer's age and gender; non-agricultural income; training; financing availability; policy demand; and perceived changes in climate change events. The average age of responders was between 46 and 65, and 86% of participants were farmers who were men. In addition, the average educational attainment of the 73% of respondents who were household heads fell between primary and junior high school. The respondents' average farming experience was found to be between six and fifteen years. One to six people lived in each family on average, and 67% of revenue was derived from agricultural sources. The respondent has been residing in the neighborhood for an average of 16 to 20 years. Most farmers raised cash crops and made two- or three-monthly trips to the market. 42% of respondents in the sample as a whole purchased crop insurance to cover losses from extreme weather events. Regarding the formulation of policies, 95% of farmers requested that the government provide them with any kind of education, direction, and/or awareness campaign about climate change and potential solutions. This shows how dependent they are on government regulations. Of the farmers, 39% had access to loans, and 52% were connected to various farming communities (Gao *et al.*, 2022).

Abid *et al.*, 2015 conducted a study in Punjab province, Pakistan, collected data from 450 households of three districts in three agroecological zones to gather information on socioeconomic characteristics. Average years of experience was 24 (Abid *et al.*, 2015). The following socio-demographic factors were substantially correlated with self-reported adaptation: age, education, family size, farm size, family income, and participation in cooperatives. The responder group ranked lack of water availability, lack of cultivable land, and unpredictable weather as their top obstacles to dealing with the effects of environmental degradation and change, despite the availability of various forms of support and technological interventions (Uddin, Bokelmann, and Entsminger, 2014).

In order to determine the relationship between the independent variables (farmers' characteristics) and the dependent variables (farmers' perception), Akanda and Howlader, (2015) conducted a study, includes 101 people as the sample size. Among them, Sixty-nine percent of the respondents had little or no education. The majority, or 72.30 percent, were between the ages of 35 and 65, and 66.3% had between 20 and 45

years of farming experience. Seventy-nine percent of farmers had medium to marginal farms, and seventy-seven percent had poor incomes. Of the respondents, about 27.70 percent had no prior training experience. The majority of respondents had low to medium exposure to communication and low to medium organizational participation, respectively, at 56.43 % and 73.25 %. The majority of farmers 72.28 percent have fatalistic attitudes (Howlader and Akanda, 2015).

Study done by Ugwoke *et al.*, (2012), where one hundred twenty (120) crop farmers were chosen. The majority of respondents, (33.33%), were between the ages of 41 and 50 years old, while 31.67% were older than 50 years old. The average age of a farmer was 44.2 years old. There were more girls than males among the responders (56.67%). On an average, more women in the state were engaged in farming activities than males. The bulk of the respondents were married (66.67%). A bigger proportion of the respondents had completed secondary schooling (35%) compared to the number who had completed primary schooling (33.33%). The majority of farmers, thirty percent, had farming experience ranging from six to ten years, while twenty-one-point six seven percent of farmers had farming experience ranging from eleven to fifteen years. The average amount of time spent in farming was approximately 13 years, which suggests that many of the farmers had been in the industry for a sufficient amount of time to witness how climate change affects farming. Sixty percent of the total, had household sizes ranging from five to eight people, while the average household size was six people. Additionally, the vast majority of farmers, or 96.67 percent of them, were members of some kind of social organization. The implication of this was that the agricultural organizations may provide the farmers with information regarding the effects of climate change (Ugwoke *et al.*,2012).

Tiyo, Orach-Meza and Edroma, (2015), analyzed small-scale farmers perceptions and impacts of climate change on agricultural production and livelihoods and adaptation options to tackle the adverse effects of climatic changes. Information gathered from 607 families, of which 41.5 percent were male and 58.5 percent were female. Compared to their female colleagues, male farmers were more likely to adapt to climate change. This may be explained by the male-dominated societies, where men were given preference when it comes to land ownership, credit availability, loans, and agricultural inputs including fertilizers, agrochemicals, and extension services (Tiyo, Orach-Meza and Edroma, 2015).

Another study found that, how arable crop farmers in Ondo State, Nigeria, perceived and respond to climate change. One hundred and twenty-eight respondents were chosen for the study by using a multi-stage sampling procedure. According to the respondents' socioeconomic characteristics, the mean age was 42.6 years, the proportion of male respondents was 65.3%, the proportion of married respondents was 52.4%, the average household size was 7.0 people, and 50.5% of respondents had only completed primary school (Ibidapo *et al.*, 2018).

In order to evaluate smallholder farmers' perceptions, adaptation constraints, and determinants of adaptive capacity to climate change, Pickson and He, (2021) conducted a study in Chengdu, China, with 383 farmers to find out about their personal, social, and economic characteristics. According to the results, 70.5% participants were men and 29.5% were women. Chengdu's smallholder farmers were, on average, 54 years old, according to the report. The minimum and maximum ages were 23 and 78, respectively, 46.7% of respondents had completed elementary school, while 40.5% had completed junior high school. Four people made up the average household size of the farmers questioned. Out of the 383 rice farmers in the study, (1.3%) on average said they received assistance and services from agricultural extension agents (Pickson and He,2021).

The socio-demographic features of the sample households in terms of sex, age, household size, and education are reported by Likinaw, Bewket, and Alemayehu in 2022. The households' ages ranged from 18 to 76 years old, with an average age of 43. Five people lived in an average household, which was the same as the national average. According to data on education, the percentage of households with no literacy in primary (grades 1–8), secondary (grades 9–12), and college was 43%, 45%, 11%, and 1% (Likinaw, Bewket and Alemayehu, 2022).

In 2019, Hasan and Kumar conducted research on the impacts of farmers' perceptions of climate change on their adaptation strategies. Survey conducted among 118 randomly selected farmers in Bangladesh's Kalapara subdistrict. Middle-aged groups made up the majority of respondent farmers. Most of the farmers were educated up to the primary and secondary levels. The average dependency ratio ( $M = 2.5$ ) showed that each household's earning members supported more than two non-earning members who were unemployed or unable to find employment. The primary agricultural activities of more than three-quarters (78%) of the families were crop cultivation (rice, wheat,

maize, soybean, watermelon, and sunflower), with the remaining households engaged in vegetable growing, cattle keeping, fisheries, and poultry rearing (Hasan and Kumar, 2019).

Acquah, (2011), found that, among 95 participants, 82.1% of the respondents were men, and the remaining 17.9% were women. Of those surveyed, 23.2% were between the ages of 24 and 30; 45.3% were between the ages of 31 and 40; 21.1% were between the ages of 41 and 50; 8.4% were between the ages of 51 and 60; and 2.1% were between the ages of 61 and 70. 35.8% of the individuals who were interviewed did not lead their family, whereas 64.2% of them did. About 23.2% of respondents had no formal education, 12.6% had completed their middle/JHS or basic education, 17.9% had completed their O'level or senior high school, and 33.7% had completed their university education. Regarding the size of their households, 41.1% of the respondents had those that varied from 1 to 5, 43.2% from 6 to 10, 12.6% from 11 to 15, 2.1% from 16 to 20, and 1.1% from 21 to 25. Twenty percent of them had three to ten years of experience farming, 47.4% had eleven to twenty years, 20% had twenty to thirty years, 7.4% had thirty to forty years, and 5.3% had forty to fifty years. The majority of respondents (55.8%) had farmland that was between one and five acres, followed by 36.8% with six to ten acres, 3.2% with eleven to fifteen acres, 3.2% with sixteen to twenty acres, and 1.1% with twenty to twenty-five acres. While 35.8% of the respondents' only source of income was farming, typically done at a subsistence level, 64.2% of the respondents engaged in other revenue-generating activities (Acquah, 2011).

According to Singh's 2020 study, the socioeconomic characteristics of the sample families demonstrate how less developed the area is relative to the national average. In comparison to the national average, the literacy rates of Jalaun and Jhansi were somewhat lower, at 50.24% and 49.76%, respectively. The unemployment rate among all workers was close to 50%. In addition, the household's mean yearly income was modest and inconsistent. In comparison to the national average of 1.18 ha, the mean land size of farm-households in these two districts was likewise small, at 0.26 ha and 0.35 ha, respectively. Scheduled castes and tribes are backward social groupings in India, making up around 15% of the population. Moreover, 20% of Jhansi families and 35% of Jalaun households lacked an electricity connection. About 50% and 40% of the sample population's homes lacked drinking and sanitary amenities. The percentage of

people living in extreme poverty was close to 30%. All things considered; the findings demonstrated that most sample households lack basic facilities (Singh, 2020).

The farmers who were interviewed ranged in age from 35 to 70 years old, with an average age of 52 ( $\pm 16$ ). The majority of farmers (58%) had never attended school, followed by those with only a primary or literacy education (29%) and a secondary education (10%). 5.9 ( $\pm 3.2$ ) ha of farmland were endowed, with grains (maize, sorghum, and millet) accounting for 71% of the total. Rainfed farming was the primary occupation of farmers, who frequently supplemented it with animal husbandry (60 percent). In the Guinean zone, which includes the southern regions of Benin (81%), Ghana (83%), and Togo (20%), maize was the only crop grown (not indicated). In the Sudanian regions, farmers who farmed maize also farmed sorghum (10–26% in Benin, Burkina Faso, Ghana, and Togo). Some farmers in Sudanian areas (northern portions of Benin 20% and Togo 32%, and southern sections of Burkina Faso 16% and Niger 31%) also grew maize, sorghum, and millet together (although on separate plots). No farmer in this area said they just grew sorghum. The Sahelian zone, which includes Burkina and Niger, as well as the Sudanian countries of Burkina Faso, Niger, and Togo, are the primary locations for millet cultivation, whether it is cultivated alone or in conjunction with sorghum (Akponikpe, Johnston and Agbossou, 2010).

## **2.8 Factors Affecting farmers Perception and Adaptation Strategies:**

Adaptation serves as a means to diminish susceptibility, enhance resilience, mitigate the threat of climate consequences on individuals and their means of living, and capitalise on prospects presented by current or anticipated climate change. In light of this context, the present study aims to investigate farmers' perspective of and response to climate change. The paper aims to examine the socio-economic characteristics of the respondents, assess farmers' perception of climate change, identify the adaptation measures chosen by farmers in response to climate change, determine the barriers to implementing these measures, and assess farmers' willingness to pay for climate change mitigation policies (Acquah, 2011).

In 2019, Mahaarcha reported that, the likelihood of farmer respondents adapting adaptation techniques to the consequences of climate change was higher for those who were younger, had a greater level of education, had larger households, had access to financing, had smaller land areas, and had contact with agricultural extension agents (Mahaarcha, 2019).

According to Obayelu *et al.*, (2014), age, gender, years of education, years of farming experience, household size, farmers' knowledge of climate change, access to credit, farm income, non-farm income, ownership of livestock, and contact with agricultural extension agents were among the factors that explain farmers' choice of climate change adaptation (Obayelu *et al.*, 2014).

Abid *et al.*, (2015), conducted a study in Punjab province, Pakistan, revealed that farmers' decisions for adaptation methods were influenced by a variety of factors, including education, farming experience, household size, land acreage, tenancy status, ownership of a tube well, access to market information, weather forecasting information, and agricultural extension services. The study had also shown that a number of issues, including a lack of knowledge, financial resources, availability of irrigation water in the study area, and resource limits, limit adaptation to climate change. (Abid *et al.*, 2015).

According to Dhaka *et al.*, (2010), there was a positive and significant correlation between farmer perceptions of climate change and age, farming experience, innovativeness, environmental consciousness, and exposure to mass media. The farmers with the most farming experience, as well as those who were creative, environmentally sensitive, and had access to the media, were probably in the best position to comment on whether or not climate change has occurred. The likelihood of adaption was also significantly increased by the respondent's educational attainment (Dhaka, Chayal and Poonia, 2010).

Lack of funding and timely information were identified by Shi-yan *et al.*, (2018) as the primary obstacles preventing farmers from adopting adaption methods. Gender, age, experience in agriculture, education level, land ownership, knowledge of crop variety and climate change causes, and belief in climate change were all factors that influenced farmers' adaptation strategies. All of these factors were positively correlated with the likelihood of using adaptive strategies. Furthermore, the proportion of households involved in agriculture as well as the number of years of farming were found to be negatively connected with the chance that farmers would apply adaptation techniques. (Shi-yan *et al.*, 2018).

Farmers' adaptation behavior was found to be significantly influenced by factors such as education, their level of climate-related knowledge, their membership in farmers' organizations, and the size of their plots. The frequency of market visits, the amount of cropland, and the revenue from sources other than farming also had an impact on

Chinese farmers' ability to adapt. Agribusiness training, landforms, farmers' technical, financial, and physical assistance, market distance, descriptive norms and efficacy beliefs, and water usage are other elements that impact the adoption of adaptation solutions (Gao *et al.*, 2022).

According to Uddin, Bokelmann, and Entsminger (2014), farmers' climate change adaptation tactics were adversely and strongly (at a 10% level) linked with age. This showed that adaptability decreased with respondent farmer age. Education was positively and significantly related to climate change adaptation methods. This showed that educated farmers were more likely to adapt to climate change than illiterate farmers. Better educated farmers were more knowledgeable, better able to understand and react to changes, better able to predict future conditions, and had more opportunities and information, which helped them adapt to climate change. Education has positively and drastically affected technology adoption. Family size adversely and strongly correlates with farmers' climate change adaptation methods. This negative indicator suggested that farmers' adaptability declines with family size (Uddin, Bokelmann, and Entsminger, 2014).

Age was an important factor in climate change adaptation, according to logistic regression. In the study, 68.6% of respondents were 30-to-60 years old, 17.8% were younger than 30, and 13.6% were older than 60. 65.3 percent were men. Gender of household head impacts the household's ability to create revenue and access assets like land and capital, which has affected agricultural productivity. Marriage was reported by 62.4% of respondents. Widowers made up 16.4%, singles 14.8%, and divorcees 6.4%. The study found that the average household size was greater than the national average, with  $7\pm 2$  people per home. Educational attainment, a factor in economic activity and decision-making, showed that 50.5 percent had primary education and 35.3 percent had secondary education. No formal education and tertiary education make up 10.5% and 3.7%, respectively (Ibidapo *et al.*, 2018).

Principal component analysis showed that smallholder farmers' ability to respond to climate change is significantly influenced by economic resources, physical resources, information, human resources, and technology. These findings were based on a cross-sectional survey of 383 sampled farming households on the outskirts of Chengdu, China. Unpredictable weather, small farms with limited space, a lack of timely weather

information, insufficient labor, restricted access to water resources, low soil fertility, expensive farm inputs, restricted market access, credit facilities scarcity, restricted access to agricultural extension services, and a dearth of farming subsidies were some of the major obstacles preventing smallholder farmers in the study area from adapting to climate change (Pickson and He ,2021).

According to the research done by Deressa, Hassan, and Ringler (2010), social capital, affluence, age of the head of the household, and agro-ecological contexts all had a substantial impact on farmers' perceptions of climate change. The degree of education of the head of the household, the size of the household, the gender of the head of the household, the ownership of livestock, the use of extension services for crop and livestock production, the availability of credit, and the temperature of the surrounding environment were all factors that had a significant impact on the ability to adapt to climate change (Deressa, Hassan and Ringler, 2010).

Sani and Chalchisa, (2016) stated that different nations, areas, and households had different preferences when it came to adaptation options. The majority of the empirical evidence at the household level showed that the most significant factors influencing farmers' decisions regarding climate change adaptation and choice of adaptation strategies were age, gender of the household head, years of formal education, farming experience, size of the household, access to credit facilities, distance from market, availability of extension services, and availability of off-farm income generating activities (Sani and Chalchisa, 2016).

According to Singh, (2020), four categories of factors related to adaptation were as follows: biophysical, social, economic, and extension services. For example, biophysical (heat and precipitation), social (land area and education), economic (income, area under cultivation and APL), and extension services (land use finance, climatic data, and access to crop insurance). The primary obstacles to adapting to climate change were low cultivated area under irrigation, low livelihood status, and less non-farm employment alternatives. The primary drivers of change in farming practices among farmers were insurance and financing (Singh, 2020).

## **2.9 Farmers perception towards climate change:**

Mahaarcha, (2019) revealed that the majority of respondents reported having experienced increases in temperature (97.5%), decreases in rainfall (90.3%), shorter

winter seasons (94.8%), longer summer seasons (96.8%), increases in drought (71.5%), decreases in flooding (73%), decreases in storming (41%), and decreases in monsoon season (89.5%). It is evident that the majority of them stated that they had encountered changes in the climate, particularly drought, which are probably going to have a detrimental effect on farming (Mahaarcha, 2019).

Abid *et al.*, (2015) conducted a study in Punjab province, the findings showed that there was a general awareness of climate change in the region. Many farmers reported feeling that the summer (56.9%) and winter (39.3%) temperatures had slightly increased. Regarding the patterns of precipitation, a greater proportion of farmers (44 %) observed a minor drop in precipitation throughout the summer (48.9%) and winter (48.9%) seasons than those who sensed no change or a large shift during either season. While the majority of farmers surveyed (57.1%) saw no change in the length of the growing season, 52.2 percent felt that the rabi season's growing season had lengthened (Abid *et al.*, 2015).

Dhaka *et al.* (2010) conducted a study to find out how well farmers were able to perceive climate change and how they had adapted to it. The study's foundation was interviews with 500 farmers in India's Bundi area. According to the report, a sizable portion of farmers (393 out of 500) thought that the monsoon had already arrived late and was ending early, that temperatures had already risen, and that extended dry spells had occurred mentioned by 312 farmers. In addition to an overall increase in temperature, the majority of farmers felt that there had been a notable shift in the distribution of temperatures. Most of the farmers thought that there had been less rainfall. Comparably, the general impression of changes in precipitation is that the area is becoming drier and that there have been noticeable shifts in the frequency and timing of droughts, as well as changes in the timing of rainstorms, and that the rain behaves erratically and in uneven ways (Dhaka, Chayal and Poonia, 2010).

Shi-yan *et al.*, (2018) done a study based on an extensive survey of 1500 farmers and their households in Henan Province in China. According to the survey results, almost 57% of the participants felt that there had been a direct influence of climate change during the previous ten years, while 31.4% were unsure and 11.4% had no perception of it. Furthermore, 70.3% of the participants thought that there was a risk to their livelihood due to climate change. The respondents reported experiencing natural

disasters, extreme weather occurrences, and variations in the timing and distribution of rainfall, among other changes in rainfall variability. 54.5% of respondents claimed that the average temperature was rising and that the freezing phenomena had all but vanished in the winter, while 58.1% of respondents reported less precipitation. Most notably, a few respondents said that winter wheat had later start dates for germination, dormancy, and sowing (Shi-yan *et al.*, 2018).

According to Gao *et al.*, (2022), through a field survey of 200 farmers, the majority of farmers reported changes in rainfall (82%), precipitation (84%), flooding patterns (91%), and overall climate (53%), over the past ten years, according to the findings. Of the sample as a whole, 86% of farmers indicated that various climate change events had negatively impacted their crops, while 14% said they had suffered no harm. The majority of the damage was caused by increased flooding (69%), which was followed by increasing rainfall (52%), typhoons (36%), and heat waves (26%). These answers highlighted the challenges that climate change poses to agriculture in the research region (Gao *et al.*, 2022).

On the basis of a case study of coastal Bangladesh consisting of three villages in the coastal Sathkhira district. One hundred (100) farmers took part in the survey conducted for the study. Approximately 88% of participants stated that they believed they have witnessed climate change in the previous 20 years. They had seen temperature rises, cyclones, flooding, droughts, and saline soil. At least 80% of the events reported experiencing climatic alterations, which were probably going to negatively affect agricultural activity (Uddin, Bokelmann, and Entsminger, 2014).

In order to determine the relationship between the characteristics of the farmers and their perception of the effects of climate change on coastal agriculture, Akanda and Howlader (2015) conducted a study, farmers' perception scored ranged from 50 to 88 out of 100. Majority of farmers (80.20 percent) had poor to medium perceptions, while 19.80 percent had strong perceptions. The study revealed that certain participants possessed a comprehensive comprehension of how climate change impacts their daily lives and means of subsistence. According to the perceived frequency/Index, the perceived aspects included rising temperatures, more crop diseases, longer summers, more insect infestations, unforeseen rainfall, a lack of water during the winter that hinders fish production, an increase in poultry diseases, a lack of fish, reduced soil fertility, saline water intrusion from increased tidal flow, climate change brought on by

deforestation, industrial CO<sub>2</sub> emissions that cause global warming, etc. (Howlader and Akanda, 2015).

As per Ugwoke et al., (2012), every farmer (100%) was aware of the alterations in the climate, and the majority (98.33%) witnessed the changes firsthand. Furthermore, a sizable fraction (48.33%) of farmers obtained information on climate change via their different social groups. The majority of farmers only obtained information from the Extension service (20.00%) and the mass media (31.67%). The inference was that farmers were not receiving adequate information about climate change from the Extension service or the mainstream media (Ugwoke *et al.*, 2012).

The majority of farmers (98.33%) reported significant changes in rainfall patterns as a result of climate change. Among other things, farmers believed that increasing flooding, drought, and decreased agricultural output were the worst consequences of climate change. While many farmers were aware of changes in sunlight (71.67%), temperature (58.33%), and wind (40%), the majority of farmers (75%) were also aware of changes in rainfall patterns. A larger percentage of farmers (45%) believed that climate change is occurring “to a large extent” and “to a little extent,” respectively, while very few (6.67% and 3.33%) believed that it is occurring “to a very small extent.” Increased flooding (85%), extreme heat (73.33%), decreased crop production (65.33%), increased soil erosion (66.67%), windstorms (64.17%), and insect and disease assault (51.67%) were perceived by the majority of them (Ugwoke *et al.*, 2012).

Tiyo, Orach-Meza and Edroma (2015), reported that, climate variability and change were already having a major effect on small-scale farmers’ agricultural productivity. 61.4% of them stated they had negative consequences, 19.1% said they had very negative effects, 18.9% said they were very mildly affected, and only 0.5% said they had no effect at all. For instance, 64.3% of families planted different kinds of crops, 71.3% utilized different planting dates, 61.5% adjusted their methods for conserving soil and water, 52.1% planted different crops, and 45.4% employed crops with shorter growing seasons (Tiyo, Orach-Meza and Edroma, 2015).

Ibidapo *et al.*, 2018 had find out how arable crop farmers in Ondo State, Nigeria, perceived and responded to climate change. One hundred and twenty-eight respondents were chosen for the study. About 56.8% of agricultural arable crop producers who had reported being aware of climate change (Ibidapo *et al.*, 2018).

Amadou *et al.*, (2022), compared farmers' perceptions of climate change with actual weather data recorded in the study region. Individual surveys and focus groups were used to identify the perceived effects of climate change on farmers and the agricultural adaptation strategies. Farmers were asked to expand on how the climate has changed historically and currently, paying particular attention to wind, temperature, and rainfall. A combination of open-ended and closed-ended questions were used at each focus group discussion level. Based on the research assistant's transcript for each group, the most common response to these questions was calculated, and the aggregated response, that is the most common response across the group was taken into consideration as the discussion's ultimate product. Farmers reported reduced rainfall, a shorter growing season, delayed and early rainfall termination, an increase in the frequency of dry spells, and a rise in the intensity of rainfall events as rainfall-related changes. Temperature reports indicated that it was getting hotter overall, at night, and throughout the growing season. There was also talk of winds becoming fiercer.

On the other hand, during face-to-face interview, the majority of farmers (more than 50%) felt that the growing season was getting shorter, there was less rainfall and there were more dry spells at the start of the season. Climate data study revealed an increase in the mean annual temperature and minimum growing season temperature and a decrease in total rainfall, which was consistent with farmers' perceptions (Amadou *et al.*, 2022).

Focus group discussion with farmers from seven different commodity groups, were done by Jemison *et al.*, in 2014. This initiative involved 199 participants in all. These imply that growers had a range of opinions regarding climate change, from rejection to acceptance and even acceptance to welcome. Due to early bud break and subsequent late frosts that damaged blooms that opened earlier than usual, many fruit growers lost a large portion of their crop. Growers of apples and blueberries, in particular, raised serious concerns about the shifting environmental circumstances. Compared to growers of other commodities, vegetable growers and consultants seemed to be more concerned about this issue. Numerous farmers mentioned constantly battling with the unpredictable weather (Jemison *et al.*, 2014).

Likinaw, Bewket, and Alemayehu (2022) employed a convergent mixed methods design. Quantitative data were collected from 352 households, and qualitative data was gathered through focus group discussions. The three districts in the South Gondar

Administration Zone of the Amhara National Regional State of Ethiopia—Lay Gayint, Tach Gayint, and Simada were included in the research area. The households perceived food insecurity, early termination of rainfall, delayed initiation of rainfall, and chronic drought as the most potentially harmful climate change concerns. The findings showed that most homes in the research area thought that the previous year's rainfall and temperature had dropped and increased, respectively. Households explicitly reported temperature and rainfall variability, an increase in minimum (nighttime) and maximum (daytime) temperatures, and a decrease in rainfall, based on the results of the FGDs. However, a disparity between household views and meteorological data was found. In several areas, there was a discernible upward trend in the annual rainfall. Potentially hazardous climate change hazards were most likely associated with extended droughts, delayed or early precipitation, and food insecurity as reported by households (Likinaw, Bewket and Alemayehu, 2022).

In another study, Kabir, Roy, and Hossain (2021), employed a combination of qualitative and quantitative methods to investigate farmers' perceptions of climate risks, factors influencing climate change, and their selections of adaptation strategies in six coastal districts of Bangladesh. According to the findings of survey 247 participants, the majority of farmers (n=74, 62%) knew what was meant by the term "climate change." Approximately 43% (n=51) of the farmers surveyed stated that they could use various natural cues (such as cloud color and direction, tidal height, and ant movement) to predict climate change-related disasters (such floods and storms) before they occurred. Farmers felt that over the previous 20 years, there had been an increase in temperature (88%), total annual rainfall (67%), cyclone frequency (79%), storm surge frequency (59%), and frequency of floods (59%), according to the poll. A little over 71%, 83%, 67%, and 78% of respondents, respectively, thought they could adjust to changes in rainfall, temperature, cyclones, storm surges, and flooding. Regarding the number of droughts over the preceding two decades, the study similarly revealed a contradictory opinion (increased=40%, decreased=43%); yet, nearly half of the respondents (51%) observed a rising temporal extension of waterlogged circumstances during the same period (Kabir, Roy and Hossain,2021).

Le Dang et al., (2013) examined six in-depth interviews with one female and five male agricultural officers in Vietnam's Mekong Delta and three focus groups with thirty male farmers. Study results found that farmers described anomalous temperature rises and fluctuations as a change in temperature distribution and an increase in annual mean and

dry season temperatures. Heat was thought to increase in the dry season. Conversely, farmers worried about unprecedented cold days. The start of dry seasons had moved back from March to November. Dry seasons were thought to endure longer. Annual rainfall was unchanged. However, distribution and timing of rainfall were irregular. Rainfall was supposed to be higher outside the wet seasons. In certain months, rainfall increased, while in others, it decreased. Ground water tables were thought to be falling, especially in dry seasons. Farmers had reported worsening droughts, typhoons, and floods and rising sea levels. Saline infiltration and thunderstorms were thought to be more frequent and powerful. Some farmers cited the 1997 deadly typhoon Linda to show how extreme weather occurrences might vary. Farmer opinions were consistent. Farmers and agricultural officers shared climate change views. The authorities said extreme weather events, temperature, and rainfall have altered recently. A 1-2 °C increase in mean temperature has been seen during the past decade. The authorities also said the rainy seasons start and end differently. Salinity intrusion was thought to be worse in coastal areas than droughts (Le Dang *et al.*,2013).

A cross-sectional household study was conducted by Deressa, Hassan, and Ringler, (2010) involved a total of 1000 farmers who raised mixed crops and cattle. According to the poll results, throughout the previous 20 years, 51% of the farmers surveyed felt that temperatures was rising and 53% that rainfall was falling. Over the previous ten years, there has been a rise in average minimum and maximum temperatures of around 0.25 °C and 0.1 °C, respectively (Deressa, Hassan and Ringler, 2010).

In order to determine how farmers perceived and adapted to climate variability and change, Hadgu, Tesfaye, Mamo, and Kassa (2014) gathered data from 253 respondents. The findings showed that all stations' annual and seasonal temperatures had increased, with the rate of increase being higher in the highlands. Similar to this, 60–97% of the farmers surveyed acknowledged that the temperature had changed, and their perspective seemed to match the local statistical data. Farmers in the highland region felt a rise in temperature compared to those in the lowlands, in line with the meteorological findings. Furthermore, around 77.1% and 84.9% of the farmers felt that the reduction in rainfall as a result of climate-related effects had decreased the amount of water utilized for irrigation as well as for domestic and animal consumption. However, climate shocks like prolonged dry spells and recurring droughts have shortened growing seasons and led to the loss of landrace cultivars (74.7%) and the

introduction of new pests (73.1), such as parthenium weeds and striga. Farmers also mentioned a decrease in agricultural yield and a subsequent scarcity of water for irrigation and consumption as signs of climate change (Hadgu *et al.*, 2014).

In 2019, Hasan and Kumar conducted research using data from home surveys of 118 randomly selected farmers in Bangladesh's Kalapara subdistrict. Out of the 118 farmers, 106 were aware of climate change. While the observed scores ranged from 27 to 118 with an average of 80.2 (SD = 18.8), perception ratings might vary from 0 to 130. The majority of farmers (61%) perceived climate change at a medium level (scoring 46 to 90). The farmers showed a modest sense of and susceptibility to climate change. The vast majority of responders (98%) thought the summer was warmer and 96% thought the winter was colder than it had previously been. Of the farmers, 91% thought there had been more rainfall, and 97% thought there had been changes in the timing of the rainfall. Of them, 98 and 99%, respectively, believed that soil salinity was rising and that there was corresponding loss (Hasan and Kumar, 2019).

In order to improve policy towards addressing the issues that climate change poses to Ghanaian farmers, Acquah (2011) conducted a study on 95 farmers. The majority of farmers observed a rise in temperature and a decline in the pattern of rainfall when it came to climate change. As seen, 60% of all respondents thought that the temperature had increased. A decrease in temperature was reported by 29% of the respondents, but 11% of the respondents felt there had been no change in temperature. 24% of respondents thought that rainfall had increased. Nonetheless, 49% of all respondents said that the amount of rainfall had decreased. While 11% of all respondents thought there had been no changes in the amount of rainfall, up to 16% disagreed, citing erratic rainfall patterns (Acquah, 2011).

In another study, the majority of sub-Saharan African farmers were aware that climate change was causing changes in precipitation patterns and temperatures. The same stated that there had been an increase in temperature throughout sub-Saharan Africa, and that there had been a 2% increase in West Africa and a 7% increase in East Africa in terms of precipitation patterns, but a 4% decrease in Southern Africa and a general decline in precipitation and water availability. Of the farmers surveyed, 60% said there had been a discernible rise in temperature, and 49% said there had been less rainfall (Sani and Chalchisa, 2016).

In 2020, S. Singh conducted a field survey in the arid region of Bundelkhand (Uttar Pradesh), India. Total 200 sample families of different land sizes were called in order to gather data. The study's conclusions showed that farmers' livelihoods had been negatively impacted by temperature and rainfall fluctuation. According to the study's findings, 134 out of 200 farm households, or 67% of them, reported that the amount of rainfall had changed. The majority of farmers (94 & 93%) thought that during the previous ten years, there had been an increase in the frequency of droughts and a rise in summer temperatures. The majority of farmers roughly 95% realized that the groundwater table had dropped. These findings also agreed with the temperature record for the Bundelkhand region provided by the Indian Meteorological Department (IMD, 2017), which indicated a notable increase in annual temperature of roughly 0.01 °C between 1951 and 2017. Regarding precipitation, the actual yearly trend from 1951 to 2017 revealed a 1.41 mm annual decrease. Additionally, a qualitative analysis had been conducted. Droughts, according to farmers, had two effects on livelihoods. The majority of farming households in the villages studied reported losing both their cattle and crops, or both, which was their first response to climate change. The survival of the cattle was the final concern of the locals, who were already struggling to survive during this time of crisis (Singh, 2020).

Another study examined Sub-Saharan West African farmers' climate change views and adaptation alternatives. Total 234 farmers were questioned. Climate change was interpreted differently by 98% of farmers based on geography and weather. Dry weather had reinforced farmers' belief that the climate had shifted. Farmers assumed the first rainy season was late. Dry spells rose, although first-rainy season rainfall decreased. Most farmers, 98% of informants believed the environment had changed. However, the climate variable of relevance (rainfall, temperature, etc.) and the moment at which this shift became visible varied widely across countries and climatic zones. Most farmers said the climatic change started fewer than 10 years ago, but a larger majority said 20–30 years ago. The climate zones differed in Guinea-Congo, where over 50% of respondents said the shift started less than ten years ago, and Sahelian Niger, where over 55% stated it started 20–30 years ago (10% more than 30 years ago). More hot days and 60% higher temperatures had been recorded by farmers. Country and temperature variations, such as hot or cold days and months, were correlated, except for the temperature trend (Johnston, Agbossou, and Akponikpe, 2010).

## **2.10 Farmers adaptation strategies towards climate change:**

In 2018, Mahaarcha reported that he carried out research in Kanchangiri, a sizable province in western Thailand. In this study, he looked into “the factors influencing farmers’ adaptation strategies for climate change.” The majority of farmer respondents (82%) said they had used at least one adaptive strategy, while only 18% said they had not used any at all. The most popular adaptation strategy was the use of cultivars tolerant to drought (69%) and salinity (65.8%). Zero tillage was the least popular adaptation approach among the farmers who reported using strategies (Mahaarcha, 2019).

A study done in Punjab province, Pakistan by Abid *et al.*, (2015), included 450 samples in all. In total, 58% of farm households modified their farming practices in response to climate change. The primary adaptation strategies used by farm households in the research area included altering crop kinds, altering planting dates, installing shade trees, and altering fertilizer. Crop variety changes (32.20%), planting date changes (28.40%), planting shade trees (25.30%), and fertilizer changes (18.70%) were the most common adaptation measures. These were followed by crop type changes (10.20%), increased irrigation (9.80%), soil conservation (9%), crop diversification (7.56 %), migration to urban areas (3%), and land rental (2.20 %) (Abid *et al.*, 2015).

The majority of respondents, according to Dhaka *et al.*, (2010), had modified agricultural management techniques in response to alterations in climate conditions. One of the most significant responses to the unpredictable nature of the climate was thought to be an integrated farming system. Another alternative was to modify the cropping sequence to take advantage of the varying lengths of growing seasons and the corresponding levels of heat and moisture. This would include altering the timing of sowing, planting, spraying, and harvesting. Farmers had created a wide range of management techniques, including crop rotations, intercropping, stubble mulching, and pre-monsoon dry sowing, to deal with climate variability. The sudden changes in climate, like the drought, forced farmers to collect rainwater for use in irrigation on dry days. A few of the farmers who responded implemented zero tillage techniques (Dhaka, Chayal and Poonia, 2010).

According to the study done by Shi-yan *et al.*, (2018), the majority of farmers stated they had Implemented new strategies to lessen the adverse effects of climate change. Creating new irrigation infrastructure, using more chemical fertilizers and pesticides,

changing the density and methods of agricultural planting, acquiring agricultural insurance, enhancing the ecological environment of farmland, implementing new technologies, and growing different crops were some of the common adaptation strategies. There were still farmers who did not respond to climate change with any strategy (Shi-yan *et al.*, 2018).

The results of the study done by Gao *et al.*, (2022), indicated that, In Hainan, among the 200 participants, the vast majority of farmers (>85%) used a variety of coping and adapting techniques. The most frequently used strategy was according to data that follows weather forecasts to adjust farming operations (84%). Other strategies that were frequently used include crop variety changes (81.6%); conservation of agriculture, which includes soil conservation and/or agroforestry (81.3%); and early maturing, stress-resistant varieties (81.6%), altering various farm practices, such as changing the way pesticides and fertilizers were applied and/or planting and harvesting methods (71.6%); investing more in infrastructure (61.3%); raising non-agricultural revenue (59.3%); adopting new cultivars (genetically modified varieties) (56.2%); and conserving water by using controlled irrigation, new technologies, or rerouting water use (52.7%). A smaller percentage of farmers also used other adaptations, such as intercropping (31.2%), mixed cropping and/or crop diversification (34.8%), changing the time of planting and/or harvesting (46.2%), mulching (12.5%), altering the area under cultivation (39.5%), and migrating to urban areas (21.8%) (Gao *et al.*,2022).

Using a case study of coastal Bangladesh, done by Uddin, Bokelmann, and Entsminger's 2014, it can be concluded that, the majority of the farmers self-identified as having participated in adaptive behavior. Just 16% of respondent farmers said they had not adopted any of the adaptive techniques included in the survey, compared to the overwhelming majority (84%) who said they had used at least one of the identified tactics. The farmers who responded to the poll ranked the various climate change adaption techniques. Among farmers' adaptation methods to climate change, greater use of irrigation was ranked first out of 14 strategies, making it the most important strategy. Enhancing plant nutrition available through irrigation results in higher production yields, but it also raises soil salinity. Crop diversity was found to be the second most effective adaptation technique. In addition to the loss risk associated with monocultures, continuous monocropping (for example, rice farming) had several negative effects, such as insect recurrence and deterioration of soil quality. "Integrated farming system" participating in two or more businesses that cooperate with one

another, was the third most crucial adaptation technique. Crop insurance came up last on the list of crucial adaptation tactics (Uddin, Bokelmann and Entsminger, 2014).

Ugwoke et al., stated that, a few tactics used to counteract the negative consequences included extending the planting season, using better crop kinds, and implementing better farming practices. The majority of farmers (66.67%) used farming activity diversification as a coping mechanism. Among other tactics included changing the planting date (60.83%) and participating in non-farm activities (53.3%). The impression of climate change among farmers in the area was shown to be significantly influenced by age, farming experience, educational attainment, and involvement in social organizations (Ugwoke *et al.*, 2012).

According to a study by Tiyo, Orach-Meza and Edroma, (2015), climate change and variability were already having a significant impact on small-scale farmers' agricultural production. Of them, 61.4% reported having bad effects, 19.1% very bad effects, 18.9% reported being slightly affected, and only 0.5% said they were not affected. Those that were unaffected adopted extensive off-farm adaptation techniques, such as revenue-generating businesses, and adopted adaptation technology, such as soil and water conservation measures. About 64.3% of families planted alternative crop species, 71.3% varied planting dates, 61.5% changed how they conserved water and soil, 52.1% diversified their crop planting, and 45.4% used crops with shorter growing seasons. Climate-smart solutions were implemented to counteract the negative impacts of climate variability and change (Tiyo, Orach-Meza and Edroma, 2015).

Farmers said they were employing adaptation methods to address perceived climate changes during focus group talks and individual questionnaires, according to Amadou *et al.*, 2022. Farmers adopted drought-tolerant cultivars and water-saving technologies to deal with the decrease in rainfall and late start of the growing season. In order to manage the alleged rise in the frequency of dry spells, farmers also discussed using contour bunds and rock bunds in fields to keep water in plots. Rising temperatures exacerbated drought stressed for farmers, so addressing rising temperatures also required adapting to changes in rainfall patterns. Farmers did not report any specific adaptation to heat stress during critical stages of plant development or to a decrease in crop duration. Living and dead hedges, as well as agroforestry, were suggested as ways to deal with the rise in heavy rains and strong winds. Surprisingly, the answer to increased erosion danger brought on by more extreme rainfall events rock or contour bunds was not considered. Farmers mentioned no particular response to heat stress,

even in spite of what appeared to be a warming. The study's findings demonstrated a connection between farmers' perceptions of climate change and their adoption of certain adaptation strategies (Amadou *et al.*, 2022).

Jemison *et al.*, (2014) held focus group discussion with farmers representing seven different commodity groups and interviewed 199 individuals. Growers discussed potential initiatives to enhance family management in order to protect against climatic whims, as they were powerless to control the unavoidable whims of nature. Specific responses included season extension, water management, and systemic initiatives utilizing ecological techniques and farm diversity (Jemison *et al.*, 2014).

Likinaw, Bewket and Alemayehu, 2022, claimed that, in response to climate change concerns, households had adopted many adaptation techniques such as altering crop planting dates, crop diversification, terracing, tree planting, cultivating drought-tolerant crop types and off-farm activities. Adjusting the planting date of crops was scored highest by 84% of households, followed by crop terracing at 82%, and crop diversification at 78% of families. The other options were tree planting (75% of households), use of enhanced crop seeds (67% of households) and use of drought tolerant crop varieties (51% of households). Off-farm activities (26% of families) and the use of water harvesting/irrigation (12%, of households) were the least adopted adaptation techniques by households in the research area (Likinaw, Bewket and Alemayehu, 2022).

In 2021, mixed method study done by Kabir, Roy, and Hossain found that farmers were using their knowledge and experience to adapt. According to the study, many climate change adaptation strategies had been taken. These adaptation options included revenue diversification, land management, crop management, and water management. Majority 72% (n=86) of respondents added new crop kinds to fields to respond to climate change events like rainfall patterns. These respondents grew 58% (n = 70) water-efficient crop types, 32% (n = 38) high-temperature crop varieties, and 9% (n = 11) salinity-sensitive crop varieties. Nearly 74% (n=89) of farmers adapted by changing crop planting and harvesting dates. Homestead gardening was a backup food source for 72.5% of climate change-related catastrophe responders (n=87). Most farmers (95.83%, n=115) increased their chemical insecticide use, although 83% (n=99) utilized organic fertilizer. Supplemental irrigation, usually from groundwater, was a common response to unexpected and prolonged droughts. 80% (n=96) of respondents used this adaptation

method in their fields. Another typical climate change adaptation in the research area was deep ploughing (73%) and reduced tillage (n=95) in home poultry production. About 63% (n=76) of respondents grew short-duration crop species, while about 63% (n=75) grew climate-adaptable cereal and horticultural crop kinds. Nearly half of respondents (50.83%, n=61) practiced mixed cropping, which comprises rice-pulse, rice-turmeric, pulse-chilly, chilly-garlic-onion, sunflower-sesame pulse, maize and red amaranth, watermelon and garlic, or lentil and mustard. This enabled for crop augmentation (space, nutrients, water) and disease suppression during climate change related occurrences (Kabir, Roy and Hossain, 2021).

Kabir, Roy and Hossain revealed that, most participants (n = 72; 60%) changed their fertilizer application frequency, while 57% (n = 68) used crop managers and guti urea to improve fertilizer efficiency. At least 35% of respondents were cultivating rain trees and mehegoni on the highlands and rotating rice and legume crops. Reduce soil salinization (e.g., by applying fertilizers and creating modest earthen barriers to block saline water entrance) and implemented integrated and locally knowledge-based pest management approaches to adapt crop fields to climate change. In permanently or semi-permanently inundated regions, 8% (n=10) used floating gardens and 41% (n=49) used conservation tillage. In crop management measures, high-saline zones had higher planting and harvesting date changes (79%), shorter growing seasons (73%), and new crops (75%). In the high saline zone, land management approached decreased deep ploughing (78%) and reduced tillage (78%) whereas water management methods increased supplemental irrigation (91%) (Kabir, Roy and Hossain, 2021).

In their study, Le Dang *et al.*, (2013) analyzed data from six in-depth interviews with one female and five male agricultural officers in the Mekong Delta of Vietnam, as well as three focus groups with thirty male farmers. Farmers described their current responses to perceived climatic variability as a number of private adaptation measures. Planting calendar adjustments, planting technique adjustments, crop and variety diversification, water usage management, income source diversification, asset and human safety reinforcement, and other measures (moving to another province) were the seven categories into which these were divided (Le Dang *et al.*, 2013).

A cross-sectional household study conducted by Deressa, Hassan, and Ringler, (2010) involved a total of 1000 farmers who raised mixed crops and cattle. The results showed that, out of the farmers surveyed, 58% said they had implemented at least one of the

main adaptation strategies found in the survey. Tree planting, conserving soil, using diverse crop varieties, adjusting planting dates, and irrigation were a few of them. Farmers who saw the effects of climate change but did not adjust cited a variety of factors, such as inadequate knowledge of adaptation strategies, financial constraints, labor scarcity, land scarcity, and inadequate irrigation potential (Deressa, Hassan and Ringler, 2010).

In order to determine how farmers in three districts located in various agroecological zones of the Tigray region of Ethiopia perceived and adapted to climate variability and change, Hadgu, Tesfaye, Mamo, and Kassa (2014) gathered data from 253 respondents chosen using a multi-stage sample technique. Farmers' choices for adapting to climate change included changing crop type and/or variety (28%), conserving soil and water (28%), diversifying their crop production (14%), shifting the planting date (18%), and implementing irrigation techniques (15%). Consequently, it was crucial to make an effort to raise farmers' understanding of climate change and provide them with the tools they needed to choose climate resilient solutions. However, 5.5% of the farmers did not adopt any of the previously mentioned adaptation methods, even though they were aware of climate change (Hadgu *et al.*, 2014).

Comparative study was done by Hasan and Kumar in 2019, revealed that, by using a variety of adaptation strategies, coastal farmers were accustomed to modifying their farming practices in response to climate change. The CFS (climate field school) farmers adopted three more agricultural practices than the general farmers on average out of the 17 selected practices, and this difference was statistically significant. A higher proportion of general farmers implemented less adaptation practices, but CFS farmers significantly outnumbered other farmers when it came to the adoption of a very high number of practices. The number of accepted adaptation practices, the feeling of vulnerability, and the perception of climate change were found to be positively correlated (Hasan and Kumar, 2019).

According to Acquah, 2011, farmers were found to have a rather high degree of adaptability, with the majority of them were utilizing soil conservation techniques, variable planting dates, and diverse crop varieties as their main adaptation strategies. Of those surveyed, 81.1% adjusted to new planting dates, but 18.9% did not. While the remaining respondents did not adjust, 73.7% of them did so by adopting other crop

kinds. Of the responders, 60% used irrigation as a means of adaptation, while 40% did not. While the remaining respondents did not adjust to planting trees, 67.4% of them did. When the climate changed, the majority of respondents (73.7%) adjusted to conserve soil, while the remainder respondents did not. In contrast, water harvesting had a lower proportion of adaptation (43.2%), and 56.8% of people did not use it as a technique for adaptation (Acquah, 2011).

Study done by Sany and Chalchisa, 2016, revealed that, farmers had resorted to crop diversification, planting a variety of crops, altering planting and harvesting dates to align with fluctuating precipitation patterns, irrigation, planting tree crops, water and soil conservation measures, and transitioning to non-farm revenue streams were other methods adopted in order to mitigate the negative effects of climate change (Sani and Chalchisa, 2016).

The most successful adaptation options, according to S. Singh's 2020 analysis, were early maturing seed variants and crop varieties that required less water. According to the study's findings, more than 60% of farmers planted mango, citrus, and eucalyptus trees around their farms and varied their cropping strategies to include less water-demanding crops. Over 40% of the households in the sample had enhanced their irrigation coverage by collecting rainwater and cultivating less water-demanding types of oilseeds, pulses, and jowar. A small percentage of farm households believed that crop yield could be raised by increasing inputs, therefore approximately 35% of households increased their usage of fertilisers and biopesticides. A fifth (19.5%) of farm households participated in non-farm pursuits in an effort to lessen their exposure to the effects of climate change (Singh, 2020).

Farmers used crop, soil fertility, and soil water management techniques as adaptive methods found in all, 234 farmers were questioned by Agbossou, Johnston, and Akponikpe in 2010. According to the study, farmers had been mentioning switching from late to early crop cultivars as a way to deal with the shortening of the rainy season due to the late start of the season. Regarding their management of soil fertility (rates of inorganic or organic applications), the majority of farmers indicated having made no changes at all. In order to lessen the impact of perceived rainfall decreases, soil water conservation measures were mostly mentioned in the Sahelian regions of Burkina Faso and Niger. Since soil fertility management is hampered by fertilizer availability and

expense, and soil water management is hampered by irrigation equipment or water availability, crop management tactics had become more popular. Rainmakers' ritual practices were mentioned as a key tactic for coping with protracted dry spells (Akponikpe, Johnston and Agbossou, 2010).

## **CHAPTER III**

### **MATERIALS AND METHODS**

- 3.1 Study Design**
- 3.2 Study Period**
- 3.3 Study Place**
- 3.4 Study Population**
- 3.5 Sample Size**
- 3.6 Selection Criteria**
- 3.7 Sampling Technique**
- 3.8 Research Instrument**
- 3.9 Pre-test of Questionnaire**
- 3.10 Data Collection Technique**
- 3.11 Data Processing**
- 3.12 Data Analysis**
- 3.13 Utilization of Results**
- 3.14 Ethical Considerations**
- 3.15 Limitation of Study**

### **3. MATERIAL AND METHODS:**

After obtaining ethical clearance from Institutional Review Board, NIPSOM (Annexure-1), this study was conducted in accordance with the following to assess the farmers' level of perception and adaptation strategies towards climate change in the southern coastal region.

#### **3.1 STUDY DESIGN:**

This was a cross-sectional study on farmers' perception and adaptation strategies towards climate change in southern coastal region.

#### **3.2 STUDY PERIOD:**

The study period spanned a duration of 12 months, commencing on the 1st of January, 2023, and concluding on the 31st of December, 2023. The study commenced by initiating the construction of a protocol, followed by the collection of data and the submission of the final report. After developing the questionnaire, a pre-test was conducted. Following the necessary revisions and corrections, data collection was started. The literature review was conducted simultaneously throughout the study period until the submission of the report.

#### **3.5 STUDY PLACE:**

The study was conducted in Hatiya Island, which is an upazila of Noakhali District, situated in the southern coastal region of Bangladesh. Hatiya is one of the larger islands among the 32 islands located in the southernmost region of Bangladesh. There are a total of 10 unions and 69 villages. The Meghna River runs along the northern and western edges of the island, while the Bay of Bengal delineates the eastern and southern boundaries. The Hatiya Upzilla, as reported by BBS (Bangladesh Bureau of Statistics) in 2015, has a population of roughly 470,000 individuals residing throughout an area of 1500 sq. km. The island is extremely vulnerable to natural disasters (Ghosh *et al.*, 2015). There are four types of water-based transportation that operate on this route: launch, sea-truck, engine-propelled local boats, and speed boats. The sea-truck service is operated by the publicly-owned Bangladesh Inland Water Transport Corporation (BIWTC), while the remaining services are operated by private owners (Aziz and Jabeen, 2021). For study purposes, the journey from Dhaka to Hatiya was made by

launch. Upon arriving at the designated data collection site, formal authorization from the local chairman and UNO was obtained to commence data gathering after providing a comprehensive explanation of the data collection procedure and assurance of ensuring the privacy of the respondents. Next, the data collection procedure was started.

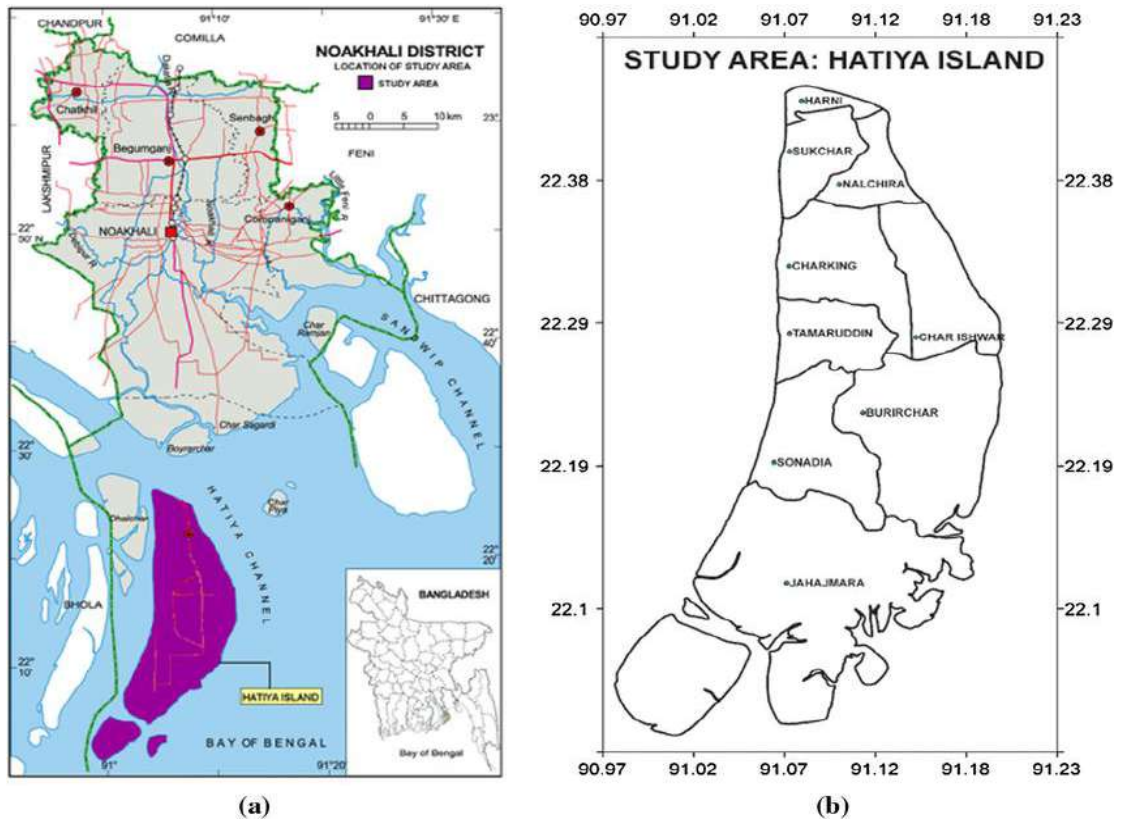


Fig 3.1: Map of Hatiya Upazilla

### 3.4 STUDY POPULATION:

The study population of this study were both male and female agricultural workers (Farmers) of Hatiya island of Noakhali district of southern coastal region.

### 3.5: SAMPLE SIZE:

The sample size calculating formula was  $n = z^2pq/d^2$

$n$  = desired sample

$z$  = confidence level at 95% is 1.96

$p$  = the proportion of target population

$q = 1 - P$

d = degree of error (5%), therefore d= 0.05

Here the p values were 73%, 82% and 57% which were collected from farmers' climate change perception stage (Abid *et al.*, 2015) and rate of farmers' adaptation to climate change (Mahaarcha, 2019) and perception of direct impact of climate change during last 10 years (Shi-yan *et al.*, 2018).

When p value was 73%,

$$\begin{aligned}
 n &= z^2pq/d^2 \\
 &= (1.96)^2 \times 0.73 \times 0.27 / (0.05)^2 \\
 &= 3.85 \times 0.73 \times 0.27 / 0.0025 \\
 &= 303
 \end{aligned}$$

When p value was 82%,

$$\begin{aligned}
 n &= z^2pq/d^2 \\
 &= (1.96)^2 \times 0.82 \times 0.18 / (0.05)^2 \\
 &= 3.85 \times 0.82 \times 0.18 / 0.0025 \\
 &= 226
 \end{aligned}$$

When p value was 57%,

$$\begin{aligned}
 n &= z^2pq/d^2 \\
 &= (1.96)^2 \times 0.57 \times 0.43 / (0.05)^2 \\
 &= 3.85 \times 0.57 \times 0.43 / 0.0025 \\
 &= 376
 \end{aligned}$$

P value	Calculated sample size	After 10% increase
0.73	302	335
0.82	226	251
0.57	376	414

(Abid *et al.*, 2015, Mahaarcha, 2019, Shi-yan *et al.*, 2018)

The largest calculated sample size was 376. To minimize non-respondents, after a 10% increase, the calculated desired sample size was 414.

### 3.6 SELECTION CRITERIA:

#### Inclusion criteria:

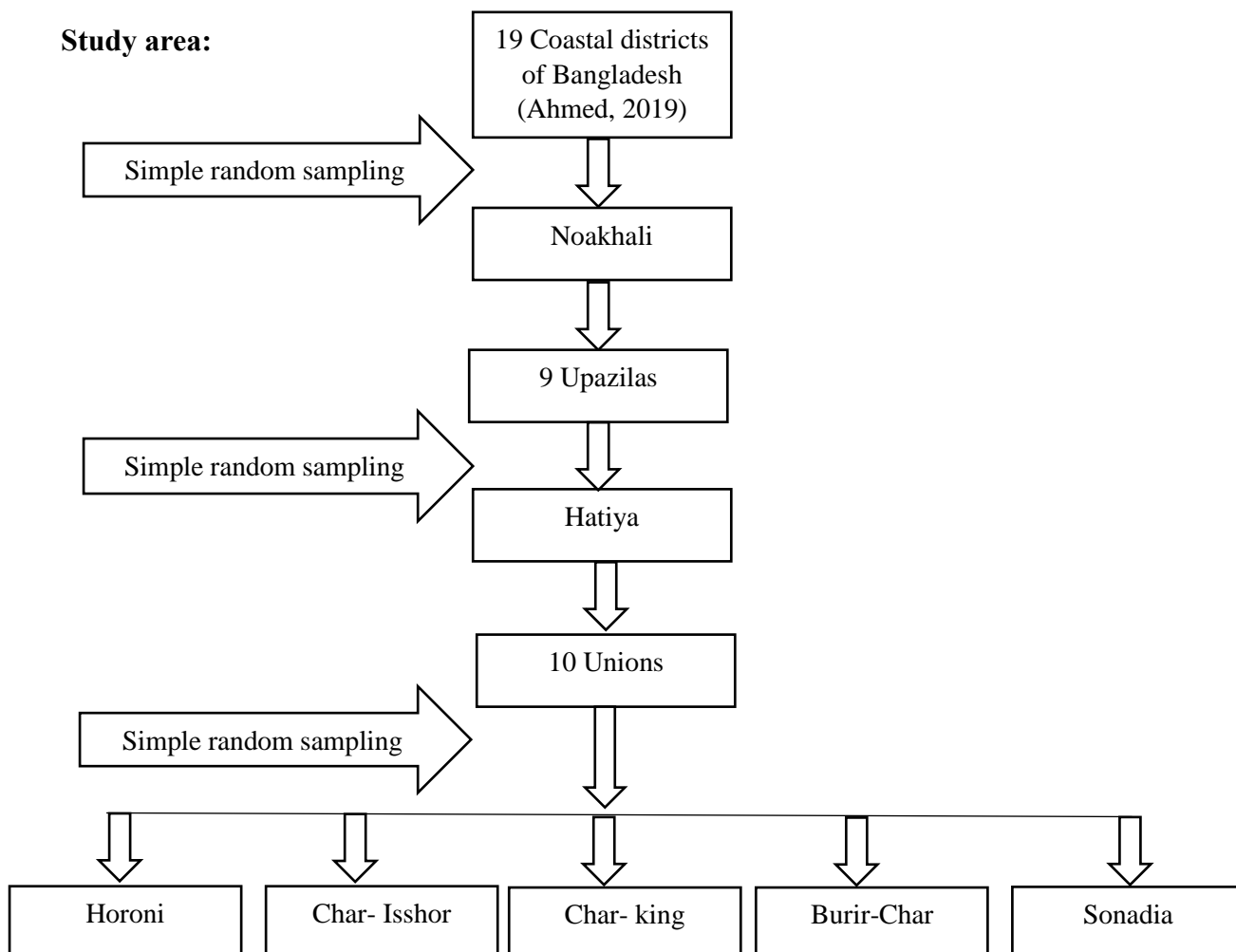
- Both male and female.
- Agricultural workers (Farmers).
- Lives in Hatiya island for at least 10 years.
- Willing to participate and give informed written consent.

**Exclusion criteria:**

- Those who were ill.

**3.7 SAMPLING TECHNIQUE:**

**Study area:**



The study area was selected by a multistage sampling technique based on inclusion and exclusion criteria. Bangladesh has a total of 19 coastal districts, namely Jessore, Narail, Gopalganj, Shariatpur, Chandpur, Shatkhira, Khulna, Bagerhat, Pirozpur, Jhalakathi, Barguna, Barishal, Patuakhali, Bhola, Lakshmipur, Noakhali, Feni, Chattogram, and Cox's Bazar (Ahmed, 2019). Among these districts, Noakhali was chosen through simple random sampling. The Noakhali district comprises nine Upazillas, namely Noakhali Sadar, Begumganj, Senbug, Sonaimuri, Chatkhil, Companiganj, Kabirhat, Hatiya, and Subarnachar. Among them, Hatiya Upazilla was chosen by a random selection procedure. The Hatiya Upazilla consists of 10 unions, out of which 5 were

randomly selected. These unions were Horoni, Char-Isshor, Char-king, Burir-char, and Sonadia. The sample size was equally distributed among these unions.

### **Study participants:**

The first household was chosen conveniently. Then, thereafter, data were collected for this study by skipping 5 residences.

### **3.8 RESEARCH INSTRUMENT:**

- Quantitative data were collected by Semi-structured questionnaire.
- Qualitative data were collected by FGD.

### **3.9 PRE-TEST OF QUESTIONNAIRE:**

Prior to onset of data collection, pre-testing was carried out in Raipur Upazilla of Lakshmipur district to finalize the procedure and evaluate the effectiveness of the research instruments. Data were collected from 41 participants (10% of the total sample size). Modifications were made as necessary, and research instruments were finalized.

One focus group discussion (FGD) was also carried out during the pretest procedure before the final data collection process. The focus group consisted of the primary investigator, an honorable local member of the union parishad, the head teacher of the local primary school, and four farmers; two of them were male and the remaining two were female. The focus group discussion was held in the school building with an open discussion regarding farmers' perceptions and adaptation strategies towards climate change in the coastal region. The questionnaire for focus group discussion was modified as necessary after this pretest.

### **3.10 DATA COLLECTION TECHNIQUE:**

Both quantitative and qualitative methods of data collection were employed by face-to-face interview and FGD respectively.

For quantitative data collection, pretested semi-structured questionnaire was used. During the household visit of participants, a questionnaire for eliciting, which was semi-structured and with sections on socio- demographic characteristics, work related factors, perceptions of farmers towards climate change and adaptation strategies of farmers towards climatic change. On completion of all activities and procedures

relevant questionnaire was checked for completeness before leaving the participants household.

Climate change, as described in this study, refers to the perceived alterations in the average temperature, average rainfall, occurrences of drought, flood, storm, late onset of monsoon, long dry spell, uneven and unpredictable rainfall and short winter season throughout the past decade. A 5-point scale was utilized to measure farmers' perceptions of climate change, with 1 as strongly agree, 2 as agree, 3 as neither agree nor disagree, 4 as disagree and 5 as strongly disagree (Akanda and Howlader, 2015; Shi-yan *et al.*, 2018; Ibidapo *et al.*, 2018).

FGD was used to acquire qualitative data. A total of five focus group discussion (FGD) were carried out from October 9<sup>th</sup> to 15<sup>th</sup>, 2023, in five selected union of Hatiya upazila of Noakhali District, with the purpose of obtaining valuable insights about farmers' perception of the current climate change. The groups of 5-6 farmers, consisting of a diverse mix of male and female farmers. The formation of these groups was arbitrary, contingent upon the farmers' desire to participate, and facilitated by the village chief's assistance in coordinating the meetings within the village. Agriculturalists were requested to provide detailed information regarding previous and ongoing climate change, with specific emphasis on precipitation, temperature, and wind patterns in a chronological order. The facilitator did not specify a certain time frame when discussing prior climate. During each focus group discussion, a combination of open-ended and closed-ended questions were asked regarding climate change awareness and perception, the impact of climate change on farming, strategies for adaptation, obstacles and limitations to adaptation, knowledge and information about weather, collaboration and assistance from government or local non-governmental organizations, and participants' future perspectives (annex-10).

### **3.11 DATA PROCESSING:**

- At the end of each interview, collected information were checked quickly.
- The data entry was started immediately after completion of data collection.
- Collected data were checked, re-checked, edited, coded and recoded for quality management in each day.

### 3. 12 DATA ANALYSIS:

The collected data were entered into the SPSS programme and analyzed according to the objectives of the study.

The data were cleaned up by checking accuracy, outliers, inconsistencies, and missing values.

**Age:** A new variable for age was created for analysis. The age of the respondents was categorized into four groups, comprising less than 25 years, 25–45 years, 45–65 years, and more than 65 years, and later coded and valued as 1, 2, 3, and 4, respectively.

**Family members:** The total number of family members was categorized into less than 5 persons, 5–10 persons, and more than 10 persons. later coded into 1, 2, and 3, respectively.

**Monthly income:** Monthly income was categorized into three groups comprising less than 10000 Tk, 10000–25000 Tk, and more than 25000 Tk and later coded into 1, 2, and 3 accordingly.

**Length of residing:** The total length of stay of the respondent was categorized into three groups, comprising less than 20 years, 20–40 years, and more than 40 years, and later coded into 1, 2, and 3, respectively.

**Land size of cultivate:** The total land size of the respondents was categorized into three groups, comprising less than 3 acres, 3-6 acres, and more than 6 acres, and later coded into 1, 2, and 3, respectively.

**Years related to agricultural occupation:** Respondents experiences of agricultural occupation (in full years) were categorized into three groups comprising less than 10 years, 10–30 years, and more than 30 years and later coded into 1, 2, and 3, respectively.

**Other socio-demographic and work-related factors:** Gender distribution, religion, educational background, marital status, land ownership, contact with local agricultural extension agents, exposure to mass media, and facilities to get information on weather forecasting were analyzed through descriptive statistics: frequency, distribution.

**Farmers perceptions of climate change:** Data were collected using a 5-point scale. These collected data were further scored as 1 for strongly disagreed, 2 for disagreed, 3 for neither agree nor disagree, 4 for agree, and 5 for highly agreed. There were 10 weather event was asked for, so, the lowest value was found 10 and highest value was 50 for the perception of climate change. The respondents ranged from 0 to 50 where 0 indicating no perception of climate change and 50 indicating extreme perception. On the basis of perception scores, the farmers were classified into three groups, comprising “low level of perception”, “moderate level of perception”, and “high level of perception”, and later coded into 1, 2, and 3, respectively.

<b>Level of perception</b>	<b>Score Range</b>	<b>Coding</b>
<b>Low level of perception</b>	<b>&lt;25</b>	<b>1</b>
<b>Moderate level of perception</b>	<b>25-40</b>	<b>2</b>
<b>High level of perception</b>	<b>&gt;40</b>	<b>3</b>

**Farmers’ adaptation strategies towards climate change:** Data on adaptation strategies towards climate change have been gathered as a dichotomous variable, where if they agreed about adapting some strategies to combat the negative impact of changing climate, they scored 1; if not, they scored 0. A total of nine adaptation strategies were asked for, so the lowest value was 0 and the highest value was 9 accordingly. If a celebrity adopted at least one adaptation strategy (scored 1), then he or she was considered to have adapted. If any farmer scored 0, they were considered not to have adapted accordingly.

<b>Level of adaptation</b>	<b>Score Range</b>	<b>Coding</b>
<b>Not adapted</b>	<b>0</b>	<b>1</b>
<b>Adapted</b>	<b>1-9</b>	<b>2</b>

The association between the gender of the farmers and their level of perception towards climate change was analyzed through the chi square test. The association between the age category of the farmers and their level of perception towards climate change was analyzed through the chi square test. To see the significance of association between the

level of education of the farmers and their level of perception towards climate change chi square test was performed. The association between having contacts with local agricultural extension agents among the farmers and their level of perception towards climate change was analyzed through a chi square test. To find out the level of significance of association between farmers exposure to mass media (radio, television, and newspapers and their level of perception of climate change, chi square test was done.

The association between farmers perceptions of climate change and their adaptation strategies was tested through a logistic regression test.

### **3. 13 UTILIZATIONS OF THE RESULT:**

The results of this study can provide valuable insights for stakeholders engaged in agricultural development, climate resilience, and policymaking in the region. Agricultural extension services can integrate the knowledge gained into their outreach programs, customizing guidance and education to correspond with the indicated adaptation strategies. Local communities and non-governmental organizations might gain advantages by creating cooperative initiatives and networks for sharing knowledge. This encourages a collaborative approach to addressing climate concerns and advocates for the adoption of sustainable agriculture practices.

### **3.14 ETHICAL CONSIDERATIONS:**

Participation in the study was completely voluntary. Prior to enrolment as a participant, each participant was provided with information forms. The form was in Bangla (Annexure 2) regarding the study. For those who were illiterate, the form was read out. The contents of the consent form were designed so as to explain the aims and nature of the study and the procedures they would need to undergo if they were enrolled in the study. The form also states that, even if they gave consent to be participants in the study, they would have the right to refuse to respond to any or all of the interview questions. Each participant was enrolled as a study participant after they had provided consent by putting their signature or thumb impression on the consent form (Annexure 3).

The participants who enrolled for the study were given assurances in writing that any information obtained during the study would not be disclosed to anyone else without

the participant's authorization. Furthermore, the information collected would be utilized in a manner that ensures the participant's identity remains confidential. No experimental drugs or placebos were administered as a part of the study.

The primary purpose of the study was to gather information about individuals' perception about climate change and at the same time information about individuals' adapted strategies to mitigate the negative impacts of climate change in their farming practices.

### **3.15 LIMITATIONS IN THE STUDY:**

1. The sample size didn't adequately represent the coastal region of Bangladesh.
2. There might be information bias in the household and personal data collected during interviews conducted through household visits.
3. Thematic analysis was not included in the qualitative part of this study.

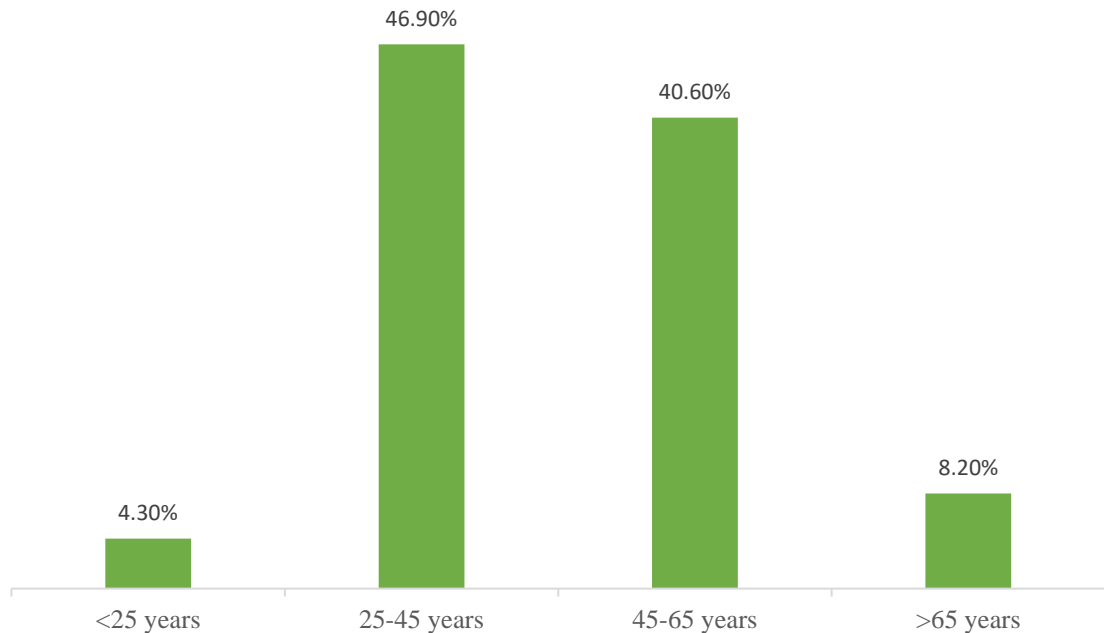
**CHAPTER IV**  
**RESULTS**

## **RESULTS:**

The results section of the thesis, “Farmers’ Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region,” unfolds with a thorough examination of data from a substantial participant pool of 414. Addressing the specific objectives, the analysis begins by elucidating the farmers’ nuanced perceptions of climate change in the southern coastal region. Subsequently, the focus shifts to unravelling the diverse adaptation strategies employed by farmers to mitigate the impact of changing climatic conditions. All of the farmer respondents (100%) indicated that they had employed at least one of the adaptive strategies. The section further delves into work-related factors influencing farmers in the region, shedding light on occupational variables that contribute to their responses to climate change. The results chapter concludes with an in-depth exploration of the sociodemographic characteristics of respondents, revealing key social and economic factors influencing farmers’ perceptions and adaptation strategies towards climate change in the southern coastal region. Overall, this section provides a comprehensive and nuanced understanding of the intricate dynamics between farmers, climate change, and contextual factors in the specified geographical area.

## **Distribution of the respondent according to socio-demographic characteristics**

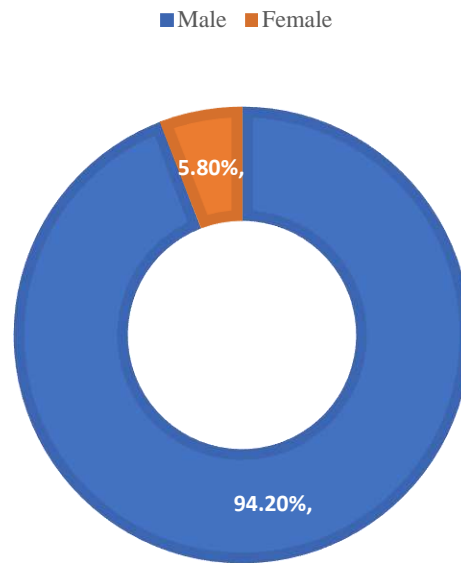
### **4.1 Distribution of the respondents according to age category**



*Figure 4.1: Distribution of the respondents according to age category*

The examination of age categories among participants in this study on reveals a diverse age distribution. The majority of respondents fall within the age range of 25-45 years, constituting 46.9% of the sample. Following closely, those aged 45-65 years account for 40.6%, while participants under 25 years and over 65 years represent 4.3% and 8.2%, respectively. This age distribution highlights the presence of both younger and older farmers in the southern coastal region, indicating a multi-generational engagement in agriculture. The age-wise segmentation provides a nuanced understanding of how different age groups may perceive and adapt to climate change challenges, contributing valuable insights for the formulation of targeted adaptation strategies that cater to the diverse needs of farmers across age categories.

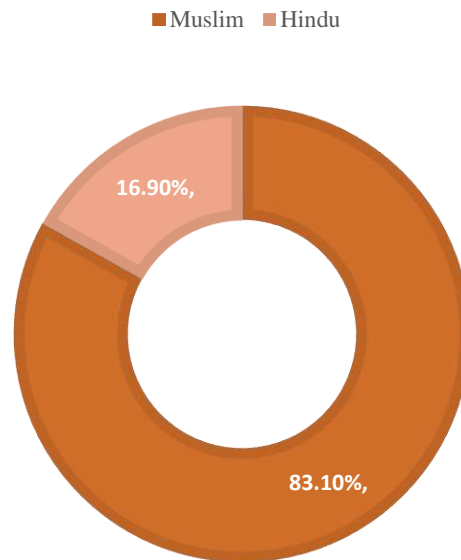
## 4.2 Distribution of the respondents according to gender



*Figure 4.2: Distribution of the respondents according to gender*

The results of this study reveal a predominantly male participant composition, with 94.2% of the respondents identifying as male, while 5.8% identified as female. This gender distribution underscores the male-dominated presence in the agricultural sector within the southern coastal region. The findings suggest a notable gender disparity among the farmers, emphasizing the importance of considering gender-specific perspectives and needs in the context of climate change adaptation strategies. This gender-based analysis provides a foundation for further exploration into how gender dynamics may influence perceptions and adaptation approaches, contributing valuable insights to the broader understanding of climate change impacts on agricultural communities in the specified region.

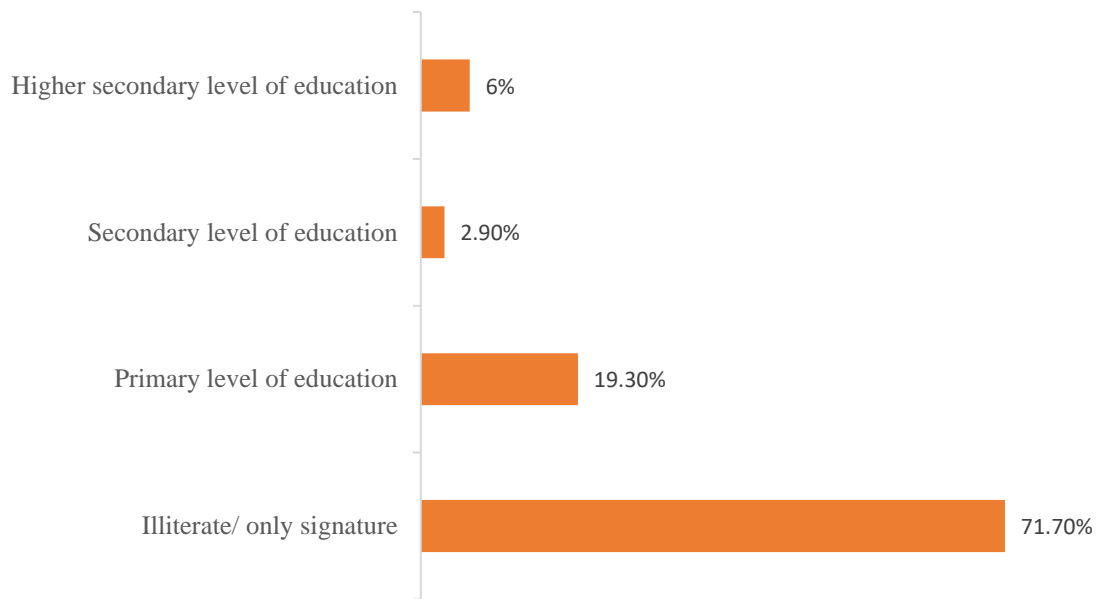
### 4.3 Distribution of the respondents according to religious view



*Figure4.3: Distribution of the respondents according to religious view*

The examination of the religious affiliations among the participants in this study reveals a predominant representation of Islam within the farming community, with 83.1% of respondents identifying as Muslims. In contrast, Hinduism constitutes 16.9% of the sample. This religious distribution underscores the religious diversity present among farmers in the southern coastal region. The findings suggest that the majority of farmers adhere to the Islamic faith, indicating the potential influence of religious beliefs and practices on their perceptions and adaptation strategies towards climate change. This religious segmentation provides a foundational understanding of the cultural and religious contexts shaping farmers' responses to climate change, contributing essential insights for the development of targeted and culturally sensitive adaptation interventions.

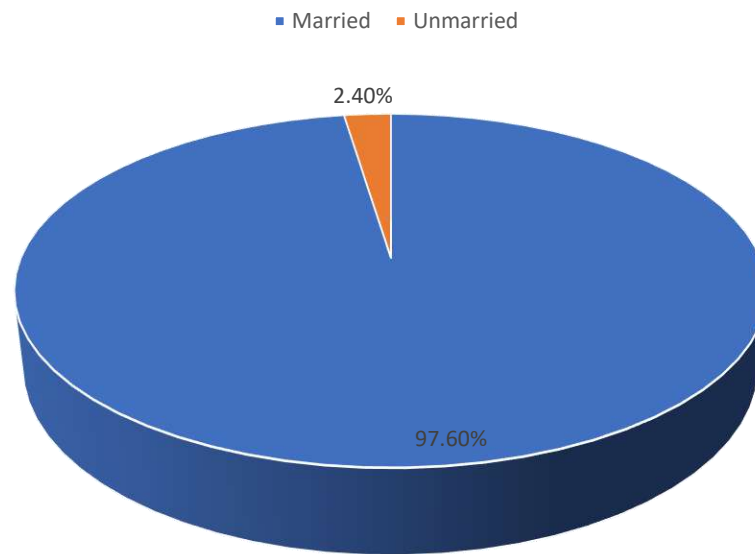
#### 4.4 Distribution of the respondents according to educational background



*Figure 4.4: Distribution of the respondents according to educational background*

The analysis of the educational background of respondents in this study on reveals a diverse educational landscape within the farming community. The majority of participants, constituting 71.7%, are categorized as either illiterate or possessing only the ability to provide a signature. Additionally, 19.3% of respondents have completed education up to the primary level, while 2.9% have attained a secondary level of education. A smaller proportion, 6%, have achieved a higher secondary level of education. This educational distribution highlights a significant portion of the farming community in the southern coastal region with limited formal education. The findings emphasize the need for targeted and accessible communication strategies when conveying information related to climate change and adaptation, taking into consideration the diverse educational backgrounds of the farming population. Furthermore, understanding how education levels may influence farmers' perceptions and adaptation strategies is crucial for designing effective interventions that cater to the varying educational capacities within the community.

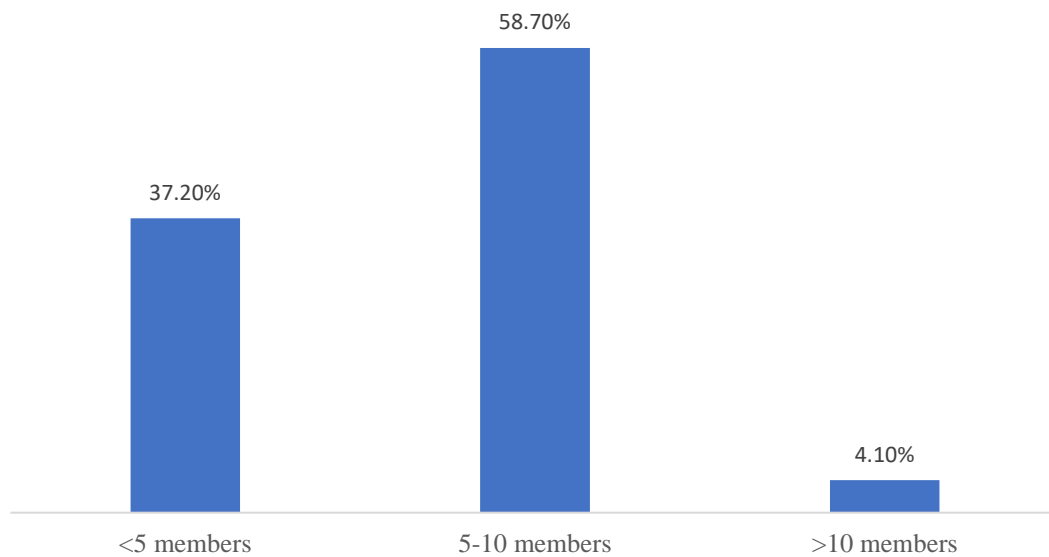
#### 4.5 Distribution of the respondents according to marital status



*Figure 4.5: Distribution of the respondents according to marital status*

The examination of the marital status of respondents in this study on reveals a predominantly married farming community, constituting 97.6% of the participants. In contrast, unmarried individuals represent a smaller proportion, accounting for 2.4% of the sample. This marital status distribution highlights the predominantly married demographic within the farming population in the southern coastal region. The findings suggest that the majority of farmers are likely to be embedded within family structures, which can play a crucial role in shaping perceptions and influencing adaptation strategies to climate change. Recognizing the significance of marital status in understanding the social dynamics of the farming community is essential for tailoring climate change communication and adaptation programs that consider the role of family structures and support systems.

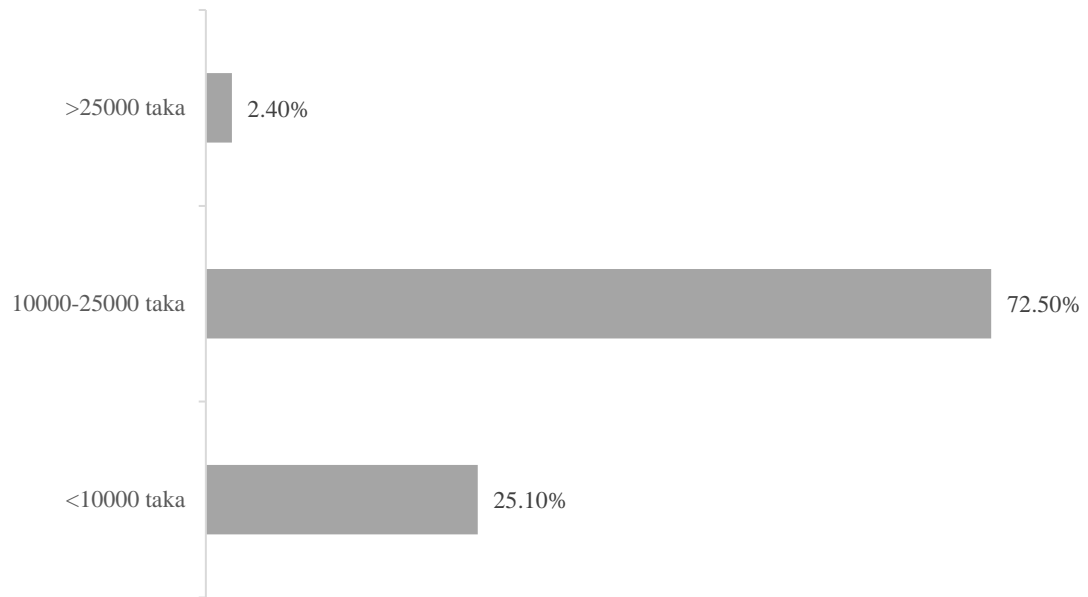
#### 4.6 Distribution of the respondents according to total family members



*Figure 4.6: Distribution of the respondents according to total family members*

A substantial portion of respondents, comprising 37.2% reported having fewer than 5 members in their family. A larger proportion, 58.7% indicated a family size ranging from 5 to 10 members. Conversely, a smaller segment, representing 4.1% reported having more than 10 members in their family. This distribution underscores the varied family sizes within the farming community in the southern coastal region. The findings suggest that family dynamics and resource-sharing may play a crucial role in shaping farmers' perceptions and influencing their adaptation strategies in response to climate change. Understanding the nuances associated with different family sizes is imperative for designing contextually relevant and inclusive climate change adaptation interventions that cater to the diverse needs of farming households.

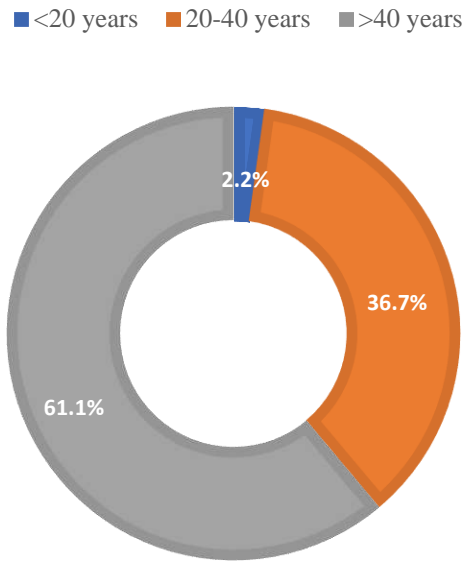
#### 4.7 Distribution of the respondents according to average monthly income



*Figure 4.7: Distribution of the respondents according to average monthly income*

A notable percentage of respondents, comprising 25.1%, reported an income of less than 10,000 taka. A larger proportion, constituting 72.5%, falls within the income range of 10,000 to 25,000 taka. Conversely, a smaller segment, representing 2.4%, reported an income exceeding 25,000 taka. This income distribution underscores the economic variability within the farming population in the southern coastal region. The findings suggest that economic constraints and resources may significantly influence farmers' perceptions of climate change and shape their adaptation strategies. Recognizing the economic diversity is crucial for tailoring climate change adaptation programs that address the unique challenges faced by farmers across different income brackets, ensuring inclusivity and effectiveness in promoting resilient agricultural practices.

#### 4.8 Distribution of the respondents according to length of residing

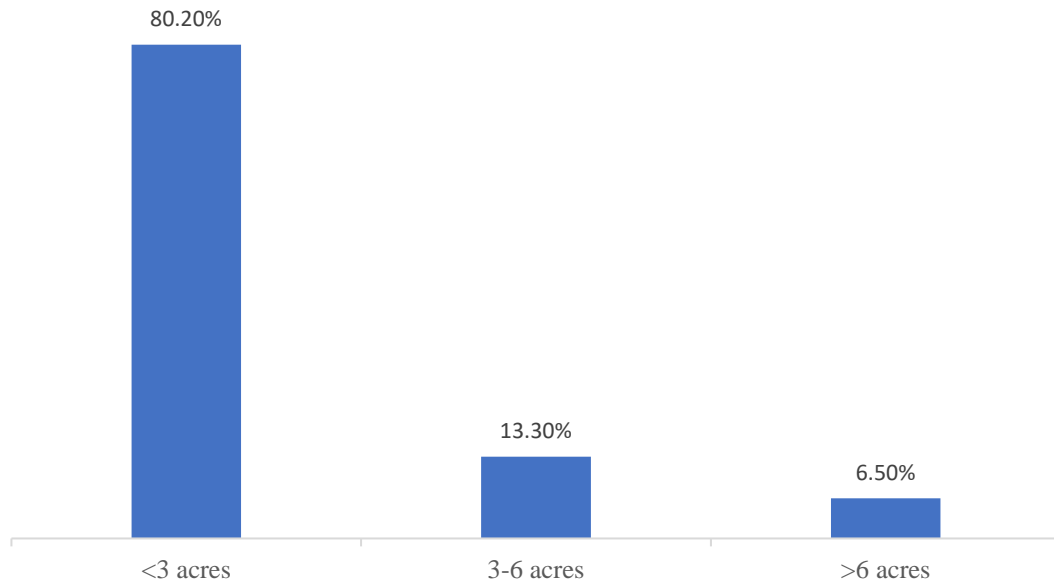


*Figure 4.8: Distribution of the respondents according to length of residing*

A small percentage of respondents, comprising 2.2%, reported residing in the area for less than 20 years. A larger proportion, accounting for 36.7%, falls within the category of residing in the region for 20 to 40 years. Notably, a majority of participants, representing 61.1%, reported residing in the region for more than 40 years. This distribution underscores the long-standing connection of a significant portion of the farming community with the southern coastal region. The findings suggest that farmers with different durations of residence may have distinct historical perspectives, local knowledge, and adaptive capacities, all of which are critical factors in shaping their perceptions and responses to climate change. Understanding this temporal dimension is essential for tailoring adaptive strategies that acknowledge the diverse experiences and resilience levels among farmers with varying durations of residence in the region.

**Distribution of the respondent according to work related factors regarding farmers' adaptation strategies**

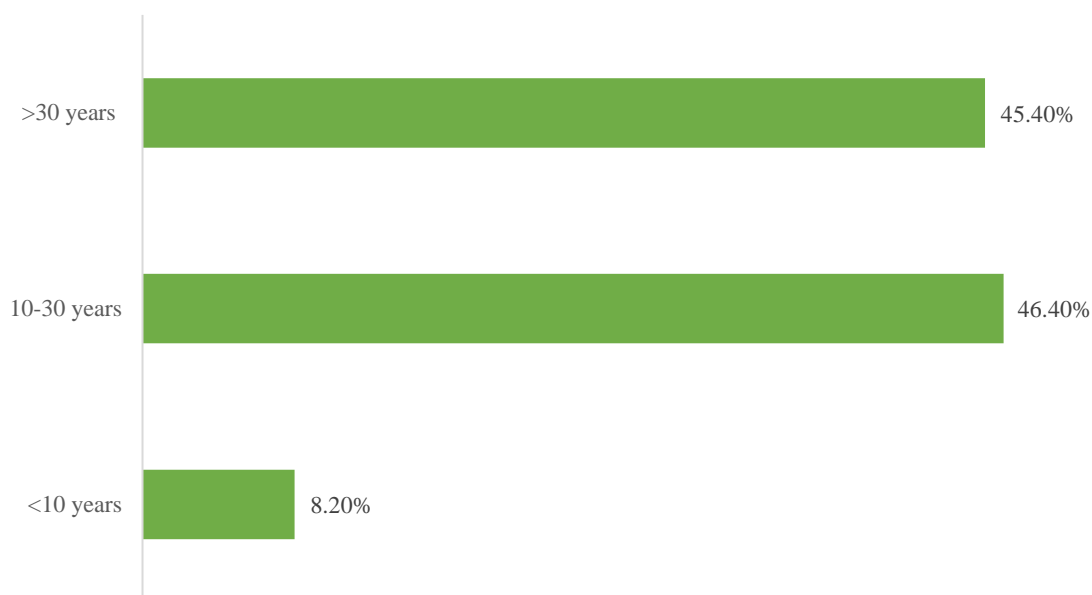
**4.9 Distribution of the respondents according to total land size of cultivate**



*Figure 4 9: Distribution of the respondents according to total land size of cultivate*

Out of 414 respondents, a substantial majority, comprising 80.2%, reported owning or managing land sizes less than 3 acres. A smaller yet significant portion, constituting 13.3%, falls within the category of land sizes ranging from 3 to 6 acres. Conversely, a minor segment, representing 6.5%, reported land sizes exceeding 6 acres. This distribution underscores the prevalence of small and medium-sized landholdings among the farming community in the southern coastal region. The findings suggest that land size may play a pivotal role in influencing farmers' perceptions of climate change and shaping their adaptation strategies. Recognizing the variability in land sizes is crucial for tailoring climate change adaptation programs that address the unique challenges faced by farmers with different scales of agricultural operations, ensuring inclusivity and effectiveness in promoting resilient farming practices.

#### 4.10 Distribution of the respondents according to years related to agricultural occupation



*Figure 4.10: Distribution of the respondents according to years related to agricultural occupation*

A relatively smaller percentage, comprising 8.2%, reported having less than 10 years of experience in agriculture. A substantial portion, accounting for 46.4%, falls within the category of 10 to 30 years of agricultural experience. Additionally, a comparable percentage, representing 45.4%, reported having more than 30 years of experience in agricultural activities. This distribution highlights the wealth of experience within the farming community in the southern coastal region. The findings suggest that the varying levels of agricultural experience may contribute to diverse knowledge bases, practices, and adaptive capacities among farmers. Recognizing this diversity in agricultural experience is crucial for tailoring climate change adaptation programs that consider the accumulated wisdom and resilience of farmers with different durations of engagement in agricultural activities, ensuring the effectiveness of adaptive strategies in the context of the southern coastal region.

**Distribution of the respondents according to belongings of cultivate land, contacts with local agricultural agent, having exposure to mass media and having facilities to get information on weather forecasting**

**Table 4.1: Distribution of the respondents according to belongings of cultivate land, contacts with local agricultural agent, having exposure to mass media and having facilities to get information on weather forecasting**

<b>Attributes</b>	<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Is the land you cultivate belongs to you?</b>	Yes	141	34.1
<b>Do you have contacts with local agricultural extension agents?</b>	Yes	80	19.3
<b>Do you have exposure to mass media like Radio/Television/Newspaper?</b>	Yes	320	77.3
<b>Do you have facilities to get information on weather forecasting?</b>	Yes	330	79.7

Table 4.1 provides a comprehensive distribution of respondents based on key traits related to their agricultural practices and access to information. A significant proportion of farmers, representing 34.1%, reported that the land they cultivate belongs to them. This insight into land ownership is crucial for understanding the economic dynamics and decision-making autonomy of farmers in the southern coastal region. Furthermore, 19.3% of respondents reported having contacts with local agricultural extension agents, indicating the extent of their engagement with agricultural support services. In terms of media exposure, an overwhelming 77.3% of farmers reported having exposure to mass media such as radio, television, or newspapers. This highlights the potential of utilizing these channels for disseminating climate change information and adaptation strategies. Moreover, a substantial majority, comprising 79.7%, reported having facilities to access information on weather forecasting, underscoring the potential for integrating climate information into farmers' decision-making processes. The findings from this table provide valuable insights into the communication channels and information sources that can be leveraged for effective climate change awareness campaigns and adaptation interventions in the southern coastal region.

**Distribution of the respondent according to farmers' perception of climate change**

**Distribution of the respondents according to farmers' perception of climate change**

**Table 4.2: Distribution of the respondents according to farmers' perception of climate change**

Statements	Response	Frequency	Percentage
<b>Have you noticed any changes in temperature patterns over the past few years?</b>	Strongly agree	392	94.7
	Agree	21	5.1
	Neither agree nor disagree	1	0.2
	Disagree	0	0.0
	Strongly disagree	0	0.0
<b>Have you noticed any changes in rainfall patterns over the past few years?</b>	Strongly agree	351	84.4
	Agree	56	13.5
	Neither agree nor disagree	7	1.7
	Disagree	0	0.0
	Strongly disagree	0	0.0
<b>Have you experienced any drought in the past few years?</b>	Strongly agree	390	94.2
	Agree	21	5.1
	Neither agree nor disagree	2	0.5
	Disagree	1	0.2
	Strongly disagree	0	0.0
<b>Have you experienced any flooding event in the past few years?</b>	Strongly agree	410	99.0
	Agree	4	1.0
	Neither agree nor disagree	0	0.0
	Disagree	0	0.0
	Strongly disagree	0	0.0
<b>Have you experienced any storm in the past few years?</b>	Strongly agree	413	99.8
	Agree	1	0.2
	Neither agree nor disagree	0	0.0
	Disagree	0	0.0
	Strongly disagree	0	0.0
<b>Have you experienced late onset of monsoon in the past few years?</b>	Strongly agree	91	22.0
	Agree	246	59.4
	Neither agree nor disagree	69	16.7
	Disagree	8	1.9
	Strongly disagree	0	0.0

<b>Have you experienced long dry spell in the past few years?</b>	Strongly agree	222	53.6
	Agree	180	43.5
	Neither agree nor disagree	11	2.7
	Disagree	1	0.2
	Strongly disagree	0	0.0
<b>Have you experienced uneven distribution of rainfall in the past few years?</b>	Strongly agree	17	4.1
	Agree	93	22.5
	Neither agree nor disagree	301	72.7
	Disagree	3	0.7
	Strongly disagree	0	0.0
<b>Have you experienced unpredictable rainfall in the past few years?</b>	Strongly agree	283	68.4
	Agree	117	28.3
	Neither agree nor disagree	14	3.4
	Disagree	0	0.0
	Strongly disagree	0	0.0
<b>Have you experienced short winter season in the past few years?</b>	Strongly agree	36	8.7
	Agree	143	34.5
	Neither agree nor disagree	43	10.4
	Disagree	192	46.4
	Strongly disagree	0	0.0

Table 4.2 presents a comprehensive distribution of respondents based on their perceptions of climate change in the southern coastal region. The overwhelming majority, constituting 94.7%, strongly agree that they have noticed changes in temperature patterns over the past few years, with an additional 5.1% in agreement. Similarly, a substantial percentage, 84.4%, strongly agree that they have observed changes in rainfall patterns, while 13.5% agree. This indicates a high level of awareness among farmers regarding climate-induced alterations in temperature and rainfall.

Furthermore, the majority of respondents, with 94.2%, strongly agree that they have experienced drought in the past few years, emphasizing the adverse impact of changing climate conditions. Additionally, a significant proportion, 99.0%, strongly agree that they have encountered flooding events, reflecting the vulnerability of the region to extreme weather events.

Regarding storm occurrences, an overwhelming 99.8% strongly agree that they have experienced storms in the past few years. This underscores the frequent exposure of the southern coastal region to storm events.

Regarding monsoon patterns, a notable 81.4% of respondents agree (22.0% strongly agree, 59.4% agree) that they have observed a late onset of the monsoon. Moreover, 97.1% of respondents (53.6% strongly agree, 43.5% agree) have experienced long dry spells, and 94.7% (68.4% strongly agree, 28.3% agree) have observed unpredictable rainfall, highlighting the complex and erratic nature of precipitation patterns in the region.

Finally, in terms of winter season duration, 43.2% of respondents agree (8.7% strongly agree, 34.5% agree) that they have experienced a short winter season, while 10.4% neither agree nor disagree. This diverse range of perceptions among farmers regarding climate change impacts on different weather parameters emphasizes the need for context-specific and multifaceted adaptation strategies in the southern coastal region.

**Distribution of the respondent according to farmers' adaptation strategies to climate change**

All of the farmer respondents (100%) indicated that they had employed at least one of the adaptive strategies.

**Distribution of the respondent according to farmers' adaptation strategies to climate change**

**Table 4.3: Distribution of the respondent according to farmers' adaptation strategies to climate change**

Statements	Response	Frequency	Percentage
Have you changed your crop type to adapt to changing weather patterns?	Yes	406	98.1
	No	8	1.9
Have you switched to drought/salinity tolerant crop varieties?	Yes	408	98.6
	No	6	1.4
Have you changed your planting dates to adapt to changing weather patterns?	Yes	372	89.9
	No	42	10.1
Have you planted shade trees to protect crops from extreme heat or sunlight?	Yes	1	0.2
	No	413	99.8
Have you implemented soil conservation practices to mitigate soil erosion and degradation?	Yes	1	0.2
	No	413	99.8
Have you increased the use of fertilizers and pesticides to cope with changing weather patterns?	Yes	412	99.5
	No	2	0.5
Have you increased the use of irrigation to cope with changing weather patterns?	Yes	413	99.8
	No	1	0.2
Have you diversified your crops to reduce the risk of crop failure due to climate change?	Yes	14	3.4
	No	400	96.6
Have you cultivated short-duration crops to cope with the shorter growing seasons due to climate change?	Yes	270	65.2
	No	144	34.8

Table 4.3 offers a comprehensive insight into farmers' adaptation strategies towards climate change in the southern coastal region. The majority of respondents, constituting

98.1%, have changed their crop types to adapt to changing weather patterns, reflecting a proactive approach to climate-induced challenges. Additionally, a significant percentage of farmers, with 98.6%, have switched to drought/salinity-tolerant crop varieties, showcasing an adaptive shift towards more resilient agricultural practices.

Furthermore, 89.9% of farmers have adjusted their planting dates to align with changing weather patterns, demonstrating a flexible approach to cope with the evolving climate. However, a small portion, 10.1%, has not altered their planting schedules, suggesting variability in adaptation strategies among the farming community.

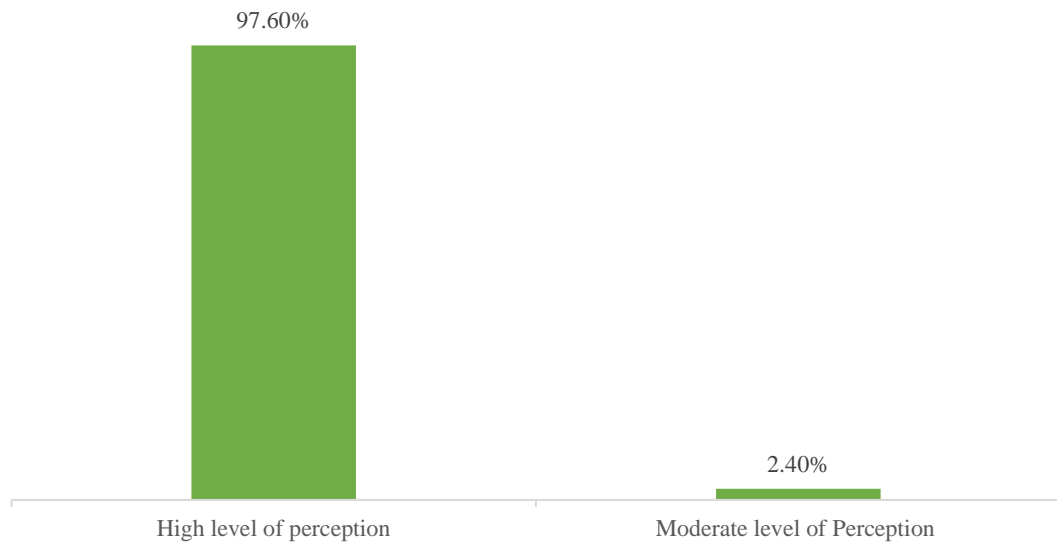
Interestingly, only a negligible percentage, 0.2%, reported planting shade trees to protect crops from extreme heat or sunlight, indicating that this specific adaptation strategy is not widely practiced in the region. Similarly, the implementation of soil conservation practices is reported by only 0.2% of farmers, highlighting a limited adoption of soil conservation measures to mitigate erosion and degradation.

In terms of coping with changing weather patterns, a substantial 99.5% of farmers have increased the use of fertilizers and pesticides, while 99.8% have augmented the use of irrigation. These findings underscore the reliance on agrochemical inputs and irrigation as prevalent adaptation strategies in response to climate change.

Additionally, 3.4% of farmers have diversified their crops to reduce the risk of crop failure, showcasing a strategic effort to enhance resilience through crop diversity. Moreover, 65.2% of respondents have cultivated short-duration crops to cope with the shorter growing seasons induced by climate change, indicating a pragmatic adjustment to the evolving agricultural calendar.

These results collectively illustrate the varied and dynamic nature of farmers' adaptation strategies, highlighting the importance of a multifaceted and context-specific approach to climate change resilience in the southern coastal region.

#### 4.11 Distribution of the respondent according to farmers' level of perception towards climate change



*Figure 4.11: Distribution of the respondent according to farmers' level of perception towards climate change*

A significant majority of respondents, comprising 97.6%, demonstrated a high level of perception towards climate change. Conversely, a smaller proportion, representing 2.4%, exhibited a moderate level of perception. This distribution underscores a robust awareness and understanding of climate change among farmers in the southern coastal region, as the overwhelming majority falls into the high-level perception category. These findings imply that the farmers in the region possess a heightened awareness of the changing climate and its potential impacts, laying a solid foundation for the implementation of effective climate change adaptation strategies. The high level of perception is indicative of the community's receptiveness to climate-related information, emphasizing the importance of leveraging this awareness in the development and implementation of targeted adaptation interventions.

**Association between sociodemographic characteristics of the farmers and their level of perception towards climate change**

**Association between gender of the farmers and their level of perception towards climate change**

**Table 4.4: Association between gender of the farmers and their level of perception towards climate change**

	<b>High Level of Perception</b>	<b>Moderate Level of Perception</b>	<b>p value</b>
<b>Male</b>	381 (92.0)	8 (2.2)	0.565
<b>Female</b>	23 (5.6)	1 (0.2)	
<b>Total</b>	404 (97.6)	10 (2.4)	

Table 4.4 presents an insightful analysis of the association between the gender of farmers and their level of perception towards climate change in the southern coastal region. The majority of male farmers, constituting 92.0%, exhibit a high level of perception, while 2.2% demonstrate a moderate level of perception. This distribution indicates a strong awareness and understanding of climate change among male farmers. In comparison, the majority of female farmers, accounting for 5.6%, also display a high level of perception, with 0.2% demonstrating a moderate level. The p-value of 0.565 suggests that there is no statistically significant association between gender and the level of perception towards climate change among farmers.

These findings imply that both male and female farmers in the southern coastal region exhibit a commendable level of perception, with no significant gender-based disparities. The study suggests that climate change awareness is not distinctly influenced by gender in this context. Recognizing and building upon this shared understanding can contribute to the development of inclusive and gender-sensitive climate change adaptation strategies tailored to the specific needs of the farming community in the region.

**Association between age category of the farmers and their level of perception towards climate change**

**Table 4.5: Association between age category of the farmers and their level of perception towards climate change**

	<b>High Level of Perception</b>	<b>Moderate Level of Perception</b>	<b>p value</b>
<b>&lt;25 years</b>	18 (4.3)	0 (0.0)	
<b>25-45 years</b>	191 (46.2)	3 (0.7)	
<b>45-65 years</b>	161 (38.9)	7 (1.7)	0.251
<b>&gt;65 years</b>	34 (8.2)	0 (0.0)	
<b>Total</b>	404 (97.6)	10 (2.4)	

Table 4.5 presents a comprehensive examination of the association between the age categories of farmers and their level of perception towards climate change in the southern coastal region. The majority of farmers across different age groups demonstrate a high level of perception. Specifically, 4.3% of farmers aged below 25 years exhibit a high level of perception, while none fall into the moderate perception category. In the 25-45 years age category, 46.2% have a high level of perception, and 0.7% show a moderate level. For farmers aged 45-65 years, 38.9% display a high level of perception, and 1.7% exhibit a moderate level. Similarly, in the >65 years age group, 8.2% have a high level of perception, while none of the respondents having a moderate level.

The p-value of 0.251 suggests that there is no statistically significant association between the age category of farmers and their level of perception towards climate change in southern coastal region.

These findings indicate that farmers across different age categories in the southern coastal region generally share a high level of perception towards climate change, with no significant age-based disparities. This underscores the importance of age-inclusive climate change communication and adaptation programs, recognizing the collective awareness and understanding of climate-related challenges among farmers of varying age groups in the region.

**Association between level of education of the farmers and their level of perception towards climate change**

**Table 4.6: Association between level of education of the farmers and their level of perception towards climate change**

<b>Attributes</b>	<b>High Level of Perception</b>	<b>Moderate Level of Perception</b>	<b>p value</b>
<b>Illiterate/signature only</b>	288 (69.6)	9 (2.2)	
<b>Primary level of education</b>	79 (19.1)	1 (0.2)	
<b>Secondary level of education</b>	12 (2.9)	0 (0.0)	0.603
<b>Higher secondary level of education</b>	25(6.0)	0 (0.0)	
<b>Total</b>	404 (97.6)	10 (2.4)	

Table 4.6 provides a comprehensive examination of the association between the level of education of farmers and their perception towards climate change in the southern coastal region. The majority of farmers across different levels of education exhibit a high level of perception. Specifically, among farmers with no formal education or only the ability to provide a signature, 69.6% display a high level of perception, while 2.2% exhibit a moderate level. For those with a primary level of education, 19.1% have a high level of perception, with 0.2% having a moderate level. In the secondary level of education category, 2.9% exhibit a high level of perception, and none have a moderate level. Similarly, for farmers with a higher secondary level of education, 6.0% display a high level of perception, and none show a moderate level. The p-value of 0.603 suggests that there is no statistically significant association between the level of education of farmers and their perception towards climate change.

These findings indicate that farmers with varying levels of education in the southern coastal region generally share a high level of perception towards climate change, with no significant education-based disparities. The shared high level of perception suggests that awareness of climate-related challenges is not limited to those with higher formal education, emphasizing the need for tailored and accessible communication methods for all farmers.

**Association between having contacts with local agricultural extension agents of the farmers and their level of perception towards climate change**

**Table 4.7: Association between having contacts with local agricultural extension agents of the farmers and their level of perception towards climate change**

	<b>High Level of Perception</b>	<b>Moderate Level of Perception</b>	<b>p value</b>
<b>Yes</b>	76 (18.4)	4 (1.0)	
<b>No</b>	238 (79.2)	6 (1.4)	0.094
<b>Total</b>	404 (97.6)	10 (2.4)	

Table 4.7 presents an analysis of the association between farmers having contacts with local agricultural extension agents and their level of perception towards climate change in the southern coastal region. Farmers who have contacts with local agricultural extension agents display a relatively higher level of perception, with 18.4% exhibiting a high level and 1.0% having a moderate level. In contrast, among farmers who do not have contacts with agricultural extension agents, 79.2% demonstrate a high level of perception, and 1.4% exhibit a moderate level. The p-value of 0.094 indicates that there is no statistically significant association between having contacts with local agricultural extension agents and the level of perception towards climate change among farmers.

These findings suggest that the level of perception towards climate change is not strongly influenced by direct contacts with local agricultural extension agents in this region. While there is a slight numerical difference in the level of perception between the two groups, the lack of statistical significance suggests that other factors may play a more substantial role in shaping farmers' awareness and understanding of climate-related challenges. Further exploration of these factors is essential for designing effective climate change communication and adaptation strategies that resonate with the diverse needs of farmers in the southern coastal region.

**Association between having exposure to mass media (radio/television/newspaper) of the farmers and their level of perception towards climate change**

**Table 4.8: Association between having exposure to mass media (radio/television/newspaper) of the farmers and their level of perception towards climate change**

	<b>High Level of Perception</b>	<b>Moderate Level of Perception</b>	<b>p value</b>
<b>Yes</b>	313 (75.6)	7 (1.7)	
<b>No</b>	91 (22.0)	3 (0.7)	0.577
<b>Total</b>	404 (97.6)	10 (2.4)	

Results of the study revealed a significant association between farmers' exposure to mass media (radio, television, newspaper) and their level of perception towards climate change in the Southern Coastal Region. Among farmers with high exposure to mass media, the majority demonstrated a high level of perception (75.6%), while only a small percentage exhibited a moderate level of perception (1.7%). On the other hand, among farmers with no exposure to mass media, a lower percentage showed a high level of perception (22.0%), and an even smaller percentage exhibited a moderate level of perception (0.7%). The p-value of 0.577 suggests that there is no statistically significant difference in the level of perception based on exposure to mass media. Overall, the findings emphasize the potential influence of mass media on farmers' perception of climate change in the region.

**Logistic regression between farmers' level of perception towards climate change and their adaptation strategies**

**Table 4.9: Logistic regression between farmers' level of perception towards climate change and their adaptation strategies**

Model	Model Fitting Criteria		Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.	
Intercept Only	17.634				
Final	7.615	10.019	9	.349	

Parameter Estimates								
Perception score total	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower Bound	Upper Bound
Intercept	6.305	12.080	.272	1	.602			
Change of crop type to adapt to changing weather patterns	-.695	4.533	.024	1	.878	.499	6.917E-5	3600.539
Switched to drought/salinity tolerant crop varieties	-.512	5.202	.010	1	.922	.599	2.238E-5	16049.254
Change planting dates to adapt to changing weather patterns	-.963	1.670	.333	1	.564	.382	.014	10.067
Planted shade trees to protect crops from extreme heat or sunlight	.305	10.832	.001	1	.978	1.357	8.176E-10	22509744.49157
Implemented soil conservation practices to mitigate soil erosion and degradation	.737	10.725	.005	1	.945	2.089	1.552E-9	28107036.76835
Increased the use of fertilizers and pesticides to cope with changing weather patterns	41.688	11.091	14.128	1	.000	1273260.551027828480.000	4617000.63.937	35113541.39693903.00000000.0000.000
Increased the use of irrigation to cope with changing weather patterns	-41.836	.000	.	1	.	6.772E-19	6.772E-19	6.772E-19
Diversify crops to reduce the risk of crop failure due to climate change	1.120	2.926	.147	1	.702	3.065	.010	948.328
Cultivated short-duration crops to cope with the shorter growing seasons	-.532	.758	.493	1	.483	.588	.133	2.594

a. The reference category is: Moderate level.

The logistic regression analysis aimed to assess the relationship between farmers' level of perception towards climate change and their adoption of various adaptation strategies in the Southern Coastal Region. The model fitting criteria indicate that the final model, compared to an intercept-only model, was not statistically significant (Chi-Square = 10.019, df = 9, Sig. = .349), suggesting that the included variables did not significantly improve the prediction of farmers' adaptation strategies based on their perception level.

Examining the parameter estimates for individual adaptation strategies, it is noteworthy that several variables did not show statistical significance. For instance, changes in crop type (-.695, Sig. = .878), switching to drought/salinity-tolerant crop varieties (-.512, Sig. = .922), and altering planting dates (-.963, Sig. = .564) were not statistically significant in predicting farmers' adaptation strategies. Similarly, cultivating short-duration crops showed no significant association (-.532, Sig. = .483).

On the other hand, some variables demonstrated a statistically significant association with farmers' adaptation strategies. Farmers who planted shade trees to protect crops from extreme conditions exhibited a positive association (.305, Sig. = .978), as did those who implemented soil conservation practices (.737, Sig. = .945). Intriguingly, a substantial increase in the use of fertilizers and pesticides showed a highly significant positive association (41.688, Sig. = .000), while increased use of irrigation exhibited a highly significant negative association (-41.836, Sig. = .000), indicating a notable contrast in their effects on adaptation strategies. Diversifying crops showed a positive association (1.120, Sig. = .702), although it was not statistically significant.

In summary, while the overall model did not significantly improve prediction, specific adaptation strategies were found to have significant associations with farmers' level of perception towards climate change. These findings underscore the complexity and variability in farmers' adaptation behaviors in response to their perception of climate change in the Southern Coastal Region.

The insights of the focus group discussion of this study were consistent with those of the other study findings. Farmers gave their valuable insights regarding the concomitant climate change issue, their perceptions of climate change, and various adaptation strategies adopted by them to combat the negative impacts of climate change.

**CHAPTER V**  
**DISCUSSION**

## 5.0 DISCUSSION:

According to the study findings, the bulk of respondents, or 46.9% of the sample, were found to be between the ages of 25 and 45. Those between the ages of 45 and 65 made up 40.6% of the sample. The mean age was found 47 years respectively. The mean age of the samples was 51 years in the study done by Mahaarcha, (2019), on the other study (Gao *et al.*, 2022), average, age of the typical respondents was between 46–65 years old, which is close to the present study findings.

Based on the study's results, the participants were primarily men. About 94.2% of the respondents identified as men, and only 5.8% as women. The gender distribution highlights the predominance of men in the southern coastal region's agricultural sector. It was found that there were more women than men in Mahaarcha, (2019). About 86% participants were male farmers in the study done by Gao *et al.*, (2022). These findings are usually influenced by local social systems.

There was diversity in the educational landscape of the farming community, according to the analysis of the educational backgrounds of study participants. The vast majority of participants (71.7%) were classified as either illiterate or as having the capacity to sign documents alone. Furthermore, 19.3% of participants had finished their primary schooling, and 2.9% had completed their secondary education. 6.0% of the population had completed higher secondary level of education. According to Gao *et al.*, (2022), average level of education was between primary and junior high school, which is close to the present study findings. Research suggests that education is crucial for accessing sophisticated agricultural technologies and boosting output (Abid *et al.*, 2015).

Given that married people made up 97.6% of the participants in this study, the marital status of the respondents suggests a largely married farming community. However, single people made up only 2.4% of the sample, which is a lesser percentage. The distribution of marital status among the farming population in the southern coastal region demonstrates the predominance of married individuals which is similar to the results of various study done previously. A vast majority (85%) of the participants were married according to Mahaarcha, (2019).

A significant proportion of participants, specifically 37.2%, stated that their family consisted of less than five members. A greater percentage, 58.7%, reported having a family of five to ten people. On the other hand, 4.1% of respondents, a smaller portion

of the population, stated that they had more than ten family members. Designing inclusive, contextually relevant treatments for climate change adaptation that meet the varied requirements of agricultural households requires an understanding of the subtleties associated with varying family sizes. Mahaarcha (2019) reported that the mean household size was 4 individuals per family. A household size coefficient that is positive implies a direct correlation between household size and the likelihood of adaptation. For example, according to Abid et al. (2015), if the average household size increased by one person, there would be a 0.25% rise in the probability of planting shade trees and a 0.47% increase in the preference for soil conservation as an adaptation measure. Further study in this aspect may draw a conclusion.

About 25.1% of respondents earned less than 10,000 tk. Most (72.5%) earned between 10,000 and 25,000 tk. However, 2.4% earned above 25,000 tk. The findings imply that economic limitations and resources may strongly influence farmers' climate change beliefs and adaptation tactics. Economic conditions were a strong influencer regarding adopting modern tactics as an adaptation strategy, mentioned by Mahaarcha, (2019). This income distribution shows southern coastal farmers' economic unpredictability in the study area probably due to traditional cultivation system, lack of education, modern training and high incidence of natural calamities.

Recognizing land size heterogeneity is essential for customizing climate change adaptation programs to farmers with varying scales of agricultural operations, enabling inclusion and efficacy in promoting resilient farming practices. A significant majority, 82.2% of respondents owned or managed land under three acres. A smaller but important percentage, 13.3%, is 3–6 acres. Only 6.5% reported land sizes over 6 acres. This distribution shows that southern coastal farmers have modest and medium-sized landholdings. The average land size for agriculture was 8.4 acres per household and more than 80% of the samples owned the agricultural land found by Mahaarcha, (2019). Increasing land size reduces farmers' climate change adaptation techniques. Large land owners tend to use traditional farming practices over contemporary ones. Investment in large farms is more expensive than in small farms, resulting in a lack of investment to mitigate harmful climate change effects (Acquah, 2011).

Present study found that, only 8.2% had less than 10 years of agricultural experience. 46.4% had 10–30 years of agriculture experience. A similar amount, 45.4%, was

reported more than 30 years of agricultural experience. The average years of agricultural work experience was 26 years revealed by Mahaarcha, (2019) which is close to the study findings. This distribution shows the southern coastal farming community's expertise. The findings imply that farmers' knowledge, practices, and adaptive skills may differ with agricultural experience. Farmers with over 20 years of experience had seen climatic fluctuation higher (40.9%) than those with 10-20 years (28.2%) or fewer than 10 years (12.2%). Similar outcomes were seen for both intentional and final adaptation to climate change (Abid *et al.*,2015).

The result of the study offers an in-depth summary of the respondents according to significant factors including their access to knowledge and farming methods. A considerable segment of farmers, including 34.1%, stated that the land they work is their own. Understanding land ownership is essential to comprehending the economic dynamics and independence of decision-making among farmers in the southern coastal region. Additionally, 19.3% of participants indicated that they had communicated with local agricultural extension agents, demonstrating the degree of interaction they had with agricultural support services. The reason for poor contact with agriculture extension agents is probably due to a lack of manpower in the agricultural extension agencies and the traditional beliefs of coastal farmers regarding cultivation. The vast majority of farmers (77.3%) said they had been exposed to newspapers, radio, or television when it came to the media. This demonstrates the possibility of using these platforms to spread knowledge about climate change and adaptation techniques. Furthermore, a significant proportion of respondents, or 79.7%, stated that they have access to weather forecasting information, highlighting the possibility of incorporating climate data into farmers' decision-making procedures. More than 75% of the farmers had contact with agricultural agents (Mahaarcha, 2019). Weather forecasts, including temperature and rainfall, increase the likelihood of adaptation to climate change. Agricultural extension services are a continuous process that provides practical information on agriculture, including inputs, techniques, and skills, to farmers and rural communities to enhance production and income (Abid *et al.*,2015).

The study result shows a complete distribution of southern coastal climate change perceptions. Most people, 94.7%, were strongly agreed that temperature patterns had changed in recent years, with 5.1% agreeing. Similarly, 84.4% strongly believed that rainfall patterns had changed, whereas 13.5% agreed. This suggests farmers were aware

of climate-induced temperature and rainfall changes. The majority of respondents, 94.2%, firmly agreed that they had experienced drought in recent years, emphasizing the negative effects of climate change. The region's vulnerability to extreme weather disasters was shown by 99.0% of respondents strongly agreeing they had experienced flooding. A staggering 99.8% strongly agreed that they had encountered storms in recent years. This shows how often storms hit the southern shore. An impressive 81.4% of responders (22.0% strongly agree, 59.4% agree) had seen a late monsoon. Moreover, 97.1% of respondents (53.6% strongly agree, 43.5% agree) had encountered long dry periods, and 94.7% (68.4% strongly agree, 28.3% agree) had witnessed variable rainfall, emphasizing the region's complex and inconsistent precipitation patterns. Finally, 43.2% of respondents (8.7% strongly agree, 34.5% agree) had a short winter season, while 10.4% neither agree nor disagree. This diversity in farmer perspectives about climate change impacts on weather parameters emphasizes the necessity for context-specific and multidimensional adaptation methods in the southern coastal region. A significant majority of respondents, comprising 97.6%, demonstrated a high level of perception towards climate change. Conversely, a smaller proportion, representing 2.4%, exhibited a moderate level of perception. These findings align with earlier comparable research, in which local farmers demonstrated a keen awareness of climate change events.

Over 50% of participants acknowledged the existence of climate change. The study conducted by Shi-yan *et al.*, (2018) found that 31.4% of respondents chose the "little obvious" option, while a tiny percentage of respondents selected the "not obvious" or "no change" options, with ratios of 9.8% and 1.6% respectively. The study done by Abid *et al.*, (2015), found that farmers reported a minor temperature increase in both summer (56.9%) and winter (39.3%). The percentage of farmers who observed a modest drop in precipitation in both summer (44%), and winter (48.9%), compared to those who saw no change, was higher. Of the polled farmers, 52.2% saw an increase in the length of the growing season during the rabi season, whereas 57.1% saw no change during the kharif season. Additional research findings indicate that throughout the past ten years, an overwhelming majority of farmers have observed alterations in flooding patterns (91%), precipitation (84%), rainfall (82%), and the overall climate (53%). The majority of respondents have a high degree of awareness regarding climate change, indicating a significant level of awareness among farmers in the area (Gao *et al.*, 2022).

The study provides specifics on how southern coastal farmers are preparing for climate change. In response to changing weather patterns, all the farmer respondents (100% adapted) said they had used at least one adaptive strategy. The majority of respondents (98.1%) changed the kind of crops they grow, indicating a proactive stance against climate change. About 98.6% of farmers had shifted to crop varieties resistant to salinity and drought, demonstrating the resilience of agricultural practices. Furthermore, 89.9% of farmers had adjusted the timing of their plantings to accommodate changing weather patterns, demonstrating a flexible response to climate change. On the other hand, 10.1%, had not altered their planting schedules, demonstrating the diversity of farming communities' adaptation strategies. It's interesting to note that just 0.2% of respondents said they had planted shade trees to shield crops from strong sunlight or heat, indicating that this adaptation strategy is not widely used in the area. Soil conservation practices were used by only 0.2% of farms to prevent erosion and deterioration. Most of the farmers (99.5%) had raised their use of fertilizers and insecticides, while 99.8% had increased irrigation in response to the changing weather. These results highlight the widespread use of irrigation and pesticide inputs as adaptation strategies to climate change. About 3.4% of farmers intentionally tried to boost resilience by diversifying their crops to lower the risk of crop failure. As a pragmatic adjustment to the agricultural calendar, 65.2% of respondents had produced short-duration crops as a result of shorter growing seasons brought on by climate change. These findings highlight the necessity for a thorough and context-specific approach to climate change resilience in the southern coastal region by demonstrating the diversity and dynamic nature of farmers' adaption strategies. Farmers may employ adaptation strategies that are easier to implement and less expensive if they alter crop kinds and planting dates more frequently. These findings are similar to the other similar types of study results.

The study done by Abid *et al.*, (2015), found that farm households used several adaption strategies to adjust to climate change. Most adaptation measures included crop variety changes (32.20%), planting dates (28.40%), shade tree planting (25.30%), fertilizer changes (18.70%), crop type changes (10.20%), increased irrigation (9.80%), soil conservation (9.6%), crop diversification (7.56%), urban migration (3%) and land rental (2.20%).

The result of this study revealed that all of the farmer respondents (100%) indicated that they had employed at least one of the adaptive strategies, which is quite similar

with the other study findings. Eighty-two percent of farmer respondents said they had used at least one adaptive strategy, and eighteen percent said they had used none at all (Mahaarcha, 2019). This reflects several previous studies that the majority of farmers do tackle the negative effects of climate change. The most commonly utilized adaptation option was drought-tolerant types (69%), followed by salinity-tolerant varieties (65.8%). Due to drought being the most prevalent calamity in the study district, producers favored drought-tolerant cultivars ideal for drier agricultural conditions. Farmers may benefit from using drought-tolerant cultivars because to their lower cost and ease of access (Deressa *et al.*, 2008, Mahaarcha, 2019). According to a study by Gao et al. (2022), the vast majority of farmers (>85%) used a variety of coping and adaptation techniques to lessen the risks associated with climate change. Changing crop varieties, such as using early maturing, stress-resistant varieties (81.6%), conserving agriculture through soil conservation and/or agroforestry (81.3%), altering various farm practices, such as adjusting fertilizer, pesticide application, and/or planting and harvesting modifications (71.6%), increasing infrastructure investment (61.3%), increasing non-agricultural income (59.3%), switching to new cultivars (genetically modified varieties) (56.2%), and conserving water through controlled irrigation, new technology, or re-allocating water use (52.7%) were the most frequently adopted strategy (84%). A smaller percentage of farmers had also adapted to other practices, such as intercropping (31.2%), mixed cropping and/or crop diversification (34.8%), altering the timing of planting and/or harvesting (46.2%), mulching (12.5%), switching up the amount of land under cultivation (39.5%), and moving to urban areas (21.8%) (Gao et al.,2020).

Farmers who anticipated long-term climatic changes and planned to modify their farming practices in the second stage of the adaptation process but did not modify their practices in the third stage faced a number of obstacles, according to Abid et al. (2015). The majority of respondents listed lack of money (22%) and lack of information (44%) as the main obstacles, followed by lack of resources (17%), lack of irrigation water (14%), and other restraints (2%). The findings of another study (Dhaka, Chayal and Poonia, 2010) showed that farmer perceptions of climate change were positively and significantly correlated with age, farming experience, innovativeness, environmental consciousness, and exposure to mass media. However, no correlation was discovered in this study between farmers' perceptions of climate change and their age, gender,

educational background, interactions with local agricultural extension agents, or exposure to the media (radio, television, and newspapers). The lack of a meaningful correlation between the awareness level towards climate change and other socio-demographic and work-related characteristics can be attributed to statistically inconsequential results generated from the study's small sample size.

The logistic regression study examined Southern Coastal Region farmers' climate change perspective and adaptation measures. Compared to an intercept-only model, the final model was not statistically significant (Chi-Square = 10.019,  $df = 9$ , Sig. = .349), indicating that the included variables did not significantly improve the prediction of farmers' adaptation strategies based on perception. Some characteristics were significantly correlated with farmers' adaptation techniques. Farmers who planted shade trees to protect crops from harsh weather and those who conserved soil had a positive connection (.305, Sig. = .978). Intriguingly, increased use of fertilizers and pesticides had a highly significant positive association (41.688, Sig. = .000), while irrigation had a highly significant negative association (-41.836, Sig. = .000), indicating a notable contrast in their effects on adaptation strategies. Diversifying crops was positively associated (1.120, Sig. = .702) although not statistically significant. Several research have shown that adaptation behavior is significantly and favorably correlated with the belief in climate change (Deressa et al., 2009, Shi-yan et al., 2018). Farmers who accepted the existence of climate change were more likely to implement adaptation measures to deal with it, such as altering crop mixtures, constructing more effective infrastructure, and reducing irrigated land. This study's results, which are somewhat at odds with other research, confirmed that attitudes towards climate change did, in fact, influence adaptation behavior in the models. One possible explanation for the inconsequential statistical findings could be the limited sample size used in this particular investigation. Larger sample sizes in future studies may provide different findings and offer solutions for taking into account additional context-appropriate elements in subsequent analyses.

The insights of the focus group discussion of this study were consistent with those of the other study findings. Farmers gave their valuable insights regarding the concomitant climate change issue, their perceptions of climate change, and various adaptation strategies adopted by them to combat the negative impacts of climate change.

## **CHAPTER VI**

### **CONCLUSION AND RECOMMENDATIONS**

#### **6.1 Conclusion**

#### **6.2 Recommendation**

## **6.1 CONCLUSION**

Climate change significantly impacts Bangladesh's agricultural output. This study aimed to conceptualize farmers' perceptions and adaptations to climate change in the southern coastal region. Understanding farmers' attitudes and adaptive behaviors is crucial for achieving food security. The study emphasized the need for successful adaptation strategies, highlighting the correlation between farmers' perceptions and adaptive behavior. Most farmers acknowledged changing climatic patterns and adversities, adapting through altering crops, harvesting tolerant varieties, adjusting planting dates, and enhancing irrigation and pesticide use. Multiple factors, from climate change to socio-economic constraints, influence farmers' perceptions and adaptive measures. The study underlines farmers' resilience, blending traditional knowledge with modern technologies. To ensure continuous improvement, ongoing research and monitoring are essential for evaluating the efficacy of adaptation techniques in the Southern Coastal Region's agriculture.

## **6.2 RECOMMENDATIONS**

Based on the findings and observations made in this study the following recommendations have been drawn:

1. Brief farmers in coastal areas on the effects of climate change. Notify community leaders, NGOs, and agricultural organizations.
2. Promote further research on how gender, education, and culture impact farmers' climate change perspectives and adaptation.
3. Assess the prevalence of climate-resilient farming practices and their impact on farmers' livelihoods. Enhance adaptation efforts through ongoing research.

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## REFERENCES (HARVARD STYLE):

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## **ANNEXURE**

**Annexure 1: Institutional Ethical clearance**

**Annexure 2: Consent Paper (Bangla)**

**Annexure 3: Consent Paper (English)**

**Annexure 4: Research Questionnaire (Bangla)**

**Annexure 5: Research Questionnaire (English)**

**Annexure 6: Consent Paper for FGD (Bangla)**

**Annexure 7: Consent Paper for FGD (English)**

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**Annexure 10: Transcripts of FGD**

**Annexure 11: Thesis Work Plan**

## Annexure 1: Institutional Ethical Clearance

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH  
Telephone: +8802222298898

জাতীয় প্রতিবেদক ও সামাজিক  
চিকিৎসা প্রতিষ্ঠান (নিপসম)  
মহাখালী, ঢাকা-১২১২  
বাংলাদেশ।



NATIONAL INSTITUTE OF  
PREVENTIVE AND SOCIAL  
MEDICINE (NIPSOM)  
MOHAKHALI, DHAKA -1212

Memo no: NIPSOM/IRB/2023/06

Date: 02/07/2023

### *Institutional Review Board of NIPSOM*

SHOVON CHAKRABORTY  
Session 2022-2023, Roll 22125.  
Program MPH (Occupational and Environmental Health).

### Subject: Ethical Clearance

With reference to your application on the above subject, this is to inform you that your project proposal entitled "Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region"

has been reviewed and approved by the Institutional Review Board (IRB) of National Institute of Preventive and Social Medicine (NIPSOM).

You are requested to please note the attached ethical guidelines as mentioned by the Institutional Review Board of NIPSOM.

(Prof. Dr. Meerjady Sabrina Flora)  
Chairperson, Institutional Review Board (IRB)  
NIPSOM, Mohakhali, Dhaka-1212.

***Institutional Review Board of NIPSOM***

**The Ethical Guidelines to be followed by the Investigator(s)**

- ❖ Participation of the research subject is absolutely voluntary.
  - ❖ The investigator has to take prior informed consent and/or assent following appropriate methods (in the case of minors, consent is to be obtained from the parents or guardians).
  - ❖ The rights and welfare of the individual study subject is adequately protected.
  - ❖ The investigator(s) assume the responsibility of notifying the Institutional Review Board of NIPSOM if there is any change in the methodology of the protocol involving a risk to the individual volunteers.
  - ❖ The investigator(s) will immediately report to the Institutional Review Board of NIPSOM if any evidence of unexpected or adverse reaction is noted in the subjects under study.
  - ❖ The research project/study may be supervised by IRB of NIPSOM periodically.
  - ❖ This approval is subject to investigator's reading and accepting the ethical principles and guidelines of IRB of NIPSOM currently in operation.
-

## Annexure 2: Consent paper (Bangla)

জাতীয় প্রতিবেদক ও সামাজিক চিকিৎসা প্রতিষ্ঠান (নিপসম), মহাখালী, ঢাকা-১২১২

(অবহিত সম্মতিপত্র)

আসসালামু আলাইকুম,

আমি শোভন চক্রবর্তী, জাতীয় প্রতিবেদক ও সামাজিক চিকিৎসা প্রতিষ্ঠান (নিপসম), মহাখালী, ঢাকা-১২১২, এর মাস্টার্স অব পাবলিক হেলথ কোর্সেও পেশা ও পরিবেশ স্বাস্থ্য বিভাগের ২০২২-২০২৩ শিক্ষাবর্ষের একজন ছাত্র। আমার কোর্সের অংশ হিসেবে আমি “Farmers’ Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region” বিষয়ক একটি গবেষণা করতে যাচ্ছি।

গবেষণার উদ্দেশ্যঃ এই গবেষণার উদ্দেশ্য হল, জলবায়ু পরিবর্তনের প্রতি কৃষকদের উপলব্ধি এবং অভিযোজন কৌশলের মূল্যায়ন করা।

পদ্ধতিঃ যদি আপনি রাজি থাকেন, তাহলে আপনাকে কিছু প্রশ্ন করা হবে।

ঝুঁকিঃ এই গবেষণার কাজে কোন ঝুঁকি নেই। আপনার দেয়া তথ্যগুলো শুধুমাত্র গবেষণার কাজে ব্যবহৃত হবে।

সুবিধাঃ আপনার দেয়া তথ্যগুলো জলবায়ু পরিবর্তনের প্রতি কৃষকদের উপলব্ধি এবং অভিযোজন কৌশলের মূল্যায়ন করতে সাহায্য করবে।

গোপনীয়তাঃ আপনার দেয়া তথ্যগুলো গোপন রাখা হবে এবং আপনার নাম কোথাও ব্যবহার করা হবেনা।

স্বৈচ্ছাভিত্তিক অংশগ্রহনঃ আপনার এই গবেষণার কাজে অংশগ্রহন সম্পূর্ণভাবে স্বৈচ্ছাভিত্তিক। আপনি যেকোনো সময় গবেষণার কার্যক্রম হতে নিজেকে প্রত্যাহার করতে পারবেন ও কোন প্রশ্নের উত্তর দিতে অপারগতা প্রকাশ করতে পারবেন।

যোগাযোগঃ উক্ত গবেষণার কোন বিষয়ে আপনার কোন প্রশ্ন থাকলে আপনি আমাকে করতে পারেন অথবা আপনার সন্তুষ্টির জন্য আপনি আমার সুপারভাইজার ডাক্তার আইরিন হোসেন, সহকারী অধ্যাপক ও বিভাগীয় প্রধান, পেশা ও পরিবেশ স্বাস্থ্য বিভাগ, জাতীয় প্রতিবেদক ও সামাজিক চিকিৎসা প্রতিষ্ঠান (নিপসম), মহাখালী, ঢাকা-১২১২, তে যোগাযোগ করতে পারেন।

অংশগ্রহনের জন্য অনুমতিপত্রঃ গবেষণার উদ্দেশ্য ও প্রক্রিয়া সম্পর্কে আমি সম্পূর্ণভাবে অবহিত এবং উক্ত গবেষণা সম্পর্কীয় আমার সকল প্রশ্নের সশেষজনক উত্তর আমি পেয়েছি। আমি নিজে সজ্ঞানে উক্ত গবেষণায় অংশগ্রহণে ইচ্ছুক এবং আমি অবহিত যে, চাইলে যেকোনো সময় গবেষণার কার্যক্রম হতে নিজেকে প্রত্যাহার করে নিতে পারব।

অংশগ্রহনকারীর নামঃ .....

অংশগ্রহনকারীর স্বাক্ষরঃ.....তারিখঃ.....

সাক্ষাতকারগ্রহনকারীর নামঃ.....

সাক্ষাতকারগ্রহনকারীর স্বাক্ষরঃ.....তারিখঃ.....

### **Annexure 3: Consent paper (English)**

**National Institute of Preventive & Social Medicine (NIPSOM)**

**Mohakhali, Dhaka-1212**

**(INFORMED WRITTEN CONSENT)**

**Assalamu alaikum,**

I am Shovon Chakraborty, student of MPH (Occupational & Environmental Health) course, session 2022-2023 of National Institute of Preventive & Social Medicine (NIPSOM), Mohakhali, Dhaka, is conducting research on **“Farmers’ Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region”** as a part of course curriculum.

**Purpose of the study:** The purpose of this research is to assess the farmers’ level of perception and adaptation strategies towards climate change in southern coastal region.

**Procedure:** Individual participants should be interviewed using a semi-structured questionnaire. It will take approximately 10-15 minutes.

**Risk:** There is no risk involved in your participation in this research. Your response will be used only for the purpose of this research.

**Benefits:** Your participation in this research will help to assess farmers’ level of perception and adaptation strategies towards climate change in southern coastal region and helps to improve capacity to mitigate the negative impacts of climate change on agriculture.

**Confidentiality:** Your given information will be kept confidential and name will not be used.

**Voluntary participation:** Your participation is completely voluntary. You have the right to withdraw yourself from this research any time you want to or refuse to answer any question if you wish. The interview will be conducted in a private place.

**Contact:** If you have any question or query about this study, you can ask me. If you want to know further related to this study, you can contact my supervisor, Dr. Irin Hossain, Assistant Professor, Head of The Department, Department of Occupational &

Environmental Health, National Institute of Preventive & Social Medicine, Mohakhali, Dhaka-1212.

**Consent for study participation:** Participation in this study was informed to me under the title of “Farmers’ Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region”. Research purpose, procedure, risks and benefits have been informed to me. I have received satisfactory answers to all my questions regarding this study. I voluntarily agree to participate in the study with this power, and I am aware that I can withdraw at any time.

**Participant’s name:** .....

**Participant’s signature:** .....

**Date:** .....

**Interviewer’s name:** .....

**Interviewer’s signature:** .....

**Date:** .....

## Annexure 4: Research Questionnaire (Bangla):

জাতীয় প্রতিবেদক ও সামাজিক চিকিৎসা প্রতিষ্ঠান (নিপসম)

পেশা ও পরিবেশ স্বাস্থ্য বিভাগ

বাংলা প্রশ্নাবলী

**Title: Farmers' Perception and Adaptation Strategies towards Climate Change  
in Southern Coastal Region**

উত্তরদাতাদের তথ্যঃ

ক. আইডি নাম্বারঃ

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খ. উত্তরদাতার নামঃ

.....

গ. ঠিকানাঃ

.....

ঘ. মোবাইল / ফোন নাম্বারঃ

.....

ঙ. তারিখঃ

সেকশন-কঃ সামাজিক- জনসংখ্যাগত তথ্যাবলীঃ

ক্রমিক নং	প্রশ্নাবলী	কোড	উত্তর
০১	আপনার বয়স কত?	(পূর্ণ বছরে)	<input type="text"/>
০২	লিঙ্গ	পুরুষ = ১ মহিলা = ২	<input type="text"/>
০৩	ধর্ম	মুসলিম = ১ হিন্দু = ২ বৌদ্ধ = ৩ খ্রিস্টান = ৪	<input type="text"/>
০৪	আপনার শিক্ষাগত যোগ্যতা কি?	নিরক্ষর / শুধু স্বাক্ষর = ১ প্রাথমিক = ২ মাধ্যমিক = ৩ উচ্চ মাধ্যমিক = ৪ অন্যান্য = ৫	<input type="text"/>
০৫	আপনার বৈবাহিক অবস্থা কি?	অবিবাহিত = ১ বিবাহিত = ২ বিধবা = ৩ বিবাহ বিচ্ছেদ = ৪ পৃথক বসবাসরত = ৫	<input type="text"/>
০৬	আপনার পরিবারের সদস্য সংখ্যা কতজন?	(মোট সদস্য সংখ্যায়)	<input type="text"/>
০৭	গড়ে আপনার মাসিক আয় কত?	(টাকায়)	<input type="text"/>
০৮	আপনি কত বছর যাবত এই বাসস্থানে বসবাস করছেন?	(পূর্ণ বছর)	<input type="text"/>
০৯	আপনার এই বাসস্থানের মালিক কে?	নিজ মালিকানাধীন = ১ আত্মীয় মালিকানাধীন = ২ ভাড়ায় বসবাসরত = ৩ অন্যান্য = ৪	<input type="text"/>

সেকশন-খঃ কৃষকদের অভিযোজন কৌশলের সাথে তাদের কাজের সাথে জড়িত কারনাবলীর তথ্যাবলীঃ

ক্রমিক নং	প্রশ্নাবলী	কোড	উত্তর
১০	আপনার মোট চাষ করা জমির পরিমাণ কত?	(পূর্ণ একর)	<input type="text"/>
১১	আপনার চাষ করা জমির মালিক কি আপনি নিজে?	হ্যাঁ =১ না =০	<input type="text"/>
১২	আপনি কত বছর যাবত এই কৃষি পেশার সাথে জড়িত আছেন?	(পূর্ণ বছর)	<input type="text"/>
১৩	আপনার সাথে কি স্থানীয় কৃষি সম্প্রসারণ কর্মকর্তার সাথে যোগাযোগ আছে?	হ্যাঁ =১ না =০	<input type="text"/>
১৪	আপনার কি রেডিও / টেলিভিশন দেখার অথবা দৈনিক পত্রিকা পড়ার কোন সুযোগ আছে?	হ্যাঁ =১ না =০	<input type="text"/>
১৫	আপনার কি আবহাওয়া পূর্বাভাস সম্পর্কে তথ্য জানার কোন সুযোগ আছে?	হ্যাঁ =১ না =০	<input type="text"/>

সেকশন-গঃ জলবায়ু পরিবর্তনের প্রতি কৃষকদের উপলব্ধি বিষয়ক তথ্যাবলীঃ

ক্রমিক নং	প্রশ্নাবলী	কোড	উত্তর
১৬	বিগত কয়েক বছর যাবত আপনি কি তাপমাত্রার কোন পরিবর্তন লক্ষ্য করেছেন?	দৃঢ়ভাবে একমত =১ একমত =২ সম্মত ও না দ্বিমত ও না =৩ অসম্মত =৪ দৃঢ়ভাবে অসম্মত =৫	<input type="text"/>
১৭	বিগত কয়েক বছর যাবত আপনি কি বৃষ্টিপাতের কোন পরিবর্তন লক্ষ্য করেছেন?	দৃঢ়ভাবে একমত =১ একমত =২ সম্মত ও না দ্বিমত ও না =৩ অসম্মত =৪ দৃঢ়ভাবে অসম্মত =৫	<input type="text"/>
১৮	বিগত কয়েক বছরে আপনি কি কোনখরার সম্মুখীন হয়েছে?	দৃঢ়ভাবে একমত =১ একমত =২ সম্মত ও না দ্বিমত ও না =৩ অসম্মত =৪ দৃঢ়ভাবে অসম্মত =৫	<input type="text"/>
১৯	বিগত কয়েক বছরে আপনার কি বন্যার কোন অভিজ্ঞতা হয়েছে?	দৃঢ়ভাবে একমত =১ একমত =২ সম্মত ও না দ্বিমত ও না =৩ অসম্মত =৪ দৃঢ়ভাবে অসম্মত =৫	<input type="text"/>
২০	বিগত কয়েক বছরে আপনার কি ঘূর্ণিঝড়ের কোন অভিজ্ঞতা হয়েছে?	দৃঢ়ভাবে একমত =১ একমত =২ সম্মত ও না দ্বিমত ও না =৩ অসম্মত =৪ দৃঢ়ভাবে অসম্মত =৫	<input type="text"/>

- ২১ বিগত কয়েক বছরে আপনার এলাকায় কি দৃঢ়ভাবে একমত =১  
দেৱীতে বর্ষা শুরু হয়েছে? একমত =২   
সম্মত ও না দ্বিমত ও না =৩  
অসম্মত =৪  
দৃঢ়ভাবে অসম্মত =৫
- ২২ বিগত কয়েক বছরে আপনার এলাকায় কি দৃঢ়ভাবে একমত =১  
দীর্ঘ সময় ধরে গুৰু মৌসুম বিৰাজ করে? একমত =২   
সম্মত ও না দ্বিমত ও না =৩  
অসম্মত =৪  
দৃঢ়ভাবে অসম্মত =৫
- ২৩ বিগত কয়েক বছরে আপনার এলাকায় কি দৃঢ়ভাবে একমত =১  
বৃষ্টিপাতের অসম বন্টনের সম্মুখীন একমত =২   
হয়েছেন? সম্মত ও না দ্বিমত ও না =৩  
অসম্মত =৪  
দৃঢ়ভাবে অসম্মত =৫
- ২৪ বিগত কয়েক বছরে আপনার এলাকায় কি দৃঢ়ভাবে একমত =১  
অসময়ে বৃষ্টিপাত হচ্ছে? একমত =২   
সম্মত ও না দ্বিমত ও না =৩  
অসম্মত =৪  
দৃঢ়ভাবে অসম্মত =৫
- ২৫ বিগত কয়েক বছরে আপনার এলাকায় কি দৃঢ়ভাবে একমত =১  
অল্প সময় ধরে শীত মৌসুম থাকে? একমত =২   
সম্মত ও না দ্বিমত ও না =৩  
অসম্মত =৪  
দৃঢ়ভাবে অসম্মত =৫

সেকশন ঘ- জলবায়ু পরিবর্তনের প্রতি কৃষকদের অভিযোজন কৌশল বিষয়ক তথ্যাবলীঃ

ক্রমিক নং	প্রশ্নাবলী	কোড	উত্তর
২৬	আবহাওয়ার ধরন পরিবর্তনের সাথে খাপ খাইয়ে নিতে, আপনি কি আপনার ফসলের ধরন পরিবর্তন করেছেন?	হ্যাঁ =১ না =০	<input type="text"/>
২৭	আপনি কি এখন গতানুগতিক ফসলের জাতের পরিবর্তে খরা অথবা লবনাক্ততা সহনশীল ফসলের জাত চাষ করছেন?	হ্যাঁ =১ না =০	<input type="text"/>
২৮	পরির্তনশীল আবহাওয়ার ধরনকে মানিয়ে নিতে, আপনি কি আপনার ফসলের চারা রোপণের তারিখ পরিবর্তন করেছেন?	হ্যাঁ =১ না =০	<input type="text"/>
২৯	প্রচন্ড তাপ বা সূর্যালোক থেকে ফসল কে রক্ষা করার জন্য আপনি কি ফসলি জমিতে ছায়াযুক্ত গাছ লাগানো পদ্ধতি অনুসরণ করছেন?	হ্যাঁ =১ না =০	<input type="text"/>
৩০	আপনি কি মাটি ক্ষয় এবং অবক্ষয় প্রশমিত করার জন্য মাটি সংরক্ষন পদ্ধতি অনুশীলন করছেন?	হ্যাঁ =১ না =০	<input type="text"/>
৩১	আবহাওয়ার ধরন পরিবর্তনের সাথে খাপ খাইয়ে নিতে, আপনি কি আপনার ফসলের জমিতে সার এবং কীটনাশক এর ব্যবহার বাড়িয়েছেন?	হ্যাঁ =১ না =০	<input type="text"/>
৩২	পরির্তনশীল আবহাওয়ার ধরনকে মানিয়ে নিতে, আপনি কি আপনার ফসলের জমিতে সেচের পরিমাণ বাড়িয়েছেন?	হ্যাঁ =১ না =০	<input type="text"/>
৩৩	জলবায়ু পরিবর্তনের কারণে ফসল চাষের ব্যর্থতার ঝুঁকি কমাতে আপনি কি আপনার ফসলের চাষের কোন বৈচিত্র্য এনেছেন?	হ্যাঁ =১ না =০	<input type="text"/>
৩৪	জলবায়ু পরিবর্তনের কারণে হওয়া স্বল্পমেয়াদী চাষের মৌসুম মোকাবেলায় আপনি কি স্বল্পমেয়াদী ফসল চাষ করছেন?	হ্যাঁ =১ না =০	<input type="text"/>

**Annexure 5: Research Questionnaire (English):**

**NATIONAL INSTITUTE OF PREVENTIVE AND SOCIAL MEDICINE  
(NIPSOM)**

**Department of Occupational and Environmental Health**

**English Questionnaire**

**Title: Farmers' Perception and Adaptation Strategies towards Climate Change  
in Southern Coastal Region**

**Particulars of the respondents:**

**A. ID number:**

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**B. Name of the respondent:**

.....

**C. Address:**

.....

**D. Mobile/Phone number:**

.....

**E. Date:**

**Section A: Socio-demographic Information: (Question no 1 to 9)**

<b>SI</b>	<b>Statements</b>	<b>Code</b>	<b>Response</b>
1	What's your age?	(In complete years)	<input type="text"/>
2	Gender	Male = 1 Female = 2 Third gender=3	<input type="text"/>
3	Religion	Muslim = 1 Hindu = 2 Buddhist = 3 Christian = 4	<input type="text"/>
4	What is your educational background?	Illiterate/ signature only=1 Primary = 2 Secondary = 3 Higher secondary = 4 Others = 5	<input type="text"/>

5	What is your marital status?	Single = 1 Married = 2 Widowed = 3 Divorced = 4 Separated = 5	<input style="width: 100px; height: 20px;" type="text"/>
6	How many members are there in your family?	Total family member	<input style="width: 100px; height: 20px;" type="text"/>
7	What is your average monthly income?	(In Taka)	<input style="width: 100px; height: 20px;" type="text"/>
8	How many years are you living in this residence?	(In years)	<input style="width: 100px; height: 20px;" type="text"/>
9	Who is the owner of your dwelling house?	Own = 1 Relatives house = 2 Rented house = 3 Others = 4	<input style="width: 100px; height: 20px;" type="text"/>

**Section B: Work related factors related to farmers adaptation strategies:  
(Question no 10 to 15)**

SI	Statement	Code	Response
10	What is your total land size of cultivate?	(In acres)	<input style="width: 100px; height: 20px;" type="text"/>
11	Is the land you cultivate belongs to you?	Yes = 1 No = 0	<input style="width: 100px; height: 20px;" type="text"/>
12	How many years are you related to this agricultural occupation?	(In years)	<input style="width: 100px; height: 20px;" type="text"/>
13	Do you have contacts with local agricultural extension agents?	Yes = 1 No = 0	<input style="width: 100px; height: 20px;" type="text"/>
14	Do you have exposure to mass media like Radio/Television/ Newspaper?	Yes = 1 No = 0	<input style="width: 100px; height: 20px;" type="text"/>
15	Do you have the facilities to get information on weather forecasting?	Yes = 1 No = 0	<input style="width: 100px; height: 20px;" type="text"/>

**Section C: Farmers' perception of climate change: (Question no 16 to 25)**

SI	Statements	Code	Response
16	Have you noticed any changes in temperature patterns over the past few years?	Strongly agree =1 Agree =2 Neither agree nor disagreed =3 Disagree =4 Strongly disagree =5	<input type="text"/>
17	Have you noticed any changes in rainfall patterns over the past few years?	Strongly agree =1 Agree =2 Neither agree nor disagreed =3 Disagree =4 Strongly disagree =5	<input type="text"/>
18	Have you experienced any drought in the past few years?	Strongly agree =1 Agree =2 Neither agree nor disagreed =3 Disagree =4 Strongly disagree =5	<input type="text"/>
19	Have you experienced any flooding event in the past few years?	Strongly agree =1 Agree =2 Neither agree nor disagreed =3 Disagree =4 Strongly disagree =5	<input type="text"/>
20	Have you experienced any storm in the past few years?	Strongly agree =1 Agree =2 Neither agree nor disagreed =3 Disagree =4 Strongly disagree =5	<input type="text"/>
21	Have you experienced late onset of monsoon in the past few years?	Strongly agree =1 Agree =2 Neither agree nor disagreed =3 Disagree =4 Strongly disagree =5	<input type="text"/>

- |    |   |  |  |
|----|---|--|--|
| 22 | Have you experienced long dry spell in the past few years?                  | Strongly agree =1<br>Agree =2<br>Neither agree nor disagreed =3<br>Disagree =4<br>Strongly disagree =5 | <input style="width: 100px; height: 20px;" type="text"/> |
| 23 | Have you experienced uneven distribution of rainfall in the past few years? | Strongly agree =1<br>Agree =2<br>Neither agree nor disagreed =3<br>Disagree =4<br>Strongly disagree =5 | <input style="width: 100px; height: 20px;" type="text"/> |
| 24 | Have you experienced unpredictable rainfall in the past few years?          | Strongly agree =1<br>Agree =2<br>Neither agree nor disagreed =3<br>Disagree =4<br>Strongly disagree =5 | <input style="width: 100px; height: 20px;" type="text"/> |
| 25 | Have you experienced short winter season in the past few years?             | Strongly agree =1<br>Agree =2<br>Neither agree nor disagreed =3<br>Disagree =4<br>Strongly disagree =5 | <input style="width: 100px; height: 20px;" type="text"/> |

**Section D: Farmers' adaptation strategies to climate change (Question no 26 to 34)**

<b>SI</b>	<b>Statements</b>	<b>Code</b>	<b>Response</b>
26	Have you changed your crop type to adapt to changing weather patterns?	Yes =1 No =0	<input type="text"/>
27	Have you switched to drought/salinity tolerant crop varieties?	Yes =1 No =0	<input type="text"/>
28	Have you changed your planting dates to adapt to changing weather patterns?	Yes =1 No =0	<input type="text"/>
29	Have you planted shade trees to protect crops from extreme heat or sunlight?	Yes =1 No =0	<input type="text"/>
30	Have you implemented soil conservation practices to mitigate soil erosion and degradation?	Yes =1 No =0	<input type="text"/>
31	Have you increased the use of fertilizers and pesticides to cope with changing weather patterns?	Yes =1 No =0	<input type="text"/>
32	Have you increased the use of irrigation to cope with changing weather patterns?	Yes =1 No =0	<input type="text"/>
33	Have you diversified your crops to reduce the risk of crop failure due to climate change?	Yes =1 No =0	<input type="text"/>
34	Have you cultivated short-duration crops to cope with the shorter growing seasons due to climate change?	Yes =1 No =0	<input type="text"/>

## Annexure 6: Consent paper (Bangla) for FGD

জাতীয় প্রতিবেদক ও সামাজিক চিকিৎসা প্রতিষ্ঠান (নিপসম), মহাখালী, ঢাকা-১২১২

(অবহিত সম্মতিপত্র)

আসসালামু আলাইকুম,

আমি শোভন চক্রবর্তী, জাতীয় প্রতিবেদক ও সামাজিক চিকিৎসা প্রতিষ্ঠান (নিপসম), মহাখালী, ঢাকা-১২১২, এর মাস্টার্স অব পাবলিক হেলথ কোর্সেও পেশা ও পরিবেশ স্বাস্থ্য বিভাগের ২০২২-২০২৩ শিক্ষাবর্ষের একজন ছাত্র। আমার কোর্সের অংশ হিসেবে আমি “Farmers’ Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region” বিষয়ক একটি গবেষণা করতে যাচ্ছি।

গবেষণার উদ্দেশ্যঃ এই গবেষণার উদ্দেশ্য হল, জলবায়ু পরিবর্তনের প্রতি কৃষকদের উপলব্ধি এবং অভিযোজন কৌশলের মূল্যায়ন করা।

পদ্ধতিঃ যদি আপনি রাজি থাকেন, তাহলে আপনাকে কিছু প্রশ্ন করা হবে।

ঝুঁকিঃ এই গবেষণার কাজে কোন ঝুঁকি নেই। আপনার দেয়া তথ্যগুলো শুধুমাত্র গবেষণার কাজে ব্যবহৃত হবে।

সুবিধাঃ আপনার দেয়া তথ্যগুলো জলবায়ু পরিবর্তনের প্রতি কৃষকদের উপলব্ধি এবং অভিযোজন কৌশলের মূল্যায়ন করতে সাহায্য করবে।

গোপনীয়তাঃ আপনার দেয়া তথ্যগুলো গোপন রাখা হবে এবং আপনার নাম কোথাও ব্যবহার করা হবেনা।

স্বৈচ্ছাভিত্তিক অংশগ্রহনঃ আপনার এই গবেষণার কাজে অংশগ্রহন সম্পূর্ণভাবে স্বৈচ্ছাভিত্তিক। আপনি যেকোনো সময় গবেষণার কার্যক্রম হতে নিজেকে প্রত্যাহার করতে পারবেন ও কোন প্রশ্নের উত্তর দিতে অপারগতা প্রকাশ করতে পারবেন।

যোগাযোগঃ উক্ত গবেষণার কোন বিষয়ে আপনার কোন প্রশ্ন থাকলে আপনি আমাকে করতে পারেন অথবা আপনার সন্তুষ্টির জন্য আপনি আমার সুপারভাইজার ডাক্তার আইরিন হোসেন, সহকারী অধ্যাপক ও বিভাগীয় প্রধান, পেশা ও পরিবেশ স্বাস্থ্য বিভাগ, জাতীয় প্রতিবেদক ও সামাজিক চিকিৎসা প্রতিষ্ঠান (নিপসম), মহাখালী, ঢাকা-১২১২, তে যোগাযোগ করতে পারেন।

অংশগ্রহনের জন্য অনুমতিপত্রঃ গবেষণার উদ্দেশ্য ও প্রক্রিয়া সম্পর্কে আমি সম্পূর্ণভাবে অবহিত এবং উক্ত গবেষণা সম্পর্কীয় আমার সকল প্রশ্নের সন্বেষণক উত্তর আমি পেয়েছি। আমি নিজে সজ্ঞানে উক্ত গবেষণায় অংশগ্রহণে ইচ্ছুক এবং আমি অবহিত যে, চাইলে যেকোনো সময় গবেষণার কার্যক্রম হতে নিজেকে প্রত্যাহার করে নিতে পারব।

## **Annexure 7: Consent paper (English) for FGD**

**National Institute of Preventive & Social Medicine (NIPSOM)**

**Mohakhali, Dhaka-1212**

**(INFORMED WRITTEN CONSENT)**

**Assalamu alaikum,**

I am Shovon Chakraborty, student of MPH (Occupational & Environmental Health) course, session 2022-2023 of National Institute of Preventive & Social Medicine (NIPSOM), Mohakhali, Dhaka, is conducting research on “**Farmers’ Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region**” as a part of course curriculum.

**Purpose of the study:** The purpose of this research is to assess the farmers’ level of perception and adaptation strategies towards climate change in southern coastal region.

**Procedure:** Individual participants should be interviewed using a semi-structured questionnaire. It will take approximately 10-15 minutes.

**Risk:** There is no risk involved in your participation in this research. Your response will be used only for the purpose of this research.

**Benefits:** Your participation in this research will help to assess farmers’ level of perception and adaptation strategies towards climate change in southern coastal region and helps to improve capacity to mitigate the negative impacts of climate change on agriculture.

**Confidentiality:** Your given information will be kept confidential and name will not be used.

**Voluntary participation:** Your participation is completely voluntary. You have the right to withdraw yourself from this research any time you want to or refuse to answer any question if you wish. The interview will be conducted in a private place.

**Contact:** If you have any question or query about this study, you can ask me. If you want to know further related to this study, you can contact my supervisor, Dr. Irin Hossain, Assistant Professor, Head of The Department, Department of Occupational & Environmental Health, National Institute of Preventive & Social Medicine, Mohakhali, Dhaka-1212.

**Consent for study participation:** Participation in this study was informed to me under the title of “Farmers’ Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region”. Research purpose, procedure, risks and benefits have been informed to me. I have received satisfactory answers to all my questions regarding this study. I voluntarily agree to participate in the study with this power, and I am aware that I can withdraw at any time.

<b>Participant’s name</b>	<b>Participant’s signature</b>	<b>Date</b>
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

**Interviewer’s name:**

**Interviewer’s signature:**

**Date:**

## Annexure 8: Questions for Focus Group Discussion (Bangla)

### Questions for Focus Group Discussion

**Title:** Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region

#### ১. সূচনাঃ

- দয়া করে আপনার পরিচয় দিন এবং দক্ষিণ উপকূলীয় অঞ্চলে আপনার কৃষি কাজের অভিজ্ঞতা বর্ণনা করুন।
- কত দিন যাবত আপনি এই অঞ্চলে কৃষি কাজ করছেন?

#### ২. জলবায়ু পরিবর্তনের প্রতি সচেতনতা এবং উপলব্ধিঃ

- আপনি কি জলবায়ু পরিবর্তন এর ব্যাপারে কিছু জানেন? কিভাবে আপনি জলবায়ু পরিবর্তন কে সংজ্ঞায়িত করবেন?
- বিগত বছরগুলোতে এই এলাকায় আপনি কি কি প্রধান জলবায়ুগত পরিবর্তন লক্ষ্য করেছেন?
- কৃষি এবং আপনার চাষাবাদ পদ্ধতিতে জলবায়ু পরিবর্তন এর প্রভাব আপনি কিভাবে উপলব্ধি করেন?

#### ৩. কৃষিতে জলবায়ু পরিবর্তনের প্রভাবঃ

- আপনার মতে এই অঞ্চলে জলবায়ু পরিবর্তনের কারণে কৃষকরা কি কি সমস্যার সম্মুখীন হচ্ছেন?
- জলবায়ু পরিবর্তন কিভাবে আপনার কৃষি কাজকে প্রভাবিত করেছে, তার উদাহরণ দিতে পারেন?

#### ৪. অভিযোজন কৌশলঃ

- জলবায়ু পরিবর্তনের প্রভাব মোকাবেলায় আপনি আপনার জমিতে বা খামারে কোন কোন কৌশল বা পরিবর্তনগুলি প্রয়োগ করেছেন?
- আপনি কি জলবায়ু পরিবর্তনের অভিযোজন সংক্রান্ত স্থানীয় কতৃপক্ষ বা কৃষি প্রতিষ্ঠানের কাছ থেকে কোন প্রকার সহায়তা, নির্দেশনা বা সমর্থন পেয়েছেন?
- আপনি কি মনে করেন যে বর্তমান অভিযোজন কৌশলগুলি জলবায়ু পরিবর্তনের নেতিবাচক প্রভাবগুলি কমাতে কার্যকর? কেন অথবা কেন নয়?

#### ৫. বাঁধা এবং সীমাবদ্ধতাঃ

- জলবায়ু পরিবর্তনের অভিযোজন কৌশল গ্রহণের ক্ষেত্রে আপনি কোন কোন প্রধান বাঁধা বা চ্যালেঞ্জের মুখোমুখি হয়েছেন?
- এমন কোন আর্থিক সীমাবদ্ধতা আছে যা আপনাকে কিছু অভিযোজন ব্যবস্থা বাস্তবায়নে বাঁধা দেয়?

- জলবায়ু পরিবর্তনের সাথে সম্পর্কিত নতুন চাষাবাদের পদ্ধতি গ্রহণের ক্ষেত্রে আপনি কি কোন সামাজিক বা সাংস্কৃতিক বাঁধার সম্মুখীন হয়েছেন?

৬. জ্ঞান এবং তথ্যঃ

- জলবায়ু পরিবর্তন এবং এর সম্ভাব্য অভিযোজন কৌশল সম্পর্কে জানতে আপনি কোন তথ্যের উৎসের উপর নির্ভরশীল?
- জলবায়ু পরিবর্তন সম্পর্কিত জ্ঞান বা তথ্যেও কোন ফাঁক বা ঘাটতি আছে যেটা আপনি উলেখ করতে চান?

৭. সহযোগিতা এবং সমর্থনঃ

- জলবায়ু পরিবর্তনের চ্যালেঞ্জগুলিকে সম্মিলিতভাবে মোকাবেলায় আপনি কি কোন কৃষকগোষ্ঠী, সমবায় বা সমিতিতে যুক্ত আছেন?
- জলবায়ু পরিবর্তনের সাথে খাপ খাইয়ে নিতে কৃষকদের সহায়তা করার জন্য সরকারী সংস্থা, এনজিও, বা অন্যান্য প্রতিষ্ঠানের ভূমিকা আপনি কেমন মনে করেন?

৮. ভবিষ্যৎ দৃষ্টিভঙ্গিঃ

- জলবায়ু পরিবর্তনের সাথে খাপ খাইয়ে নিতে কৃষকদের আরও সহায়তা করার জন্য স্থানীয়, আঞ্চলিক বা জাতীয় পর্যায়ে কি কি করা যেতে পারে বলে আপনি মনে করেন?
- কৃষিতে জলবায়ু পরিবর্তন মোকাবেলায় কোন সুনির্দিষ্ট নীতি বা উদ্যোগ আপনি বাস্তবায়িত দেখতে চান?

৯. উপসংহারঃ

- জলবায়ু পরিবর্তন এবং কৃষিতে অভিযোজন সম্পর্কে আপনি কি আর কোন অতিরিক্ত মন্তব্য পরামর্শ বা অভিজ্ঞতা জানাতে ইচ্ছুক?

## **Annexure 8: Questions for Focus Group Discussion**

**Title:** Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region

### **1. Introduction**

- Please introduce yourself and briefly describe your farming experience in the southern coastal region.
- How long have you been farming in this area?

### **2. Climate Change Awareness and Perception**

- Are you familiar with the concept of climate change? How would you define it?
- What are the major climate-related changes that you have observed in the region over the years?
- How do you perceive the impact of climate change on agriculture and your farming practices?

### **3. Climate Change Effects on Farming**

- In your opinion, what specific challenges or problems do farmers face due to climate change in this region?
- Can you provide examples of how climate change has affected your farming activities?

### **4. Adaptation Strategies**

- What strategies or changes have you implemented on your farm to cope with the effects of climate change?
- Have you received any assistance, guidance, or support from local authorities or agricultural institutions regarding climate change adaptation?
- Do you think the current adaptation strategies are effective in reducing the negative impacts of climate change? Why or why not?

### **5. Barriers and Constraints**

- What are the main barriers or challenges you face in adopting climate change adaptation strategies?
- Are there any financial constraints or limitations that prevent you from implementing certain adaptation measures?
- Have you faced any social or cultural barriers in adopting new farming practices related to climate change?

## **6. Knowledge and Information**

- What sources of information do you rely on to learn about climate change and potential adaptation strategies?
- Are there any gaps in knowledge or information related to climate change that you would like to address.

## **7. Collaboration and Support**

- Do you engage in any farmer groups, cooperatives, or associations to collectively address climate change challenges?
- How do you perceive the role of government agencies, NGOs, or other institutions in supporting farmers in adapting to climate change?

## **8. Future Perspectives**

- What do you think can be done at the local, regional, or national level to further support farmers in adapting to climate change?
- Are there any specific policies or initiatives you would like to see implemented to address climate change in agriculture?

## **9. Conclusion**

- Do you have any additional comments, suggestions, or experiences you would like to share regarding climate change and adaptation in agriculture?

## **Annexure 10: FGD transcripts**

### **FGD 10.1**

#### **Focus Group Discussion (FGD) on Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region**

The topic of my thesis, titled "Farmers' Perception and Adaptation Strategies to Climate Change in Southern Coastal Region," included a qualitative component in the form of a focus group discussion (FGD). As the moderator, Dr. Shovon Chakraborty, I facilitated this Focus Group Discussion (FGD) at Purbo-Horoni Government Primary School, Hatiya, Noakhali, on October 9th, 2023, starting at 11:15 am and lasting for around 30 minutes. The focus group discussion (FGD) comprised a collective of 9 people, encompassing myself, the school's principal and assistant teacher, as well as 6 farmers, with an equal distribution of 3 male and 3 female participants.

Before the scheduled focus group discussion (FGD) date, I contacted the school's principal, providing her with a summary of my thesis topic and research goals. After obtaining her consent, official invitations were sent to the school's assistant teacher, as well as other nearby farmers. In close collaboration with the school assistant, we meticulously organized the practical aspects, such as setting up the discussion room, cordially welcoming the participants upon their arrival, and ensuring that they were situated in their assigned seats. Throughout the Focus Group Discussion (FGD), I meticulously documented notes and effectively operated recording equipment to precisely capture the discourse. In addition, a consent form was given to each participant, ensuring the adherence to ethical norms throughout the procedure.

My role as primary investigator was to moderate the session. All participants were introduced before the FGD. I then briefly discussed my FGD topic, the study's purpose, why they were chosen, and some guidelines, such as I'm tape recording, one person at a time, there are no right or wrong answers, only different points of view, you don't need to agree with others, but you must listen respectfully as they share their views, talk to each other, etc.

Following the introductory remarks, our conversation picked up speed, and a common thread emerged: everyone was very worried about climate change. Every person had a story to tell about their experiences with increasingly severe and frequent extreme

weather, such as scorching heatwaves, excessive fog, terrifying cyclones, turbulent tropical storms, river erosion, devastating floods, and unyielding droughts in their coastal home. All along, these things pointed to a changing climate. It was brought to light that there has been an undeniable rising trend in temperatures over the past few years. Nevertheless, there was an extra challenge that was intricately related to the erratic sky. A small number of people have noticed that the length of the monsoon season has been gradually decreasing. The difficulties of daily life were worsened by the prolonged drought and erratic rainfall patterns caused by this change. Their primary concern was dealing with pest infestations that had an impact on the crops. There is a significant financial loss for farmers due to the ineffectiveness of current insecticides, which do not control these insects even after repeated applications. A tropical storm mostly destroys the seed-plate, but another important factor is the soil's higher salinity due to flooding and overflow of river water. Without hesitation, they blamed climate change, a strong element that has made farming a risky and difficult endeavor, for these problems. Because of these obstacles, the dogged farmers had to change their ways. They made adjustments including switching to rice types like IRRI Dhan 54 and Swarno IRRI 52, 53 that do well in salty environments. A number of people tried other approaches, such as planting at different times, using fertilizers and irrigation extensively, or growing crops with shorter maturation periods. They sought advice and guidance from local agricultural experts who were essential in their development during these changes. Some people also learned about things through media like newspapers and television. But huge challenges were approaching. There were significant challenges due to the limited availability of cash and state-of-the-art technology. Inadequate financial support and limited credit alternatives had a detrimental impact on their desire for knowledge and training in climate-resilient agriculture. So, they made their requests for help heard. Their adaptation efforts were bolstered by the significance of government and non-governmental organizations (NGOs). They also give importance on tree plantation for preventing negative impacts of climatic change. Their demands were modest, consisting only of more funding with low interest, better training opportunities, and easier access to relevant data. Their hope was that these developments would improve their financial status while also significantly influencing the national economy.

I closely monitored the participants' discussions while we engaged in conversation. If a participant strayed from one of my subjects or someone else's, I provided assistance to guide them back to the intended subject. The equitable distribution of each participant's voice was another worry that troubled me.

After much deliberation, we reach a conclusion in our FGD. Everyone that attended and shared their thoughts and opinions was deeply appreciated, and I wanted to thank them all personally. As we went around, I took shots of everyone. Goodies were given to all those who participated. Everything about the FGD was perfect: the location, the participants, and the ease of the process. This focus group discussion (FGD) illuminated the realities faced by farmers in the southern coastal region, highlighting both their resiliency and the critical challenges they confront as a result of climate change.

## **FGD 10.2**

### **Focus Group Discussion (FGD) on**

#### **Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region**

My thesis, titled "Farmers' Perception and Adaptation Strategies to Climate Change in Southern Coastal Region," incorporated a qualitative element in the form of a focus group discussion (FGD). As the moderator, Dr. Shovon Chakraborty, I conducted this FGD at Nando-Kumar Junior Girls High School, Lokkhidiya, Char-Ishwar, Hatiya, Noakhali on October 10th, 2023, commencing at 12:51 pm and lasting approximately 40 minutes. The FGD involved a total of 8 participants, including myself, the school's principal and assistant teacher, the khatib of local Mosque, and 4 local farmers.

I informed the school administrator of my thesis topic and research goals before the FGD. After his consent, the local mosque's Khatib, the school's assistant teacher, and other farmers were invited. We worked closely with the school assistant to prepare the discussion room, greet participants, and seat them. I took careful notes and managed recording equipment during the FGD to capture the dialogue. Every participant received a consent form, ensuring ethical conduct.

I acted as the session's moderator as I was the principal investigator. All of the participants were introduced before the FGD started. Then I briefly discussed my FGD topic, the purpose of the study, why they were chosen, and gave some guidelines, such as I am tape recording, one person speaking at a time, there are no right or wrong answers, only different points of view, you don't need to agree with others, but you must listen respectfully as others share their views, talk to each other, etc.

Every participant expressed concern about the new risks posed by climate change. Every one of them had a story to tell about having to deal with increasingly severe and frequent extreme weather events, like erratic and uneven rainfall, higher soil salinity, intense heat waves, perilous cyclones, violent tropical storms, destructive floods, and unrelenting droughts in their coastal home. They also paid attention to how rising sea levels cause the lowlands to flood, which severely damages fish hatcheries and farmers' land. These incidents served as constant reminders of the changing environment. They cited the unavoidable trend of rising temperatures in recent years. Some participants reported that the monsoon season was gradually getting shorter. This change made life

even more difficult by bringing with it protracted dry spells and unpredictable rainfall patterns. Recent pestsssss infestations that were resistant to their pesticides alarmed some people. These hardy farmers had to adapt to these difficulties. They changed things up, like switching to rice varieties like BRRI Dhan 54 that are better adapted to salinity. Some experimented with planting schedules, while others focused more on fertilizers and irrigation, and still others shifted to crops with short maturities. Some even went so far as to raise fish in an attempt to find new sources of income. But obstacles were ahead. Modern technology and limited financial resources proved to be major obstacles. Through personal experiences, they gained knowledge about climate-resilient agriculture. However, they were constrained by a lack of local agricultural extension agents' oversight, a lack of financing choices, and a lack of financial support. They called out for assistance as a result. They underlined the importance of government and non-governmental organizations (NGOs) in aiding their attempts at adaption. They focused on importance of protecting river embankment. All they asked for was increased funding during cropping season, increased quality of seeds, insecticides and fertilizers under government supervision, also further training, and improved access to the information they required. As we talked, I listened in on the participants' talks. I helped the participant get back on track whenever they strayed from one of my or another person's subjects. Another thing that worried me was the equity of each participant's voice.

In our FGD, we discuss and then reach a conclusion. I personally thanked everyone who attended and took part for their opinions and views. I took pictures with each person that participated. All participants were given some treats. All in all, the FGD proceeded smoothly, the participants were quite willing, and the environment was very pleasant. This FGD shed light on the urgent problems farmers in the southern coastal region confront in the context of climate change and offered insightful information about their real-world experiences.

## **FGD 10.3**

### **Focus Group Discussion (FGD) on**

#### **Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region**

Focus groups were used as a qualitative component of my thesis, "Farmers' Perception and Adaptation Strategies to Climate Change in Southern Coastal Region" (FGD). In my capacity as moderator, Dr. Shovon Chakraborty, I led this focus group discussion (FGD) at Choumuhoni High School in Sonadia, Hatiya, Noakhali on October 12, 2023. It started at 11:50 am and lasted for around forty minutes. Nine people participated in the FGD: me, the principal and assistant teacher of the school, and five local farmers.

I contacted the principal of the school in advance of the FGD date and informed her of my research objectives and thesis topic. Following his consent, formal invitations were sent to the assistant teacher at the school, the local temple's priest, and a number of nearby farmers. We worked closely with the school assistant to arrange all the logistics, such as setting up the discussion room, greeting guests politely, and making sure they were sat in their assigned places. I carefully took notes during the FGD and operated the recording equipment to ensure that the talk was captured. Every participant also received a consent form, maintaining ethical standards all along the way.

Since I was the lead investigator, I moderated the session. Prior to the FGD, each participant was given a brief introduction. After that, I gave a brief explanation of my FGD topic, the study's goals, the rationale behind their selection, and some guidelines, like the fact that I would be taping, that only one person would speak at a time, that there are no right or wrong answers—just differing points of view—and that you don't have to agree with others to listen to them respectfully as they express their opinions and interact with one another.

After our introduction, the topic heated up and everyone was concerned about climate change. Each had a story about living in their seaside house throughout increasingly severe and frequent extreme weather events like searing heat waves, hazardous cyclones, tropical storms, damaging floods, and relentless droughts. Another worry is floods salinizing agricultural land. Increasing pesticide-resistant bug infestations were another issue. Over time, traditional rice varieties perished. These instances constantly

reminded us of the changing environment. They mentioned rising temperatures as inevitable. There was one more issue with the sky's fluctuating behavior. Participants said the monsoon season was shortening. This change caused prolonged dry periods and irregular rains, making living harder. They immediately blamed climate change, which made farming unsafe and difficult. These tough farmers changed to survive. They switched to salt-tolerant rice cultivars including IRRI Dhan 52, 56, and 57. Some tried different planting times, some focused-on fertilizers and irrigation, and others switched to short-lived crops. Some even raised fish to make extra money. In addition, lack of guidance of local agricultural experts is a common finding. Technological advances and limited funds were important obstacles. Due to limited financial support and credit options, they wanted climate-resilient agriculture training. They requested help. They stressed the role of government and NGOs in adapting. They only wanted more financing, higher-quality seeds, fertilizers, insecticides, training, and information. They wanted to avoid river erosion, protect the riverfront embankment, and maintain switch gates under government control to prevent raising salinity of the lands. This would enhance their finances and boost the economy, they believed. I listened in on participants' conversations. I helped participants get back on course when they strayed from my or another's topics. I also worried about participant voice equity.

In our FGD, we discuss and then reach a conclusion. I personally thanked everyone who attended and took part for their opinions and views. I took pictures with each person that participated. All participants were given some treats. All in all, the FGD proceeded smoothly, the participants were quite willing, and the environment was very pleasant. This FGD focused light on the urgent problems farmers in the southern coastal region confront in the context of climate change and offered insightful information about their practical knowledge.

## **FGD 10.4**

### **Focus Group Discussion (FGD) on**

#### **Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region**

Focus groups were used as a qualitative component of my thesis, "Farmers' Perception and Adaptation Strategies to Climate Change in Southern Coastal Region" (FGD). On October 16, 2023, starting at 10:40 am and lasting roughly 40 minutes, I, Dr. Shovon Chakraborty, the moderator, conducted this focus group discussion (FGD) at Burir Char Syedia High School, Burir Char, Hatiya, Noakhali. Total nine people participated in the focus group discussion (FGD), including four farmers, the assistant teachers, principal of the school, local commissioner and me.

I informed the school administrator of my thesis topic and research goals before the FGD. Her acceptance led to formal invites for the school's assistant teacher, local Commissioner, and other farmers. We worked closely with the school assistant to prepare the discussion room, greet participants, and seat them. I took careful notes and managed recording equipment during the FGD to capture the dialogue. Every participant received a consent form, ensuring ethical conduct.

I acted as the session's moderator as I was the principal investigator. All of the participants were introduced before the FGD started. Then I briefly discussed my FGD topic, the purpose of the study, why they were chosen, and gave some guidelines, such as I am tape recording, one person speaking at a time, there are no right or wrong answers, only different points of view, you don't need to agree with others, but you must listen respectfully as others share their views, talk to each other, etc.

After the introduction, our discussion accelerated, and a common theme emerged: participants were deeply concerned about climate change. Each person described their experiences with increasingly intense and frequent extreme weather, including burning heatwaves, terrifying cyclones, tumultuous tropical storms, river erosion, catastrophic floods, and unyielding droughts in their coastal home. Continuing climatic change was indicated by these events. They noted the recent rise in temperatures, a substantial change that could not be ignored. However, the sky's unpredictability presented another challenge. Some people noticed the monsoon season shortening. They targeted crop-

damaging insects. Even after repeated applications, current insecticides fail to control these insects, costing farmers a lot of money. The elevated soil salinity caused by tropical storm and flood-related river flooding is another important factor. They immediately blamed climate change, which had made farming dangerous and difficult. These determined farmers adjusted to these obstacles. They switched to saline-tolerant rice cultivars including IRRI Dhan 54 and BIRRI 52, 53. Some tried changing the planting date, some used irrigation and fertilizers, and others grew short-term crops. They sought advice from local agricultural experts during these changes, which helped them progress. Some people also got information via TV and newspapers also. Personal experiences were also an important factor for adapting new techniques for cultivation. The horizon held enormous challenges. Lack of funding and cutting-edge technology were major obstacles. Their quest for climate-resilient agriculture training was hampered by poor financial support and financing options. So, they asked for help. They stressed the necessity of government and NGOs in supporting their adaptation efforts. Their requirements were simple: additional funds, training, and expertise. They expected these variables to improve their finances and boost the economy. I monitored participants' conversations during discussion. If a participant strayed from my or another's topic, I helped them return. I also worried about participant voice equity.

After deliberation, we reach a conclusion in our FGD. I personally thanked everyone who attended and contributed for their ideas and perspectives. I took photographs of each person. Goodies were given to each participant. Overall, the FGD went well, the participants were genuinely willing, and the atmosphere was very pleasant. This focus group discussion (FGD) focused light on the significant issues facing farmers in the southern coastal region in the context of climate change and offered insightful information about their lived experiences.

## **FGD 10.5**

### **Focus Group Discussion (FGD) on Farmers' Perception and Adaptation Strategies towards Climate Change in Southern Coastal Region**

My thesis, "Farmers' Perception and Adaptation Strategies to Climate Change in Southern Coastal Region," integrated a focus group discussion (FGD) as a qualitative part of its theme. On October 17th, 2023, at 11:15 am, I, Dr. Shovon Chakraborty, presided over a Focus Group Discussion (FGD) at Dokkhin Rajerhawla Government Primary School in Hatiya, Noakhali. The meeting lasted for about half an hour. Myself, the assistant principal and teacher at the school, a priest from the nearby temple, five farmers, four of male and one female participant made up the nine-person focus group discussion (FGD).

I informed the school administrator of my thesis and research goals before the focus group discussion (FGD). After her consent, the school's assistant teacher and nearby farms received official invitations. We coordinated with the school assistant to set up the meeting area, greet guests, and seat them. I took detailed notes and recorded the Focus Group Discussion (FGD) to capture every word. The operation followed ethical norms by having each participant sign a consent form.

Principal investigator, I moderated the session. Before the FGD, everyone was introduced. I briefly discussed my FGD topic, the study's purpose, why they were chosen, and some guidelines, such as tape recording, one person at a time, no right or wrong answers, only different points of view, you don't need to agree with others, but you must listen respectfully as they share their views, talk to each other, etc.

Our discussion quickly progressed after the opening remarks, and a consensus on one topic surfaced: widespread concern about the effects of climate change. In their coastal home, every individual had a story to share about the increasingly severe and frequent extreme weather, including terrible cyclones, heavy fog, river erosion, disastrous floods, and relentless droughts. These indicators of a changing climate have been present throughout. It has come to light that temperatures have been steadily rising for some time now. But there was another difficulty, intertwined with the unpredictable sky. The length of the monsoon season has been steadily diminishing, as a small number of people have noticed. The chronic drought and unpredictable rainfall patterns

brought on by climatic shift have only added to the already challenging conditions of daily existence. Infestations of pests that damaged the crops were their main worry. Current insecticides are so ineffective that farmers lose a lot of money since they don't control these insects no matter how many times, they apply them. While flooding and river overflow are the primary causes of soil salinity increases, tropical storms also play a significant role in destroying seed-plates. They immediately pointed the finger at climate change, a powerful factor that has increased the difficulty and danger of farming, as the cause of these issues. These challenges forced the persistent farmers to adapt. Among the changes they implemented was the use of salt-tolerant rice varieties such as IRRI Dhan 54 and Swarno IRRI 52, 53. Some experimented with growing crops with shorter maturation periods, some with various planting schedules, and still others with heavy fertilizer and irrigation use. They turned to local agricultural professionals for counsel and direction, who played a pivotal role in their growth throughout these transitions. Media such as newspapers and television also had a role in informing some individuals. Ahead, though, were enormous obstacles. The lack of readily available capital and cutting-edge technology posed substantial obstacles. Their willingness to learn about climate-resilient agriculture was hindered by a lack of funding and limited credit options. As a result, they had their pleas for assistance heard. Both official and non-official groups played an important role in their adaptation efforts. More money at a reasonable interest rate, improved training chances, and simpler access to pertinent data were their only moderate demands. They believed these changes would boost their wealth and have a major impact on the economy of the country.

During our FGD, we finally come to a conclusion after extensive discussion. I wanted to personally thank everyone who came and gave their views; their presence was really appreciated. I made sure to snap pictures of everyone as we went around. All individuals who took part were provided with goodies. The setting, the participants, and the overall ease of the FGD were all excellent. The southern coastal region's farmers were the subjects of this focus group discussion (FGD), which shed light on their realities and showed how resilient they are in the face of the major challenges brought about by climate change.

## Annexure 11: Thesis work plan:

CONTENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Topic selection & Proposal Submission	Grey											
Approval of Proposal			Red									
Literature Review	Green											
Development of Research Instrument				Blue								
Data collection								Yellow				
Data Completion & Analysis											Dark Blue	

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