EFFECTIVENESS OF ADAPTATION STRATEGIES TO CLIMATE CHANGE AS PERCEIVED BY THE FARMERS OF NOAKHALI DISTRICT

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CERTIFICATE

This is to certify that the thesis entitled **"EFFECTIVENESS OF ADAPTATION STRATEGIES TO CLIMATE CHANGE AS PERCEIVED BY THE FARMERS OF NOAKHALI DISTRICT"** submitted to the department of Agricultural Extension and Information System, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka in partial fulfillment of the requirements for the degree of Master of Science (M.S.) in Agricultural Extension, embodies the result of a piece of bona fide research work carried out by **MOJAHID BIN BELAL, Registration No. 19-10076** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, as has been availed of during the course of this investigation has been duly acknowledged by the Author.

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TO

MY BELOVED

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ABBREVIATIONS

BBS	Bangladesh Bureau of Statistics
GDP	Gross Domestic Product
DAE	Department of Agricultural Extension
et al.	All Others
Ag. Ext. Ed.	Agricultural Extension Education
β	Multiple Regression
IPCC	Intergovernmental Panel on Climate Change
FAO	Food and Agriculture Organization
BARI	Bangladesh Agricultural Research Institute
GoB	Government of Bangladesh
MoA	Ministry of Agriculture
UNO	The United Nations
MoYS	Ministry of Youth and Sports
MoP	Muriate of Potash
NAPA	National Adaptation Program of Action
MoEF	Ministry of Environment and Forest
BINA	Bangladesh Institute of Nuclear Agriculture
CCC	Climate Change Cell
DCRMA	Disaster and Climate Risk Management in Agriculture
AAS	Agriculture Advisory Society
SAAO	Sub Assistant Agriculture Officer
SAU	Sher-e-Bangla Agricultural University
SPSS	Statistical Package for Social Sciences
UNFCCC	United Nations Framework Convention on Climate Change
DoE	Department of Environment

EFFECTIVENESS OF ADAPTATION STRATEGIES TO CLIMATE CHANGE AS PERCEIVED BY THE FARMERS OF NOAKHALI DISTRICT

MOJAHID BIN BELAL

ABSTRACT

The objectives of the study were to determine socio-economic profile of the farmers of Noakhali district; to determine farmers' opinion about effectiveness of adaptation strategies to climate change and to explore the contributing factors that affect farmers' selected characteristics with their effectiveness of adaptation strategies to climate change. The study was undertaken purposively in three villages of Chatkhil upazila under Noakhali district. A validated and well-structured interview schedule was used to collect data from 103 farmers during 1st February to 28th February 2021. Descriptive statistics and multiple regressions were used for analysis. The highest percentage (85.44%) of the farmers had medium effectiveness of adaptation strategies to climate change compared to 1.94 percent of the farmers as low effectiveness and 12.62 percent of the farmers had high effectiveness of adaptation strategies to climate change. Among 11 selected characteristics of the farmers, 5 characteristics namely, education, farm size, access to extension services, knowledge on climate change and use of climate smart agricultural technologies of the respondents had significant positive contribution to their effectiveness of adaptation strategies to climate change. The rest 6 characteristics namely, age, family size, annual family income, organizational participation, agricultural extension media contact and perception on climate change had no significant contribution with their effectiveness of adaptation strategies to climate change. Majority of the farmers had medium to high effectiveness of adaptation strategies to climate change. It is, therefore, recommended that necessary steps should be taken to motivate the farmers in participating different organization. Extension workers must be well trained on the newly adaptation practices. Proper arrangements should be made for enhancing the education level of the farmers by the concerned authorities through the establishment of night school, adult education and other extension methods as possible.

CHAPTER I

INTRODUCTION

1.1 General Background of the Study

The Intergovernmental Panel on Climate Change (IPCC, 2007) forecasts that developing countries, like Bangladesh, will continue to be affected by extreme weather variability such as temperature, severe water shortage, and flood-inducing rainfall events during the coming decades. Weather variability and sea-level rise are the most pressing predicted consequences of climate change with a 0.6 °C global temperature change, 2% to 3% precipitation increase of the tropical latitudes and 3% precipitation decrease in subtropical areas within the 20th century. Scenarios predict global temperature could increase between 1.4 °C and 5.8 °C by the end of the 21st century (IPCC, 2001). About 10 to 25 millimeters of sea-level rise was observed over the 20th century and models predict continued rise in a range of anywhere from 20 to 90 centimeters within the 21st century (IPCC, 2013).

Similarly, the most recent IPCC report has noted empirical models forecasting a lengthening and intensification of precipitation periods, notably the Indian/South Asian subsystem of the Asian-Australian Monsoon. The inundation of land areas through sea-level rise and increased precipitation is not the only worrisome effect of global climate change; the literature reviewed and reported by the IPCC also notes drought events as well. In the final decades of the 20th century roughly 2.7 million ha of land in Bangladesh alone were vulnerable to annual drought with a 10% probability that 41%–50% of the country experiencing drought in a given year and those figures are forecast to increase in both geographic scope and event intensity (IPCC, 2013 and 2001). Critically for this study, the Indian/South Asian summer monsoon subsystem "is known to have undergone abrupt shifts, giving rise to prolonged and intense droughts". The investigations reported in the 2013 IPCC report come to central conclusion about the South Asian region under global climate change models:

“normal” monsoon seasons are seen as less likely, leaving uncertainty about the extremes to be experienced in the region (IPCC, 2013).

The prediction of climatic changes has the potential to severely affect countries highly dependent upon agrarian livelihoods, resulting in food shortages, among other consequences. Therefore, people who depend on farming activities will require a variety of adaptation strategies to mitigate the negative effects of climate change effects and maintain the livelihoods of farming families. Different modern technologies have been developed and introduced at the farm level in order to achieve target measures of the Millennium Development Goals (Rosegrant *et al.,* 2008). Specific adaptation strategies to climate change effects include changing the timing of planting and using heat and drought resistant varieties [Swearingen and Bencherifa, 2000; Mortimore and Adams, 2001; Southworth *et al.,* 2002 and Howden *et al.,* 2007) with new cultivars having been selected and applied for the same purposes (Rosegrant and Cline, 2003 and Eckhardt *et al.,* 2009). Practicing soil and water conservation techniques (Asfaw and Lipper, 2011), fertilizer use, irrigation (Howden *et al.,* 2007 and Eakin, 2005) and diversification to non-farm activities (Mortimore and Adams, 2001 and Morton, 2007) are also adaptation strategies that have been practiced at farm level in response to climate change.

Bangladesh is considered to be one of the country’s most vulnerable to climate change and its effects on environmental degradation because of its geographic location. These impacts on average temperature and precipitation have a baseline impact on the productive capacity of agricultural activity, altering the underlying yield expectations and risk regimes faced by farmers (Ministry of Environment and Forest, 2008). Additionally, the region faces recurrent, climate-related natural disasters; about 174 events such as floods, droughts, and cyclones, have affected Bangladesh from 1974 to 2007. These natural disasters have damaged agriculture and its production in ways that severely affected the farming activities and national economy as well (GoB, 2013 and Uddin, 2012).

By way of example, cyclones hit Bangladesh, on average, every three years, causing serious damage to the people, infrastructure, and agriculture of the country. In 1970 and 1991, cyclones killed 500,000 and 140,000 people, respectively (Asian Development Bank, 1991 and Bangladesh Center for Advanced Studies, 1991). An estimate made by the Government of Bangladesh (GoB) about the destruction and loss in the country due to the Cyclone Sidr (GoB, 2013) found significant damage to infrastructures, assets, and loss of production; specifically, within the agricultural sector these losses were valued at US $438 million, which accounts for approximately 95% of the total losses to all sectors. Table 1 indicates the sector-wide values (in millions of US Dollars) of damage and economic losses in agriculture. The frequency and magnitude of such climate-related natural disaster events are likely to be affected by global climate change, compounding the baseline effects on agricultural production which can be expected under global climate change models. Frequent natural hazards due to climate change affect agricultural enterprises and, subsequently, the key to agricultural production activities- farm households- are also severely affected. Some farm households have already altered their production strategies in response to environmental degradation (regardless of cause) and weather variability associated with climate change effects. Such changes in production strategies are referred to in this paper as coping strategies. Choices about management practices, enterprise types, and genetic varieties of crops, have been adapted by farmers according to soil properties, location, and climatic conditions.

Proper management systems such as weeding, mulching, irrigation with fresh water, and thinning applied by the farmers can help overcome salinity and drought. Recently, a number of varietals adapted for salinity and drought tolerance have been used for planting, but it is not widespread throughout the country (Uddin, 2012). Farmers' responses to climate change effects, as well as use of adaptation strategies, are influenced by their socio-economic characteristics, with knowledge of the farmers being the most influential

(Deressa *et al.,* 2009). There is a growing consensus that neither sound technological protocols, nor local techniques, suffice persue to enhance farmers' capacity to overcome climate related risks and challenges. The integration of sound technological solutions with local practices is increasingly identified as a more-necessary pathway. In Bangladesh, research and development programs are tailored to provide technological solutions to farmers through cooperative extension systems and other means, leading farmers in Bangladesh to implement various coping strategies (Amha, 2006 and Ramasmasy and Baas, 2007), strategies which have been identified within the prevailing literature as potential avenues for mitigating climate change effects. However, the empirical research regarding these adaptation strategies has not documented how farmers adapt their farming practices in relation to the continuous and sudden changes in climatic events, nor identified what are the important socio-economic factors which contribute (or hinder) their adaptation. While largely absent, what little evidence does exist is mostly anecdotal.

Therefore, there is an urgent necessity to identify the strategies that are best suited to support farmers and farming communities in this period of climate change and to identify the factors affecting the farmers' adoption of adaptive strategies to climate change. Farmers in Bangladesh at present face increasing environmental degradation which is the result of multiple source-points; this degradation is both similarly situated to and likely to be exacerbated under the increasing effects of global climate change. This paper focuses on identifying socio-economic factors likely to be influential in adaptive behavior, along with the perception of farmers about challenges faced in adopting coping strategies. It is important to note that empirical analysis of climatic events and their causation lies well beyond the scope of our research and that this paper represents a jumping-off point for further studies which can later elucidate causation of adaptive strategy adoption.

1.2 Statement of the Problem

In our country salinity is emerged as a devastating problem due to climatic hazards. Due to rising sea level resulting from climate change every year it gives an alarm to us the effects of climatic variations which include salinity intrusion. Salinity is increasing day by day in coastal region in our country. Like other country the people of coastal areas are suffering by its impacts. Around 37 million of people living in the coastal districts and 70 percent of them are engaged in farming activities (BBS, 2020). Every year farmers of the coastal region are facing new problems in crop production due to the boisterous effects of salinity and even they give up their regular farming activities and engaged in off firm activities. Finally, they are facing low income which leads to poor economic status. From this short discussion it can be said that salinity problem in Bangladesh is certainly a crucial development challenge and we need deeper understanding of people's effectiveness of adaptation strategies to climate change and their adaptation extent towards the effects in agriculture. The study aimed at providing information about the following queries:

i. What is the present socio-economic profile of farmers in study area?
ii. What is the extent of effectiveness of adaptation strategies to climate change farmers?
iii. Is there any contributing relationship between the selected characteristics of farmers with their effectiveness of adaptation strategies to climate change?

1.3 Specific Objectives of the Study

Specific objective(s) are pre-requisite for conducting any research work which gives a guideline to researcher to obtain concerned goal. From the above statement of problem, the researcher had set the following specific objectives:

i. To describe socio-economic profile of the farmers of Noakhali district;

ii. To determine the extent of effectiveness of adaptation strategies to climate change; and
iii. To explore the contributing factors of the farmers' selected characteristics on their perceived effectiveness of adaptation strategies to climate change.

1.4 Justifications of the Study

The main aim of the study was to determine the extent of effectiveness of adaptation strategies to climate change in the coastal area. In our country salinity problem causes tremendous effects and it hampers our agricultural production in coastal areas. People could not cultivate crop comfortably for this problem. Salinity rise is a boisterous component of climate change which affects farmers seriously in socio-economic aspects. It is now recurrent phenomenon which is now an alarming discussion to every country in the world. People are taking indigenous adaptive measure against salinity effects which need to be enhanced scientifically to reduce its impact. (Anik, S. And Khan, M. 2012)

In our country, the Government and Non-Government organizations has carried out different policy to mitigate the problem by enhancing and adopting some important adaptive measures by the farmers. Various studies were conducted about climate change, climatic hazards and its variation, adaptation of climate change in agriculture, but lack of study has conducted specifically on adaptation strategies towards effects of salinity problem which is a boisterous problem resulting from climate change effects. In our country, farmers are facing various problems in agriculture due to salinity and it is very important to challenge against the problem by adapting some measures. Considering the above circumstances, the researcher became interested to undertake a study entitled, Farmers' extent of effectiveness of adaptation strategies to climate change. (Schipper, E.L.F. 2004)

1.5 Assumptions of the Study

The following assumptions have been taken into consideration for the present study: The researcher who acted as an interviewer was well aware of the social and cultural environment of the study area. Hence, the data collected by the researcher were free from bias and the respondents furnished their opinions without hesitations.

i. Respondent's response, views and opinions were the representative views and opinions of the whole target population.
ii. The respondents selected for the study were decent to satisfy, the exploration of research and their responses were reliable.
iii. The items, questions and scales used for measuring the variables were reasonably adequate to reflect the respondents' real answer.
iv. The findings of the study would be useful for planning and implementation of the program of extension services.

1.6 Limitations of the Study

Researcher had some limitations considering budget, time and other resources are noted below:

i. The study was confined to three villages of Chatkhil upazila under Noakhali district.
ii. Characteristics of the farmers were many and varied. Only (11) eleven characteristics were selected as independent variables for this study.
iii. Researcher was depended on only farming practices as adaptation strategies where farmers had also off-firm strategies towards salinity effects.
iv. In the study area around 15-20 farm practices were regularly or irregularly followed by farmers from where researcher was taken

only ten (10) adaptation practices for determining effectiveness of adaptation extent.

v. For information about the study, the researcher has to depend on the data furnished by the selected respondent's instant memory during the interview time.

vi. Time allocation and budget was also limitation in this study.

1.7 Definition of related terms

In this study, the certain terms have been frequently used. These are defined and explained below for clarity of understanding to the investigator and readers.

Age: Age of the respondent refers to the period of the time in actual years from his birth to the time of interview.

Education: It was defined to the development of desirable changes in knowledge, skill and attitudes in an individual through reading, writing, working, observations and others activities. It was measured on the basis of classes passed from a formal educational institution by the respondents.

Farm size: The term related to the hectare of land owned by a respondent on which he carried out his farming activities, the area being estimated in terms of full benefit to the farmers. A farmer was considered to have full benefit from cultivated area either owned by her/ him or got lease from others and obtain half benefit from the area which was either cultivated by him on borga or given to others for cultivation on borga basis.

Farming experience: Farming experience refers to the experience of a farmer in agricultural works and expressed in years.

Annual family income: The term annual family income referred to the total earning by the earning members from agriculture, livestock, fisheries and other accessible sources (business, service, daily labor etc.) during a year. It was expressed in Thousand Taka.

Extension media contact: It is a communication about agriculture-related information among agricultural stakeholders and between agricultural and non-agricultural stakeholders.

Knowledge on climate change: It was the extent of basic understanding of the farmers in different aspects of climate change.

Farmer's category: Farmer's category is the classification of farmers based on different views. For example, based on innovativeness farmers are categorized into Innovator, Early adopter, Early majority, Late majority and Laggards. Innovativeness: Rogers (1983), defined innovativeness as 'the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of the social system'.

Variable: Variable is a general indication in statistical research of the characteristics that occurs in number of individuals, objects, groups etc. and that can take on various values for example the age of an individual.

Climate: It is a larger term view of the weather patterns of a particular locality is frequently called climate.

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.

Adaptation: It refers to change in behavior, resource, Infrastructure or the functioning of a system that reduces vulnerability.

Effectiveness: Effectiveness means the usefulness or efficiency for the specific initiatives with viewing specific objectives. Effectiveness may be defined as the degree to which a group or social system achieves its goal. (Scharmerhom *et al.*, 1988). Effectiveness may be defined as the degree to usefulness of socio-economic development program emphasizing on agricultural activities.

CHAPTER II
REVIEW OF LITERATURE

The researcher made an intensive search for available literature on the present study. The review was conveniently presented on the major objectives of the study. This chapter is divided into five major sections. The first section deals with concept of effectiveness. The second section deals with the Salinity issues. The third section deals with concept of climate change, section four deals with the concept of adaptation and the last section deals with the conceptual framework of the study. Therefore, available literatures' on studied related to farmers' effectiveness of adaptation strategies to climate change was only presented in this chapter.

2.1 Concept of effectiveness

Effectiveness is the capability of producing a desired result. When something is deemed effective, it means it has an intended or expected outcome, or produces a deep, vivid impression. On the other hand, effectiveness is defined as "the accuracy and completeness of users' tasks while using a system (Wikipedia, 2014).

Effectiveness of any project on people or other pertinent aspect has a problem of conceptualization. The term may be variously perceived depending on one's orientation, purpose and field of investigation. Relevant literatures have been reviewed to clarify the concept of effectiveness and the factors that are likely to influence it. However, the problem is that the word effectiveness is relatively a new concept for the field of worker and client of extension and rural extension work (Hasanullah, 1989).

2.2 Salinity issues

Bangladesh is a disaster-prone country and due to these unwanted events, the country experiences disasters of one kind or another (such as tropical cyclones, storm surges, coastal erosion, salinity intrusion, floods, and droughts) almost every year causing heavy loss of life and resources and jeopardizing the development activities (NAPA, 2005). Identified drought, flood, soil salinity and cyclones as the major extreme climatic events. Climate change has emerged as one of the greatest environmental challenges facing the world today (IPCC, 2007; Anik and Khan, 2012).

Bangladesh is one of the most vulnerable countries to climate change. Climate induced hazards are increasing day by day. The last era the country has faced many climatic hazards. The country has faced devastating Sidr in November 2007, Aila in April 2009, series of flood of 2004, 2007 and 2009, Nargis in 2010 and Mahasen in May 2013 (Ahmed, 2010; MoEF, 2009). The main reasons for its vulnerability include its tropical climate; the predominance of floodplains for the majority of the land area; the low level of elevation and proximity to sea level; the high population density; and limited technological capacities to offset climate change effects (MoEF, 2005; DoE, 2007; Shahid and Behrawan, 2008; Pouliotte et al., 2009).

Climate change effects are already occurring, as measured by increasing temperatures, variable rainfall and an increase in climate related extreme events such as floods, droughts, cyclone, sea level rise, salinity and soil erosion and sea level rise is most occurring factor of salinity (Yu et al., 2010).

Sea level rise has increased coastal flood frequency which caused salinity intrusion in coastal area (Ali, 2005). World Bank (2000), showed 0.10 m, 0.25 m and 1 m rise in sea level by 2020, 2050 and 2100; affecting 2%, 4% and 17.5% of total land mass respectively 1.0 centimeter per year sea level rise in Bangladesh which develops salinity. Salinity intrusion is a growing problem in around the globe, especially in the low-lying developing countries. The rate of salinity intrusion in coastal Bangladesh is faster than it was predicted a decade ago (Agrawala et al., 2003). The problem becomes exacerbated particularly in the dry season when rainfall is inadequate and incapable of lowering the concentration of salinity on surface water and leaching out salt from soil.

It has been found that the sea level rise of 0.5 m over the last 100 years has eroded approximately 162 km of Kutubdia, 147 km of Bhola and 117 km of Sandwip (CCC, 2007). Maximum soil salinity was observed in pre-monsoon, whereas, minimum was in monsoon in all coastal districts. It was observed that soil salinity starts increasing from post-monsoon and continued to increase in pre-monsoon when it reaches the highest level. Highest (1.14 ds/cm) soil salinity was measured in pre-monsoon at Shahporir Dwip of Cox's Bazar district while lowest (0.82 ds/cm) was in monsoon at Alaipur union of Khulna district (Hossain et al., 2012).

Salt occurs naturally in many of the world's wetland systems, whether it is from the ocean in estuaries and tidal marshes or from the ground and atmosphere in inland potholes and playas. Coastal wetlands are dominated by NaCl salts derived from the oceans, whereas inland wetlands may contain various salt combinations leached from bedrock and surface material, deposited from atmospheric salts and agricultural 10run-off. In addition to salt composition, inland wetlands may vary in salt concentration (Topping and Scudder, 1977).

2.2.1 Effects of salinity in agriculture

Even though salinity intrusion is a slow process, but the effects are devastating. Based on observable symptoms, it is therefore assumed that agricultural lands in the coastal area will be affected by salinity (Sarwar, 2005). Sikder (2010) studied on long-term climatic and crop productivity data, regional climatic scenarios and impact analysis of different aspects of climate change on agriculture. The study reveals that the crop yield would be negatively impacted by salinity. Soil salinization has been worldwide recognized as being among the most important problems for crop production in arid and semi-arid regions (FAO, 2008).

Soil salinization affects an estimated 1 to 3 million hectares in Europe, mainly in the Mediterranean countries. It is regarded as a major cause of desertification and therefore is a serious form of soil degradation being salinization and sodification among the major degradation processes endangering the potential use of European soils. For instance, in Spain 3% of the 3.5 million hectares of irrigated land is severely affected, reducing markedly its agricultural potential while another 15% is under serious risk (EC, 2012). It is estimated that up to 20 % of irrigated lands in the world is affected somehow by different levels of salinity. In Iran for example, about 15% of lands, that is about 25 million ha, are suffering from this problem, including 0.32 million hectare of lands in Isfahan province (Feizi, 1993). Robertson et al., (2007) discussing dry land salinity problem in Western Australia found that "salinity was a second order issue for many landholders, particularly those higher in the catchments and it was mentioned as a pressing threat mostly by landholders in the valley floor and is not expected to greatly worsen in the catchments, so many landholders see little merit in investing in salinity prevention when the benefits are typically small" and it was perceived to be a problem that only gradually would effect on farm profitability. They identified lack of knowledge on salinity management as a great constraint of the farmers.

Being an agrarian country, 60% people of Bangladesh are directly or indirectly dependent on agriculture for their livelihood, with the contribution of 20 percent to its GDP (BBS, 2011). The dominant land use in coastal Bangladesh is also agriculture. Even though gross and net-cropped areas in the coastal zone of Bangladesh are 144,085 and 83,416 hectare respectively (Islam, 2004), but net-cropped area of coastal zone has been showing a decreasing trend over the years due to a combination of factors. Coastal agro-lands often suffered from saline intrusion that prevented crop production in dry season (Gowing et al., 2006).

Increased salinity alone from a 0.3-meter level sea rise will cause a net reduction of 0.5 million metric tons of rice (World Bank, 2000). In recent cyclone Sidr, among the productive sectors, damage was highest (USD 0.43 Million) in agriculture. Latest estimates shows; about 800,000 to 1300,000 MTs (metric tons) of paddy have been destroyed in Sidr which created severe food insecurity among the affected people (GoB, 2008). In last thirty years', salinity intrusion has degraded land quality and farmers can't grow any agricultural crops in their fields. Thus farmer's become zero productive land owners, in one sense landless with their existing saline land. Size of land which is the firm of shrimp with Transplanted Amon (rice) decrease 15294 hectares to 10000 hectares cause of salinity (Hasan et al., 2013).

In general, soil salinity is believed to be mainly responsible for low land use as well as cropping intensity (Rahman & Ahsan, 2001). This problem is not only reducing the agricultural productivity, but is also putting far reaching effects on the livelihood strategies of small farmers (Tanwir et al., 2003). Due to sea level rise related effect particularly salt water intrusion can destroy all kinds of livelihood of the coastal population where 100 million people could be affected; (Finan, 2009). Reduction of fresh water availability due to salinity caused by tidal flooding is seen as a threat to livelihood of coastal region in Bangladesh especially.

Salinity also affects farmer's socio-economic status. It is estimated that salinity of irrigated lands causes annual global income loss of about US$ 12 billion (Ghassemi et al., 1995). Generally, the worst salinity effects occur where farming communities 12are relatively poor and face economic difficulties. In severe cases, salinity causes occupational or geographic shifting of the affected communities, with the male population seeking alternate off-farm income opportunities (Abdel-Dayem, 2005).

2.3 Concept of adaptation

Adaptation is widely used in the biological sciences to refer a successful coping strategy. In social sciences and especially in Anthropology the term has long been used to describe successful or functional interactions of human cultures in localized environment (Finan, 2009). Sometimes it is used as synonymous to adjustment, cope with and other similar words. But one thing is common to all discipline and that is adaptation is related to habitat. Adaptation can be a specific action like a farmer changing crops, a systemic change like diversifying livelihoods or an institutional reform like changing resource management practices. It can also denote the whole process, including learning about risks, evaluating response strategies, to enable adaptation, mobilizing resources, implementing adaptations and revising choices with new learning (Leary, 2008).

Adaptation refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Adapt or adaptation is a synonym to make more suitable or to fit some purpose by altering or modifying (Smith et al., 1999). The main goals of climate change adaptation are to reduce vulnerability and build resilience to the impacts brought by climate change (IPCC, 2007). Adaptation can be spontaneous or planned and can be carried out in response to or in anticipation of change in conditions (Watson et al., 1996). There are many different conceptualizations of adaptation, including actions to improve situations, measures by which to embrace new circumstances and conditions, or strategies to reduce vulnerability, or enhance resilience. Strategies such as coastal protection, adjustments in agriculture and forest management, early warning systems and migration corridors have all been considered adaptation and it is a response to short-term climate variability, long-term climate change and extreme events (Schipper, 2004). The concept has been criticized for being too techno-managerial, offering the promise that problems are manageable. It excludes the possibility of non-adaptation or simply accepting losses (Orlove 2009 and Schipper, 2004).

2.3.1 Salinity effects adaptation practices in agriculture

Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation (Haddad, 2005). The born rice fully dependent on the irrigation water or the short duration variety of Aus rice is often cultivated by local people taking water from the kharies, canals (locally called khal) and ponds (Muller, 2009).

Mini pond for supplementary irrigation (dry seedbed) practice with minimal supplemental irrigation), homestead gardening, Jujube cultivation, cultivation of chickpea after T. Aman, the utilization of fallow land by establishing homestead garden to cultivate year-round homestead vegetables, preparing the mini nursery and established nursery, linseed production as less water loving crop cultivated in rain fed area. This technology had been induced to farmers and peasant's communities have been practicing some extent (Hasan, 2013).

Saline tolerate rice varieties like BINA dhan - 8, BINA dhan - 10, BRRI dhan - 47, BRRI dhan-55 are cultivated by more than one million farmers in Bangladesh. BINA dhan-8 and BINA dhan-10 have been cultivated by farmers in Satkhira, Khulna and Bagerhat districts of south-west coastal region in Boro season. Farmers cultivate BRRI dhan-47 variety that requires less water and tolerance capacity to saline soil is quite high (Alam et al., 2013). BINA dhan-8 varieties have salt tolerance capacity are cultivated by farmers in those regions (DCRMA, 2011).

Floating bed is a popular practice in Gopalganj, Madaripur, Barisal, Pirojpur and Jhalokhathi districts where land remain submerged most of the time in a year. Farmers are raising seedlings and producing vegetables, spices and more than thirty crops using floating gardens in pond or other places where there is no saline water intrusion occurs (AAS, 2012). Cultivated vegetables in floating bed include okra, cucumber, bitter guard, kholrabi, pumpkin, water gourd, turmeric, ginger, karalla, arum, tomato, turturi and potato (Alauddin & Rahman, 2013).

Shallow depth sorjans are suitable for the year round cultivation of vegetables and monsoon rice, where the sorjans with higher depths also allow rice-fish or rice-duck farming along with the year-round vegetables cultivation on raised beds. This sorjan system is very popular among the farmers in this coastal region of Patuakhali and annul net return from investment in sorjan system is very high (Sattar & Abedin, 2012). Homestead gardening is a widely accepted practice in Bangladesh and mainly managed by women in saline area. It ensures food security and additional income by enhancing livelihoods of poor people. Leafy vegetables such as kangkong, batisak, sweet tasting stem, amaranth (Ktoradanta) are grown in homestead gardens (FAO, 2008).

Two crop production cycles are also popular as nutrition requirement of crops is supplemented by each other cultivation like sunflower, chickpea and Khesari after the cultivation of T. Aman in coastal regions (Rashid et al., 2014). Salt tolerant sugarcane variety ISWARDI-40, BINA sarisa-5 and BINA sarisa-6, sweet potato varieties like BARI SP-6 and BARI SP-7, BARI Mung and 6, BARI Sweet Gourd-1 and 2, spinach, BARI Tomato-1, Knolkhol and beet are being cultivated as adaptive options in the coastal areas.

2.4 Concept of climate change (definition and causes)

By climate change, the GIEC intends any climate change in the time it is due to natural variability or human activities. This definition does not differ from that of the United Nations Framework Convention on Climate Change (UNFCCC) in Article 1, where climate change is understood to mean variations in climate directly or indirectly due to human activity that alters the composition of the global atmosphere and add to the observed natural climate variability of comparable periods (UNFCCC, 1992). Choisnel (1992), quoted by Johnson (1997) will go further by putting much more emphasis on the energy balance of the Earth-ocean-atmosphere system. For him, climate change is large enough to correspond to a significant change in the energy balance of the Earth-Oceans-Atmosphere system, leading to a change. However, in our study, climate change means changes in temperature and precipitation, whether natural or anthropogenic.

2.4.1 Concept of vulnerability in terms of climate change

In the climate context, according to IPCC (2007), vulnerability is the degree to which a system is able to cope with the adverse effects of climate change (including climate variability and extremes). It describes the extent to which a system is sensitive and unable to cope with the adverse effects of climate change, whether climate variability or meteorological extremes (Nelson et al., 2002). Vulnerability depends on the character, magnitude and pace of climate change, variations in the system, sensitivity and adaptive capacity (IPCC, 2007). The degree of vulnerability for an individual, household or group of people is determined by their exposure to risk factors and their ability to cope with crisis situations.

2.4.2 Adaptation to climate change

Climate change creates risks but also compensatory strategies around the world. Individuals and companies can take advantage of opportunities and reduce risks if they understand, plan and adapt to climate change. The effects of climate variability and climate change are potentially greater for the poor in developing countries than for rich countries. Vulnerability to the impacts of climate change is a function of exposure to climate variables, sensitivity to these variables and the adaptive capacity of the affected community. Often the subsistence of the poor population depends on economic activities that are climate sensitive. For example, agricultural and forestry activities depend on weather and local climatic conditions; a change in these conditions could have a direct impact on productivity levels and reduce substances. The concept of adaptation can be understood as the adjustment of natural systems and human systems to a changing environment or environment. Adaptation to climate change indicates the adjustment of natural and human systems in response to current or future climateinduced stimuli in order to mitigate adverse effects or exploit beneficial opportunities (IPCC, 2007). This adaptation consists of a set of readjusted or self-operated readjustments within natural and human systems in curative or preventive responses to current or future climate stimuli or their effects in order to mitigate their nuisance or wholly appropriately Profit (Issa, 1995). Thus, the adaptation can be carried out in two different ways.

Climate change interventions require a two-pronged approach to reduce greenhouse gas emissions (climate change mitigation measures) as well as activities and practices to reduce our vulnerability to potential impacts (measures of adaptation). Mitigation measures are needed to reduce the pace and magnitude of climate change on a global scale. However, in themselves. These measures do not prevent climate change. In the poorest countries. Adaptation is largely a matter of effort, autonomy and personal initiative. Millions of people who have barely sufficient resources to feed, clothe and shelter their families are forced to allocate funds and work to accommodate them. In the agriculture sector, adaptation requires the use of good agricultural, forestry and fisheries practices to cope with changing and harsher environmental conditions. Adaptation in agriculture is illustrated in particular by changes in the timing of planting or planting, the adoption of new technologies, and the promotion of agricultural biodiversity (FAO, 2007). The literature on coping strategies is very abundant. As an example, in Bangladesh, women farmers build "floating gardens" of hyacinth rafts on which vegetables can be grown in flood-prone areas. In Sri Lanka, farmers experiment with rice varieties that can resist the saline intrusion and reducing the amount of water. The development of adaptation strategies is an inescapable way to reduce the damage expected in the short term (Pielke, 1998). However, adaptation could be achieved through technological innovation.

2.5 Review of Concerning Relationships of the Selected Characteristics of the Farmers with their Adaptation Strategies Practiced

Adaptation strategy is a relatively new research concept. Therefore, no direct study regarding relationship between the selected characteristics of the farmers and their adaptation strategies were found.

Faruq (2017) found that farmers age had significant and positive contribution to boro rice yield gap minimizing strategies practiced by the farmers.

Faruq (2017) found that farmers education had significant and positive contribution to boro rice yield gap minimizing strategies practiced by the farmers.

Faruq (2017) found that farmers age had no significant and negative contribution to boro rice yield gap minimizing strategies practiced by the farmers.

Faruq (2017) found that farmers annual family income had no significant and positive contribution to boro rice yield gap minimizing strategies practiced by the farmers.

Faruq (2017) found that farmers yield gap had significant and negative contribution to boro rice yield gap minimizing strategies practiced by the farmers.

Faruq (2017) found that farmers training had significant and positive contribution to boro rice yield gap minimizing strategies practiced by the farmers.

Faruq (2017) found that farmers extension media contact had significant and positive contribution to boro rice yield gap minimizing strategies practiced by the farmers.

Faruq (2017) found that farmers knowledge had on significant and positive contribution to boro rice yield gap minimizing strategies practiced by the farmers.

Faruq (2017) found that farmers problem had significant and negative contribution to boro rice yield gap minimizing strategies practiced by the farmers.

Hasan (2015) found that farmers age had significant and positive contribution to adoption of modern practices in rice cultivation.

Hasan (2015) found significant contribution of farmers education to adoption of modern practices in rice cultivation.

Hasan (2015) found non- significant contribution of farm size to adoption of modern practices in rice cultivation.

Hasan (2015) found no significant contribution of annual family income to adoption of modern practices in rice cultivation by the farmers.

Hasan (2015) also found no significant contribution of training exposure to adoption of modern practices in rice cultivation by the farmers.

Hasan (2015) also found significant contribution of extension contact to adoption of modern practices in rice cultivation by the farmers.

Hasan (2015) found no significant contribution of rice production knowledge to adoption of modern practices in rice cultivation by the farmers.

Ahmed et al. (2009), found that cultivation of potato was more profitable than boro rice in view point of farmers.

Talukder (2006) found that farmers age had significant and positive relationship with their adoption to selected rice production practices.

Ahmed (2006) found that age had non-significant relationship with adoption to selected rice production technologies by the farmers.

Taluker (2006) found non-significant relationship between education and adoption of rice production practices of the farmers.

Ahmed (2006) found positive significant relationship between farmers' education and adoption of selected rice production technologies.

Talukder (2006) found positive significant relationship between farm size and adoption of selected rice production practices.

Ahmed (2006) also found non-significant relationship between farm size and adoption of selected rice production technologies.

Talukder (2006) and Ahmed (2006) found positive significant relationship between annual family income and farmers adoption of selected rice production practices and technologies.

Haque (2006), found rice seed production was not as profitable as investment in rice seed cultivation.

Ahmed (2006) found no significant relationship between training exposure and adoption of selected rice production technologies by the garo farmers.

Talukder (2006) and Ahmed (2006) found significant positive relationship between extension contact and adoption of selected rice production practices and technologies by the farmers.

On the other hand, Talukder (2006) and Ahmed (2006) found significant positive relationship between knowledge and adoption of selected rice production practices and technologies.

Talukder (2006) found significant positive relationship between problems and adoption of selected rice production practices by the farmers.

2.6 The Conceptual Framework of the Study

In scientific research, selection and measurement of variables constitute an important task. The hypothesis of a research while constructed properly contains at least two important elements i.e. a dependent variable and an independent variable. A dependent variable in that factor which appears, disappears or varies on the researcher introduces, removes or varies the independents variables. An independent variable in that factors which is manipulated by the researcher in this attempt to ascertain its relationship to an observed phenomenon. A simple conceptual framework for the study is shown in figure 2.1.

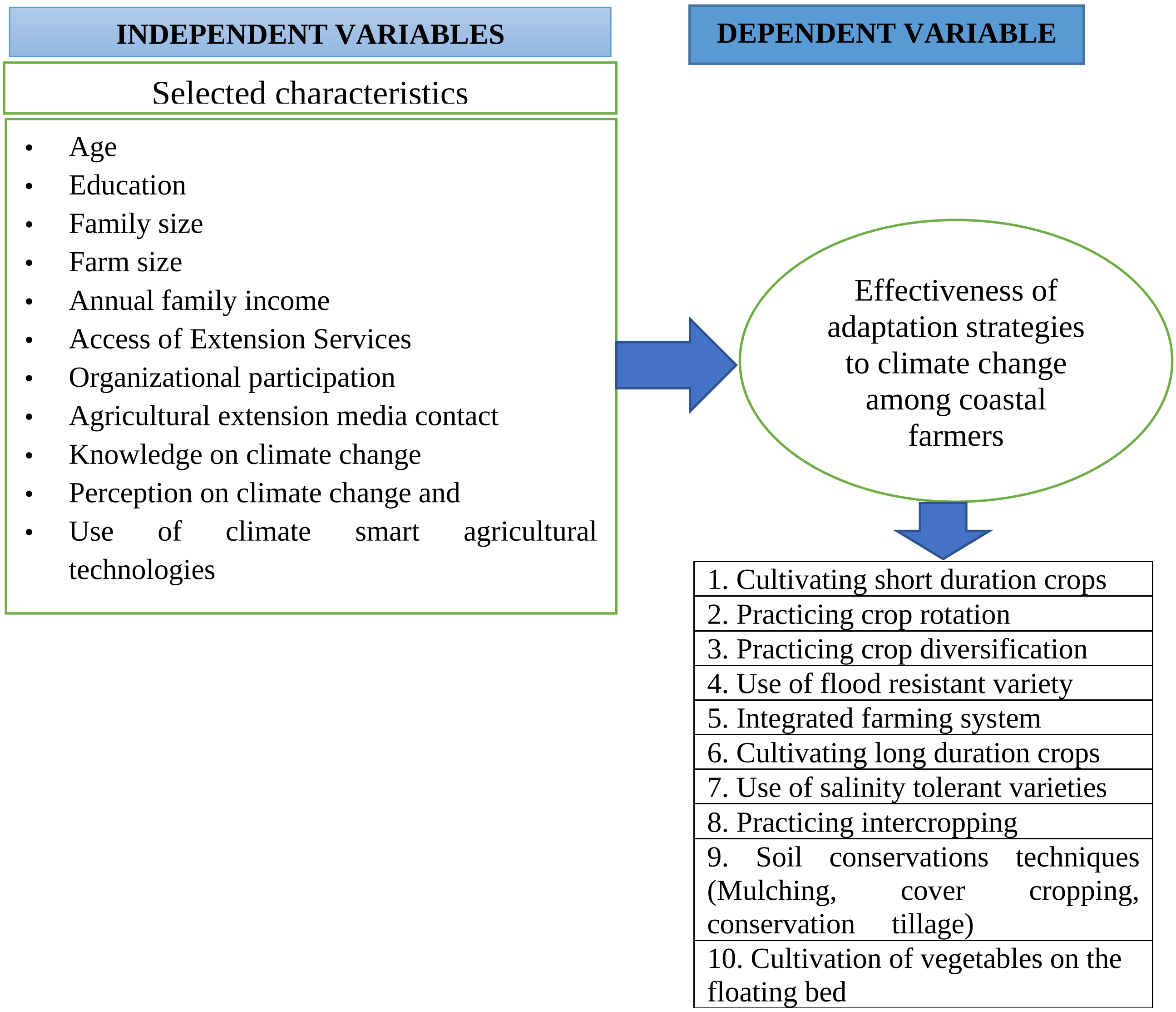

Figure 2.1 The Conceptual Framework of the Study

CHAPTER III
METHODOLOGY

The method and procedure used in the study are presented in this chapter. The principal method used in this study was field survey using structured interview schedule. In any scientific research methodology plays an important role. To perform a research work systematically, careful consideration of appropriate methodology was a must. It should be such that it would enable the researcher to collect valid and reliable information to arrive at correct decisions. The methods and procedures followed in conducting this study have been described in this chapter in the following sections.

3.1 Locale of the Study

The study was conducted at Chatkhil upazila under Noakhali district of Bangladesh where people were affected by climate change especially salinity, flood and so on. One union namely, Mohammadpur under Chatkhil upazila of Noakhali district were selected purposively. Three villages from this union were selected randomly as the locale of the study. A purposive sampling procedure was followed to selected one district from coastal 19 districts. A map of Noakhali district showing the Chatkhil upazila and a map of Chatkhil upazila showing the study area are presented in Figure 3.1 and 3.2.

Chatkhil is an upazila of Noakhali District in the Division of Chittagong, Bangladesh. It is bounded by Laksham and Shahrasti Upazila on the north, Lakshmipur Sadar Upazila on the south, Begumganj Upazila on the east, and Ramgonj Upazila on the west. Chatkhil thana was formed in 1977 and was upgraded into an upazila in 1983.

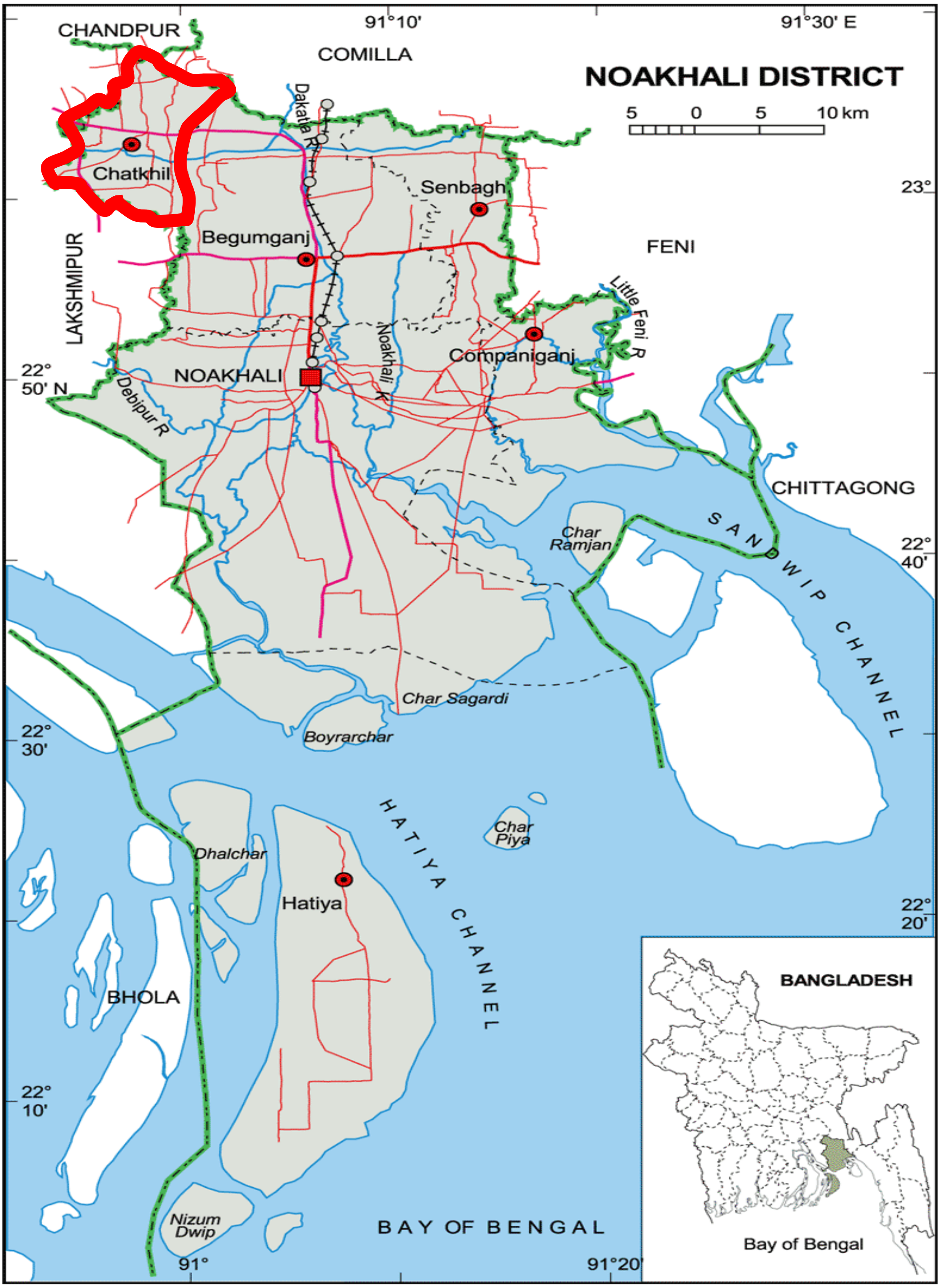

Figure: 3.1 Map of Noakhali District showing Chatkhil Upazila with red marking

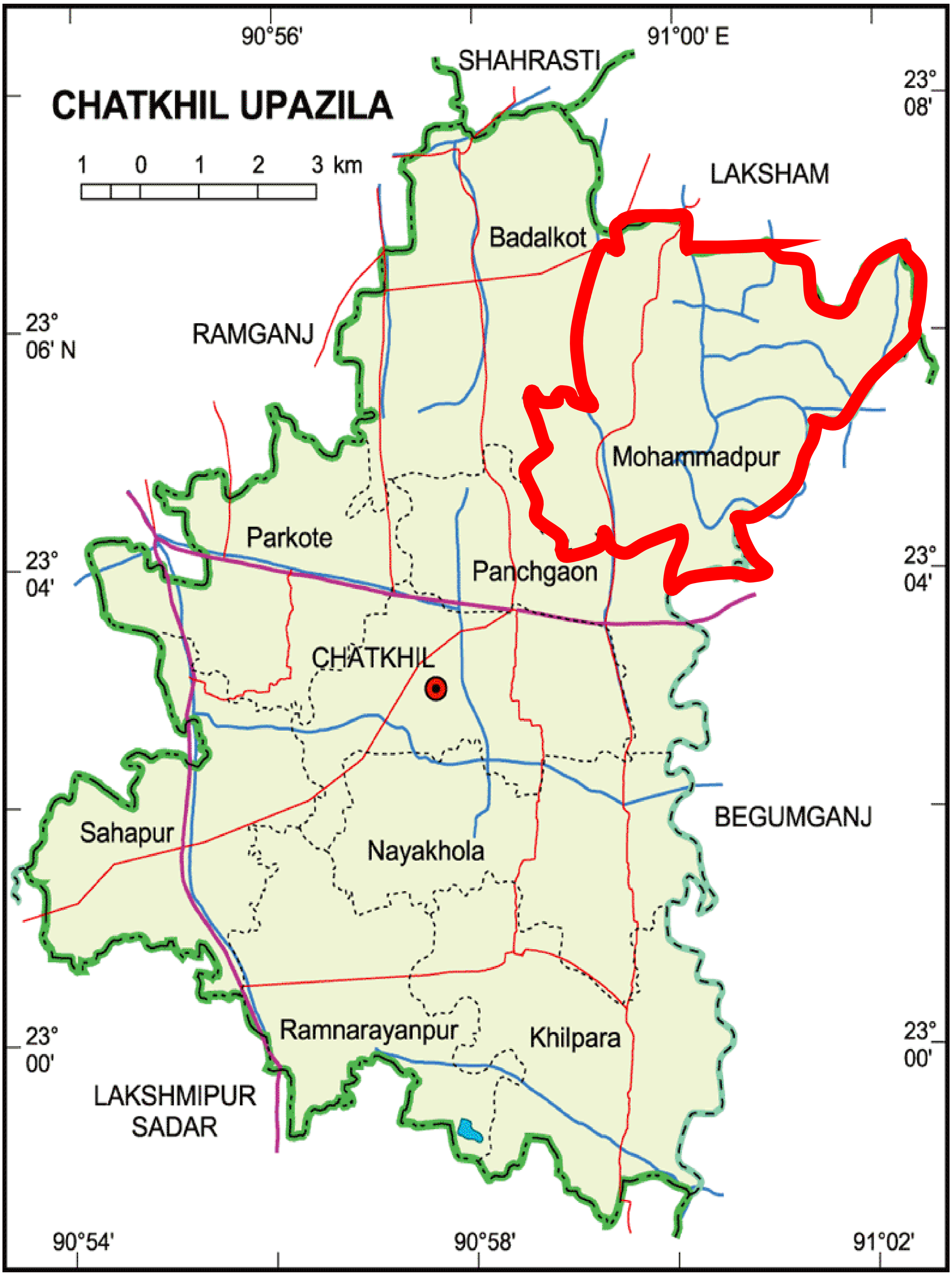

Figure: 3.1 Map of Chatkhil Upazila showing mohammadpur union with red marking

3.2 Population and Sampling Procedure

The numbers of villages of one union are 17. It was much difficult to conduct data collection from all the farmers of 17 villages within a short period of time. So out of 17 villages three villages were selected randomly and the households of these three selected villages constituted the population of the study. The numbers of households of these three selected villages were 394, 332 and 308 respectively. Thus, a total of 1034 farmers constituted the population of the study. Out of these 1034 farmers around 10 % were selected randomly as the sample of the study (Kaisar, 2018). Thus, one hundred three (103) households were selected as the sample of the study. The village- wise distribution of population and sample of farmers are shown in table 3.1.

Besides this 10 percent of the samples were selected randomly as reserves list who were supposed to be interviewed only when a respondent in the original sample list was unavailable during data collection.

Table 3.1 Distribution of selected sample households in the study areas

Upazila	Unions	Villages	Population	Sample size	Reserved list
Chatkhil	Mohammadpur	Kalampur	394	39	4
		Bansha	332	33	3
		Noapara	308	31	3
Total			**1034**	**103**	**10**

3.3 The Research Instrument

For the purpose of data collection an interview schedule was prepared keeping the objectives of the research in view. The schedule contained both open and closed form questions. Most of the questions were simple and direct, while four point Likert scale was included in the schedule to collect data regarding the effectiveness of adaptation strategies to climate change and relevant matters. The draft schedule was prepared in Bangla and pre-tested before using it for collections of data.

Based on the pre-test experience, necessary corrections, addition, alterations and rearrangements were made in the schedule. Thus, the schedule was prepared for final use. The schedule was prepared both in the Bangla and English version. The Bangla version of interview schedule was multiplied as per requirements to collect data from the respondents. An English version of the interview schedule has been presented at Appendix-A.

3.4 Variables and their Measurement

3.4.1 Measurement of independent variables

Eleven characteristics of f households were selected as independent variables of this study. Procedures followed in marauding the selected characteristics are described in the subsequent sections.

3.4.1.1 Age

Age of an individual was defined as the period of time from the birth to the time of interview and was operationally measured in terms of yeas. It was located in the serial no. 1 of the interview schedule.

3.4.1.2 Education

Education of a respondent was measured by the highest grade of formal schooling completed by him or her in any educational institute. If a respondent was found illiterate, he/she was given a score of “0”. In case of can sign only the score was given “0.5”. A score of 1 was assigned for each class one formally completed or passed. The literate assigned for each class one formally completed or passed. The literate respondents with no formal schooling were assigned scores that seemed appropriate. This variable appears in the serial no. 2 of the interview schedule.

3.4.1.3 Family size

Family size was operationally measured by assigning a score of one for each member of the family who jointly lived and ate together. The members included the respondent himself, his wife, children and other members.

3.4.1.4 Farm size

Farm size of a respondent was measured as the size of his/her farm on which he/she continued his farming operations during the period of study. It included the area of farm owned by her/him, farm area given or taken under share cropping (borga), lease or mortgage. The farm size of a respondent was measured by using the following formula:

Farm size = A+B+1/2(C+D)+E

Where,

A= homestead Area (with pond)

B= own land under own cultivation

C= Given to others as borga

D= Taken from others as borga

E= taken lease from others

The data was first recorded in terms of local measurement unit i.e. decimal and then converted into hectare. The total area, thus, obtained is considered as his farm size score (assigning a score of one for each hectare of land). This variable appears in item number four (4) in the interview schedule as presented in Appendix-A.

3.4.1.5 Annual family income

Annual family income indicates total earning of a farmer and the members of his family both from agriculture and other socially acceptable regular means such as business, service, etc. during a year. The value of all the agricultural products encompassing crops, livestock, vegetables, etc. were taken into consideration. For calculation, a score of one (1) was assigned for each one thousand (1000) taka of the annual income of a family. According to their annual income, farmers' income was categorized as low income, medium income and high income. This variable appears in item number 5 in the interview schedule as presented in Appendix- A.

3.4.1.6 Access to extension services

The extension services of a respondent were measured on the basis of the response of the farmers against the extent of his visiting of selected four criteria by putting tick mark against any one of the four responses- 4 times and above, 2-3 times, once time and no visit at all. The responses were scored as 3, 2, 1 and 0 respectively. The visit of extension services score of the respondents ranged from 0 to 12 where, 0 indicates no visit and 12 indicates very high visit. Based on their extension services, the respondents were classified into three categories as low, medium and high services. This variable appears in item number 6 in the interview schedule as presented in Appendix-A.

3.4.1.7 Organizational participation

Social organizational participation of respondent was measured on the basis of the nature of their participation in 6 selected organizations. Final score was computed by adding all the scores of selected organizations.

Organizational participation score = P X D

Where,

P- Participation Score

D- Duration (no. of years)

Following scores were assigned for nature of participation:

Nature of participation	**Scores assigned**
No participation	0
Participation as ordinary member	1
Participation as executive member	2
Participation as executive committee officer	3

This variable appears in item number seven (7) in the interview schedule as presented in Appendix-A.

3.4.1.8 Agricultural extension media contact

The extension contact of a respondent was measured with seven selected extension media. A scale was developed arranging the weights for 0, 1, 2, 3 and 4 for the responses for not at all, rarely, occasionally, frequently and regularly contact with these media respectively. Extension contact score of the respondents could range from 0 to 28, while '0' indicating no extension contact and '28' indicating very high extension contact (Appendix-A).

3.4.1.9 Knowledge on climate change

Knowledge of the farmers towards climate change was measured on 8 basic open-ended questions. Each question contains 2 marks. Knowledge of farmers was determined by summing up the weights for their responses to all the ten statements. Thus, knowledge of the farmers towards climate change score of the respondents could range from 0 to 16, where zero (0) indicating no knowledge and 16 indicate sound knowledge. Based on their climate change knowledge, the respondents were classified into three categories as low knowledge, medium knowledge and high knowledge. This variable appears in item number 9 in the interview schedule as presented in Appendix- A.

3.4.1.10 Perception on climate change

It reveals whether the respondent is aware of climate changes or not and it is measured by the number of changes he noticed in last year from a list of changes. Again, over the last ten years if he observed any changes relating to the weather or not. Then it is measured by the number of ways he uses to get that information. Here, 1=positive response and 0=negative response (Ahmed, 2017). Again, the access was determined by adding up the total scores he received. The score could range from 0 to 10 while, 0 indicates the least consciousness and 10 indicates maximum consciousness.

3.4.1.11 Use of Climate-Smart Agricultural Technologies

The indicator signifies how frequently farmers use selected ecologically sound practices and technologies. The scores are assigned as 0, 1, 2, 3, and 4 respectively. For all categories of use: 4 = adequately; 3 = moderately; 2 = no opinion; 1 = rarely and 0 = never (Ahmed, 2017). The sum of the total score reveals the extent of using climate smart agricultural practices by the respondent. Here, the score could range from 0 to 24 while '0' indicating no use and '24' indicating maximum use.

3.4.2 Measurement of dependent variable

Ten adaptation strategies (Cultivating short duration crops, Practicing crop rotation, Practicing crop diversification, Use of flood resistant variety, Integrated farming system, Cultivating long duration crops, Use of salinity tolerant varieties, Practicing intercropping, Soil conservations techniques (Mulching, cover cropping, conservation tillage), Cultivation of vegetables on the floating bed) were carefully constructed to develop effectiveness scale. 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 four-point scale as, highly effective, moderately effective, low effective and not at all effective. Scores were assigned to these four alternate responses as 3, 2, 1, and 0 respectively for each statement. However, the score of a respondent was obtained by adding his/her scores for all the 10 adaptation strategies. Thus, the effectiveness score of a respondent could range from 0 to 30, where, 0 indicated lowest levels of effectiveness and 30 indicated highest level of effectiveness. This variable appears in item number 12 in the interview schedule as presented in Appendix- A

3.5 Hypothesis test

A null hypothesis states that there is no relationship between the concerned variable. If a null hypothesis is rejected on the basis of statistical test, it is concluded that there is a contribution with the concerned variables. However, following null hypotheses was formulated for the present study:

There was no contribution with the selected characteristics of the farmers and their effectiveness of adaptation strategies to climate change.

The selected characteristics are: age, education, family size, farm size, annual family income, access to extension services, organizational participation, agricultural extension contact, knowledge on climate change, perception on climate change and use of climate smart agricultural technologies.

3.6 Collection of Data

Pre-test was done during 20-25 January, 2021 and final data were collected by the researcher himself during, 1st February to 28th 2021. The researcher made all possible efforts to explain the purpose of the study to the respondents.

Interviews were conducted with the respondents in their homes and farms. While staring interview with respondent, the researcher looks all possible care to establish rapport with him/her so that she/he did not feel hesitant or hesitate to furnish proper response to the questions and statements in the schedule. The questions were clearly explained wherever any respondent felt difficulty in understanding properly.

3.6.1 Compilation of data

After completion of field survey data from all the interview schedules were compiled, tabulated and analyzed according to the objectives of the study. In this process, all the responses in the interview schedule were given numerical coded values. Local units were converted into standard units. The responses to the questions in the interview schedules were transferred to a master sheet to facilitate tabulation. Tabulations and cross tabulations were done on the basis of categories developed by the investigator himself.

3.6.2 Categorization of data

For describing the various independent and dependent variables the respondents were classified into various categories. In developing categories, the researcher was guided by the nature of data and general consideration prevailing on the social system. The procedures have been discussed while describing the variable in the sub-sequent sections of next chapter.

3.7 Statistical Analysis

Data collected from the respondents were analyzed and interpreted in accordance with the objectives of the study. The analysis of data was performed using statistical treatment with SPSS (Statistical Package for Social Sciences) computer program, version 20. Statistical measures as a number, range, mean, standard deviation was used in describing the variables whenever applicable. Step wise multiple regression analysis was used to determine the contribution of farmers with regard to their effectiveness of adaptation strategies to climate change based on selected characteristics. Throughout the study the 0.01 and 0.05 levels of probability were used as the basis of rejection or accepting a null hypothesis.

CHAPTER IV

RESULTS AND DISCUSSION

In this chapter the findings of this study have been discussed in relation to the present findings and also to those found in other studies. The study investigated the effectiveness of adaptation strategies to climate change among coastal farmers. In accordance with the objectives of the study, presentation of the findings has been made in three sections. The first sections deal with selected characteristics of the farmers. The second section deals with extent of effectiveness of adaptation strategies to climate change and the third section deals with contribution with their selected characteristics of the farmers and their effectiveness of adaptation strategies to climate change.

4.1 Selected Characteristics of the Farmers

Eleven characteristics of the farmers were selected for this research. The characteristics include: age, education, family size, farm size, annual family income, access to extension services, organizational participation, agricultural extension contact, knowledge on climate change, perception on climate change and use of climate smart agricultural technologies. Some descriptive statistics of these features are given in Table 4.1 Data contained in the Table 4.1 reveal the salient features of the characteristics of the farmers in order to have an overall picture of these characteristics at a glance. However, for ready reference, separate tables are provided while presenting categorizations, discussing and /or interpreting results concerning each of the characteristics in this Chapter.

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

Categories	Measuring Unit	Range		Mean	SD
		Possible	Observed		
Age	Years	-	20-67	37.76	9.06
Education	Year of schooling	-	00-18.00	7.48	4.95
Family size	Number	-	2-9	4.25	1.35
Farm size	Hectare	-	.017-4.68	1.07	.618
Annual family income	‘000’ Tk.	-	40-525	190.85	109.51
Access to extension services	Score	0-12	0-12	4.52	3.58
Organizational participation	Score	-	0-15	4.20	3.86
Agricultural extension media contact	Score	0-28	6-22	12.74	3.60
Knowledge on climate change	Score	0-16	7-15	11.82	2.25
Perception on climate change	Score	0-10	2-9	5.97	1.65
Use of climate smart agricultural technologies	Score	0-24	8-24	17.39	3.35

4.1.1 Age

Age of the farmers ranged from 20 to 67 years, the average being 37.76 years and the standard deviation, 9.06. All the variables were categorized on the basis of their possible scores except age was categorized based on the classification provided by the Ministry of Youth and Sports, Government of the People’s Republic of Bangladesh. The distribution of the farmers according to their age is shown in Table 4.2.

Table 4.2 Distribution of the farmers according to their age

Categories	Farmers		Mean	SD
	Number	Percent		
Young aged (up to 35)	46	44.66	37.76	9.06
Middle-aged (36-50)	51	49.51		
Old (>50)	6	5.83		
Total	**103**	**100**		

Table 4.2 showed that the highest proportion 49.51 percent of the farmers were in "middle aged" category, while 44.60 percent of them were "young aged" category and 5.83 percent of the farmers in "old aged" category. The findings indicate that a large proportion (94.17) of the farmers were middle to young aged.

4.1.2 Education

The education scores of the farmers ranged from 0 to 18. The average was 7.48 and the standard deviation was 4.95. On the basis of their educational scores, the hybrid rice growers were classified into four categories, namely "illiterate (0-0.5), primary (1-5), secondary (6-10) and above secondary (above 10). This distribution was supported by Hoque (2016) and Masud, (2007) and shown in the Table 4.3.

Table 4.3 Distribution of the farmers according to their education

Categories	Farmers		Mean	SD
	Number	Percent		
Illiterate (0-0.5)	23	22.33	7.48	4.95
Primary level (1-5)	15	14.56		
Secondary level (6-10)	38	36.89		
Above secondary level (>10)	27	26.21		
Total	**103**	**100**		

Table 4.3 indicated that the majority (36.89 percent) of the farmers had secondary level of education compared to 26.21 percent of them having above secondary. About 22.33 percent of the farmers were illiterate, while 14.65 percent had primary level of education. Similar result was observed by Hossain et al. (2012) where highest numbers of respondents were completed up to secondary education level.

4.1.3 Family size

To describe the family size of the respondents, the category has been followed as represented by Hossain et al. (2012). Family size scores of the fanners ranged from 2 to 9 with an average of 4.25 and standard deviation of 1.35. According to family size, the respondents were classified into three categories (Mean±SD) as shown in Table 4.4.

Table 4.4 Distribution of the farmers according to their family size

Categories	**Farmers**		Mean	S D
	Number	Percent		
Small family (up to 3)	29	28.16	4.25	1.35
Medium family (4-5)	59	57.28		
Large family (above 5)	15	14.56		
Total	**103**	**100**		

Data contained in Table 4.4 indicates that (57.28%) of the farmers had medium family while 14.56 percent of them had large family and 28.16 percent of them had small family. Thus, the overwhelming majority 85.44 percent of the farmers were small to medium family size. Similar result was observed by Hossain *et al.* (2012) where highest numbers of respondents were completed up to medium family size.

4.1.4 Farm size

The farm size of the respondents varied from 0.17 to 4.68 hectares. The average farm size was 1.07 hectare with a standard deviation of 0.61. The respondents were classified into four categories based on their farm size as followed by DAE (DAE, 1999): "marginal farm" (upto 0.2 ha), "small farm" (0.21 – 1.0 ha), "medium farm" (1.0 -3.0 ha) “and large farm” (above 3.01 ha). The distribution of the farmers according to their farm size is shown in Table 4.5.

Table 4.5 Distribution of the farmers according to their farm size

Categories	**Farmers**		Mean	SD
	Number	Percent		
Marginal farm (up to 0.2 ha)	1	0.97	1.07	0.61
Small farm (0.21-1.0 ha)	53	51.56		
Medium farm (1.01-3.0 ha)	47	45.63		
Large farm (>3.01 ha)	2	1.94		
Total	**103**	**100**		

Table 4.5 indicated that more than half (51.56 percent) of the farmers possessed small farms compared to 0.97 percent of them having marginal farms and 1.94 percent large farms and 45.63 % of the farmers having medium farm. Thus, the overwhelming majority 97.09 percent of the farmers had small to medium farms. Majority of the farmers were under small farmer's category which is consistent with national scenario.

4.1.5 Annual family income

Annual family income of the farmers ranged from Taka 40 thousand to 525 thousand, the mean being 190.85 thousand and standard deviation 109.51 thousand. On the basis of their annual income scores, the farmers were divided into three categories: "low income" (up to 81), "medium income" (82-299) and "high income" (above 299). The distribution of the farmers according to their annual family income is shown in Table 4.6.

Table 4.6 Distribution of the farmers according to their annual family income

Categories ('000' taka)	**Farmers (n=103)**	
	Number	**Percent**
Low income (up to 81)	12	11.65
Medium income (82-299)	73	70.87
High income (above 299)	18	17.48
Total	103	100

The majority (70.87 percent) of the farmers had medium income compared to 11.65 percent of them having low income and 17.48 percent had high income. Thus, the vast majority (89.35 percent) of the farmers had medium to high income.

4.1.6 Access to extension services

Access to extension services of the farmers ranged from 0 to 12, the mean being 4.52 and standard deviation 3.58. On the basis of their access to extension services scores, the farmers were divided into three categories: "low access" (up to 1), "medium access" (2-7) and "high access" (above 7). The distribution of the farmers according to their access to extension services is shown in Table 4.7.

Table 4.7 Distribution of the farmers according to their access to extension services

Categories (Score)	Farmers (n=103)	
	Number	**Percent**
Low access (up to 1)	24	23.30
Medium access (2-7)	54	52.43
High access (above 7)	25	24.27
Total	103	100

The majority (52.43 percent) of the farmers had medium access compared to 23.30 percent of them having low access and 24.27 percent had high access. Thus, the vast majority (76.70 percent) of the farmers had medium to high access to extension services.

4.1.7 Organizational participation

The observed organizational participation score of the respondents ranged from 0 to 15. The mean score was 4.20 with the standard deviation 3.86. On the basis of organizational participation scores, the respondents were classified into three categories (Mean ±SD) namely, low organizational participation, medium organizational participation and high organizational participation, as shown in Table 4.8.

Table 4.8 Distribution of the farmers according to their organizational participation

Categories (Scores)	Farmers		Mean	SD
	Number	**Percent**		
No (0)	35	33.98	4.20	3.86
Low (up to 5)	31	30.09		
Medium (6-10)	30	29.13		
High (above 10)	7	6.80		
Total	**103**	**100**		

Data contained in the Table 4.8 revealed that the majority (33.98%) of the farmers had no organizational participation as compared to (6.80%) and (29.13%) having high and medium organizational participation respectively and 30.09 percent of the farmers had low organizational participation. The majority (59.22%) of the respondents had medium to low organizational participation.

4.1.8 Extension media contact

Extension media contact scores of the farmers ranged from 6 to 22 with an average of 12.74 and standard deviation of 3.60. On the basis of their media contact, the respondents were classified into three categories (Mean ±SD) namely, low contact, medium contact and high contact. The scale used for computing the media contact score of a respondent is given Table 4.9.

Table 4.9 Distribution of the farmers according to their media contact

Categories (Scores)	**Farmers**		**Mean**	**SD**
	Number	**Percent**		
Low (up to 9)	13	12.62	12.74	3.60
Medium (10-18)	77	74.93		
High (above 18)	13	12.45		
Total	**103**	**100**		

Data contained in the Table 4.9 indicated that the highest proportion (74.93%) of the respondents had medium extension media contact as compared to (12.62%) and (12.45%) having low and high extension media contact respectively. The majority (87.55%) of the respondents had low to medium extension contact.

4.1.9 Knowledge on climate change

The knowledge on climate change of the respondents ranged from 7 to 15 scores with an average of 11.82 and standard deviation of 2.25. The respondents of the study area were classified into three categories on the basis of their knowledge on climate change. Distribution of the respondents according to their knowledge on climate change has been shown in the Table 4.10.

Table 4.10 Distribution of the respondents according to their knowledge on climate change

Categories (Scores)	**Farmers**		**Mean**	**SD**
	Number	**Percent**		
Low (up to 9)	22	21.36	11.82	2.25
Medium (10-13)	53	51.46		
High (above 13)	28	27.18		
Total	**103**	**100**		

Data contained in the Table 4.11 indicated that the highest proportion (51.46%) of the respondents had medium knowledge on climate change as compared to (21.36%) and (27.18%) having low and high knowledge on climate change respectively. The majority (78.64%) of the respondents had medium to high knowledge on climate change.

4.1.10 Perception on climate change

The observed perception scores of the respondents ranged from 2 to 9 against the possible range of 0-10. The mean scores were 5.97 with the standard deviation of 1.65. Based on their perception, the respondents were classified into three categories (Mean±SD) namely, 'low', 'medium' and 'high'. The distribution of the farmers' according to their perception is shown in the Table 4.11.

Table 4.11 Distribution of the farmers according to their perception

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
Low perception (up to 4)	22	21.36	5.97	1.65
Medium perception (5-7)	38	36.89		
High perception (above 7)	43	41.75		
Total	103	100		

Findings shown in the Table 4.11 revealed that the majority (41.75%) of the respondents had high perception while (21.36%) and (36.89%) having low and medium perception categories respectively. However, still 21.36% farmers possess low perception which need to change or improved their perception through taking various steps.

4.1.11 Use of climate smart agricultural technologies

Use of climate smart agricultural technologies of the respondents ranged from 8 to 24 scores with an average of 17.39 and standard deviation of 3.35. The respondents of the study area were classified into three categories on the basis of their use of climate smart agricultural technologies. Distribution of the respondents according to their use of climate smart agricultural technologies has been shown in the Table 4.12.

Table 4.12 Distribution of the respondents according to their use of climate smart agricultural technologies

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
Low (up to 18)	11	10.50	17.39	3.35
Medium (09-16)	56	54.08		
High (above 20)	36	35.42		
Total	**103**	**100**		

Data contained in the Table 4.12 indicated that the highest proportion (54.08%) of the respondents had medium use of climate smart agricultural technologies as compared to (10.50%) and (35.42%) having low and high use of climate smart agricultural technologies respectively. The majority (89.50%) of the respondents had medium to high use of climate smart agricultural technologies.

4.2 Effectiveness of adaptation strategies to climate change

The effectiveness scores of the farmers ranged from 8-27 against possible range of 0-30 with a mean of 13.38 and standard deviation of 4.22. On the basis of effectiveness scores, the farmers were classified into three categories as low effectiveness (up to 9), medium effectiveness (10-17) and high effectiveness (above 17) and shown in Table 4.13.

Table 4.13 Distribution of the respondents according to their effectiveness

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
Low effectiveness (up to 10)	2	1.94	13.38	4.22
Medium effectiveness (11-20)	91	88.44		
High effectiveness (above 20)	10	9.62		
Total	**103**	**100**		

Data presented in Table 4.13 shows that the highest percentage (88.44%) of the farmers had medium effectiveness of adaptation strategies to climate change compared to 1.94 percent of the farmers had low effectiveness and 9.62 percent of the farmers had high effectiveness of adaptation strategies to climate change. Overwhelming the majority (98.06%) of the respondents had medium to high effectiveness of adaptation strategies to climate change.

4.3 Contribution of the selected characteristics of the respondents to their effectiveness of adaptation strategies to climate change

In order to estimate the effectiveness of adaptation strategies to climate change, the multiple regression analysis was used which is shown in the Table 4.14.

Table 4.14 Multiple regression coefficients of the contributing variables related to their effectiveness of adaptation strategies to climate change

Dependent variable	Independent variable	β	ρ	R^2	Adj. R^2	F
Effectiveness of adaptation strategies to climate change	Age	.024	.772^{NS}	0.50	0.44	8.28
	Education	.252	.003**			
	Family size	.022	.783^{NS}			
	Farm size	.216	.008**			
	Annual family income	-.047	.550^{NS}			
	Access to extension services	.227	.013*			
	Organizational participation	.065	.482^{NS}			
	Agricultural extension media contact	.008	.922^{NS}			
	Knowledge on climate change	.191	.036*			
	Perception on climate change	.051	.558^{NS}			
	Use of climate smart agricultural technologies	.192	.045*			

** Significant at p<0.01; *Significant at p<0.05 and NS Non significant

Table 4.14 shows that there is a significant contribution of the respondents, education, farm size, access to extension services, knowledge on climate change and use of climate smart agricultural technologies. Of these, education and farm size were the most important contributing factors (significant at the 1% level) and access to extension services, knowledge on climate change and use of climate smart agricultural technologies were the important contributing factors (significant at the 5% level) while coefficients of other selected variables don’t have any contribution with their effectiveness of adaptation strategies to climate change.

The value of R^2 is a measure of how of the variability in the dependent variable is accounted by the independent variables. So, the value of $R^2 = 0.50$ means that independent variables account for 50% of the variation in effectiveness of adaptation strategies to climate change. The F ratio is 8.28 which is highly significant ($\rho<0.000$).

However, each predictor may explain some of the variance in respondent's effectiveness of adaptation strategies to climate change simply by chanced. The adjusted R^2 value penalizes the addition of extraneous predictors in the model, but values 0.44 is still show that variance is effectiveness of adaptation strategies to climate change. can be attributed to the predictor variables rather than by chanced the suitable model (Table 4.14). In summary, the models suggest that the respective authority should be consider the education, farm size, access to extension services, knowledge on climate change and use of climate smart agricultural technologies and in this connection some predictive importance has been discussed below:

4.3.1 Significant contribution of education to their effectiveness of adaptation strategies to climate change

The contribution of education to their effectiveness of adaptation strategies to climate change was measured by the testing the following null hypothesis;

"There is no contribution of education to their effectiveness of adaptation strategies to 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 education was at 1% significance level (p=0.003).
b. So, the null hypothesis could be rejected.
c. The b-value of level education was (0.252). So, it can be stated that as education increased by one unit, effectiveness of adaptation strategies to

climate change increased by 0.252 units. Considering the effects of all other predictors are held constant.

Based on the above finding, it can be said that farmers' have more education increased the perception on effectiveness of adaptation strategies to climate change. This implies that with the increase of education of the farmers will increase their effectiveness of adaptation strategies to climate change.

4.3.2 Significant contribution of farm size to their effectiveness of adaptation strategies to climate change

From the multiple regression, it was concluded that the contribution of farm size to their effectiveness of adaptation strategies to climate change was measured by the testing the following null hypothesis;

"There is no contribution of farm size to their effectiveness of adaptation strategies to 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 farm size was significant at 1% level (0.008).
b. So, the null hypothesis could be rejected.
c. The b-value of farm size was 0.216. So, it can be stated that as farm size increased by one unit, effectiveness of adaptation strategies to climate change increased by 0.216 units. Considering the effects of all other predictors are held constant.

From the multiple regressions, it was concluded that farm size of the farmers had highest positive contribution to their effectiveness of adaptation strategies to climate change. This implies that with the increase of farm size of the farmers will increase their effectiveness of adaptation strategies to climate change.

4.3.3 Significant contribution of access to extension services to their effectiveness of adaptation strategies to climate change

From the multiple regression, it was concluded that the contribution of access to extension services to their effectiveness of adaptation strategies to climate change was measured by the testing the following null hypothesis;

"There is no contribution of access to extension services to their effectiveness of adaptation strategies to 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 access to extension services was significant at 5% level (0.013).
b. So, the null hypothesis could be rejected.
c. The b-value of access to extension services was 0.227. So, it can be stated that as access to extension services increased by one unit, effectiveness of adaptation strategies to climate change increased by 0.227 units. Considering the effects of all other predictors are held constant.

From the multiple regressions, it was concluded that access to extension services of the farmers had highest positive contribution to their effectiveness of adaptation strategies to climate change. This implies that with the increase of access to extension services of the farmers will increase their effectiveness of adaptation strategies to climate change.

4.3.4 Significant contribution of knowledge on climate change to their effectiveness of adaptation strategies to climate change

From the multiple regression, it was concluded that the contribution of knowledge climate change to their effectiveness of adaptation strategies to climate change was measured by the testing the following null hypothesis;

"There is no contribution of knowledge climate change to their effectiveness of adaptation strategies to 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 knowledge on climate change was significant at 5% level (0.036).
b. So, the null hypothesis could be rejected.
c. The b-value of knowledge on homestead vegetable cultivation was 0.191. So, it can be stated that as knowledge on climate change increased by one unit, women effectiveness of adaptation strategies to climate change increased by 0.191 units. Considering the effects of all other predictors are held constant.

From the multiple regressions, it was concluded that knowledge on climate change of the farmers had highest positive contribution to their effectiveness of adaptation strategies to climate change. This implies that with the increase of knowledge on climate change of the farmers will increase their effectiveness of adaptation strategies to climate change.

4.3.5 Significant contribution of use of climate smart agricultural technologies to their effectiveness of adaptation strategies to climate change

From the multiple regression, it was concluded that the contribution of use of climate smart agricultural technologies to their effectiveness of adaptation strategies to climate change was measured by the testing the following null hypothesis;

"There is no contribution of use of climate smart agricultural technologies to their effectiveness of adaptation strategies to 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 use of climate smart agricultural technologies was significant at 5% level (0.045).
b. So, the null hypothesis could be rejected.
c. The b-value of use of climate smart agricultural technologies was (0.192). So, it can be stated that as use of climate smart agricultural technologies increased by one unit, women effectiveness of adaptation strategies to climate change increased by 0.192 units. Considering the effects of all other predictors are held constant.

Multiple regressions showed that use of climate smart agricultural technologies was positive contribution to their effectiveness of adaptation strategies to climate change. This implies that with the increase of use of climate smart agricultural technologies of the farmer will also increase their effectiveness of adaptation strategies to climate change. Use of climate smart agricultural technologies helps farmers to make favorable possess- as which ultimately help them to take adaptation.

CHAPTER 5
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Findings

5.1.1 Selected characteristics of the farmers

Age: The highest proportion 49.51 percent of the farmers was "middle aged" category, while 44.60 percent of them was "young aged" category and 5.83 percent of the farmers was "old aged" category.

Education: The majority (36.89 percent) of the farmers had secondary level of education compared to 26.21 percent of them having above secondary. About 22.33 percent of the farmers were illiterate, while 14.65 percent had primary level of education.

Family size: The highest proportion (57.28%) of the farmers had medium family while 14.56 percent of them had large family and 28.16 percent of them had small family.

Farm size: The highest proportion than half (51.56 percent) of the farmers possessed small farms compared to 0.97 percent of them having marginal farms and 1.94 percent large farms and 45.63 % of the farmers having medium farm.

Annual family income: The highest proportion (70.87 percent) of the farmers had medium income compared to 11.65 percent of them having low income and 17.48 percent had high income.

Access to extension services: The majority (52.43 percent) of the farmers had medium access compared to 23.30 percent of them having low access and 24.27 percent had high access.

Organizational participation: The highest proportion **(**33.98%) of the farmers had no organizational participation as compared to (6.80%) and (29.13%) having high and medium organizational participation respectively and 30.09 percent of the farmers had low organizational participation.

Extension media contact: The highest proportion (68.93%) of the respondents had medium extension media contact as compared to (12.62%) and (18.45%) having low and high extension media contact respectively.

Knowledge on climate change: The majority (51.46%) of the respondents had medium knowledge on climate change as compared to (21.36%) and (27.18%) having low and high knowledge on climate change respectively.

Perception on climate change: The majority (41.75%) of the respondents had high perception while (21.36%) and (36.89%) having low and medium perception categories respectively. However, still 21.36% farmers possess low perception which need to change or improved their perception through taking various steps.

Use of climate smart agricultural technologies: The highest proportion (64.08%) of the respondents had medium use of climate smart agricultural technologies as compared to (16.50%) and (19.42%) having low and high use of climate smart agricultural technologies respectively.

5.1.2 Effectiveness of adaptation strategies to climate change

The effectiveness scores of the farmers ranged from 8-27 against possible range of 0-30 with a mean of 13.38 and standard deviation of 4.22. The highest percentage (88.44%) of the farmers had medium effectiveness of adaptation strategies to climate change compared to 1.94 percent of the farmers had low effectiveness and 12.62 percent of the farmers had high effectiveness of adaptation strategies to climate change.

5.1.3 Factors related to their effectiveness of adaptation strategies to climate change

There is a significant contribution of respondents' education, farm size, access to extension services, knowledge on climate change and use of climate smart agricultural technologies and the rest six characteristics namely, age, family size, annual family income, organizational participation, agricultural extension media contact and perception on climate change had no significant contribution with their effectiveness of adaptation strategies to climate change.

5.2 Conclusion

A conclusion may be looked upon as an inference based on the findings of empirical study, pertinent facts and unbiased judgments. On the basis of the findings of the study the logical interpretation of their meanings and other relevant facts are promoted the researcher to draw the following conclusion:

1. The findings indicated that a large proportion of (98.06 percent) the farmers had medium to high effectiveness. It may, therefore, be concluded that proper emphasis should be given on the farmers of all effectiveness categories by the extension workers in order to encourage effectiveness of adaptation strategies to climate change.
2. The findings indicated that a large proportion (36.89 percent) of the farmers were primary level to illiterate. Education of the farmers had significant contribution with their effectiveness of adaptation strategies to climate change. According to this result we can draw a conclusion that high literacy rate as well as higher educational level among the farmers of the study area have much influence in their effectiveness of adaptation strategies to climate change. Though education of the farmers has direct effect on their effectiveness of adaptation strategies to climate change, it can directly help the farmers to become aware of the benefits of adaptation strategies to climate change.

3. The findings of the study indicated that overwhelming majority (76.70) percent of the respondents had medium to high access to extension services for getting necessary agricultural information. Extension services of the framers had a significant positive contribution with their effectiveness of adaptation to climate change. Hence, it may be concluded that extension services increase the outlook of the farmers which lead them to adopt new technologies related to adaptation to climate change.
4. Farm size had significant and positive contribution with their effectiveness of adaptation strategies to climate change. It was thus proved that farmers' effectiveness of adaptation strategies to climate change is dependent with their farm size.
5. Data indicated that the highest proportion (83.50 percent) of the respondents had medium to high use of climate smart agricultural technologies. Use of climate smart agricultural technologies of the farmers had significant positive contribution with their effectiveness of homestead vegetable cultivation. The farmers having high use of climate smart agricultural technologies gained more knowledge on climate change and as a result, they adopt new technologies related adaptation strategies to climate change very swiftly. Considering the above facts, it may be concluded that the effectiveness can be increased if more use of climate smart agricultural technologies is conducted for the farmers of the study area.

6 The findings indicated that majority (78.64%) of the respondents had medium to high knowledge on climate change. Knowledge on climate change of the farmers had significant contribution with their effectiveness of adaptation strategies to climate change.

5.3 Recommendations

Based on the findings of the present study, the following recommendations were made:

5.3.1 Recommendations for Policy Implications

Recommendations based on the findings and conclusions of the study are presented below:

i. Effectiveness of adaptation strategies to climate change, but in the present study, majority of the farmers had medium to high effectiveness of adaptation strategies to climate change. It is, therefore, recommended that necessary steps should be taken to motivate the farmers in participating different organization. Extension workers must be well trained on the newly adaptation practices/techniques as well as the running techniques so as to fit them as a credible source of information about the techniques and to make them skilled to implement/ solve any problem of the farmers.
ii. Education of the respondents had a significant contribution to the effectiveness of adaptation strategies to climate change. It indicates the importance of education for increasing effectiveness of adaptation strategies to climate change. It may be recommended that arrangements should be made for enhancing the education level of the farmers by the concerned authorities through the establishment of night school, adult education and other extension methods as possible.
iii. Finding revealed that possession of small farms was not favourable for improvement of knowledge on climate change. It may therefore, be recommended that involving more medium to large farmers in this programme would be helpful for its adaptation.
iv. Access to extension services of farmers had significant positive contribution with their effectiveness of adaptation strategies to climate change. Therefore, it may be recommended that, DAE and

other agriculture related organizations should take necessary steps to enhance their access to extension services with the farmers. So, more extension worker should be employed to make personal contact along with other enhance group and mass media.

v. Use of climate smart agricultural technologies had significant positive contribution with their effectiveness of adaptation strategies to climate change. Therefore, it may be recommended that, DAE and other agriculture related organizations should organize necessary training and skill development program like training on new technologies, fertilizer application etc. so that the farmers could increase use of climate smart agricultural technologies in their area as well as can increase their effectiveness.

vi. Maximum (78.64%) of the farmers had medium to high knowledge on climate change. It should be selected on priority basis for any motivational training by Department of Agricultural Extension (DAE) and concern Non-Government Organizations (NGOs) for gaining sustainable adaptation strategies as well as to increase the effectiveness of adaptation strategies to climate change through increasing the knowledge on climate change.

5.3.2 Recommendations for further study

Short term and sporadic study being conducted in some specific location cannot provide all information for the proper understanding of the farmers towards the effectiveness of adaptation strategies to climate change. Therefore, the following recommendations were made for further study:

I. The present study was conducted in three selected villages of Noakhali district. It is strongly felt that study of this nature be replicated in other parts of Bangladesh.

II. This study investigated the contribution of 11 personal and socio-economic characteristics of the farmers with their effectiveness of adaptation strategies to climate change. Therefore, it is recommended that further study should be conducted involving other characteristics in this regard to better interpret the unexplained variations.

III. Effectiveness of adaptation strategies to climate change may be determined by using other ways and methods which may be used in conducting further research.

IV. The study was conducted on climate victims' farmers but other farmers are equally important. So, a similar study may be conducted with other farmers.

REFERENCES

Abdel-Dayem, S. 2005. Understanding the Social and Economic Dimensions of Salinity. Proceedings of the International Salinity Forum, Riverside, California.

Agrawala, S., Ota, T., Ahmed, A.U., Smith, J. and Aalst, M.V. 2003. Development and Climate Change in Bangladesh: Focus on Coastal Flooding and the Sunderbans. Organization for Economic Co-Operation and Development (OECD).

Agriculture Advisory Society. 2012.“Annual Activity Report”, http://aas-bd.org/wpcontent/uploads/2014/04/Annual-Activity-Report-2012.

Ahmad, M. 2004. Living in the Coast: People and Livelihoods. Dhaka, Program Development Office for Integrated Coastal Zone Management Plan Project, Water Resources Planning Organization. March 2004.

Ahmed, A.U. 2010. Reducing Vulnerability to Climate Change: The Pioneering Example of Community Based Adaptation in Bangladesh. Center for global change and CARE Bangladesh.

Ahmed, M. 2006. Adoption of Selected Rice Production Technologies by the Garo Farmers of Bangladesh. Sher-E-Bangla Agricultural University, Dhaka, Bangladesh.

Ahmed, M.M. 2017. Sustainability of coastal agriculture in Bangladesh. MS. Thesis, Department of Agricultural Extension and Information System, Sher-e- Bangla Agricultural University, Sher-e- Bangla Nagar, Dhaka.

Ahmed, S. Rashid, M.H.A. Chowdhury, N. 2009. Comparative Profitability of Boro Rice and Potato Production in Some Selected Areas of Mymensingh District. *Progressive Agriculture*. Vol-20.

Alam, M., Ahammad, R., Nandy, P. and Rhaman, S. 2013. “Coastal Livelihood Adaptation in Changing Climate: Bangladesh Experience of NAPA Priority Project Implementation.” *Springer- Japan*, DOI 10.1007/978-4-431-54249-014.

Alauddin, S.M. and Rahman, K.F. 2013. "Vulnerability to Climate Change and Adaptation Practice in Bangladesh." Journal of SUB, 4(2):25-42.

Ali, A. 2005.Vulnerability of Bangladesh Coastal Region to Climate Change with Adaptation Option. Bangladesh Space Research and Remote Sensing Organization (SPARRSO), Dhaka.

Amha, R. 2006. Impact Assessment of Rainwater Harvesting Ponds: The Case of Alaba Woreda, Ethiopia. Master's Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Anik, S. And Khan, M. 2012. "Climate change adaptation through local knowledge in the north eastern region of Bangladesh", Mitigation and Adaptation Strategies for Global Change.

Asfaw, S. and Lipper, L. 2011. Economics of PGRFA Management for Adaptation to Climate Change: A Review of Selected Literature; Background Study Paper No. 60; Agricultural Economic Division: Rome, Italy.

Asian Development Bank. 2004. Flood, Response, Damage and Recovery; Asian Development Bank: Manila, Philippines.

BBS. 2011. Statistical Year Book of Bangladesh. Bangladesh Bureau of Statistics. Planning Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BBS. 2020. Statistical Year Book of Bangladesh. Bangladesh Bureau of Statistics. Planning Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BCAS. (Bangladesh Center for Advanced Studies). 1991. A Follow up Study; Bangladesh Center for Advanced Studies: Dhaka, Bangladesh.

CCC. (Climate Change Cell). 2007. Climate Change and Bangladesh. Department of Environment, Government of the People's Republic of Bangladesh, Dhaka.

Choisnel E. 1992. "Droughts and their diagnoses".

DAE. 1999. Agricultural Extension Manual. Department of Agricultural Extension, Ministry of Agriculture, Government of the People's Republic of Bangladesh.

DCRMA (Disaster and Climate Risk Management in Agriculture). 2011. Project of DAE, Khamarbari, Dhaka.

Department of Environment (DoE). 2007. Climate Change and Bangladesh, Bangladesh Government & United Nations Development Programme, Dhaka, Bangladesh.

Deressa, T.D., Hassan, R.M., Ringler, C., Alemu, T. and Yesuf, M. 2009. Determinants of farmers' choice of adaptation methods to climate change effects in the Nile Basin of Ethiopia. *Glob. Environ. Chang;* 19, 248–255.

Eakin, H. 2005. Institutional change, climate risk, and rural vulnerability: Cases from Central Mexico. *World Dev*., 33, 1923–1938.

Eckhardt, N.A., Cominelli, E., Galbiati, M. and Tonelli, C. 2009. The future of science: Food and water for life. *Plant Cell*., 21, 368–372.

European Commission. 2012. Report of the meeting on salinity gradient power generation. Brussels.

FAO. 2007. "Climate Change and Food Security" a Framework for Action Rome, 2007.

FAO. 2008. "Community Based Adaptation in Action, A Case Study from Bangladesh, Improved Adaptive Capacity to Climate Change for Sustainable Livelihoods in Agriculture Sectors". Rome, Italy.

FAO. 2008. Land and plant nutrition management service. Rome, Italy.

Faruq, M.O. 2017. Boro Rice Yield Gap Minimizing Strategies Practiced by the Farmers of Dhamrai Upazilla under Dhaka District. M.S. Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, SAU, Dhaka.

Feizi, M. 1993. Considering the effect of water quality and quantity on desalinization of Isfahan Roudasht Soils. Technical Research Report, Isfahan Agricultural and Natural Resources Research Center, Isfahan, Iran, 8: 16–34.

Finan, T. 2009. Storm Warnings: The Role of Anthropology in Adapting to Seal-Level rise in Southwestern Bangladesh in Anthropology and climate change: From Encounters to Actions edited by Crate, Susan A. and Nuttall, Mark.

Ghassemi, F., Jakeman A.J and Nix, H.A. 1995. Salinization of Land and Water Resources: Human Causes, Extent, Management and Case Studies. CABI Publishing: Wallingford.

GoB (Government of Peoples Republic of Bangladesh). 2008. Cyclone Sidr in Bangladesh: Damage, Loss, and Needs Assessment for Disaster Recovery and Reconstruction. A Report Prepared by the Government of the People's Republic Bangladesh Assisted by the International Development Community with Financial Support from the European Commission, Dhaka, Bangladesh.

GoB, Government of Bangladesh. 2014. Cyclone sidr in Bangladesh: Damage, Loss and Needs Assessment for Disaster recovery and Reconstruction. Available online: http://gfdrr.org/docs/ Assessment Report_Cyclone%20Sidr_Bangladesh_2008.pdf (accessed on 26 July 2013).

Gowing, J.W., Tuong, T.P. and Hoanh, C.T. 2006. Land and Water Management in Coastal Zones: Dealing with Agriculture-Aquaculture-Fishery Conflicts. Environmental Livelihoods in Tropical Coastal Zones: Managing AgricultureFishery-Aquaculture Conflicts.

Haddad, B. 2005. Ranking the Adaptive Capacity of Nations to Climate Change when Sociopolitical Goals are Explicit. Global Environmental Change, 1(5): 165-176.

Haque, S.A. 2006. Salinity Problems and Crop Production in Coastal Regions of Bangladesh. *Pakistan Journal of Botany* 38: 1359–1365.

Hasan, M. 2015. Adoption of Modern Practices In Rice Cultivation By The Farmers Of Madhukhali Upazila Under Faridpur District. Sher-E-Bangla

Agricultural University, Dhaka, Bangladesh.

Hasan, M., Alamin, M., Islam, S. and Hasan, R. 2013. Scenario of climate change on agriculture in South-East coastal belt of Bangladesh. International Journal of Science, Engineering and Technology Research, 2(6):1407-1410.

Hasanullah, M. 1989. Performance Determination of Extension Organization of Bangladesh. Ph.D. Thesis, Institute of Business Administration, University of Dhaka.

Hoque, D.M. 2016. Farmers Attitude towards Industrialization in Narayanganj District. Sher-E-Bangla Agricultural University, Dhaka, Bangladesh.

Hossain, M.L., Hossain, M.L., Salam, M.A. and Rubaiyat, A. 2012. Seasonal variation of soil salinity in coastal areas of Bangladesh. International Journal of Environmental Science, *Management and Engineering Research*, Vol. 1 (4):172-178.

Howden, S.M., Soussana, J., Tubiello, F.N., Chhetri, N., Dunlop, M. and Meinke, H. 2007. Adapting agriculture to climate change effects. *Proc. Natl. Acad. Sci. USA*, 104, 19691–19696.

Intergovernmental Panel on Climate Change (IPCC). 2001. Impacts, Adaptation, and Vulnerability; Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change; Cambridge University Press: Cambridge, UK

Intergovernmental Panel on Climate Change (IPCC). 2001. Special Report on the Regional Impacts of Climate Change: An Assessment of Vulnerability; Cambridge University Press: Cambridge, UK.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: impacts, adaptation and vulnerability: contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.

Intergovernmental Panel on Climate Change (IPCC). 2007. Impacts, Adaptation and Vulnerability: An Assessment Report of the

Intergovernmental Panel on Climate Change; Cambridge University Press: Cambridge, UK.

Intergovernmental Panel on Climate Change (IPCC). 2013. The Physical Science Basis; Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Cambridge University Press: Cambridge, UK.

IPCC. 2007. Intergovernmental Panel on Climate Change fourth report.

Islam, M.R. 2004. Where Land Meets the Sea: A Profile of the Coastal Zone of Bangladesh. The University Press Limited, Dhaka.

Issa, D.S.C. 1995. The technology adoption process in subsistence agriculture: The case of Cassava in Southwestern Nigeria. *Agric. Syst.*, 36, 65–78.

Jonhson E. 1997. "Changes in Earnings Inequality: The Role of Demand Shifts"

Kisar, M.A. 2018. Climate Change Vulnerability on Farmer's Food Security in The Northern Part of Bangladesh. A M.Sc. (Ag. Ext. Info. Syst.) Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka.

Masud, M.A. 2007. Farmers' Adoption of Modern Maize Cultivation. Sher-E-Bangla Agricultural University, Dhaka, Bangladesh.

Ministry of Environment and Forest (MOEF). 2009. Bangladesh climate change strategy and action plan, Government of Bangladesh, Dhaka, Bangladesh.

Ministry of Environment and Forest. 2008. Bangladesh Climate Change Strategy and Action Plan 2008; Government of the People's Republic of Bangladesh: Dhaka, Bangladesh.

Mortimore, M.J. and Adams, W.M. 2001. Farmer adaptation, change and "crisis" in the Sahel. *Glob. Environ. Chang.*, 11, 49–57.

Morton, J.F. 2007. The impact of climate change on smallholder and subsistence agriculture. *Proc. Natl. Acad. Sci. USA*, 104, 19680–19685.

Muller, A. 2009. Benefits of Organic Agriculture as a Climate Change Adaptation and Mitigation Strategy for Developing Countries, Environment for Development Discussion Paper Series, EFD, pp. 9-17.

National Adaptation Program of Action (NAPA). 2005. Ministry of Environment and Forest (MOEF), Government of Bangladesh, Dhaka, Bangladesh.

Nelson, G. C. 2009. "Climate change and agriculture" international food policy, Research institute.

Orlove, B. 2009. The Past, the Present and Some Possible Futures of Adaptation. Chapter 9 in: Adapting to Climate Change: Thresholds, Values, Governance. Cambridge Univeristy Press. London.

Pielke R. 1998. "Rethinking the role of adaptation in climate policy".

Pouliotte, J., Smit, B. and Westerhoff, L. 2009. "Adaptation and Development: Livelihoods and Climate Change in Subarnabad, Bangladesh", *Climate and Development*,1(1): 31-46.

Rahman, M. M. and Ahsan, M. 2001. Salinity Constraints and Agricultural Productivity in Coastal Saline Area of Bangladesh, Soil Resources in Bangladesh: Assessment and Utilization. *Journal of Agricultural Science*, 2:201-206.

Ramasmasy, R. and Baas, S. 2007. Climate Variability and Change: Adaptation to Drought in Bangladesh. A Resource Book and Training Guide; Abu Dhabi Ports Company, Thailand and Food and Agriculture Organization of the United Nations: Rome, Italy.

Robertson, M. J. Kingwell, R. Measham, T.G. O’Connor, M. and Batchelor, G. 2007. Constraints to Farmers Managing Dry Land Salinity in the Central Wheat belt of Western Australia. Paper presented in the 2nd international salinity forum: Salinity, Water and Society–Global Issues, Local Action, Australia. Adelaide Convention Centre Adelaide, South Australia, 31 March – 3 April.

Rosegrant, M.W. and Cline, S.A. 2003. Global food security: Challenges and policies. *Science*, 302, 1917–1919.

Rosegrant, M.W., C. Ringler, T., Benson, X.; Diao, D., Resnick, J., Thurlow, M. and Orden, D. 2008. Agriculture and Achieving the Millennium Development Goals; *World Bank Report No*. 32729-GLB; World Bank: Washington, DC, USA.

Sarwar, G.M. 2005. Impacts of Sea Level Rise on the Coastal Zone of Bangladesh. Unpublished Master's Thesis, Lund University, Lund.

Sattar, S.A. and Abedin, M.Z. 2012. "Option for coastal farmers of Bangladesh adapting to impacts of climate change". International Conference of Environment, Agriculture and Food sciences (ICEAFS), Phuket, Thailand.

Scharmerhom, J.R., Hunt, R.J.G. obbom, J. and Richard, N. 1988. Managing organization behaviourr. New York; John Wiley and sons.

Schipper, E.L.F. 2004. Exploring Adaptation to Climate Change: A Development Perspective. A thesis submitted to the School of Development Studies of the University of East Anglia in partial-fulfillment of the requirements for the Degree of Doctor of Philosophy.

Shahid, S. and Behrawan, H. 2008. "Drought risk assessment in the western part of Bangladesh". Natural Hazards, 46(3):91-413.

Sikder, M. T. 2010. The Impacts of Climate Change on the Coastal Belt of Bangladesh: An Investigation of Risks & Adaptations on Agricultural Sector. In: Proceedings of International Conference on Environmental Aspects of Bangladesh, Japan, September, Sapporo: Hokkaido University, pp. 26-28.

Smits, B., O. Pilifosova, I. Burton, B. Challenger, S. Huq, R. Klein, and Yohe, G. 2001. Climate Change 2001: Impacts, Adaptation and Vulnerability, contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK and New York.

Southworth, J., Pfeifer, R.A., Habeck, M., Randolph, J.C., Doering, O.C. and Rao, D.G. 2002. Sensitivity of winter wheat yields in the midwestern

United States to future changes in climate, climate variability, and CO2 fertilization. *Clim. Res.*, 22, 73–86.

Swearingen, W. and Bencherifa, A. 2000. An Assessment of the drougth hazard in Morocco. In Drought: A Global Assessment; Wilhite, D.A., Ed.; Routledge: London, UK, Volume 1, pp. 279–286.

Talukder, M.M.R. 2006. Adoption of Selected Rice Production Practices by The Farmers of CharLand of Gomoti River. Sher-E-Bangla Agricultural University, Dhaka, Bangladesh.

Tanwir, F., Saboor, A. and Nawaz, N. 2003. Soil Salinity and the Livelihood Strategies of Small Farmers: A Case Study in Faisalabad district, Punjab, Pakistan International Journal of Agricultural Biology, 5: 440-443.

Topping, M.S. and Scudder, G.G.E. 1977.Some physical and chemical features of saline lakes in central British Columbia. Syesis, 10:145-166.

Uddin, M.N. 2012. An Analysis of Farmers' Perception and Adaptation Strategies of Climate Change in Bangladesh. Master's Thesis, Humboldt University of Berlin, Berlin, Germany.

UNFCCC. 1992. "The Sahel in the face of climate change: a challenge for sustainable development", monthly bulletin, special issue of the Inter-State Committee for Drought Control in the Sahel.

Watson, R.T., Zinyowera, M.C. and Moss, R.H. 1996. Climate change 1995, Impacts, Adaptations, and Mitigation. Cambridge University Press, Cambridge.

Wikipedia. 2014. Effectiveness of Service Center. Revised on August 2014 from http://en.wikipedia.org/wiki/Effectiveness of service center

World Bank. 2000. "Bangladesh: Climate Change and Sustainable Development. Report No. 21104-BD", Rural Development Unit, South Asia Region, World Bank, Dhaka, pp. 95.

Yu, W., Alam, M., Hassan, A., Khan, A. S., Ruane, A. C., Rosenzweig, C., Major, D. C. and Thurlow, J. 2010. Climate change risk and food security in Bangladesh. Earth Scan, London.

APPENDIX-A

English Version of Interview Schedule

Department of Agricultural Extension and Information System

Sher-e-Bangla Agricultural University

Dhaka-1207

An interview schedule for a research study entitle

EFFECTIVENESS OF ADAPTATION STRATEGIES TO CLIMATE CHANGE AS PERCEIVED BY THE FARMERS OF NOAKHALI DISTRICT

Serial No…………

Respondent Name:

Village:

Union:

Upazila:

District:

Mobile No:

Please answer the following questions:

1. Age

What is your present age?................Years

2. Education

What is your level of education?

a) Illiterate………………………

b) Can sign only …………………

c) Have passed class……………..

d) I took non-formal education…………weeks/months/years

3. Family size

Please mention the number of your family member

a) Male……....

b) Female…….

Total…………

4. Farm size

Please state the following information

Type of land	**Farm area (in decimal /acre /hectare)**
(A). homestead Area (with pond)	
(B). own land under own cultivation	
(C). Given to others as borga	
(D). Taken from others as borga	
(E). Taken lease from others	
Total area= (A+B+1/2(C+D)+E)	

5. Annual family income

Please indicate your annual family income (in BDT)

Sl. No.	Source of income	of income (in BDT)
1.	Agriculture	
2.	Livestock (cattle, goat, etc.)	

3.	Poultry (duck, poultry, etc.)	
4.	Fisheries	
5.	Service	
6.	Business	
7.	Other (Please specify)	
Total		

6. Access of Extension Services

Please mention the extent of extension contact in the last year

Query	Extent of extension contact in the past year			
	No visit (0)	Once (1)	2 to 3 Times (2)	4 times and Above (3)
Extension officers (Agriculture) visit to farmers				
Extension officers (Fisheries) visit to farmers				
Extension officers (livestock) visit to farmers				
Farmers visit to extension officers				

7. Organizational participation

Please mention the nature of your participation:

Name of the organizations	Nature of participation			
	President/ Secretary (3)	Executive Member (2)	Ordinary Member (1)	Not Involved (0)
1. GO organized co-operative				
2. Youth club				
3. NGO organized co-operative				
4. Farmers' co-operative organized by themselves				
5. IPM club				
6. FFS				

8. Agricultural extension Media contact

Please indicate the extent of contact in following sources

Name of information sources	Extent of contact				
	Regularly (4)	Frequently (3)	Occasionally (2)	Rarely (1)	Not at all (0)
1. Contact/model farmers					
2. Social Worker					
3. SAAO					
4. NGO Worker					
5. Union / upazilla					

level Agricultural organization					
6. Agricultural program through mass media (radio/TV)					
7.Agricultural features In printing media (daily newspaper, leaflet, booklet, magazine etc)					

9. Knowledge on climate change

Please answer the following questions

Questions	Full Marks	Marks obtained
1. Have you ever heard about Climate Change?	2	
2. Which month does the temperature highest and lowest?	2	
3. What are the effects of temperature in agriculture?	2	
4. When does the rain fall highest?	2	
5. Why does flood occur?	2	
6. What is the effects of flood in agriculture?	2	
7. What is the effect of drought in agriculture?	2	
8. What is the effect of salinity in agriculture?	2	

10. Perception on climate change

*Are you aware of climate change?					
Increased rainfall	Decreased rainfall	Drought	Increased rainfall variability	Increased temperature	Flooding
*Over the last ten years, have you observed any changes relating to the weather?					
If yes, how did these impact in your agriculture?					
Crop failure	Less income	Migration or off farm income	Outbreak of pest		

11. Use of climate smart agricultural technologies

What climate smart technology are you used?					
Name of the practices and technologies	Adequately (4)	Moderately (3)	Occasionally (2)	Rarely (1)	Never (0)
Integrated farming system					
Homestead farming					
Legume crop/pulse crop					
Farm Yard manure					

Cultivation of flood resistant crop varieties					
Deep placement of guti urea					

12. Effectiveness of adaptation strategies to climate change

How effective the following adaptation strategies are	Highly effective (3)	Moderately effective (2)	Low effective (1)	Not at all effective (0)
1. Cultivating short duration crops				
2. Practicing crop rotation				
3. Practicing crop diversification				
4. Use of flood resistant variety				
5. Integrated farming system				
6. Cultivating long duration crops				
7. Use of salinity tolerant varieties				
8. Practicing intercropping				
9. Soil conservations techniques (Mulching, cover cropping, conservation tillage)				
10. Cultivation of vegetables on the floating bed				

Thank you very much for your cooperation

Date---------

____
Signature of the interviewer