FISH FARMERS' PERCEPTION ON CLIMATE CHANGE

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DECEMBER, 2021

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A Thesis

Submitted to the Faculty of Agriculture,

Sher-e-Bangla Agricultural University, Dhaka

In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE (MS)

IN

AGRICULTURAL EXTENSION

SEMESTER: JULY-DECEMBER, 2021

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CERTIFICATE

This is to certify that the thesis enlightens, **"Fish Farmers' Perception on Climate Change"** submitted to the faculty of agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (MS) in AGRICULTURAL EXTENSION**, embodies the result of a piece of bona fide research work conducted by **AROJITA MOTTASIMA**, Registration no. **19-10289** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this study has been dully acknowledged.

Dated: DECEMBER, 2021
Dhaka, Bangladesh

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Dedicated

to

My Beloved Parents

ACKNOWLEDGEMENTS

At the beginning, the author bows the grace and mercy of the “Almighty Allah”, the omnipresent, omnipotent and omniscient, who enabled her to complete this thesis.

One of the rewarding moments of writing this acknowledgement is to look back on researchers whole study trip and remember all the people starting from supervisor, co-supervisor to course instructors, friends and family.

The researcher is indebted to her supervisor, Professor **Dr. Ranjan Roy**, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka, for his continued guidance and an endless supply of fascinating projects. His approach to research and science is a source of inspiration. This approach is reflected by his simple but clear writing style, which is something the researcher hope to carry forward throughout her career.

The researcher is proud to express her respect, sincere appreciation and enormous debt to her co-supervisor Professor **Dr. M M Shofi Ullah**, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka, for his academic orientation and research work.

The researcher gratefully recognize the help of all the faculties of the Department of Agricultural Extension and Information System, SAU, for their valuable teaching, suggestions and encouragement during the period of the study.

The researcher would like to extend her appreciation to Upazila Fisheries Officer of Rangpur Sadar upazila for his cordial help and cooperation.

The researcher would like to thank her supervisor for guiding and helping her in getting National Science and Technology Scholarship on this research.

The researcher would also like to thank her husband and younger brothers for their cooperation and dedication to helping her to conduct the surveys when traveling to different unions.

Last but not least, the researcher would like to express her sincere appreciation to her parents and all of her well-wishers.

The Researcher

December 2021

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ABBREVIATION AND ACRONYMS

AEO	Agricultural Extension Officer
AIS	Agricultural Information Service
BBS	Bangladesh Bureau of Statistics
DAE	Department of Agricultural Extension
FAO	Food and Agriculture Organization of the United Nation
ICT	Information and Communication Technology
NGO	Non-Government Organization
SPSS	Statistical Package for Social Science
SAAO	Sub- Assistant Agriculture Officer
SAU	Sher-e-Bangla Agricultural University
UAO	Upazila Agriculture Officer
UFO	Upazila Fisheries Officer
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
WWW	World Wide Web

Fish Farmers' Perception on Climate Change

Arojita Mottasima[1]

Abstract

Climate change perception is a complex process that encompasses a range of psychological constructs that are important for the acquisition and interpretation of climate information. How climate change is understood and perceived by fish farmers is important because it can influence their management practices. The objectives of this study were to measure fish armers' perception on climate change, to describe the selected characteristics of the fish farmers and to explore the contributory factors that shape fish farmers perception on climate change. The study was conducted in three villages of Mominpur union of Rangpur sadar upazila. Data were collected by using interview schedule from the randomly selected 106 respondents, during 1 May to 30 May, 2022. Descriptive statistics and multiple regressions (β) were used for analysis. Among ten selected characteristics cosmopiliteness, knowledge on climate change, access to information on climate change and education had significant positive contribution to the fish farmers perception on climate change and knowledge on climate change had the 1st highest contribution to the fish farmers' perception on climate change. The study showed that among 14 statements regarding climate change perception 10 statements were either strongly agreed or agreed by more than 50% of the fish farmers. The findings conclude that increasing cosmopoliteeness, knowledge on climate change, access to information on climate change and education increase fish farmers' perception on climate change. Climate school can be a great solution to increase fish farmers' knowledge on climate change. To increase the access to information on climate change DoF and DAE can arrange different campaigns regarding climate change.

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CHAPTER I

INTRODUCTION

1.1 General background

Climate change has a serious environmental, social, and economic impact on human society (Roy et al., 2019). Rapidly changing climate will create tremendous problems in fisheries, aquaculture, and other sectors like agriculture (Roy et al., 2019). The issue of climate change is therefore, on the high of the global political agenda, including Bangladesh.

Fish farmers in Bangladesh are a highly exposed to this rapidly changing climate, because the minimum income needed for their subsistence comes from the fisheries sector only. Climate change is a vital concern of fish farmers because climate change not only affects their livelihood but also damages their home or living place. Climate change is causing hazards that cause farmers to lose not only their home but also their identity, nationality, and existence.

Climate change refers to "a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer" (UNFCCC, 2011). In a broader sense, climate change consists of changes in temperature, rainfall pattern, humidity, sea level, greenhouse gasses (GHG), continental drifts, deviation in the Earth's orbit, activities of man (Yazdi and Shakouri, 2010) which interact with each other to exist as a unified entity.

Changes in weather patterns, namely rainfall, relative humidity, winds, temperature, and light intensity and period have undoubtedly affected agricultural production systems including fisheries. Climate change has both direct and indirect influence on fisheries. The direct implications of climate change are on the physiology and behavior of the fish that affect growth, reproduction, mortality, and distribution (Allison et al., 2009; IFAD, 2014; Yazdi and Shakouri, 2010). The indirect impact affects the productivity, structure, and composition of the ecosystem in which the fish depend on food (Yazdi and Shakouri, 2010). Changes in biophysical characteristics of the aquatic environment and frequent occurrence of extreme events will have significant effects on the ecosystems that support fish (Essam and Uraguch, 2013).

Climate change to different people means different things and the perception of climate change differs from person to person. Perception and knowledge vary according to geographical location, occupation, political, ecological, cultural background of the individual in question (Adelek, 2017). So, the perception of fish farmers is different from the policymaker, so to adjust the between policy and farmer's application it is very important to measure fish farmers' perception on climate change. Perception is the bedrock to apprehend the assertiveness and interpretations of the farmers which are the grass-root receptors or benefactors of the effects of climate change. The attitude of the farmers is often neglected; therefore, emphasis should be laid on their perceptions to know the right strategy to implore in solving climate change issues (Cherif et al., 2017).

Bangladesh is located between 20º to 26º North and 88º to 92º East. It is bordered on the west, north and east by India, on the south-east by Myanmar, and on the south by the Bay of Bengal. Most of the country is low-lying land comprising mainly the delta of the Ganges and Brahmaputra rivers. Floodplains occupy 80% of the country. Mean elevations range from less than 1 meter on tidal floodplains, 1 to 3 meters on the main river and estuarine floodplains, and up to 6 meters in the Sylhet basin in the north-east (Rashid 1991). Only in the extreme northwest are elevations greater than 30 meters above the mean sea level. 80 per cent of the land is floodplain, and only in the extreme northwest do elevations exceed 30 meters above mean sea level, making the majority of Bangladesh (with the exception of the highlands) prone to flooding at least part of the year, with the floodplains of the north western, central, south central and north eastern regions subject to regular flooding. Northwest regions are particularly susceptible to drought. Greater precipitation extremes associated with climate change also mean less rainfall in the dry season, which will increase water stress on those areas that already experience water shortages, particularly in the winter months. This will be worse for those areas that depend on glacial melt water for their main dry-season water supply, as glaciers recede with rising temperatures.

The tropical and subtropical countries will be more vulnerable to the potential impact of climate change. Bangladesh is in the subtropical region. Therefore, fish farming and aquaculture will be affected by climate change. Some impacts of climate change on fish culture are (i) high inland water temperatures (ii) changes in precipitation (iii) water availability (iv) increase in the frequency of storm (v) drought etc.

Bangladesh is one of the leading countries in the world in producing fish with 46.21 lakh MT production in FY 2020-2021 (BBS, 2020). Aquaculture production contributes 56.24 to total production. The average growth performance of this sector is 5.26 percent for the last 10 years (BBS, 2020). If the increasing fish production continues it is possible to reach the vision. But if the changing climate affects fisheries production, it is not possible to reach the destination. So, to mitigate the impact of climate change on aquaculture fish production it is very important to measure the perception of fish farmers. Perception measurement can help the policymaker to make the policy about decreasing the negative impact of climate change on fish farming.

According to the FAO report The State of World Fisheries and Aquaculture 2022, Bangladesh ranked 3rd in inland open water capture production and 5th in world aquaculture production. Currently, Bangladesh ranks 4th in tilapia production in the world and 3rd in Asia. National fish hilsa as a single species has been making the highest contribution (around 12 percent) to the country's total fish production. Geographical Indication Registration Certificate has been achieved for our national fish hilsa.

1.2 The specific objective of the study

The following specific objectives are set for the study:

1. To identify and describe fish farmers' characteristics, namely age, education, fish farm size, fish farming experience, fish farm income, extension media contact, use of ICT for updating knowledge on fish farming, access to information on climate change, cosmopoliteness and knowledge on climate change
2. To measure fish farmers' perception on changing climate, and
3. To explore the contributory factors that shape fish farmers' perceptions on climate change

1.3 Statement of the problem

Bangladesh is one of the most climate vulnerable countries in the world. Located between the Himalayas and the Bay of Bengal, the country is very prone to natural disasters. Climate change accelerated the intensity and frequency of occurrences of salinity, storms, drought, irregular rainfall, high temperature, flash floods, etc. that

resulted from global warming. Due to climate change, fish farming was adversely affected. The investigator undertook a study entitled "**Fish Farmers' Perception on Climate Change**". The research information may help the policymaker and concerned bodies such as Department of Fisheries (DoF), Bangladesh Fisheries Research Institute (BFRI) etc. by providing the perception of fish farmers on climate change.

This study also aimed at finding the demographic characteristics of fish farmers.

The purpose of the study is to have the answers to the following questions

1. What are the demographic characteristics on fish farmers?
2. What is the perception of fish farmers on climate change?
3. What are the contributory factors that shape fish farmers perception on climate change?

1.4 Justification of the study

Climate change is a very obvious occurrence that cannot be denied. Changing climate is affecting the fisheries sector. Fish is a poikilothermic animal that cannot regulate their body temperature through physiological process and this is regulated by environmental process. Fish physiology like growth, reproduction and activity are directly influenced by the change of temperature. Increase of world temperature rise is thought to be ranged from 0.3 to 6.4°C at 2090-2099 relatively to 1980-1999. The temperate and polar latitudes are predicted to experience a higher temperature change than tropical and sub-tropical latitudes. Due to the location of Bangladesh in lower latitude, its temperature change is little compare to polar and temperate zone. Fish farming is dependent on fish farmers so to mitigate the impact of climate change on the fisheries sector concerned policy is very important. To, formulate fisheries policy, it is necessary to know about the perception of fish farmers on climate change otherwise synchronization between fish farmers and guidelines will not occur. This study will help to measure fish farmers' perception at the field level situations. By measuring the field level situations, it will be helpful to make the policy and will help the concerned body to alleviate the effect of climate change on fish farming. The field level adaptation strategies will also be helpful for concerned bodies like Department of Fisheries (DoF), Bangladesh Fisheries Development Corporation (BFDC), Bangladesh Fisheries Research Institute (BFRI). It is projected that, by 2050, so many people will be affected by water stress caused by climate change around the world. Low-lying coastal regions,

are vulnerable to sea level rise and the increased occurrence of intense, extreme weather conditions such as the cyclones, floods, temperature rise. As a result of all this, Bangladesh would need to prepare for long-term adaptation, which could be as drastic as changing sowing dates due to seasonal variations, introducing different species. To tackle climate change effect fish farmers perception is essential. Fish farmer adaptation is determined by their perception. It is very important to measure their perception before planning adaptation strategies. After measuring fish farmers perception, policy makers and other concerned authorities can take necessary steps to tackle climate change effect. It is interesting to know which types of farmers are likely to observe the climate change an important issue to understand for practicing adaptation strategies

1.5 Scope of the study

The main focus of the study is to ascertain fish farmers' perception on climate change. Climate change is forcing people to take diversified occupations to maintain their life. Lives lead on food, clothes, housing conditions, and education and medicare of the rural fish farmers of Bangladesh. Fish farmers of Bangladesh are continuously fighting the effects of climate change on fish farming. The findings of this research will be acceptable in the selected area. The fish farmers' perception on climate change will be visible through this research. Thus, the findings of the study will have importance to fish farming in Bangladesh. The findings of the study will, in particular, be applicable to the study area at Mominpur union of Rangpur Sadar upazila of Rangpur District. The findings may also be applicable to other locale of Bangladesh where socio-cultural, psychological and economic circumstance do not differ much than those of the study areas. To the academicians, it may help in the further conceptualization of the systems model for analyzing the factors influence fish farmers' perception on climate change.

1.6 Assumption of the study

An assumption is a supposition that an apparent fact or principle is true in the light of the available evidence (Good, 1945). The researcher has the following assumption in mind while undertaking this study:

- The respondents were capable of furnishing proper answers to the questions contained in the interview schedule.
- The respondents were provided views and opinions included in the sample representative of the whole population of the study area.

- The items, questions and scale of measurement of the variables were reasonably authentic to present the actual condition of the respondents.
- The findings of the study would give a clear concept of fish farmers perception on climate change.
- The data furnished by the respondents were free from bias.
- The researcher was capable to adjust with the social and cultural environment of the study area. So, the respondents could provide their information correctly.

1.7 Limitation of the study

There are many limitations when the researcher conducts the research. Some limitations are given below

- Facts and figures were collected by the investigator applied to the present situation in the selected area.
- Many of the factors of farmers and situations were excluded from the investigation due to the limitations of time, money and other resources.
- Facts and figures were collected by the investigator applied to the present situation in the selected area.
- Characteristics of the farmers are many and varied but only some were selected for this study.
- The study was conducted only in the 2 unions of 2 upazilas of Rangpur District.

1.8 Definition of important terms

Age

The age of the respondent was defined as the period of time in actual years from his birth up to the time of interviewing.

Education

Education refers to the development of desirable Knowledge, skill, and attitude in the individual through reading, writing, and other related activities. It was measured in terms of actual grades or class passed by a respondent.

Fish farm size

It referred to the total area on which a fish farmers' family carries on a fish farming operation. The area is estimated in terms of full benefit to the farmer's family.

Fish farming experience

Fish farming experience is the number of years a farmer is practicing fish farming. This will be measured in terms of years of fish farming experience

Annual income from fish farming

It referred to the earning of the respondent from selling of fish and fish fry and it was expressed in Thousand Taka.

Extension contacts

The agricultural extension department of Bangladesh provides various services to the farmers. These services are called extension services

Accessibility to ICT for fish culture information

It referred to an individual's (farmer) exposure to or contact with different information and communication technologies, communication media, source being used for dissemination of new technologies.

Cosmopoliteness

Cosmopoliteness of a respondent is the nature of visits to different places external to his own social system.

Knowledge on climate change

It referred to the extent of basic understanding of climate change, causes of climate change and effects of climate change.

Perception

Perception can be defined as our recognition and interpretation of sensory information. Perception also includes how we respond to the information. We can think of perception as a process where we take in sensory information from our environment and use that information in order to interact with our environment. Perception allows us to take the sensory information in and make it into something meaningful. Perception refers to the process concerned with the acquisition and interpretation of information from one's

environment (Maddox, 1995). Maddison (2006) described that adaptation to climate change requires that farmers first notice that the climate has changed, and then identify useful adaptations and implement them. There are many differences in such perceptions from one place to another since perceptions are culturally and socially contextual, which necessitates evaluating these perceptions within a particular geographical context. While a belief in climate change and concern regarding its impacts serve to motivate adaptation, the presence of barriers to adaptation can limit the implementation of adaptation options in both the short and long-term.

Climate change perception is a complex process that encompasses a range of psychological constructs such as knowledge, beliefs, attitudes and concerns about if and how the climate is changing (Whitmarsh, 2018). Perception is influenced and shaped, among other things, by the individuals' characteristics, their experience, the information that they receive, and the cultural and geographic context in which they live (Whitmarsh, 2018).

Climate change

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years). Climate change may refer to a change in average weather conditions, or in the time variation of weather around longer-term average conditions (i.e., more or fewer extreme weather events). Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have also been identified as significant causes of recent climate change, often referred to as global warming.

CHAPTER II

REVIEW OF LITERATURE

This chapter is a review of past studies having relevance to this research and for this reason, the researcher made an elaborate search for available literature on different sources. Available literature was extensively reviewed to find out work in Bangladesh as well as abroad. Moreover, the investigator extensively went through the available literature from various sources, which enriched her knowledge and gave a clear understanding on the topic. The purpose of this chapter is to review the extant literature and identify pertinent gaps with a view to fulfill the objectives of the study.

The literature collected for the study has been presented in different sections. Even minor changes in precipitation amount or temporal distribution, short periods of extreme temperatures, or localized strong winds can harm farmer's perceptions (Bele et al., 2013).

The adverse impacts of weather events and climate increasingly threaten and erode basic needs, capabilities, and rights, particularly among poor and disenfranchised people, in turn reshaping their farmers' perceptions (UNDP, 2007; Quinn et al., 2011).

Throughout human history, farmers have adapted to changing environmental, social and economic conditions (Kurukulasuriya and Rosenthal, 2013). Nonetheless, it is not clear if agricultural producers will be able to keep up with the unprecedented speed at which climate is expected to change in the coming years (Jones et al., 2012). The negative effects of these changes will be higher for agricultural producers that practice rainfed agriculture, as well as for those with limited access to credit and insurance, and those that are disconnected from regional or national markets (Castells-Quintana et al., 2018). In order to ameliorate these negative effects, public policies and interventions to promote and facilitate adaptation will be needed (Kumar et al., 2020). Nonetheless, in order to be willing to implement adaptation measures, farmers need to be aware of climate change (Meldrum et al., 2018). In that sense, the perception that farmers have about climate change not only informs their planting decisions, but also determines the adoption of adaptation measures (Meldrum et al., 2018; De Matos Carlos et al., 2020). Therefore, understanding farmers' perceptions about climate change can be seen as a

condition for the design and successful implementation of adaptation policies in agriculture (De Matos Carlos et al., 2020). The number of studies that focus on understanding farmers' climate change perception has been increasing, but it is still scant. This is particularly true for Latin America (Dang et al., 2019; Karki et al., 2020), a region highly vulnerable to climate change (López et al., 2016). This phenomenon is expected to have serious negative impacts on the income, consumption and health of agricultural producers in the region (Reyer et al., 2017), leading to increases in poverty and inequality (Harvey et al., 2018; López et al., 2018). Given this scenario, the lack of research on the determinants of climate change perception is worrisome.

2.1 Perception on climate change

Climate change perception is a complex process that encompasses a range of psychological constructs such as knowledge, beliefs, attitudes and concerns about if and how the climate is changing (Whitmarsh and Capstick, 2018). Perception is influenced and shaped, among other things, by the individuals' characteristics, their experience, the information that they receive, and the cultural and geographic context in which they live (Whitmarsh and Capstick, 2018). Therefore, measuring climate change perception and trying to find its determinants is not an easy task. The variability that local weather can have from one day to the other, from one season to the next, and between years, is one of the many challenges that a person faces when trying to distinguish between normal short-run variations and climate change manifestations (Hansen et al., 2012). In fact, local short-term variations tend to be more salient than long-term trends and hence can have a key impact on the formation of climate change perceptions (Lehner and Stocker, 2015). Although the perception of those that directly depend on the weather for at least part of their income, such as farmers, tend to be more accurate than that of their counterparts, they might still have problems using their own experience with weather variables to correctly interpret changes as being big enough as to feel worried and compelled to do something about it (Whitmarsh and Capstick, 2018).

Life experiences influence perception, individuals who have been directly affected by extreme climatic events tend to report that the probability of such event happening again is relatively high (De Matos et al., 2020). Furthermore, the perception that a person has about climate change can be influenced or modified by the information that she receives (Weber, 2010). Finally, it should be noted that perception is in part a subjective

phenomenon, therefore, different people in the same locality might construct different perceptions of climate change even though they experience the same weather patterns (Simelton et al., 2013).

According to A. Aphunu and G. O. Nwabeze (2012) Fish farmers' perception of the impacts of climate change is the extent of their agreement to which variables such as high rainfall, massive flood, food insecurity and hunger, poor harvest, extinction of plant and animal species, etc represented their awareness level of climate change. The result of the research showed that respondents were of the general opinion that climate change has caused a drastic change in weather conditions; destruction of property; increased incidence of flooding; high temperatures and heat waves; excessive sunshine; the poor harvest of fish (especially during spawning for fingerlings production) and increase in food insecurity and hunger. However, respondents did not believe that climate change caused increased harvest of fish; increased incidence of drought; increased cost of fish production, or reduced the cost of fish production. The findings are in line with that of George (2010) that farmers perceived climate change effects from sustained changes over time in environmental temperatures, rainfall intensity and pattern, and also wind variability. Dewit and Stankiewicz (2006) predicted that significant negative impacts will be felt across 25 percent of Africa's inland aquatic ecosystems by 2100. Results of this study confirmed that negative impacts of climate change are being experienced by fish farmers.

Perception refers to the process concerned with the acquisition and interpretation of information from one's environment (Maddox, 1995). Maddison (2006) described that adaptation to climate change requires that farmers first notice that the climate has changed, and then identify useful adaptations and implement them. Another important issue related to adaptation in agriculture pointed out by Bryant et al. (2000) is how perceptions of climate change are translated into agricultural decisions. Howlader et al., (2015) described that adaptation towards climate change is affected by mostly the same factors affecting farmers' perception in this study, thus perception is the preliminary stage to adaptation towards climate change. Maddison (2006) argues that if farmers learn gradually about the change in climate, they will also learn gradually about the best adaptation options towards it. According to him, farmers learn about the best adaptation options through three ways: (1) learning by doing, (2) learning by copying, and (3) learning from instruction. So, Farmers' perception on climate change needs to be

documented for these are thought to influence the success of agricultural production compared to other factors.

Even though the focus of this review was not farmers' adoption of adaptation practices, the articles that do look at adoption show that, in general, farmers try to adapt to the changing environmental circumstances that they are facing (De Matos et al., 2020). Particularly relevant for the focus of this review is the result reported by De Matos Carlos et al. (2020) showing that there is a positive correlation between the adoption of adaptation practices and perceiving a change in climate.In order to protect the livelihoods of the population that directly depends on agriculture, adaptation of the agricultural sector to the adverse effects of climate change is crucial (Asfaw et al., 2016). In a world with perfect information, complete markets, and adequate incentives, the decision to adopt or implement a particular adaptation measure would simply be a matter of evaluating the net benefits of said measure. That is certainly not the setting in which small and subsistence farmers in developing countries operate (Castells-Quintana et al., 2018). Therefore, the adoption of adaptation measures is not an automatic or smooth process, quite the contrary. The evidence has shown that factors like inadequate access to insurance or credit, limited information about adaptation alternatives, and incomplete property rights, constitute barriers that small and subsistence farmers face in relation to technology adoption (Asfaw et al., 2016). Furthermore, the decision to adopt a new technology or production method frequently entails cognitive processes, like mental accounting (Thaler, 1999), loss aversion (Kahneman and Tversky, 1979), and hyperbolic discounting (Laibson, 1997), which can lead to suboptimal levels of adoption (Zilberman et al., 2012). This is particularly relevant for adaptation to climate change, as even farmers with access to weather information and climate forecasts face considerable levels of uncertainty (Silvestri et al., 2012). Under these conditions, the perception that farmers have about climate change is a key component to understanding their adaptation decisions (Clarke, et al., 2012).

Adaptation requires not only that individuals perceive that something is changing or could change, but also that they attribute enough weight to this perception to be willing to take action and try to do something about it (Eakin et al., 2014). In this sense, perceiving that the climate is changing can be seen as a precondition for the adoption of agricultural adaptation measures (Makuvaro et al., 2018). Furthermore, the

successful implementation of public policies aimed towards the promotion of adaptation requires, among many other things, the cooperation and participation of the intended beneficiaries. If their perception about the consequences or immediacy of climate change is different from that of the policy makers, then it is likely that the implementation of the policy will fail (Patt and Schrö, 2008).

2.2 Climate Change Perception of Farmers and other contributors

Hansen et al. (2004) were the first to analyze the climate perceptions of farmers in a Latin American country (Argentina). The literature on this topic has slowly grown since then, although it is still scarce compared to that from Africa and South-East Asia (Altea, 2020; Karki et al., 2020).

The literature for Africa and Asia has shown that factors such as age, gender, education, and culture, play an important role in the processes that determine farmers' perception of climate change (Karki et al., 2020). Results for Chile show that younger and more educated household heads tend to have a perception of climate change that is more aligned with the observed changes in weather variables than the perception of their older and less educated counterparts (Roco et al., 2015). Nonetheless, there is also evidence showing that, in other contexts, farmers might have similar perceptions of climate change irrespective of their age; that is the case for Southern Mexico (Meli et al., 2015). Meanwhile, results for Brazil (Funatsu et al., 2019), Peru (Altea, 2020), and Mexico (Orduño et al., 2019) show that women are less involved than men in agricultural activities and in general in decision making. Furthermore, they tend to be less perceptive of climate change, and, at least according to the evidence for Brazil and Peru, when they perceive it, they do not think of it as an anthropogenic phenomenon. Similarly, some indigenous farmers in Bolivia see climate change as a punishment of God to inappropriate human behavior (Boillat and Berkes, 2013). Results from an analysis of indigenous farmers in Mexico, show another relevant cultural aspect behind climate change perception; the Zoques in Chiapas use biological indicators (e.g., ants, birds and some plants), in addition to their observation of weather variables, to explain perceived changes in climate variability (Sánchez-Cortés and Lazos, 2011). In addition to the aforementioned characteristics, agroclimatic conditions can also play a relevant role as a determinant of climate change perception (Karki et al., 2020). In Chile, for example, farmers living in dryland areas, where rainfall is always marginal, seem to be more aware of climate change than those located in places where irrigation

infrastructure is widely available (Roco et al., 2015). Something similar, although less conclusive, is reported for Ecuador (VanderMolen, 2011). Altea (2020) presents evidence suggesting that in Peru perception of climate change varies with the altitude in which the agricultural land is located. Meanwhile, in the case of Brazil, although droughts affect farmers located in the tropical rainforest as well as those living in shrubland areas (characterized by low and irregular levels of precipitation), rainforest farmers seem to be less aware of the effects of climate change (De Matos Carlos et al., 2020). Farmers' location can be related to perception for another reason: access to meteorological information. This seems to be the case of Chilean farmers, those located close to the regional capital are more aware of the actual changes in weather (Roco et al., 2015). Finally, perception could be affected by recent experience with climate events. Barrucand et al. (2017) report that the perception of changes in precipitation could be biased upwards when farmers have been recently affected by a weather phenomenon; La Nina occurred a few months before farmers participating in their case study were interviewed.

2.3 Climate change and fish farming

Climate and fisheries are closely related. Although climate change is a global problem, the need for adaptation is higher among developing countries where vulnerability is presumably higher (Adger W N, 2003). Climate change has both direct and indirect influences on fisheries and aquaculture. The direct implications of climate change are on the physiology and behavior of the that affect growth, reproduction, mortality and distribution (Allison et al., 2009; IFAD, 2014; Yazdi and Shakouri, 2010). Changes in biophysical characteristics of the aquatic environment and frequent occurrence of extreme events will have significant effects on the ecosystems that support fish (Essam and Uraguch, 2013). Consequently, any increase or decrease in the temperature of the fish habitat would have a significant influence on general metabolism and hence the rate of growth and therefore total production, reproduction, seasonality and even possibly reproductive efficacy (e.g., relative fecundity, number of spawning (Wood and McDonald, 1997), increased susceptibility to diseases and toxicants (Ficke, Myrick, and Hansen, 2007). Despite huge achievements of the fisheries and aquaculture sector of Bangladesh in reaching global rankings, there are some potential threats to the fisheries sector, climate change being one of them. z (2013) showed that high temperature, sea-level rise, cyclone and storm surges, heavy monsoon downpours etc.

are the signs of climate change. As a component of climate change, global warming has become a cause of concern of the present world, specifically for the fisheries and aquaculture sector. There are two kinds of effect of climate change on the fisheries and aquaculture sector. The first one is the direct effect acting on physiology and behavior and altering growth reproductive capacity, mortality and distribution and the second one is the indirect effect altering the productivity, structure and composition of marine ecosystems on which fish depends for food (Yazdi and Shakouri, 2010).

2.4 Research Gaps and Opportunities for Future Research

The "finite pool of worry" hypothesis proposes that climate change concern is a finite resource, that is, it diminishes as other worries rise in prominence (Weber, 2006; Weber, 2015). Understanding how the presence of more immediate threats (e.g., violence) might hinder concern, and therefore action, about the implications of climate change is crucial in a region with high levels of poverty, inequality and social unrest. In particular, it has been shown that exposure to violence can induce higher levels of risk aversion, which in turn hampers productive investments (Moya, 2018). The studies available for Bangladesh are mostly qualitative in nature and based on case studies and small samples. While these studies provide abundant information in terms of the local context, it is desirable to complement them with quantitative studies, in particular with econometric studies. Econometric studies have the potential to identify the main factors behind climate change perceptions as well as the relationship between perception and adaptation. Furthermore, given the adequate data and the correct identification strategy, econometric tools can help establish causal relationships. Moreover, data from surveys that are representative at the national or sub-national levels are necessary to obtain results that can be generalized and used to scale-up adaptation policies and programs. Ideally, these data should be longitudinal in order to better understand how information and the occurrence of extreme climatic events affect perception and adaptation over time. The use of field experiments and choice experiments is an alternative approach which can complement the use of observational data. These tools are used widely in behavioral, environmental and experimental economics, among other disciplines. The use of hypothetical scenarios, a characteristic of these two methods, allows for the construction of mental simulations of the negative effects of climate change. By being based on hypothetical scenarios, these methods have an important advantage over observational studies: they can be used to analyze policies before they are actually

implemented. These methods could also be useful to test how successful different policies might be in terms of promoting adoption of adaptation measures. Furthermore, they can help to analyze the effect that different approaches to communicate climate change information has on perception. The issue of the perception of climate change in a context where the concern is in fact a finite resource could also be analyzed using these methods. Applying field and choice experiments to study perception and adaptation to climate change in Bangladesh is a very promising agenda from a purely academic perspective, but, more importantly, it could be very relevant in terms of providing valuable information that could aid in the design and successful implementation of public policies. The complexity behind the analysis of farmers' climate change perception implies that the collaboration between researchers from different disciplines, such as economics, geography, meteorology, psychology, and sociology, among others, is almost a necessity. If such collaboration is successfully achieved, the results could generate recommendations for the design of adaptation policies that are better tailored to local conditions, less costly, more efficient, and conducive to rural development.

To the best of researcher's knowledge vary little attempts were made to measure fish farmers perception on climate change. Hence, the researcher carried out the present study to measure fish farmers' perception on climate change of Rangpur sadar upazila and Gongachora upazila in Rangpur district following the method which is important to be able to identify and understand the research approach suitable for any given study because the selection of a research approach influences the methods chosen, the statistical analyses used, the inferences made and the ultimate goal of the research (Creswell, 1994). Furthermore, according to Bryman (2001) an area can be explored in two ways, with an unstructured approach to data collection in which participants' meaning are the focus of attention, and more structured approach of quantitative research to investigate a specific set of issues.

2.5 Conceptual framework

In scientific research, selection and measurement of variables constitute an important task. Studies on individual, group and society revealed that acceptance of modem technologies is conditional upon many factors. Some of these are social, personal, economical and situational factors and the behavior of rice cultivators are influenced by these characteristics. The hypothesis of a research while constructed properly consist

at least two important elements i.e.: a dependent variable and an independent variable. A dependent variable is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variables (Townsend, 1953). An independent variable is that factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. Variables together are the causes and the phenomenon is effect and thus, there is cause effect relationship everywhere in the universe for a specific events or issues.

This study is concerned with the 'Fish farmers perception on climate change'. Thus, perception was the dependent variable and 10 selected characteristics of the respondents were considered as the independent variables under the study. Fish farmers perception on climate change may be affected through interacting forces of many independent variables. It is not possible to deal with all of the independent variables in a single study. It was therefore, necessary to limit the independent variables, which were age, education, fish farm size, fish farming experience, fish farm income, extension media contact, access to ICT, access to information on climate change, cosmopoliteness and knowledge on climate change for this study. To make the process conspicuously interpretable a conceptual framework has been presented in a schematic Figure 3.3.

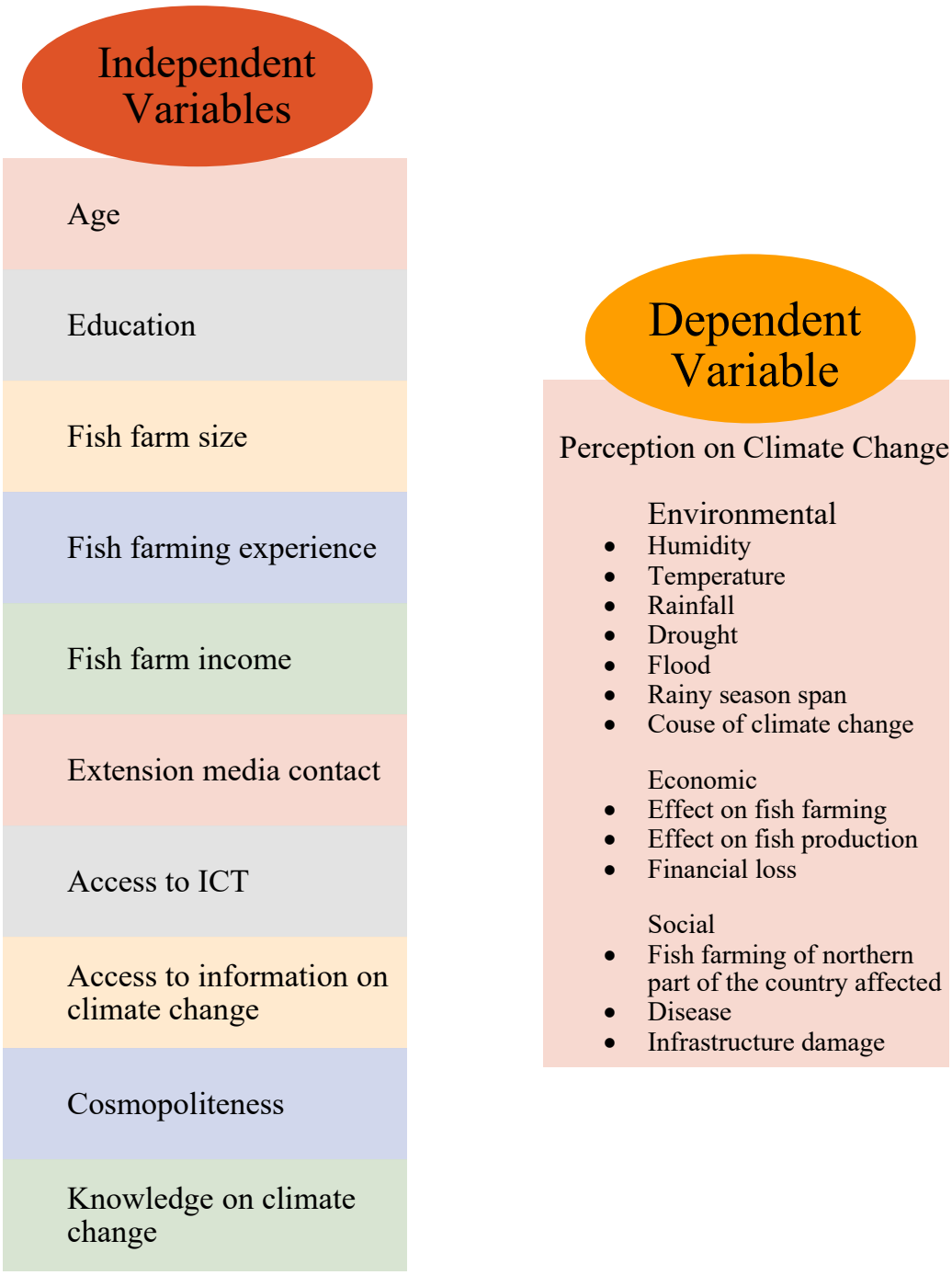


Figure 2.1: The conceptual framework of the study

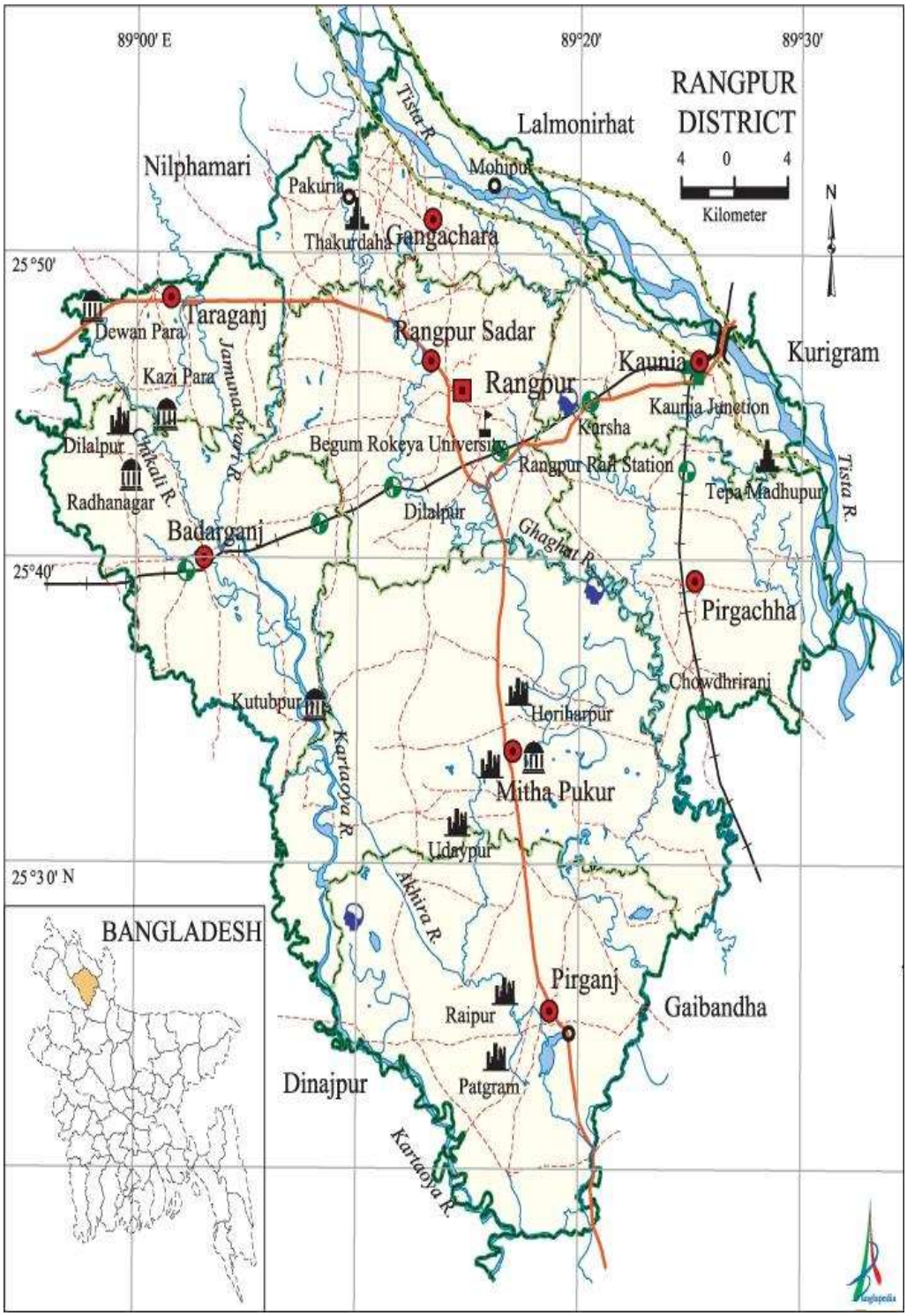
CHAPTER III

MATERIALS AND METHODS

Methods and procedures used for collection and analysis of data are very important in any scientific research. It requires careful consideration before conducting a study. The researcher has a great responsibility to clearly describe what sorts of research design, methods and procedures she would follow in collecting valid and reliable data and to analyze and interpret those to arrive at correct conclusions. The methods and procedures followed in conducting this study have been discussed in this chapter. Further, the chapter includes the operational format and comparative reflection of some variables used in the study. Also, statistical methods and their use have been mentioned in the later section of this Chapter.

3.1 Locale of the study area

The Study was conducted in Rangpur Sadar Upazila of Rangpur District. There are 8 Upazilas in Rangpur District namely Pirganj, Mithapukur, Pirgasa, Gongachora, Badarganj, Kaunia, Taraganj and Rangpur Sadar. 3 villages namely Boro mukutpur, Master para and Janpur of Mominpur union of Rangpur Sadar and 3 villages namely Matukpur, Kuribisha, Chilakhal of Kolkanda union of Gangachara Upazila was selected purposively as study area. There are very few researches regarding fish farmers' perception on climate change in Rangpur Mominpur union of Rangpur District (personal communication with Upazila Fisheries Officer on 19 April, 2022) so this area was selected as study area. Maps of Rangpur District and rangpur Sadar Upazila are presented in Figure 3.1 & 3.2.



(Source: Banglapedia)

Figure 3.1: A Map of Rangpur district showing the study area

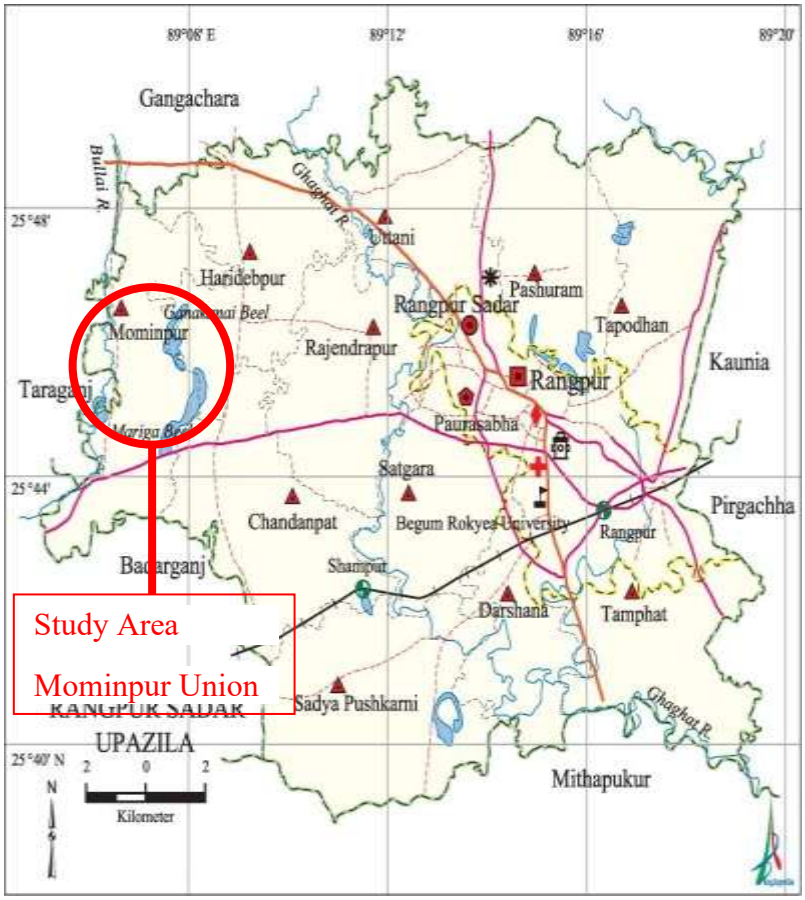
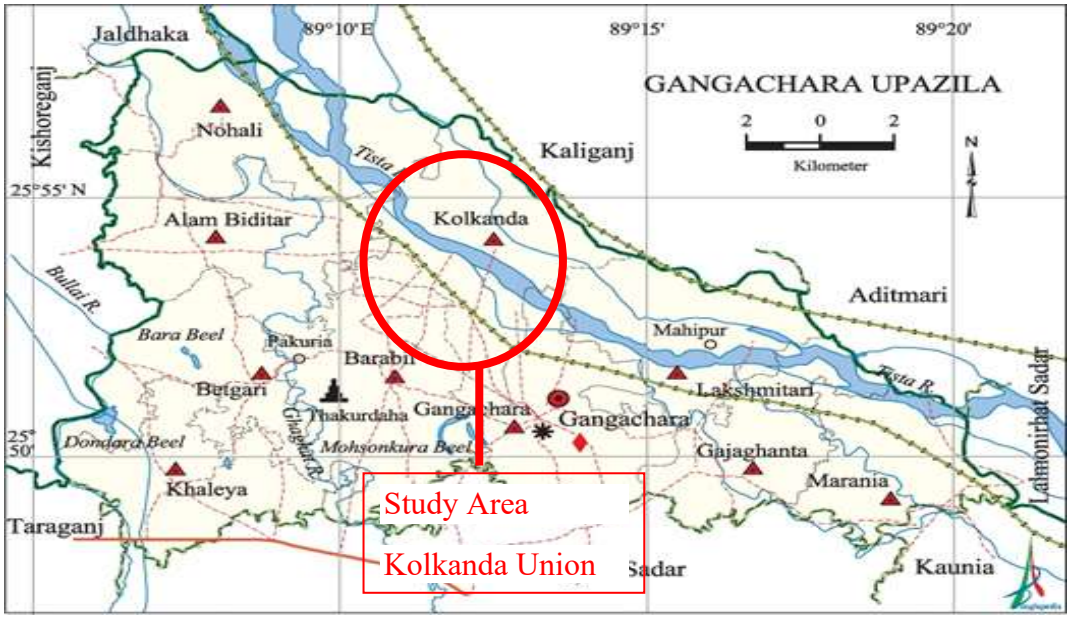


Figure 3.2: A Map of Rangpur Sadar upazila showing the study area Mominpur and Darshana union



(Source: Banglapedia)

Figure 3.3: A Map of Rangpur Gangachara upazila showing the study area Kolkanda union

3.2 Population of the study

Considering the time, financial resources and other constraints, data were collected from a sample rather than the entire population. A list of fish farmers who are currently growing fish and fish fry in their fish farm was prepared with the help of Upazilla Fisheries Officer and his field staff. The number of fish farmers of the selected 3 villages of Mominpur union of Rangpur Sadar Upazila and 3 villages of Kolkanda union of Gangachara Upazila was 221 which constituted the population of the study. The lists comprised 221 fish famers which served as the population of the study. Among 221 farmers, 106 farmers were selected following Yamane's formula (1967). Proportionate random sampling technique was used in order to select the respondents. An appropriate sample reserve list was determined to avoid the uncertainty related with the availability of samples during data collection. Proportional sampling is a method of sampling in which the investigator divides a finite population into subpopulations and then applies random sampling techniques to each subpopulation. As indicated by Yamane's (1967) formula, the sample size was resolved as 106.

The formula is shown below:

$$n = \frac{N}{1+N(e)^2}$$

Where,

n = sample size

N = population size

e = the level of precision 7% = .07

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{221}{1 + 221(.07)^2}$$

$$=106.10$$

$$\cong 106$$

Table 3.2.1 Population and sample size of selected area

Selected upazila	Selected union	Selected villages	Respondent	Sample Size	Reserve List
Rangpur Sadar Upazila	Mominpur	Boro mukutpur	28	14	2
		Master para	46	22	2
		Janpur	36	17	2
Gangachara Upazila	Kolkanda	Matukpur	34	16	1
		Kuribisha	56	27	3
		Chilakhal	21	10	1
Total			221	106	11

Then 106 fish farmers were selected from the population by using proportionate random sampling techniques. A reserve list of 11 (10% of total sample size) farmers was also prepared. Farmers in the reserve list were used only when a respondent in the original list was not available.

3.3 Development of instrument

The face-to-face interviewing method was used for data collection. A structured interview schedule containing both close and open form questions was prepared for this purpose. The question included was simple and direct to ascertain the opinion of the fish farmers. Pre-test with the draft interview schedule with 10 farmers was accomplished. Data was collected by face-to-face interviewing of the respondents. The duration for this imposition was from 15 April to 30 April, 2022. Based on the pre-test result, necessary corrections, modifications, addition, alternation were made in the interview schedule and then finalized.

3.4 Data collection procedure

Data were collected from the selected 106 fish farmers by face-to-face interview. Questions were asked systematically and explanations were made whenever necessary. The respondents were interviewed at their leisure time so that they can give accurate information in a cool mind. The investigator faced no serious problems. To build rapport and motivation in the interview situations, the researcher endeavored to provide conditions that maximum trust maintained each respondent's interest and minimized status difference. The final data were collected during 1 May to 30 May, 2022.

3.5 Selection of the variables of the study

In descriptive social research, selection and measurement of the variables is an important task. In this connection, the researcher reviewed literature as far as possible to widen his understanding about the nature and scope of the variables relevant to his research. Many scholars have dealt with the design of indicators for gauging agricultural sustainability. It was observed that the design of an appropriate set of indicators is a crucial and complex problem (Bossel, 2001) as indicators should provide a representative picture of sustainability. Crabtree and Bayfield (1998) discussed the indicators of sustainability. The indicators have to be based on an understanding of the pressures on the environment and the processes through which human activity induces environmental change. Rasul and Thapa (2003) also discussed the applicability of the indicators. Their study showed that although a large number of indicators have been developed, they do not cover all dimensions. Due to variation in biophysical and socioeconomic conditions, indicators used in one country are not necessarily applicable to other countries. The selection of inappropriate and inconsistent types of variables may lead to misleading and unfruitful results. The researcher keeping all these in mind took adequate measurement in selecting the dependent and independent variables of the study. Before setting the variable of the study, the researcher herself visited the study area and talked to the fish farmers and she was able to observe the selected characteristics of the fish farmers (in the study area). Based on this experience, review of literature, discussion with the relevant experts and academicians and also with the research supervisor, the researcher selected 10 independent variables.

3.6 Dependent variable

Dependent variable is the variable that is being measured in an experiment. Or the variables that are affected during research are called dependent variables. In this study the dependent variable that is fish farmers' perception on climate change was measured based on whether fish farmers agree or disagreeness on some statements related to climate change.

3.7 Measurement of dependent variable

Fish farmers' perception on climate change is the extent of their agreement to which variables such as increased humidity, high temperature, high rainfall, massive flood, drought, infrastructure damage, fish disease, financial loss etc represented their

awareness level of climate change. Fourteen relevant statements were carefully constructed to develop perception scale. These statements were from Islam (2017), Rakib (2016), Adelek (2018), Aphunu (2012). The Likert scale was used to serve the purpose. A respondent was asked to indicate his/her degree of agreement about each of the statements along with a five-point scale as, strongly agree, agree, neutral, disagree and strongly disagree. Scores were assigned to these five alternate responses as 5, 4, 3, 2, and 1 respectively for each statement. However, the score of a respondent was obtained by adding his/her scores for all the 14 statements. Thus, the perception score of a respondent could range from 0 to 70, where, 0 indicated highest levels disagree that climate has changed and 70 indicated highest level of agreement that climate has changed.

3.8 Independent variable

Independent variables are the variables that the researcher changes to test their dependent variables. Or the variables that can take different values and can cause corresponding changes in other variables. In this research, the researcher selected ten characteristics of the respondent as the independent variables. The independent variables for this study are- age, education, fish farm size, fish farming experience, fish farm income, extension media contact, access to ICT, cosmopoliteness, access to information on climate change and knowledge on climate change.

3.9 Measurement of independent variable

For conducting the study in accordance with the objectives it was necessary to measure the independent variables. The independent variables were age, education, fish farm size, fish farming experience, fish farm income, extension media contact, access to ICT, cosmopoliteness, access to information on climate change and knowledge on climate change. Procedures for measuring these variables are described below:

Age

Age of the farmers was measured in terms of actual years from his birth to the time of interview, which was found on the basis of the verbal response of the rural people (Rashid, 2014). A score of one (1) was assigned for each year of one's age.

Level of education

Level of education was measured as the ability of an individual respondent to read and write or the formal education received up to a certain standard. If a respondent did not attain formal education, his score was assigned as zero (0). A score of 0.5 was given to a respondent who only could sign his/her name. A score of one (1) was assigned for each year of schooling. If a respondent passed the S.S.C examination, his education score was given as 10, 12 for H.S.C., score 15 for Degree pass and score 16 for Hons. pass.

Fish farm size

Fish farm size referred to the total area of a pond or other fish farming system on which farmers carried out fish farming operations. The farm size was estimated in consideration of the full benefit of the fish farm owners in terms of hectares.

Fish farming experience

Fish farming experience is the number of years of experience in fish farming. Fish farming experience will be measured in terms of years of fish farming experience.

Fish farm income

Fish farm income refers to the earnings of the respondent from selling fish and fish fry. Fish farm income was measured in Thousand Taka. A score of one was given for each Tk. 1,000 to compute the annual income scores of the respondents.

Extension media contact

The extension media contact of a respondent was measured on the basis of the response of the media contact user farmers against the extent of his using of selected seven media by putting tick mark against any one of the five responses: regularly, frequently, occasionally, rarely, not at all. The responses were scored as 4, 3, 2, 1 and 0 respectively.

Access to ICT to increase farming knowledge

It indicates whether the respondent is aware of climate changes or not and it is measured by the number of changes he noticed last year from a list of changes. Again, over the last ten years if he observed any changes relating to the weather or not. In case of fish farming practice, it indicates the respondent`s access to farming related information.

Then it is measured by the number of ways he uses to get that information. Here, 1= 'positive response' and 0 = 'negative response'.

Access to information on climate change

It indicates the source from which the respondent got information about climate change. It was measured on the basis of whether respondents got information from some selected sources or not and the responses were recorded as 1 = 'yes/positive response' and 0 = 'no/negative response'.

Cosmopoliteness

Cosmopoliteness of a respondent was measured in terms of his nature of visits to the six (6) different places external to his own social system. The cosmopoliteness of a respondent was measured by computing cosmopoliteness score on the basis of his/her visits with six selected cosmopoliteness. Respondents mentioned the nature of his/her visits by putting a tick mark against any one of 4 responses, not at all, rarely, frequently, occasionally and regularly. The score for each respondent was determined by his/her response to all the items on the basis of his/her frequency of visits with a score of 0, 1, 2 and 3 respectively.

Knowledge on climate change

Knowledge of the farmers towards climate change was measured on 10 basic open-ended questions. Each question contains 3 marks. Knowledge of fish farmers was determined by summing up the weights for their responses to all the ten statements. Thus, the knowledge of the farmers towards the climate change score of the respondents could range from 0 to 30, where zero (0) indicates no knowledge and 30 indicates sound knowledge. Based on their climate change knowledge, the respondents were classified into three categories as low knowledge, medium knowledge and high knowledge.

3.10 Statement of the problem

Hypothesis may be divided into two categories such as research hypothesis and null hypothesis.

3.11 Research hypothesis

The following research hypothesis was put forward to test the contribution of the selected characteristics of the fish farmers' perception on climate change. The research

hypothesis was “each of the” selected characteristics of the fish farmers have significant contribution to their perception on climate change.

3.12 Null hypothesis

In order to conduct statistical tests, the research hypotheses were converted to null form. Hence, the null hypotheses were as follows: “Each of the selected characteristics of the farmers had no significant contribution to their perception on climate change.”

3.13 Data processing and analysis

3.13.1 Compilation of data

After completion of the field survey, data from all the interview schedules were coded, compiled, tabulated and analyzed in accordance with the objectives of the study. In this process, all responses in the interview schedule were given numerical coded values. Local units were converted into standard units and qualitative data were converted into quantitative data by assigning suitable scores whenever necessary. The responses of the questions in the interview schedule were transferred to a master sheet to facilitate tabulation.

3.13.2 Categorization of data

For describing the different characteristics and their fish farmers' perception on climate change, the respondents were classified into several categories. These categories were developed by considering the nature of distribution of data, general understanding prevailing in the social system and possible observed scoring system. The procedure for categorization of data in respect of different variables is elaborately being discussed.

3.14 Statistical technique

The analysis was performed using the Statistical Package for Social Sciences (SPSS V 26) computer package. Descriptive analyses such as range, number, percentage, mean, standard deviation was used whenever possible. To find out the contribution of identified characteristics of the fish farmers' perception on climate change, multiple regression was used. Throughout the study, at least five percent (0.05) level of probability was used as the basis of rejecting a null hypothesis.

CHAPTER IV

RESULT AND DISCUSSION

Findings and discussion are the central point of the whole research work. The purpose of this chapter is to describe the findings of the study. The research quality depends upon how well the findings of the research are interpreted. Procedures of using data for the measurement needed some discussion for clarity of understanding. Data obtained from respondents by interview were measured, analyzed, tabulated and statistically treated according to the objectives of the study. This chapter has been discussed in three sections such as 1. Selected characteristics of the respondents, 2. Perception of fish farmers on climate change and 3. Regression for fish farmers' perception on climate change and its dimensions etc.

4.1 Selected characteristics of fish farmers

The findings of the farmers' selected characteristics have been presented and discussed (Table 4.1) in this section. The selected characteristics are: age, education, farm size, fish farming experience, annual fish farm income, extension media contact, access to ICT to increase farming knowledge, access to information on climate change, cosmopoliteness, knowledge on climate change.

Table 4.1 The salient features of the selected characteristics of fish farmers'

Categories	Measuring unit	Range		Mean	SD
		Possible	Observed		
Age	Year	-	33-67	48.23	8.77
Education	Year of schooling	-	0.5-16	8.11	3.68
Fish farm size	Hectare	-	0.2-6.47	1.41	1.23
Fish farming experience	Year of experience	-	3-17	8.77	3.27
Fish farm Income	Taka (in thousand)	-	1,38-35,20	842	798
Extension media contact	Score	0-24	6-16	11.35	2.56
Access to ICT	Score	0-6	0-6	3.57	1.67
Access to information on climate change	Score	0-10	1-7	4.67	1.61
Cosmopoliteness	Score	0-24	9-19	15.12	3.18
Knowledge on climate change	Score	0-30	10-28	21.24	6.12

4.1.1 Age

The age of the farmers has been varied from 33 to 67 years with a mean and standard deviation of 48.23 and 8.77 respectively. Based on their age, the farmers were classified into three categories (Mean ± Standard Deviation) namely young, middle and old aged (Rashid, 2014). This category was done according to Ministry of Youth. The distribution of the farmers in accordance with their age is presented in Table 4.2.

Table 4.2 Distribution of the fish farmers according to their age

Categories	**Range (Years)**		**Respondents**		**Mean**	**SD**
	Score	**Observed**	**Number**	**Percent**		
Young aged	Up to 35	33-67	10	9.4%	48.23	8.77
Middle aged	36-50		72	67.9%		
Old aged	Above 51		24	22.6%		
Total			106	100		

Table 4.2 reveals that the middle-aged farmers comprised the highest proportion 67.9% followed by old aged 22.6% and the lowest proportion were made by young aged 9.4%. Data also indicates that the middle and old aged respondents constitute almost 90.6 % of total respondents. Fish farmers of different age may have different perception on climate change. Results for Chile show that younger and more educated household heads tend to have a perception of climate change that is more aligned with the observed changes in weather variables than the perception of their older and less educated counterparts (Roco et al., 2015)

4.1.2 Education

The level of education scores of the respondents ranged from 0 to 16 with the mean of 8.11 and the standard deviation was 3.68. Based on their educational scores, the farmers were classified into four categories (Mean ± Standard Deviation) namely illiterate, primary level, secondary level and above secondary level. The distributions of the respondents according to their level of education are presented in Table 4.3.

Table 4.3 Distribution of fish farmers' according to their education

Categories	Range (Years)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Illiterate	0.5	0.5-16	18	17%	8.11	3.68
Primary level	1-5		22	20.8%		
Secondary level	6-10		52	49%		
Above Secondary level	11-16		14	13.2%		
Total			106	100		

Table 4.3 shows that farmers in the secondary education category constitute the highest proportion 49% followed by the primary level 16% and illiterate 17%. On the other hand, the lowest 13.2% is above secondary level category. Education broadens the horizon of the outlook of farmers and expands their capability to analyze any situation related to climate change. An educated farmer is likely to be more responsive to the modern facts, ideas, technology and information of climate change. This finding is in line with Islam (2017) who found that most of the farmer that is 41.6% passed secondary education level. Results for Chile show that younger and more educated household heads tend to have a perception of climate change that is more aligned with the observed changes in weather variables than the perception of their older and less educated counterparts (Roco et al., 2015)

4.1.3 Fish farm size

The farm size of the farmers in the study area varied from 0.20-6.47 hectares (ha). The average farm size was 1.41 hectare and the standard deviation was 1.23. On the basis of farm size, the respondents were classified into three categories (according to DAE, 1999) namely small farm, medium farm and large farm as shown in Table 4.4.

Table 4.4 Distribution of fish farmers' according to their fish farm size

Categories	Range (Years)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Small	0.2-1.0	0.20-6.47	58	54.7%	1.41	1.23
Medium	1.1-2.0		34	32.1%		
Large	2.01-10		14	13.2%		
Total			106	100		

Data in Table 4.4 reveals that the majority of the respondents 54.7% had small farm size, while 32.1% have medium farm and 13.2% have large farm size. Farmers having large fish farm tries to have a good knowledge on climate because climate highly affects fish farming.

4.1.4 Fish farming experience

Fish farming experience in the study area varied from 3 years to 17 years. The average fish farming experience was 8.77 years and the standard deviation was 3.27. On the basis of fish farming experience year, the respondents were classified into three categories (Mean ± Standard Deviation) namely low experienced, medium experienced, high experience as shown in Table 4.5.

Table 4.5 Distribution of fish farmers' according to their fish farming experience

Categories	Range (Years)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	Up to 5	3-17	18	17%	8.77	3.27
Medium	6-10		54	50.9%		
High	Above 10		34	32.1%		
Total			106	100		

Data in Table 4.5 reveal that the majority of the respondents 50.9% had medium experience. While 17% had low and 32.1% had high experience in fish farming. More experienced fish farmers may have more perception about climate change.

4.1.5 Fish farm income

Annual fish farming income scores of the respondents ranged from Tk.1,38 to Tk. 35,20 with the average of Tk. 8,42 and the standard deviation was Tk. 798 From the observed range, on the basis of the annual fish farm income, According to the scores of income from fish farming the respondents have been classified into three categories (Mean ± Standard Deviation) such as low (<3), medium (4-5) and high (>5). The categories are shown below in Table 4.6.

Table 4.6 Distribution of fish farmers' according to their fish farm income

Categories	Range (Years)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	Up to 5,00	1,38-35,20	34	32.1%	8,42	7,98
Medium	5,01-10,00		56	52.8%		
High	Above 10,00		16	15.1%		
Total			106	100		

Data in Table 4.6 reveal that the majority of the respondents 52.8% had medium fish farm income. While 32.1% had low and 15.1% had high fish farm income. According to fish farm size most of the farmers possess small to medium sized fish farm so their income from fish farming is dependent on their fish farm size. Fish farm income is low of the farmer who have small fish farm and fish farm income is high who have large fish farm.

4.1.6 Extension media contact

An extension contact score was computed for each respondent on his extent of contact with 6 selected media. Each respondent was asked to mention the frequency of his contact with each of the 6 selected media. Extension media contact scores of the farmers ranged from 6 to 16 with an average of 11.35 and standard deviation of 2.56. It was measured as one's extent of exposure with different information sources. On the basis of their extension media contact score the respondents were classified into three categories (Mean ± Standard Deviation) namely, low contact, medium contact and high contact. The scale used for computing the extension contact score of a respondent is given in table 4.7.

Table 4.7 Distribution of fish farmers' according to extension media contact

Categories	Range (Years)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	Up to 10	6-16	36	34%	11.35	2.56
Medium	11-12		18	17%		
High	Above 12		52	49.1%		
Total			106	100		

Data contained in Table 4.7 indicated that the highest proportion 49.1% of the respondents had high extension media contact as compared to 17% and 34% having medium and low extension media contact respectively. It was assumed that the more contact an individual would have with different information sources, the more he becomes educated and knowledgeable, and thus perception increases.

4.1.7 Access to ICT

The observed access to ICT score of the respondents ranged from 0 to 6. The mean score was 3.57 with the standard deviation 1.67. Based on the access to ICT score, the respondents were classified into three categories (Mean ± Standard Deviation) namely low access to ICT, medium access to ICT, and high access to ICT as shown in Table 4.8.

Table 4.8 Distribution of fish farmers' according to access to ICT

Categories	Range (Years)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	0-2	0-6	18	17%	3.57	1.67
Medium	3-4		54	50.9%		
High	5-6		34	32.1%		
Total			106	100		

Data contained in Table 4.8, revealed that the majority 50.9% of the farmers had medium access to ICT as compared to 17% and 32.1% having low and high access to ICT respectively. The majority 83% of the farmers are in medium to high access to ICT. More access to ICT increases knowledge on different things thus perception increases with more use of ICT.

4.1.8 Access to information on climate change

Access to information related to climate scores of the respondents ranged from 1 to 7 with an average of 4.67 and standard deviation 1.61. Based on their access to information on climate change scores the respondents have been classified into three categories (Mean ± Standard Deviation) such as low access (up to 3), medium access (4-6) and high access (above 6). The categories are shown in the table 4.9 below.

Table 4.9 Distribution of fish farmers' according to access to information on climate change

Categories	Range (Years)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	Up to 3	1-7	20	18.9%	4.67	1.61
Medium	4-6		56	52.8%		
High	Above 6		30	28.3%		
Total			106	100		

From the above table 4.9, we see that respondents of the study area had a variety of access to information related to climate change. Here, a plenty of people 52.8% had medium access to climate information while 18.9% had low access and 28.3% of the respondents had frequent access to climate information. More access to information on climate change increases perception of climate change.

4.1.9 Cosmopoliteness

The score of cosmopoliteness of the fish farmers ranged from 9-19 with a mean and standard deviation of 15.12 and 3.18. On the basis of cosmopoliteness score, the respondents were classified into three categories (Mean ± Standard Deviation) namely low, medium and high. The scale used for computing the Cosmopoliteness score is presented in Table 4.10.

Table 4.10 Distribution of fish farmers' according to cosmopoliteness

Categories	Range (Years)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	Up to12	9-19	18	17%	15.12	3.18
Medium	13-16		54	50.9%		
High	Above 16		34	32.1%		
Total			106	100		

Data contained in Table 4.10 shows that the highest proportion 50.9% of the respondents had medium cosmopoliteness while 17% had low and 32.1% of them had high cosmopoliteness categories. The majority of the farmers 85% medium to high cosmopoliteness. Cosmopoliteness of the farmers increases their knowledge about climate change. Because more cosmopolite person meets more people and gain

knowledge on different things which increases their perception of a topic. This finding is in line with Islam (2017) who found that 55.7% of the farmer were medium cosmopolite.

4.1.10 Knowledge on climate change

The score of the knowledge on climate change ranged from 10-28 with a mean and standard deviation of 21.24 and 6.12 respectively. On the basis of knowledge on climate change fish farmers score the respondent were classified into three categories (Mean ± Standard Deviation) such as, low knowledge, medium knowledge and high knowledge on climate change. The distribution of the fish farmers according to their knowledge on climate change scores is shown in the table 4.11.

Table 4.11 Distribution of fish farmers' according to knowledge on climate change

Categories	Range (Years)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	Up to 15	10-28	20	18.9%	21.24	6.12
Medium	16-25		58	54.7%		
High	Above 25		28	26.4%		
Total			106	100		

Data presented in Table 4.11 showed that the majority 54.7% of the respondents had medium knowledge on climate change while 26.4% had high knowledge and 18.9% of the farmers had low knowledge on climate change. The majority of the farmers 81.1% have medium to high knowledge on climate change. Knowledge on climate change indicates a person's perception on climate change. The person who has high knowledge on climate change have a proper perception on climate change. On the other hand, person having low knowledge on climate change have low perception on climate change. This finding is in line with Islam (2017) who found that 78.8% of the farmer possess medium to high knowledge on climate change.

4.2 Fish farmers perception on climate change

The observed perception scores of the respondents ranged from 44 to 63 against the possible range of 0-70. The mean scores were 55.24 with the standard deviation of 5.72. There are many differences in such perceptions from one place to another since perceptions are culturally and socially contextual, which necessitates evaluating these perceptions within a particular geographical context (Woods, 2017). While a belief in

climate change and concern regarding its impacts serve to motivate adaptation, the presence of barriers to adaptation can limit the implementation of adaptation options in both the short and long-term.

14 statement was constructed to measure dependable variable fish farmers' perception on climate change. 14 statements are humidity is increasing, temperature has increased, increased rainfall, drought has increased, flood has increased, late rainy season, short rainy season, damage of fish farming infrastructure due to flood, climate change has caused a decreased in fish production, fish disease is increasing, financial losses due to flood, fish farming of northern part of the country is affected by climate change, drought has negative impact on fish farming and flood has negative impact on fish farming. These 14 statements were constructed with the help of research conducted by Jha and Gupta (2021), Adeleke (2018), Islam (2017), Woods (2017), Akanda (2015).

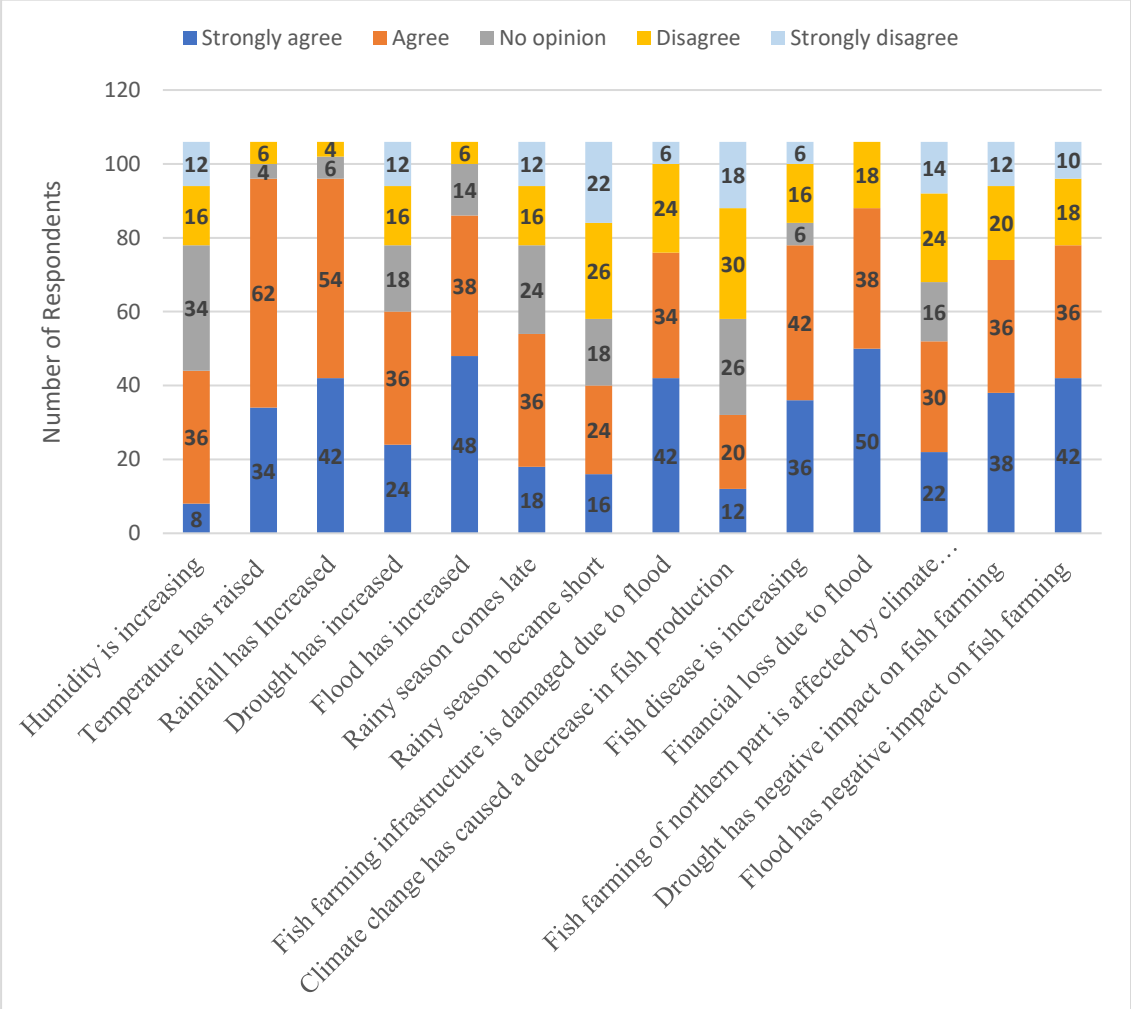


Figure 4.1. Distribution of fish farmers' according to perception on climate change

Among 14 statements most of the statements were agreed by fish farmers. Statement that says 'Humidity is increasing' is agreed by highest number of fish farmers 33.96% followed by no opinion 32.07%. Next statement that says 'Temperature has raised' is also agreed by highest number of respondents that is 58.5% followed by strongly agreed 32.07%. 'Rain fall has increased' statement is agreed by highest number of respondents that is 50.94% followed by strongly agreed 39.62%. 'Drought has increased' statement is agreed by highest number of respondents that is 33.96% followed by strongly agreed 22.64% and no opinion 16.98%. Next statement that says 'Flood has increased' is strongly agreed by highest number of respondents that is 45.28% followed by agreed 35.84%. 'Rainy season comes late' is agreed by highest number of respondents that is 33.96% followed by no opinion 22.64%. 'Rainy season became short' statement was disagreed by highest number of respondents that is 24.52% followed by agreed 22.64% and strongly disagreed 20.75%. 'Fish farming infrastructure is damaged due to flood' statement was strongly agreed by highest number of respondents 39.62% followed by agreed 32.07%. 'Climate change has caused a decreased in fish production' statement was disagreed by highest number of respondents that is 28.30% followed by no opinion 24.52% and agreed 18.87%. 'Fish disease is increasing' statement was agreed by highest number of respondents that is 39.62% followed by strongly agreed 33.96%. 'Financial loss due to flood' statement was strongly agreed by highest number of respondents that is 47.17% followed by agreed 35.85%. 'Fish farming of northern part of the country is affected by climate change' statement is agreed by highest number of respondents that is 28.30% followed by disagreed 22.64% and strongly agreed 20.75%. 'Drought has negative impact on fish farming' statement was strongly agreed by highest number of respondents that is 35.84% followed by agreed 33.96%. 'Flood has negative impact on fish farming' statement was strongly agreed by highest number of respondents that is 39.62% followed by agreed 33.96%.

Summary of the above statement is among the 14 statements 10 statements were either agreed or strongly agreed by more than 50% of the respondents.

Study conducted by Woods (2017) showed that over 50% of the farmer agreed that global climate is changing. In a 2015 survey of the general population, 80% of the respondents agreed with a statement that global temperatures are increasing (6% disagreed) (Minter, 2015). Study conducted by Sujakhu (2020) in Nepal showed that respondents were asked about seasonal temperature changes, 55% stated that summer

temperature increased, and 19% said that winters were getting warmer. About 60% reported a decrease of total annual precipitation, but when asked about seasonal rainfall change, 44% and 48% stated a decrease in summer and winter rainfall, respectively; and 38% reported a decrease in snowfall.

Fish farmer who agreed highly about climate change more aware of climate change and possess high knowledge about climate change, fish farmer who agreed low about climate change are less aware of climate change and possess low knowledge about climate change.

4.3 The Contribution of the selected characteristics of the respondents to their perception on climate change

In order to measure the fish farmers' perception on climate change, the multiple regression analysis was used which is shown in Table 4.13.

Table 4.12 Multiple regression coefficients of the contributing variables related to the fish farmers' perception on climate change

Dependent Variable	Independent Variable	β	ρ	R^2	Adj R^2	F
Farmers' Perception on Climate Change	Age	.122	.233	.689	.653	37.21
	Education	.101	.038*			
	Fish Farm Size	.203	.782			
	Fish Farming Experience	.235	.498			
	Fish Farm Income	-.105	.156			
	Extension Media Contact	.322	.128			
	Access to ICT	.150	.320			
	Access to Information on Climate change	.345	.005**			
	Cosmopoliteness	.321	.004**			
	Knowledge on Climate Change	.456	.001**			

** Significant at p<0.01; *Significant at p<0.05

Table 4.13 shows that education, access to information on climate change, cosmopoliteness and knowledge on climate change were the main contributory factors for fish farmers' perception on climate change. Of these, cosmopoliteness, access to information climate change and knowledge on climate change were the most important contributing factors that were significant at the 1% level of significance and education was significant at 5% level of significance while coefficients of other selected variables don't have any significant contribution on fish farmers' perception on climate change.

The value of R^2 is a measure of how the variability in the dependent variable is accounted for by the independent variables. So, the value of $R^2 = 0.689$ means that independent variables account for 68.9% of the variation in fish farmers' perception on climate change. This means that 31.1% of the perception of fish farmers cannot be explained by the selected variables. Therefore, there must be other variables that have an influence also. The F ratio is 37.21 which is highly significant ($\rho<0$).

However, each predictor may explain some of the variance in respondents' perception on climate change simply by chance. The adjusted R^2 value penalizes the addition of extraneous predictors in the model, but values Adj R^2 0.653 still show that variance in fish farmers' perception on climate change can be attributed to the predictor variables rather than by chance the suitable model (Table 4.13). In summary, the models suggest that the respective authority should consider the fish farmers' education, access to information on climate change, cosmopoliteness and knowledge on climate change and in this connection some predictive importance has been discussed below:

4.3.1 Significant contribution of education to the fish farmers' perception on climate change

From the multiple regression, it was concluded that the contribution of education to the fish farmers' perception on climate change was measured by testing the following null hypothesis;

"There is no contribution of education to the fish farmers' perception on climate change".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of education was significant at 5% level (.038)
b. So, the null hypothesis could be rejected

c. The β-value of education is (0.101). So, it can be stated that as education increased by one unit, fish farmers' perception on climate change increased by 0.101 units. Considering the effects of all other predictors are held constant.

Based on the above finding, it can be said that fish farmers' age increased fish farmers' perception on climate change. So, education has significantly contributed to the fish farmers' perception on climate change. This implies that with the increase of education of the fish farmers' will increase their perception on climate change. This finding is supported by the study conducted by Howlader et al., (2015) which says that education have significant contribution on farmers' perception on climate change's effects on agriculture. Educational level is a key social indicator (Roy et al., 2011). Several empirical studies substantiated education has a strong association with awareness, knowledge, adoption of management practice, access and right to information etc. these are also important aspects for sustainability (Roy et al., 2021).

4.3.2 Significant contribution of access to information on climate change to the fish farmers' perception on climate change

From the multiple regression, it was concluded that the contribution of access to information on climate change to the fish farmers' perception on climate change was measured by testing the following null hypothesis;

"There is no contribution of access to information on climate change to the fish farmers' perception on climate change".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the access to information on climate change was significant at 1% level (.001)

b. So, the null hypothesis could be rejected

c. The β-value of knowledge on climate change is (0.345). So, it can be stated that as access to information on climate change increased by one unit, fish farmers' perception on climate change increased by 0.345 units. Considering the effects of all other predictors are held constant

Based on the above finding, it can be said that fish farmers had more access to information on climate change increased fish farmers' perception on climate change. So, access to information on climate change has highly significantly contributed to the

fish farmers' perception on climate change. This implies that with the increase of access to information on climate change of the fish farmers' will increase their perception on climate change. This finding is supported by the study conducted by

4.3.3 Significant contribution of cosmopoliteness to the fish farmers' perception on climate change

From the multiple regression, it was concluded that the contribution of cosmopoliteness to the fish farmers' perception on climate change was measured by testing the following null hypothesis;

"There is no contribution of cosmopoliteness to the fish farmers' perception on climate change".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the cosmopoliteness was significant at 1% level (.008)
b. So, the null hypothesis could be rejected
c. The β-value of cosmopoliteness is (0.321). So, it can be stated that as cosmopoliteness increased by one unit, fish farmers' perception on climate change increased by 0.321 units. Considering the effects of all other predictors are held constant.

Based on the above finding, it can be said that fish farmers' cosmopoliteness increased fish farmers' perception on climate change. So, cosmopoliteness has highly significantly contributed to the fish farmers' perception on climate change. This implies that with the increase of cosmopoliteness of the fish farmers' will increase their perception on climate change because more cosmopolite people meet more people and gain knowledge which increases perception. This finding is supported by the study conducted by Ali (2021) which says that cosmopoliteness has a significant contribution to the perception of farmers on maize as a potential crop for climate change adaptation.

4.3.4 Significant contribution of knowledge on climate change to the fish farmers' perception on climate change

From the multiple regression, it was concluded that the contribution of knowledge on climate change to the fish farmers' perception on climate change was measured by testing the following null hypothesis;

“There is no contribution of knowledge on climate change to the fish farmers’ perception on climate change”.

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

d. The contribution of the knowledge on climate change was significant at 1% level (.001)

e. So, the null hypothesis could be rejected

f. The β-value of knowledge on climate change is (0.456). So, it can be stated that as knowledge on climate change increased by one unit, fish farmers’ perception on climate change increased by 0.456 units. Considering the effects of all other predictors are held constant.

Based on the above finding, it can be said that fish farmers had more knowledge on climate change increased fish farmers’ perception on climate change. So, knowledge on climate change has highly significantly contributed to the fish farmers’ perception on climate change. This implies that with the increase of knowledge on climate change of the fish farmers’ will increase their perception on climate change. This finding is supported by the study conducted by Aphunu and Nawabeze (2012) which says that knowledge on climate change has significant contribution on fish farmers’ perception on climate change impact on fish production.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

The purpose of the study was to measure fish farmers' perception on climate change. So, the study was conducted in the purposefully selected Rangpur Sadar Upazila of Rangpur District. Population of the study was 221 and the sample size of the study was 106. A well-structured interview schedule was developed based on objectives of the study for collecting information. The indicators were age, education, fish farm size, fish farming experience, fish farm income, extension media contact, access to ICT, access to information on climate change, cosmopoliteness and knowledge of climate change. The entire process of collecting data took place during May, 2022. Various statistical measures such as frequency, percentage, mean and standard deviation were used in describing data. In order to estimate the contribution of the selected indicators of respondents to perception on climate change multiple regression analysis (B) were used. The major findings of the study are summarized below:

5.1 Major findings of the study

5.1.1 Selected characteristics of the respondent

Age

The age of fish farmers ranged from 33 to 67. The average age was found to be 48.23 with the standard deviation of 8.77. The highest proportion 67.9% of the respondents was middle aged compared to 9.4% was young and 22.6% percent were old aged.

Level of education

The level of educational scores of the fish farmers ranged from 0.5 to 16 with a mean and standard deviation of 8.11 and 3.68 respectively. Respondents under the secondary education category constitute the highest proportion 49% secondary followed by primary 20.8% and illiterate 17%. On the other hand, the lowest 13.2% above higher secondary category.

Fish farm size

The fish farm size of the fish farmers ranged from 0.02 ha to 6.47 ha with a mean and standard deviation of 1.41 and 1.23 respectively. The researcher found that the small fish farm holder constituted the highest proportion 54.7% followed by medium fish farm holder 32.1%, whereas 13.2% was the large farm holder. The findings of the study reveal that the majority of fish farmers were small to medium sized fish farm holders.

Fish farming experience

The fish farming experience of the fish farmers ranged from 3 to 17 years with a mean and standard deviation of 8.77 and 3.27 respectively. The researcher found that the medium fish farming experience constitutes the highest proportion 50.9% followed by high 32.1%, whereas 17% was medium. The findings of the study reveal that the majority of fish farmers were highly experienced.

Fish farm income

The fish farm income of the fish farmers ranged from 138 thousand tk to 3520 thousand tk with a mean and standard deviation of 842 thousand tk and 798 thousand tk respectively. The researcher found that the medium fish farm income constitutes the highest proportion 52.8% followed by low 32.1%, whereas 15.1% was high. The findings of the study reveal that the majority of fish farmers had high fish farm income.

Extension media contact

The extension media contact scores of fish farmers ranged from 6 to 16, against the possible range of 0 to 24. The average extension media contact was found to be 11.35 with the standard deviation of 2.56. The highest proportion 49.1% of the respondents had high extension media contact compared to 34% having low and 17% with medium extension media contact.

Access to ICT to increase farming knowledge

The access to ICT score of the fish farmers ranged from 0 to 6 against the possible range of 0 to 6. The mean and standard deviation of access to ICT score 3.57 and 1.67 respectively. The researcher found that the medium access to ICT score constitutes the highest proportion 50.9% followed by high 32.1%, whereas 17% was low. The findings of the study reveal that the majority of fish farmers were medium access to ICT.

Access to information on climate change

The access to Information on climate change score of the fish farmers ranged from 1 to 7 against the possible range of 0 to 10. The mean and standard deviation of access to Information on climate change score 4.67 and 1.61 respectively. The researcher found that the medium access to Information on climate change score constitutes the highest proportion 52.8% followed by high 28.3%, whereas 18.9% was low. The findings of the study reveal that the majority of fish farmers were medium access to Information on climate change.

Cosmopoliteness

The cosmopoliteness score of the fish farmers ranged from 9 to 19 against the possible range of 0 to 24. The mean and standard deviation of cosmopoliteness score 15.12 and 3.18 respectively. The researcher found that the medium cosmopoliteness score constitutes the highest proportion 50.9% followed by high 32.1%, whereas 17% was low. The findings of the study reveal that the majority of fish farmers were medium cosmopolite.

Knowledge on climate change

The knowledge on climate change scores of the fish farmers ranged from 10 to 28 against the possible range of 0 to 30. The mean and standard deviation of knowledge on climate change score 21.24 and 6.12 respectively. The researcher found that the medium knowledge on climate change score constituted the highest proportion 54.7% followed by high 26.4%, whereas 18.9% was low. The findings of the study reveal that the majority of fish farmers were knowledgeable on climate change.

5.1.2 Fish farmers' perception on climate change

Fish farmers' perception score varied from 44 to 63 with the mean and standard deviation of 55.24 and 5.72 respectively. Among the 14 statements regarding climate change and fish farming 10 statements were either agreed or strongly agreed by more than 50% of the respondents. So, it can be said that fish farmers are aware of climate change. But still there are some fish farmers who lack perception and knowledge on climate change.

5.1.3 Contribution of the selected characteristics of fish farmers' perception on climate change

There is a significant contribution of access to information on climate change, cosmopoliteness and knowledge on climate change on fish farmers' perception on

climate change and both of these were the most important contributing factors (significant at the 1% level of significance), education were also the important contributing factors (significant at the 5% level of significance).

Adjusted $R^2 = 0.653$ of the variation in the fish farmers' perception on climate change can be attributed to their education, cosmopoliteness and knowledge on climate change. The F value (37.21) indicates that the model is significant ($p<0.008$). However, each predictor may explain some of the variance in perception on climate change of fish farmers simply by chance. The adjusted R^2 value penalizes the addition of extraneous predictors in the model, but values of 0.653 still show that the variance in perception on climate change can be attributed to the predictor variables rather than by chance.

5.2 Conclusion

The study explores the detail empirical picture of fish farmers' perception on climate change. The findings and relevant facts of research work prompted the researcher to draw following conclusions:

I. Among the fish farmers, more than 50% fish farmer either strongly agreed or agreed on 10 statements out of 14 statements regarding climate change perception. Therefore, it may be concluded that there is scope to increase fish farmers' perception through increasing education, cosmopoliteness and fish farmers' knowledge on climate change.

II. Maximum of the respondents that is 42% had passed secondary level of education as compared to 36% and 8% had above secondary and primary level of education and 14% of the respondent were illiterate. The regression analysis revealed that education of the respondents was a contributing factor to the fish farmers' perception on climate change. Therefore, it may be said that the higher the education level the higher the perception of the fish farmers of climate change.

III. Maximum of the respondents 52.8% had medium level of access to information on climate change. The regression analysis revealed that access to information on climate change was a contributing factor to the fish farmers' perception climate change.

IV. Cosmopoliteness had contribution to the fish farmers' perception on climate change. It also showed that the majority of the respondents had medium

cosmopoliteness. The result concluded that establishment of more cosmopoliteness will increase the fish farmers' perception on climate change.

V. Knowledge on climate change of the respondents had a significant contribution to the fish farmers' perception on climate change, consequently. The majority 56% of the respondents had medium knowledge on climate change while 24% had high knowledge and 20% of the fish farmers had low knowledge on climate change. Knowledge helps fish farmers to make favorable perceptions of climate change which ultimately helps the farmers to follow coping strategies.

5.3 Recommendations

5.3.1 Recommendations for policy implications

On the basis of observation and conclusions drawn from the findings of the study following recommendations are made to the planners and policy makers in contriving micro or macro level policy for increasing of crop production:

I. Education increases fish farmers' perception on climate change. So, policies should be taken to increase fish farmers' education level with night school, open school or old age school to broaden their outlook and to develop favorable perception on climate change. GO and NGOs can play a vital role in this regard.

II. Majority of the fish farmers of the study area had medium knowledge on climate change. The study also showed that the higher the knowledge on climate change the higher the perception on climate change. So, to increase the perception on climate change knowledge needs to be increased, for that DAE along with experts NGOs, representatives, different social media and mass media can play a key role in this regard. Climate school can be a great solution to increase fish farmers' climate knowledge.

III. Cosmopoliteness also positively influence fish farmers perception on climate change. To increase the cosmopoliteness DoF and DAE can arrange different climate change campaigns to broaden fish farmers' access to information on climate change.

5.3.2 Recommendation for further research

A single research work is very inadequate to have in-depth understanding of fish farmers' perception on climate change. Further studies should be undertaken covering more dimensions of the same issue. Therefore, the following suggestions are made for further research work:

I. The present study was conducted in 3 villages of Mominpur union of Rangpur Sadar upazila and 3 villages of Kolkanda union of Gangachara Upazaila of Rangpur District. It is recommended that similar studies should be conducted in other areas of the country.

II. This study investigated only ten characteristics of the fish farmers with their perception on climate change. Therefore, it is recommended that further study should be conducted with other independent and dependent variables.

III. In this research the author conducted his survey on only fish farmers. So, further study can be taken with other farmers' groups and compared among these groups.

IV. Researchers will have the opportunity or scope to identify the factors causing hindrance to the adoption of fish farming practices by fish farmers in fish farming.

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APPENDIX – A

An English Version of the Interview Schedule

Department of Agricultural Extension and Information System

Sher-e-Bangla Agricultural University, Dhaka-1207

An interview Schedule for the Study Entitled

FISH FARMERS' PERCEPTION ON CLIMATE CHANGE

Name of the respondent: ……..... Serial No: ……

Contact number: …….

Union: ……. Village……..

Please provide the following information. Your information will be kept confidential and will be used for research purposes only.

1. Age	
How old are you?	

2. Education: (Described as a percentage)	
What is the level of your education?	
a. Do not know reading and writing	[ ]
b. Do not know reading and writing but can sign	[ ]
c. Read up to class (actual year of schooling)	[ ]

3. Fish Farm Size

Sl. No.	Categories of Fish Farm	Number of Ponds	Area of Land		Total Area (Hectare)
			Local Unit	Hectare	
1	Earthen Pond				
2	Concrete Pond				
3	Cage or Pen Ponds				

4. Fish Farming Experience

Categories	Problem Faced	
	Yes (1)	No (0)
a. Experience (1 to 5 Years)		
b. Experience (5 to 10 Years)		
c. Experience (Above 10 Years)		

5. Fish Farm Income			
Sl. No.	**Source of Income**	**Monthly Income (TK)**	**Annual Income (TK)**
1	Selling Fish		
2	Selling Fish Fry		

6. Extension Media Contact						
Sl. No.	**Name of information sources**	**Not at all (0)**	**Extent of Contact**			
			Rarely (1)	**Occasionally (2)**	**Frequently (3)**	**Regularly (4)**
1	Agricultural input (seed / fertilizer / pesticide / equipment) dealers					
2	SAAO					
3	NGO Worker					
4	Upazila level agricultural organization					
5	Agricultural program through electronic media (radio/TV)					
6	Agricultural features in printing media (daily newspaper, leaflet, booklet, magazine etc.)					
	Total					

7. Access to ICT to Increase Fish Farming Knowledge					
Sl. No.	**Technologies**	**Do you have the technology**		**Do you use it to increase fish farming knowledge?**	
		Yes (1)	**No (0)**	**Yes (1)**	**No (0)**
1	Radio				
2	Newspaper				
3	Television				
4	Non-Android phone				
5	Android Phone				
6	Internet				
7	Computer				
8	Extension Workers				
9	Neighbors				

8. Access to Information on Climate Change			
Sl. No.	**Sources**	**Yes (1)**	**No (0)**
1	Other Farmer		
2	Extension officer		
3	Climate Campaign		
4	NGO		
5	School Teacher		
6	Educated Children		
7	Relatives		
8	Old aged people		
9	Newspaper		
10	Training		
11	TV		
12	Other media		

9. Cosmopoliteness						
Sl. No.	**Place of Visit**	**Extent of Visit**				
		Regularly (4)	**Frequently (3)**	**Occasionally (2)**	**Rarely (1)**	**Not at all(0)**
1	Neighbor Village (times/month)	≥6	5-6	3-4	1-2	0
2	Other Union (times/month)	≥5	4-5	3-2	1	0
3	Upazila Sadar (times/month)	≥4	3-4	2	1	0
4	Other Upazila Sadar (times/month)	≥6	5-6	3-4	1-2	0
5	Own District town (times/month)	≥5	4-5	3-4	1-2	0
6	Other District Town (times/month)	≥4	3	2	1	0
	Total					

10. Training Received Regarding Climate Change			
Sl. No.	**Training Content**	**Yes (1)**	**No (0)**
1	Training on what is climate change		
2	Training on the effect of climate change on fish culture		
3	Training on adoption technology of climate change for fish culture		

11. Knowledge on Climate Change Fish			
Sl. No.	**Questions**	**Full marks**	**Obtained Marks**
1	What is your idea about Climate Change?	3	
2	What are the elements of climate change?	3	
3	Which month does the temperature highest and lowest?	3	
4	What are the effects of temperature on fisheries?	3	
5	Which month do we call the rainy season?	3	
6	When does the rain fall highest?	3	
7	Why does flood occur?	3	
8	What are the effects of flood on fish farming?	3	
9	When do we call drought?	3	
10	What are the effects of drought on fish farming?	3	
	Total	30	

12. Perception of Fish Farmer on Climate Change						
Sl. No.	**Description**	**Strongly agree (5)**	**Agree (4)**	**No opinion (3)**	**Disagree (2)**	**Strongly disagree (1)**
1.	Humidity is increasing					
2.	Temperature has raised					
3.	Climate change caused increased rainfall					
4.	Drought has increased					
5.	Flood has increased because of climate change					
6.	Late-onset of the rainy season					
7.	Rainy season has became short					
8.	Damage of fish farming infrastructure due to flood					
9.	Climate change has caused a decrease in fish production					
10.	Fish disease is increasing because of climate change					
11.	Financial loss due to flood					
12.	Fish farming of northern part of the country will be affected by climate change					
13.	Drought has negative impact on fish farming					
14.	Flood has negative impact on fish farming					

Thank you for your kind co-operation

Date:

(Signature of the interviewer)