EFFECTS OF CLIMATE CHANGE ON RURAL FARMERS` LIVELIHOOD

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CERTIFICATE

This is to certify that the thesis enlighten, **"EFFECTS OF CLIMATE CHANGE ON RURAL FARMERS'LIVELIHOOD"** submitted to the faculty of agriculture, Sher-e-Bangla Agricultural university, Dhaka in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURAL EXTENSION,** embodies the result of a piece of bona fide research work conducted by **KISHOR KUMAR PODDAR, Registration no. 09-03613** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

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

Dated:
Dhaka, Bangladesh

Dr. Mohummed Shofi Ullah Mazumder
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Dedicated To

My Beloved Parents

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The Author

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ABBREVIATION AND ACRONYMS

BBS Bangladesh Bureau of Statistics

DAE Department of Agricultural Extension

et al. All others

etc. et cetera, and the other

FAO Food and Agriculture Organization

IPCC Intergovernmental Panel on Climate Change

SAAO Sub-Assistant Agriculture Officer

SAU Sher-e-Bangla Agricultural University

SO Scientific Officer

SPSS Statistical Package for Social Science

* Significant of 10% level of probability

** Significant of 5% level of probability

*** Significant of 1% level of probability

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KISHOR KUMAR PODDAR

ABSTRACT

Bangladesh is vulnerable to disasters mainly due to her geographic location. The present study is concerned with the effects of climate change on rural farmers` livelihood in Bangladesh. The study carried out in Faridpur sadar upazila under Faridpur district. The objectives of the research were to describe the selected characteristics of the farmers, assess the effect of climate change among them and the contribution of the selected characteristics farmers to the changes in the indicators of effect of the farmers in study group. The effect was measured by various dimension with different categories and also t-test value taking both study and control group with the minimizing spill-over effects. Data were collected from the 92 test respondents selected from the intervention area (6 study villages) considering those who were affected to climate change. On the other hand, data were collected from 30 control respondents selected from the two control villages in purposive random sampling method considering those who were not affected to the climate change effects. The basic right as changes in nutrition consumption, changes in body weight, changes in clothe value, changes in housing condition, changes in sources of drinking water, changes in level of education, changes in treatment, and quality of life as changes in poverty level by the respondents were observed from 2013 to 2016 in case of both study and control group to measure the effects. It indicated that changes in body weight and changes in housing condition showed significant difference between study and control group. It may be enlightened that climate change has commencing role in changing different dimension of livelihood condition of the study group.

CHAPTER I

INTRODUCTION

1.1 General Background

Climate is generally or average conditions of a certain region, including temperature, rainfall and wind. On earth climate is most affected by latitude, the tilt of the earth`axis, the movement of the earth` wind belts, the difference in temperature of land and sea, and topography. Climate change may refer to a change in average weather conditions, or in the time variation of weather around longer-term average conditions. Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have also been identified as significant causes of recent climate change, often referred to as "global warming". Glantz (2010) Climate change is defined as any change in global temperatures and precipitation over a period of time due to natural variability or as a result of human activity**.** It is the mother of all environmental changes. Nasreen (2012) shows that climate change induced disasters affect both women and men but the burden of coping with disasters falls heavily on women.

The climate of Bangladesh can be characterized by high temperatures, heavy rainfall, high humidity, and fairly marked three seasonal variations like hot summer, shrinking winter and medium to heavy rains during the rainy season. In general, maximum summer temperatures range between 38 and 41°C (100.4 and 105.8°F). April is the hottest month in most parts of the country. January is the coolest month, when the average temperature for most of the country is 16–20°C (61–68°F) during the day and around 10°C (50°F) at night. According to IPCC (2007) due to climate change effect sea level in the coastal region of Bangladesh has been predicted to rise up to 80 cm by 2100. Climate change in Bangladesh has become a threat to the livelihoods of rural farmers and agricultural workers.

Livelihood is a means of making a living. It encompasses people's capabilities, assets, income and activities required to secure the necessities of life. A livelihood is sustainable when it enables people to cope with and recover from shocks and stresses (such as natural disasters and economic or social upheavals) and enhance their well-being and that of future generations without undermining the natural environment or resource base.

Rural areas are highly vulnerable to climate change, since people there depend heavily on natural resources such as local water supplies and agricultural land. In fact, about 70% of the population in developing countries lives in rural areas, where agriculture is their main source of livelihood (IPCC 2007). Livelihoods have been increasingly affected by climate variability and changes, Olsson *et al.* (2014) have affirmed their adverse impacts on people's health and safety, particularly those of poor people in poor countries.

It has experienced frequent natural and human induced disasters including sea level rise, cyclones, storm surge, flooding, land erosion, water logging, and salinity intrusion in soil and water because of extreme variability of climate change which cause loss of life, damage the infrastructure and economic assets, decrease of income, social security, inadequate of food, sanitation, pure drinking water, health care, education and adversely affect the livelihoods of rural people especially the poor, vulnerable and destitute living in environmentally fragile areas. The combination of a high level of poverty, and a depleted ecological system increase the country's vulnerability to the impacts of climate change (Khan, *et al*., 2010). It affects all segments of population, there are gender variations to vulnerability and elasticity during disasters. In this context, the study has been conducted to assess the climate change effect on rural farmers` livelihood of Bangladesh.

1.2 Statement of the Problem

Bangladesh is one of the most climate vulnerable countries in the world. Located between the Himalayas and the Bay of Bengal, the country is very prone to natural disasters. Climate change accelerated the intensity and frequency of occurrences of salinity, storms, drought, irregular rainfall, high temperature, flash floods, etc. that resulted from global warming. Due to climate change, farmers` livelihood affected adversely. The marginal people and poor are affected mainly by salinity and flood in Bangladesh. More intense and more frequent extreme weather events such as flood and droughts, high temperature increasing abnormalities in rainy season patterns and rising sea levels are already having instant effect on livelihood condition through reducing food production, decreasing human health and livelihood assets and opportunities, in both urban and rural areas of Bangladesh.

In the context of the above circumstances the researcher intended to find out the answers of the following research questions

1. What are the socio economic profiles of the rural farmers?

2. What are the effects of climate change on rural farmers` livelihood?

3. What are the contributions of the selected characteristics of the rural farmers to the effects of climate change on their livelihood?

1.3 Specific Objectives

In order to answer the above the questions the following specific objectives were formulated that supposed provide proper direction and to the study

i. To describe the socio-economic profile of the rural farmer

ii. To ascertain the effects of climate change on rural farmers` livelihood

iii. To explore the level of contribution of the selected characteristics of the rural farmers to the effects of climate change on their livelihood

1.4 Justification of the Study

Bangladesh is an innocent victim of climate change. Rural people living in the marginalized lands pursuing nature dependant livelihoods are facing barriers and constraints earning well being in the changing climate. The main focus of the study is to ascertain the climate change effect on rural farmers` livelihood. Climate change is forcing people to take diversified occupation to maintain their livelihood. Livelihood leads on food, clothes, housing condition, education, and medicare of the rural farmers of Bangladesh. Rural farmers of Bangladesh are continuously fighting with effects of climate change on livelihood. Extreme weather events not only limits livelihood persuasion during the event but also has the potential to erode household assets, like destruction of house, trees and even it may kill people or injure them. The household assets including human health and motivation, houses, trees, other physical assets, livelihood tools and equipments are destroyed in the extreme weather events and thus reducing capitals to pursue livelihoods and accordingly reducing resilience to extreme conditions (OXFAM, 2009).

The findings of this research will be acceptable in the selected area. The socio-economic condition of the rural farmers will be visible due to climate change through this research. Thus, the findings of the study will have great importance to the livelihood condition of Bangladesh

1.5 Assumption of the Study

An assumption is the supposition that an apparent fact or principle is true in the light of the available evidence (Goode and Hatt,1952). The researcher had taken the following assumptions into consideration during carrying out the study:

1. The respondents had enough capability to provide proper response of the question furnished in the interview schedule.
2. The respondents were provided views and opinions included in the sample representative of the whole population of the study area.
3. The items, questions and scale of measurement of the variables were reasonably authentic to present the actual condition of the respondents.
4. The findings of the study would give clear concept of the effect of climate change.
5. The data furnished by the respondents were free from bias.
6. The researcher was capable to adjust with the social and cultural environment of the study area. So, the respondents could provide their information correctly.

1.6 Limitations of the Study

It is necessary to impose certain limitations to make the research manageable and meaningful.

Thus, during the entire research the most challenging limitations were:

1. The research was confined to the 8 villages of Faridpur sadar upazila under Faridpur district.
2. Data were collected from a small group of respondents taken as the sample of the study because of time and resource constrains.
3. The researcher had to face many difficulties during data collection. All the data were recall data. So, the researcher had to depend on the data as given by the respondents.
4. Only eleven socio-economic characteristics of the farmers were selected as independent variables.
5. The researcher had to face many difficulties in conducting the research as ascertainment of effect is very complex especially in case of measuring the climate change effect of rural farmers` livelihood as it has slow changing nature.

CHAPTER II

REVIEW OF LITERATURE

Bangladesh is one of the most vulnerable country in the world. The main reasons for its vulnerability are due to (i) its location in the tropics, (ii) the dominance of floodplains, (iii) its low elevation from sea level and (iv) its high population density. (MOEF 2005; DOE 2007; Shahid & Behrawan 2008; Pouliotte *et al.* 2009; Hossain & Deb 2011). The geographical location of the country has made the people very much depended on the environment and vulnerable to natural disasters. According to IPCC (2007), sea level in the coastal region of Bangladesh has been predicted to rise up to 80 cm by 2100. As people of Bangladesh will be affected by climate change directly or indirectly in all regions. Climate change is the biggest global health threat of the 21st century and increasingly recognized as a public health priority (WHO, 2008; Lancet, 2011, Young *et al*., 2002; Yongyut *et al*., 2009).

Climate change is defined as any change in global temperatures and precipitation over a period of time due to natural variability or as a result of human activity**.** It is the mother of all environmental changes (Glantz, 2010). Changes in climate generally involve changes in two major climate variables: temperature and rainfall. It`s leads to increased temperatures, changing rainfall patterns and amounts, and a higher frequency and intensity of extreme climate events such as floods, cyclone, droughts, and heat wave (IPCC 2007; Tirado *et al*. 2010; Roudier *et al.* 2011). According to the International Panel for Climate Change (2007), an increase in the average global temperature will lead to changes in precipitation, and atmospheric moisture, sea level rise due to the changes in atmospheric circulation, and increases in evaporation, and water vapor.

2.1 Climate Change Effects on Natural Hazards

The effects of climate change are heterogeneous and region specific. For example, a rise in temperature with reduced and more variable rainfall has already affected the natural and physical ecosystems of Bangladesh, predominantly the northwest with its recurrent droughts and the southwest with rising soil salinity (Ahsan *et al*. 2011).

The temperature is rising all over the world due to global warming as a result of gas emission and anthropogenic activities. The ice-sheets of the Antarctica and glaciers of the Himalayas are melting quickly due to increased temperature. Being situated at the base of the Himalayas, Bangladesh suffers from various natural calamities which impacted negatively on fish and fisheries of the country (Rahman , 2008). Global average temperature has warmed and cooled many times in the twentieth century and is likely to rise constantly in the future mainly due to an increased concentration of Green House Gas (GHG) in the atmosphere. Without GHGs, the earth surface temperature was raised by 0.740 and 0.180 (1.33± 6.0F) during 20^{th} century and scientists estimated that it could increase as much as 6.40C average in the 21th century (UNFCC, 2007). Edward H. Allison (2004) predicted that during the next 50 years, temperatures in Bangladesh are predicted to increase by 1.1° C during the flood season and by 1.8° C during the dry season. The effect of temperature on agriculture is complex due to a number of interplaying factors: However, while higher Carbon-dioxide levels and solar radiation theoretically can increase food production, heat stress, shorter growing seasons and higher evapo-transpiration resulting in soil moisture levels being lowered counteract the former influences leading to overall lower production of most foodstuffs such as most varieties of rice, wheat and potato. Reductions in yield could potentially be as high as a 17-28% decline for rice and 31-68% decline in wheat production (Karim *et al*, 1999). So 8% smaller rice harvests and a 32% smaller wheat harvests by 2050 now look likely (IPCC in Reid *et al*, 2007).

Alam *et al*. (2009) found that the highest monthly rainfall (362.4mm) was occurred in July 2007 and no rain in December 2006 in the Basantapur beel under Natore district. The highest rainy day was recorded in 26th July, 2007. According to Quadir, D. A. (2003) the annual profile of monsoon precipitation occurs during July and August. Sylhet shows very high precipitation and Rajshahi a relatively monsoon precipitation compared to the other stations. It was clear that the northeastern and southeastern part of Bangladesh gets high precipitation than other western part. Changes in rainfall can affect soil erosion rates and soil moisture, both of which are important for crop yields. The IPCC predicts that precipitation will increase in high latitudes, and decrease in most subtropical land regions some by as much as about 20 percent. (IPCC, 2007). A holistic perspective on changing rainfall-driven flood risk is provided for the late 20th and early 21st centuries Kundzewicz, *et al*., (2014).

Sea levels continue to rise due to climate change. It has already been observed that the mean annual water level in the south-west region is increasing by 5.5 millimetres per year (Rahman *et al*., 2011). The effects of sea level rise go beyond the gradual inundation of coastal land areas to include the intrusion of saline water into freshwater rivers and aquifers and the intensification of impacts from cyclones and storm surges. As sea levels rise, saline water will intrude directly into rivers and streams, advancing not only as a function of the water level but also according to changes in river discharge that may result from climate change (Islam, 2004). 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). In Khulna, Bagerhat and Satkhira districts of southwest region of Bangladesh found that the suitable area for transplanted Aman rice cultivation will reduce from 88% to 60% with 32 cm rise in sea level and 12% with an 88 cm rise in sea level (CEGIS, 2005)

The inundation of land areas through sea-level rise and increased precipitation is not the only worrisome effect of global climate change. 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). Agrawala *et al*. (2003) studied Development and Climate Change in Bangladesh and they observed south-west and north-west regions were particularly susceptible to drought. Islam *et al.* (2002) described that ascent and descent of severity of drought mostly depended on fluctuation in rainfall distribution. Higher fluctuation was responsible for higher drought; while less varied distribution causes somewhat lower drought. Rice is the main crop in Bangladesh covering 80% of the total cultivated area of the country and is important both in terms of the nutrition and income it gives to the people of Bangladesh. However, drought can affect the rice crop in three different seasons: Firstly Pre-Karif droughts in March and April prevent land preparation and ploughing, delaying the planting of crops during the monsoon season; secondly Karif droughts in July and August delay the transplantation of aman rice in highland and medium high areas, as well as in Modhupur Tract and western Rajshahi Division, while Karif droughts in September and October reduce yields of both broadcast and transplanted aman rice and delay sowing of pulses and potatoes in the west of Rajshahi Division and along major rivers.

Meanwhile Rabi droughts in winter months affect boro rice, wheat and other crops grown in the dry season, most severely in the Barind Tract and west of Khulna division, severely in areas of the Chittagong Hilltracts, southern Sylhet Division and other parts of Rajshahi Division and slightly in remaining areas of western, northern and central Bangladesh (Selvaraju *et al*, 2006; Agricultural Research Council, 2005).

Flooding is a regular occurrence in Bangladesh. On average, nearly one quarter of Bangladesh is flooded each year (Ahmed and Mirza, 2000). Bangladesh experiences four types of floods: flash floods, rain floods (due to poor drainage), monsoon floods, and coastal floods (IPCC, 2012: 254). Das (2009) conducted an analysis on the adverse effects of flood. He concluded that, floods can cause enormous damage, destroying standing crops, houses, lives and livestock. Floods also deposit layers of sand on existing crops, which can cause irreversible harm. Climate change is believed to affect Bangladesh river system badly as the melting of Himalayan glaciers will result in higher flow of water in the river, which in turn will result into flood and water logging in huge urban areas. (Daily Star, 2011). Food supply will be another problem caused by river floods; for the 1998 flood reduced agricultural production by 45% (Ahmed, 2006). It will also affect on rural incomes, where agriculture still employs 70% of the population. High-yielding aman rice varieties are very easily destroyed by floods as they 34 are unable to grow fast enough to keep up with the increasing depth of flood water and if the flood water rises faster than 4-5cm deep per day other rice varieties will also be lost. Monsoon vegetables also die when under water (Karim *et al*, 1999). The quality of floodwater may also be reducing, threatening rice production, including the bumper harvests of boro rice after flooding. For instead of depositing silt, that boosts soil fertility, floods are now carrying more sands which often cover whole fields making them useless for agriculture (Chowdhury, 2002).

Bangladesh's vulnerability to cyclones is exacerbated by the shape of the coastline and low, flat terrain combined with high population density and poorly built infrastructure (World Bank, 2000). In fact, 60 percent of the cyclone-related deaths that occurred worldwide between 1980 and 2000 were in Bangladesh (Nicholls *et al*., 2007). In 1991, a devastating cyclone hit the coastal region, accompanied by a tidal bore, which was between five and eight metres high with winds of up to 240 kilometres per hour (Paul, 2009).

Ali (2003) showed that Bangladesh currently has extreme vulnerability to cyclones, both on account of its somewhat unique location and topography (that creates an inverted funnel effect), and because of the low (though growing) capacity of its society and institutions to cope with such extreme events. A cyclone in 1970 resulted in close to 300,000 deaths, and another, in 1991 led to the loss of 138,000 lives, although in recent years greater success in disaster management has significantly reduced the lives lost (World Bank, 2000).

FAO (2008) reported that fisheries, aquaculture and fish habitats are at risk in the developing world. For example, saltwater intrusion into the Mekong delta from sea level rise and reduced flows threatens the viability of the aquaculture industry for catfish in the delta, which currently produces 1 million tons valued at $1 billion a year and provides over 150,000 livelihood opportunities for mostly rural women, unless saltwater tolerant strains can be developed. About 6.0 million people are already exposed to high salinity (>5 ppt), but due to climate change this is expected to increase to 13.6 million in year 2050 and 14.8 million in 2080 and the population in Khulna, Satkhira and Bagerhat will be most affected (Mohal and Hossain, 2007). This will be due to the boundary to the area of high salinity „the salinity front“ moving gradually north by 40 km (Mohal *et al.*, 2006) to 60 km (NAPA, 2005a) inland from the coast by 2100. But as well as making household water supply problematic, salinity negatively affects agricultural production.

Livelihoods can be defined as the bundle of different types of assets, abilities and activities that enable a person or household to survive (FAO, 2003). These assets include physical assets such as infrastructure and household items; financial assets such as stocks of money, savings and pensions; natural assets such as natural resources; social assets, which are based on the cohesiveness of people and societies; and human assets, which depend on the status of individuals and can involve education and skill (FAO, 2003).

Climate change will affect rural livelihoods, or "the capabilities, assets (stores, resources, claims, and access) and activities required for a means of living" (Chambers and Conway, 1992). Many, though by no means all, rural livelihoods are dependent on natural resources (e.g. agriculture, fishing, and forestry), and their availability will vary in a changing climate. This will have effects on human security and wellbeing (Kumssa and Jones, 2010). Some livelihoods are directly climate-sensitive, such as rainfed smallholder agriculture, seasonal employment in agriculture (e.g. tea, coffee, sugar), fishing, pastoralism, and tourism. Climate change also affects households dependent on informal livelihoods or wage labor in poor urban settlements, directly through unsafe settlement structures or indirectly through rises in food prices or migration.

2.2 Climate Change Effect on affected farmers` livelihood

Climate change has on natural systems threatens the livelihoods, food intake and health of poor people. Climate change will mean that many semi-arid parts of the developing world will become even hotter and drier, with even less predictable rainfall. Climate-induced changes to crop yields (Rahman and Mallick, 2011). Various nature and climate change shocks affect coastal livelihoods differently and govern vulnerability and adaptive capacity. Some of the disasters are fast in coastal areas in terms of its sudden affects to coastal life and livelihoods like tropical cyclone and storm surges, where others are slow in events like salinity or inundation increase, but these have long-term impacts on social and economic functions (Nicholls *et al*., 2007). The adverse impacts of weather events and climate increasingly threaten and erode basic needs, capabilities, and rights, particularly among poor and disenfranchised people, in turn reshaping their livelihoods (UNDP, 2007; Leary *et al.*, 2008; Adger, 2010; Quinn *et al.*, 2011).

Weather events and climate affect the lives and livelihoods of millions of poor people (Field *et al.*, 2012). Even minor changes in precipitation amount or temporal distribution, short periods of extreme temperatures, or localized strong winds can harm livelihoods (Douglas *et al.*, 2008; Ostfeld, 2009; Midgley and Thuiller, 2011; Bele *et al.*, 2013).

Climatic and other stressors affect livelihoods at different scales: spatial (e.g., village, nation) or temporal (e.g., annual, multi-annual). Both direct and indirect impacts are often amplified or weakened at different levels. Global or regional processes generate a variety of stressors, typically mediated by cross-level institutions, that result in locally experienced shocks (Reid and Vogel, 2006; Thomas *et al.*, 2007; Paavola, 2008; Pouliotte *et al.*, 2009) Poor people generally depend more on ecosystem services and products for their livelihoods than wealthy people. The means by which a poor family gains an income and meets its basic needs are often met by multiple livelihood activities. They are therefore severely affected when the environment is degraded or their access to it restricted (NAPA, 2005b).

The tropical cyclone of 2007 caused loss of valuable mangroves, social and physical resources and livelihood bases that post-disaster recovery has not yet been possible in Bangladesh (Mallick *et al.*, 2011). With changing frequency of cyclonic wind and storm surges and inundation coastal agriculture and domestic fisheries and open fishing have been highly affected which are significant livelihoods sources to majority coastal people. Salinity level is slowly increasing over the time and causing serious threats to traditional agriculture farming and mangrove ecosystems (Moniruzzaman, 2012). Changes in temperature and rainfall may change the geographic range of vector-borne diseases such as malaria and dengue fever, exposing new populations to these diseases. Young children as well as pregnant women and their unborn children are especially vulnerable to malaria. Malaria contributes to prenatal mortality, low birth weight, and maternal anemia (WHO, 2002).

Thomas *et al.* (2013) Bangladesh is extremely vulnerable to the impact of climate change because it is a low-lying, flat country subject to both riverine flooding and sea level rise, and because a large portion of its population is dependent on agriculture for its livelihood. The effect of the climate changes on farmers' livelihoods, poverty and family food security is significant. A gradual decline in yields affects the viability of agriculture as a dependable base for subsistence and income. An increase in extreme events causes yields to fall abruptly or total loss of crops (IFAD, 2013). Seasonal variations have also diverse influence on fishing, hatchery operations, fish production and livelihoods of a wide range of people (Haque, 2007).

2.3 Research Gap of the Study

There are lots of researches on climate change indicator but very few researches was so far conducted to ascertain the climate change effects on rural farmers` livelihood. Moreover very few researchers carried out to assess the effects of climate change on rural farmers` livelihood considering study and control group to compare between the groups. Yet there was no research work in Bangladesh where minimized spill-over effect of climate change on livelihood. Only a few researchers followed systematic method of effect analysis to ascertain the effect of climate change. This was a research gap of the study. Hence, the researcher carried out the present study to ascertain the effect of climate change among the farmers` livelihood of sadar upazila under Faridpur dristrict.

2.4 The Conceptual Framework of the Study

The contribution between the experimental variables and the main focus of the study can be clearly delineated with the help of conceptual framework of the study. The researcher was made an attempt to ascertain the climate change effects on rural farmers` livelihood of sadar upazila under Faridpur dristrict as the main focus of the study. It was conceptualized in the research that the climate change effect on rural farmers may be influenced and affected by the interacting forces of many socio-economic and others characteristics of the farmers. To make the process conspicuously interpretable a conceptual framework has been presented in a schematic diagram (Fig 2.1).

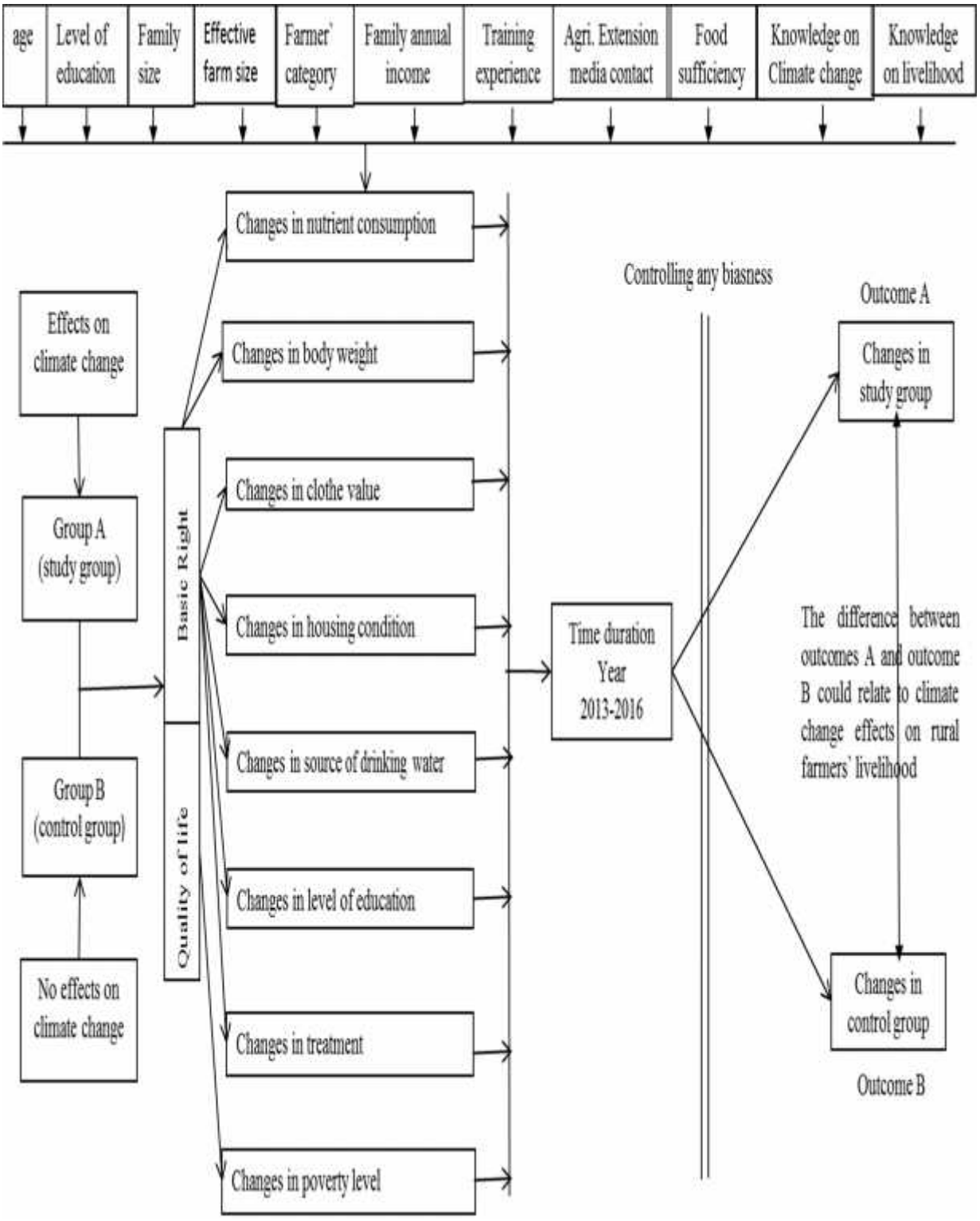

Figure 2.1: The conceptual framework

CHAPTER III

MATERIALS AND METHODS

A researcher should do work very carefully in formulating methods and procedures. Methodology gives clear direction to a researcher about his works and activities during the whole period of the study. Appropriate procedures for collecting data were taken by the researcher to collect valid and reliable information. Methods of analysis were appropriate to arrive at correct conclusion. Various methods, tools and techniques were used during different stages of this research work and compilation of data. The purpose of this chapter was to describe the setting, methods and procedures used in conducting this study.

3.1 Locale of the Study

The study was conducted at Faridpur sadar upazila under Faridpur district of Bangladesh where people were affected by climate change. Three unions of Faridpur sadar upazila namely Aliabad, Digrirchar and Northchanel were selected for study group and Ambikapur union of Faridpur sadar upazila was selected for control group. Six villages were finally selected from the selected three unions by taking two from each union for study group. Two villages were finally selected through random technique from the selected union for control group. Climate change affected people were considered as a study group and climate change non affected people were considered as a control group. A purpose sampling procedure was followed to selected one district from all over the Bangladesh. A map of Faridpur district showing the Sadar upazilla and a map of Faridpur sadar upazila showing the union of the study area are presented in Fig. 3.1 & Fig. 3.2.

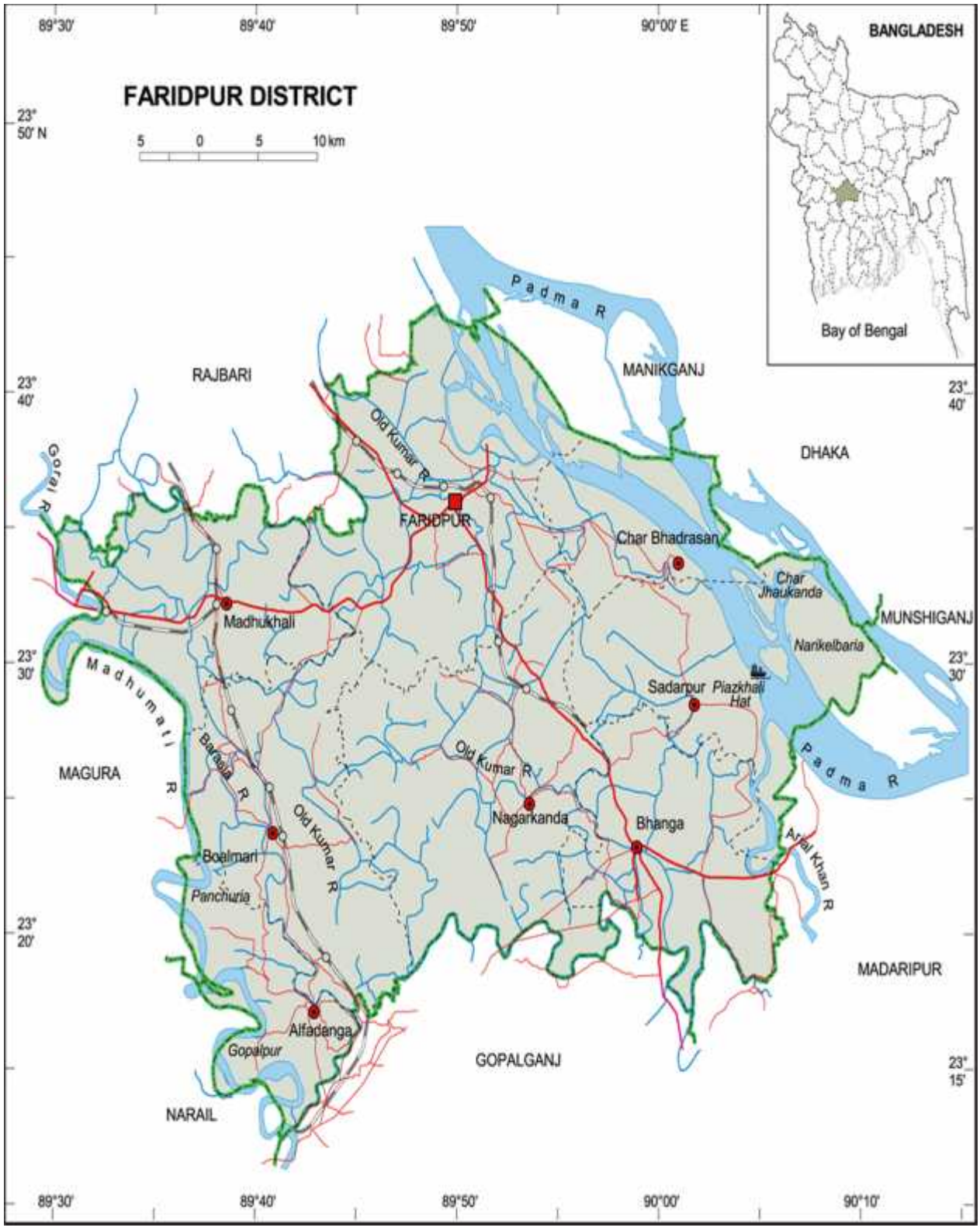

Figure 3.1: Map of Faridpur district

Figure 3.2: Map of Faridpur sadar upazilla

3.2 Population and sampling procedure

A random sampling method was used to select one upazila under climate change affected area. Random sampling procedure was also used to select 6 villages from three selected unions. The total number of individuals under study was estimated to be 1910 in selected areas. To determine the sample size, Yamane (1967) formula was used.

The formula is

$$n = \frac{z^2 P\,(1-P) N}{z^2 P\,(1-P) + N\,(e)^2}$$

Where, n = sample size, N = population size, e = the level of precision (10%), z = the value of the standard normal variable given the chosen confidence level (e.g. z= 1.96 with a CL = 95%), p = the proportion or degree of variability = 50%

Thus, 92 respondents constituted the sample size of the study from the study respondents. The test respondents were selected by using purposive random sampling procedure. Thus the sample size for Char komlapur, Bil mahmudpur, Aiz uddin matubborer dangi, Vangi dangi, Yousuf matubborer dangi, Hazrat matubborer dangi were 27, 30, 10, 11, 6 and 8 respectively.

An earlier study by Pitt and Khandker (1998) showed that endogenecity (program placement and program participation) is a serious issue ; results could be misleading if endogenecity is not taken into account during estimation. To reduce spill-over effect i.e to avoid the problem of information flow from climate change affected farmers to climate change non affected farmers, study and control group were selected from separate village. Six villages namely Char komlapur, Bil mahmudpur, Aiz uddin matubborer dangi, Vangi dangi, Yousuf matubborer dangi, Hazrat matubborer dangi were selected for study group and 2 villages namely East vasan char and Ramkanto pur was selected for control group. The study and control group villages were kept separate with a remarkable distance of about 3-5 km (Mazumder, 2015; Hulme,

2000), 30 control respondents (not affected to climate change) were selected in 1:3 ratio of the test respondents following two way stratified random sampling where education and annual family income was the strata (Mazumder, 2015; Haque, 2002). Education was categorized into three groups: group 1 (denoted E1), respondents are illiterate or can sign only ; and group 2 (denoted E2), respondents have primary education ; and group 3 (denoted E3), respondents have secondary or higher education . Similarly, Family annual income was also categorized into three groups: group 1 (denoted H1), low -income group (income up to BDT 60000 per year); group 2 (denoted H2), medium- income group (income BDT 60001 to BDT 100000 per year) ; and group 3 (denoted H3), high–income group (income BDT 100001 and above per year) (Mazumder, 2015). Two-way stratified random data is shown in table 3.2. the total sample size was 92. The control farmers were selected by using purposive random sampling procedure. Ten percent of the population was selected through proportionate random sampling procedure to include in the reserve list for both study and control group.

Table 3.1 Distribution of population, sample and reserve list for the study

Village		Population sample		Reserve list
		Population (No of respondents)	Sample (No of respondents)	
Study village	Char komlapur	**570**	**27**	**2**
	Bil mahmudpur	**630**	**30**	**3**
	Aiz uddin matubborer dangi	**210**	**10**	**1**
	Vangi dangi	**235**	**11**	**1**
	Yousuf matubborer dangi	**120**	**6**	**1**
	Hazrat matubborer dangi	**145**	**8**	**1**
	Sub total	**1910**	**92**	**9**
Control village	East vasan char	**147**	**17**	**2**
	Ramkanto pur	**115**	**13**	**1**
	Sub total	**262**	**30**	**3**
	Grand total	**2172**	**122**	**15**

Table 3.2 Two-way stratified random data of the study group and control group respondents based on their level of education and annual family income as strata

Category	% of respondents	No. of respondents from study group	No. of respondents from control group
E1 ×H1	3.26	3	1
E1× H2	17.39	16	6
E1× H3	9.78	9	3
E2× H1	3.26	3	1
E2× H2	23.91	22	7
E2× H3	5.43	5	2
E3× H1	4.34	4	1
E3× H2	28.29	26	8
E3× H3	4.34	4	1
Total	100	92	30

Source: (Mazumder, 2015)

3.3 Data Collection Instrument

An interview schedule was prepared keeping in mind the objectives of the study. Direct questions and different scales were kept in the questionnaire to get the desired information. After preparation of data collection instrument pre-test was conducted on 15% of the sample i.e. 17 respondents (13 climate change affected farmers and 4 climate change non affected farmers) from the population but excluded from the sample. Necessary correction, addition and alternation were made in the interview schedule based on the pre-test. After correction, the interview schedule was finalized for the data collection.

3.4 Data Collection

Data were gathered using a semi-structured interview schedule. Data were collected by the researcher himself through face to face interview of the selected farmers. The data were collected from November 03, 2015 to January 20, 2016.

3.5 Variables of the Study

In a descriptive research, the selection and measurement of variables constitute an important task. The hypothesis of a research, constructed properly, contains at least two important variables viz., independent and dependent variables. A dependent variable is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variable. An independent variable is that factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. To determine the condition of rural farmer`s livelihood was the main focus of this study. Reasonably, it constituted the dependent variable. A variety of factors might have influence to the effect of climate change. It is very difficult to deal with all the factors in a single study. It was therefore, necessary to limit the independent variables. As the study was conducted to farmer`s benefit , so the characteristics of rural people in some cases were different for the selection of independent variables, the researcher went through the past studies as far as available and also discussed with teachers, experts, supervisor. The researcher carefully considered the various characteristics of the rural farmers as independent variables. These were: age, education, family size, effective farm size, Farmers` category, family annual income, agricultural extension media contact, food sufficiency, training experiences, knowledge on climate change and knowledge on livelihood also as independent variable. The dependent variable was treated as climate change effects on rural farmer`s livelihood of this study.

3.6 Measurement of Independent Variables

For conducting the study in accordance with the objectives it was necessary to measure the independent variables. The independent variables were age, education, family size, effective farm size, Farmers` category, family annual income, agricultural extension media contact, food sufficiency, training experiences, knowledge on climate change and knowledge on livelihood. Procedures for measuring these variables are described below:

3.6.1 Age

The age of respondent farmers was measured by counting the actual years from his/her birth to the time of interview on the basis of his/her statement. It was measured in terms of complete years on the basis of his response. No fractional year was considered for the study. This variable appears in item number one (1) in the interview schedule as presented in Appendix-A. Based on the available information cited by the respondents, they were classified into three categories.

Categories	**Years**
Young age	≤ 35
Middle age	36 to 50
Old age	≥ 50

3.6.2 Level of education

The education level of a rural farmer was measured by the number of years of schooling completed in an educational institution. A score of one (1) was given for each year of schooling completed. If a rural farmer didn't know how to read and write, his education score was zero, while a score of 0.5 was given to a rural farmer who could sign his name only. If a farmer did not go to school but took non-formal education, his educational qualification was determined as the equivalent to a formal school student.

According to Reza (2007) the level of education of a respondent were classified as:

Categories	**score**
Illiterate	0
Can sign only	.5
Primary education	1-5
Secondary education	6-10
Above secondary education	≥11

3.6.3 Family size

The family size of the respondents was measured by the total number of members in the family of a respondent. The family members included the respondent himself/herself, his/her spouse, children and other dependents who jointly live and eat together during interview time. It was measured by computing total number of member in the family. One score was given for each family member. According to Haque (2002) based on their total farm size, the respondents were classified into three categories:

Categories	Family members
Small family	1-4
Medium family	5-8
Large family	Above 8

3.6.4 Effective farm size

Farm size of the respondents farmer was measured using the following formula. The farm size was expressed in hectare.

Farm size, A= a+b+c+1/2d+e

Where,

a = Homestead area b= Own cultivation area

c= Cultivated area leased in d =Area under share cropping

e= Pond area

Total farm size of each respondents was categorized into 4 types (Islam, 2007). The farmers who had land bellow 0.20 hectare were considered as marginal farmer. The farmers who had land between >0.20 to 1.00 hectare were considered as small farmers ; the farmers who had the land between >1.00 acres to 3.00 acres were considered as medium farmers ; the farmers who had the land above 3.00 hectare were considered as large farmers.

Scores assigned for respondents farmer in respect of land are given bellow:

Categories	**Scores**
Marginal (up to .20 hec)	1
Small (>0.20 to 1.00 hec)	2
Medium (>1.00 to 3.00 hec)	3
Large (above 3.00 hec)	4

3.6.5 Farmers` category

An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption (Ray, 1996). According to Rogers (1962) the respondents are generally categorized into five categories on the basis of innovativeness: innovators, early adopters, early majority, late majority and laggards. In this research, Farmers` category was measured on the basis of innovativeness of the respondents. Innovator (Willing to take risk, have the highest social status, have financial liquidity), Early adopter (Highest degree of opinion leadership, higher social status, financial liquidity, advanced education), Early majority (Adopt an innovation after innovator and early adopter, have above average social status, seldom hold position of opinion leadership), Late majority (Adopt an innovation after the average participant, have below average social status, little financial liquidity, little opinion leadership), Laggard (show little to no opinion leadership, tend to be focused on tradition, lowest social status, lowest financial liquidity). Scores assigned for respondents farmer in respect of innovativeness are given bellow:

Categories	**scores**
Innovator	5
Early adopter	4
Early majority	3
Late majority	2
Laggard	1

3.6.6 Annual family income

Annual family income of a respondent was measured in thousand taka on the basis of total yearly earnings from agriculture and other sources of his family. The method of ascertaining income from agriculture and other sources like service, business etc. was determined by asking direct question. Yearly earnings of all the members of the family from agriculture and other sources were added together to calculate the actual amount of Annual family income of the respondent by using following formula.

Total annual income = Agricultural income + Income from livestock / fisheries + Income from non agricultural source

A score of 1 (one) were assigned for the income of one thousand taka.

Based on their total annual family income, the respondents were classified into three categories as low income, medium income and high income.

3.6.7 Training Experience

Training experience was measured by total number of days of agricultural training received by the respondents` farmer in his/her life. One score was assigned for each day of training received by the respondent. According to training experience the respondents` farmer were categorized as no experience, low experience, medium experience, high experience

3.6.8 Agricultural extension media contact

The agricultural extension media contact of a respondent was measured on the basis of the response of the media contact user farmers against the extent of his using of selected eight media by putting tick mark against any one of the five responses- regularly, frequently, occasionally, rarely, not at all. The responses were scored as 4, 3, 2, 1 and 0 respectively. The use of agricultural extension media contact score of the respondents ranged from 0 to 32 where, 0 indicates no use and 32 indicates very high use.

Based on their extension media contact, the respondents were classified into four categories as no contact, low contact, medium contact, high contact.

3.6.9 Food sufficiency

Food sufficiency was measured by considering the reservation of food for future. If he reserves food for 1 year then he was considered as high storage and he reserves for 3 meals per day then he was considered as low storage. According to food sufficiency, food availability of respondents were classified as low storage, medium storage and high storage.

3.6.10 Knowledge on climate change

Knowledge of the farmers towards climate change was measured on 10 basic open ended questions. Each question contains 2 marks. Knowledge of rural 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 20, where zero (0) indicating no knowledge and 20 indicate sound knowledge. Based on their climate change knowledge, the respondents were classified into four categories as no knowledge, low knowledge, medium knowledge and high knowledge.

3.6.11 Knowledge on livelihood

Knowledge of the farmers` livelihood was measured on 10 basic open ended question. Each question contains 2 marks. Knowledge of livelihood was determined by summing up the weights for their responses to all the ten statements. Thus knowledge of the farmers towards livelihood score of the respondents ranged from 0 to 20, where zero (0) indicating no knowledge and 20 indicate sound knowledge. Based on their livelihood knowledge, the respondents were classified into four categories as no knowledge, low knowledge, medium knowledge and high knowledge.

3.7 Measurement of Dependent Variable

The dependent variable was treated as climate change effects on rural farmer`s livelihood. Climate change effects on rural farmers` livelihood were measured by two selected dimension as basic right and quality of life. Basic rights had seven selected sub dimension viz. a) Changes in nutrition consumption, b) Changes in body weight, c) Changes in clothe value, d) Changes in housing condition, e) Changes in sources of drinking water, f) Changes in level of education, g) Changes in treatment and quality of life as Changes in poverty level. The data of the respondents was collected from 2013 and 2016.

1. Basic rights

a) Changes in nutrition consumption

Nutrition consumption of the respondents was measured in score on the basis of his daily consumption value during 2013 and 2016. One hundred cal. nutrition consumption value was assigned for score 1. According to the daily nutrition consumption, the changes in nutrition consumption of the study group respondents were classified into three categorized as low, medium and high nutrition consumption and then comparing with control group.

b) Changes in body weight

Body weight of the respondents was measured in score on the basis of his body weight during 2013 and 2016. 1kg body weight was assigned for score 1. The changes in body weight score of the study group respondents were classified into three categorized as low, medium and high body weight and then comparing with control group.

c) Changes in clothe value

The clothe value of respondents was measured in taka on the basis of his previous year using clothes during 2013 and 2016. One thousand taka was assigned for score 1. The changes in clothe value of study group was determined on the basis of changed clothe value score during 2013 and 2016.

The clothe value of the study group respondent was three categories as low changes, medium changes and high changes clothe value and then comparing with control group.

d) Changes in housing condition

The housing condition of respondents was measured in score. There were seven types housing in the study area as slum house, two thatch tin shade with bamboo and/or timber fence boundary, two thatch tin shade with tin fence boundary, four thatch tin shade with bamboo and/or timber fence boundary, four thatch tin shade with tin fence boundary, semi-pucca building, pucca building and assigned score were given as 1, 2, 3, 4, 5, 6 and 7 respectively. The change in housing condition was measured on the basis of change score of housing condition of the respondents during 2013 and 2016. The study group respondents were categorized into three categories as low housing condition, medium housing condition and high housing condition and then comparing with control group.

e) Changes in sources of drinking water

The sources of drinking water of respondent were measured in score. There were three types of sources as direct tap water, boil water, deep/shallow/tube well water and assigned score was given as 1, 2, 3 respectively. The changes in sources of drinking water were measured by changes in sources of drinking water score during 2013 and 2016 in study group. The respondents were three categories as low, medium and high changes in sources of drinking water and then comparing with control group.

f) Changes in level of education

The level of education was measured by the number of years of schooling completed in an educational institution. A score of one (1) was given for each year of schooling completed. If a rural farmer didn't know how to read and write, his education score was zero, while a score of 0.5 was given to a rural farmer who could sign his name only.

If a farmer did not go to school but took non-formal education, his knowledge status were determined as the equivalent to a formal school student. The changes in level of education score of the study group were three categorized as low education level, medium education level and high education level and then comparing with control group.

g) Changes in treatment

The treatment was measured in score. There were 6 types of physician in taking treatment as pir/fakir, homeopath medicine seller, allopathic medicine seller, trained village medical practitioners, MBBS doctor, specialist doctor and assigned score were given as 1, 2, 3, 4, 5, and 6 respectively. The change in treatment was measured on the basis of changed treatment score of the study group during 2013 and 2016.The respondents were three categories as low treatment, medium treatment and high treatment and then comparing with control group.

2. Quality of life

a) Changes in poverty level

The poverty level was measured in score. There were two types of poverty as moderate poverty and extreme poverty (ultra poor, hard core poor, poorest of the poor). Score 1 assigned for moderate poor, 2 for ultra poor, 3 for hard core poor and 4 for poorest of the poor. The changes in quality of life were measured on the basis of changed poverty level score during 2013 and 2016 of the study group. The respondents were categorized as low poverty level, medium poverty level and high poverty level of the study group and then comparing with control group.

On the other hand, Total climate changes effects on rural farmers` livelihood were measured in score. The total changes score of the respondents were classified into three categories as low change, medium change, and high changes.

3.8 Descriptive Statistics and Multivariative Analysis

Data were coded, tabulated, compiled, and analyzed according to the objectives of the study. SPSS were used for data analysis. Descriptive statistical measures, including number, percentage distribution, average, and standard deviation were used. The sample sizes in the two groups (study group and control group) were not equal and were therefore, estimated separately. Paired t test were used to assess differences between means. In addition, a single sample of t-test were used each changed variable. The mean value of t-test may result significant difference between study and control group with same df and one or five percent level of significant.

3.9 Multiple Regression Analysis

Multiple regression analysis was conducted to examine the contribution of the independent variables to the climate change effects on rural farmers` livelihood. Five percent (0.05) level of significance was used as the basis for rejecting any null hypothesis.

3.10 Statement of Hypothesis

According to Kerlinger (1973), a hypothesis is a conjectural statement of the relation between 2 or more variables. Hypothesis are always in declarative sentence form and they relate either generally of specifically variables to sentence form and they relate either generally or specifically variables to variables. Hypothesis may be broadly divided into two categories, namely, research hypothesis and null hypothesis

3.10.1 Research hypothesis

“Each of the eleven (11) selected characteristics (age, education, family size, effective farm size, Farmers` category, family annual income, agricultural extension media contact, food sufficiency, training experiences, knowledge on climate change and knowledge on livelihood) of the respondents has significant contribution to the change in different indicators of dependent variable in study group.” However, when a researcher tries to perform statistical tests, then it becomes necessary to formulate null hypothesis.

3.10.2 Null hypothesis

A null hypothesis states that there was no contribution to the concerned variables. The following null hypothesis was undertaken for the present study “There was no contribution of the selected characteristics of rural farmers to the climate change effects on their livelihood.” “The selected characteristics were age, education, family size, effective farm size, Farmers` category, family annual income, agricultural extension media contact, food sufficiency, training experiences, knowledge on climate change and knowledge on livelihood”.

CHAPTER IV

RESULTS AND DISCUSSION

The findings of the research have been presented in this chapter in the following three sections: a) Selected characteristics of the respondents b) The effect of climate change on rural farmer`s livelihood c) Contribution of the selected characteristics of the respondents on the climate change effects on their livelihood.

4.1 Selected characteristics of the respondents

The findings of the eleven selected characteristics of the respondents have been discussed in eleven subsections. A brief summary of the characteristic profile of the respondents like measuring unit, categories, and distribution, mean, standard deviation have been presented as follows in Table 4.1.

Table4.1 Characteristics profile of the respondent farmers

Sl no	Characteristics	Measuring Unit	Range		Mean	Standard deviation
			Possible	Observed	Study group	Study group
01	Age	Year	Unknown	24-64	43.58	9.999
02	Education	Year of schooling	Unknown	.0-12	4.668	4.1972
03	Family size	score	Unknown	3-13	6.71	2.156
04	Effective farm size	Ha.	Unknown	.234-5.21	3.74	.768
05	Farmer's category	Score	Unknown	1-5	2.62	.947
06	Annual family income	'000' taka	Unknown	55-250	126.15	47.965
07	Agricultural extension media contact	Score	Unknown	0-9	3.15	2.243
08	Food sufficiency	Score	Unknown	1-3	1.40	.680
09	Training experience	no. of days	Unknown	0-10	2.84	2.841
10	Knowledge on climate change	Score	0-20	6-13	8.86	1.675
11	Knowledge on livelihood	Score	0-20	5-13	8.21	1.726

4.1.1 Age

Age of the farmers ranged from 24 to 64 years with a mean of 43.58 years and standard deviation of 9.999. Data furnished in the Table 4.2 shows that the middle aged respondents group was higher than old aged and young aged group. Different result were observed by Nasreen *et al.*, (2013) in different study area where young aged respondents group was higher than the middle and old aged respondents groups.

Table 4.2 Distribution of the respondents according to their age

Categories(Years)	Respondents number	Percent	Mean	SD
Young (up to 35)	23	25.0	**43.58**	**9.999**
Middle (36-50)	43	46.7		
Old (>50)	26	28.3		
Total	92	100.0		

It was found that 46.7 percent of the respondents were middle-aged, 28.3 percent of the respondents were old and rest 25 percent were young (Table 4.2). It seems that climate change effects decrease young and old farmers for non- farming, but middle aged may be indicated that middle aged farmers can carry challenges more as they have comparatively more energy and have experience

4.1.2 Education

The level of education of the respondents ranged from 0 to 12, the average being 4.668 with a standard deviation of 4.197. Results presented that highest number of the respondents were in secondary education level where lowest number of the respondents were higher secondary level. It seems that due to lack of available support from family they were unable to continue their higher study. Similar result were observed by Reza (2007) where the highest number of respondents were educated up to secondary level education.

Table 4.3 Distribution of the respondents according to their education

Categories (Schooling years)	Respondents number	Percent	Mean	SD
Illiterate (0)	18	19.6	**4.668**	**4.1972**
Can sign only (.5)	21	22.8		
Primary education (1-5)	12	13.0		
Secondary education (6-10)	34	37.0		
Higher secondary education (11and above)	7	7.6		
Total	92	100		

But contradictory result was observed by Nasreen *et al.* (2013) where highest number of respondents were completed up to primary education level. According to the national standard of classification, among the respondents of rural farmer, 19.6 percent had no education, 22.8 percent could sign only, 13.0 percent had education at primary level, 37 percent had education at secondary level and 7.6 percent had education at higher level.

4.1.3 Family size

Data presented in the Table 4.4 show that the respondents having medium sized family were higher than the respondents having small and large sized family respectively.

Table 4.4 Distribution of the respondents according to their family

Categories (No. of members)	Respondents number	Percent	Mean	SD
Small family(1-4)	14	15.2	**6.71**	**2.156**
Medium family (5-8)	58	63.0		
Large family >8	20	21.7		
Total	92	100.0		

Family size of the respondents ranged from 3 to 13 members, having an average of 6.71 and standard deviation 2.156.

Data presented in table 4.4 indicated that 63.0 percent of the farmers had medium family size, while 15.2 percent of the farmers were small family and 21.7 percent had large family size. The family size is bigger than the national average might be due to laggardness of size control progress and lack of enjoyment facilities in their daily life.

4.1.4 Effective farm size

Data presented in the Table 4.5 indicate that most of the respondents had small farm size where medium and large farm size was lower than small farm size. It seemed that most of the rural farmers were poor due to the effect of climate change. Similar result was observed Nasreen *et al.* (2013) where highest respondents were small farm sized

Table 4.5 Distribution of the respondents according to their effective farm size

Categories(ha)	Respondents number	Percent	Mean	SD
Small farm (.20-1.00 ha)	42	45.7	**3.74**	**0.768**
Medium farm (1.00-3.00 ha)	32	34.8		
Large Farm > 3.00ha	18	19.6		
Total	92	100.0		

Farm size of the respondents ranged from 0.234 to 5.21 ha having an average of 3.74 and standard deviation 0.768. Results presented in Table 4.5 indicate that 45.7 percent of the farmers had small farm size, while 34.8 percent of the farmers had medium and 19.6 percent had small farm size. There were no farmers with marginal farm.

4.1.5 Farmer's category

Data presented in the table 4.6 amplify that the highest percent of the respondents having early adopter and early majority. It may be indicated that most of the farmers were educated up to secondary level that's why they adopted any innovation quickly than others

Table 4.6 Distribution of the respondents according to their farmer's category

Categories (score)	Respondents number	Percent	Mean	SD
Innovator	8	8.7	**2.62**	**0.947**
Early Adopter	36	39.1		
Early Majority	36	39.1		
Late Majority	7	7.6		
Laggard	5	5.4		
Total	92	100		

On the basis of the innovativeness of the farmers, they were classified into five categories where 8.7 percent were innovator, 39.1 percent were early adopter and early majority, 7.6 percent were late majority and 5.4 percent were laggard having an average of 2.62 and standard deviation .947.

4.1.6 Annual family income

Data presented in the Table 4.7 shows that the respondent having medium Annual family income were higher than the respondents of low Annual family income and high Annual family income respectively. It seems that rural farmers are involved in different income generating activities due to the climate change effects.

Table 4.7 Distribution of the respondents according to their income

Categories ('000' Taka)	Respondents number	Percent	Mean	SD
Low income (80)	20	21.7	**126.15**	**47.965**
Medium income(81-160)	48	52.2		
High income(>160)	24	26.1		
Total	92	100.0		

Reza (2007) found the similar result where highest number of respondents were medium annul income. In this table presented that 52.2 percent respondent had medium income, 21.7 percent had low income and 26.1 had high income. The average of income of the respondents were 126.15 and standard deviation of 47.965.

4.1.7 Agricultural extension media contact

Data presented in the table 4.8 amplify that the respondents having low contact on climate change were higher than the respondent having no contact, medium contact and high contact respectively. It may be indicated that most of the rural farmers were not conscious about climate change effects on their livelihood.

Table 4.8 Distribution of the respondents according to their extent of contact

Categories (no. of days)	Respondents number	Percent	Mean	SD
No contact (0)	14	15.2	**3.15**	**2.243**
Low contact (1-3)	47	51.1		
Medium contact (4-6)	22	23.9		
High contact (>6)	9	9.8		
Total	92	100.0		

Among the respondents 51.1 percent were involved in low contact, 22.00 percent were involved in medium contact, 9.00 percent were involved in high contact and 14 percent respondent weren`t involved in any contact. It seemed that due to the lower education of the respondents, they can`t develop their communication behavior.

4.1.8 Food Sufficiency

Information contained in Table 4.9 indicated that 70.7 percent respondents had low storage food availability, 18.5 percent respondents had medium storage food availability, and rest had high storage food availability.

Table 4.9 Distribution of the respondents according to their food availability

Categories (no of meals)	Respondents number	Percent	Mean	SD
Low storage (meals available for one day)	65	70.7	**1.40**	**0.680**
Medium storage (meals available for one month)	17	18.5		
High storage (meals available for one year)	10	10.9		
Total	92	100.0		

Results presented in the Table 4.9 reveals that most of the respondents having low storage food were higher than medium storage and high storage respondents respectively. It indicated that due to medium annual income they can`t store food in future.

4.1.9 Training experience

Training received scores of the respondents computed as days of participating training, which ranged from 0 to 10 days. The mean and standard deviation were 2.84 and 2.841 respectively

Table 4.10 Distribution of the respondents according to their training experience

Categories (score)	Respondents number	Percent	Mean	SD
No experience (0)	35	38.0	**2.84**	**2.80**
Low experience (1-3)	33	35.9		
Medium experience (4-6)	5	5.4		
High experience (>6)	19	20.7		
Total	92	100.0		

Information furnished in the Table 4.10 amplify that the respondent having no training experience were higher than the respondents having low, medium and high training experience respectively. It seemed that rural farmers were not involved in training experience due to their unconsciousness and lack of proper communication.

Thirty eight percent respondents had no experience while 35.9 percent respondents had low experience, 5.4 percent had medium experience, and 20.7 percent had high experience.

4.1.10 Knowledge on climate change

Knowledge on climate change scores of the farmers ranged from 6-13 against the possible range of 0-20. The average score and standard deviation were 9.84 and 9.442 respectively.

Table 4.11 Distribution of the respondents according to knowledge on climate change

Categories (score)	Respondents number	Percent	Mean	SD
Poor knowledge (1-6)	7	7.6	**9.84**	**9.442**
Moderate knowledge (7-11)	76	82.6		
Good knowledge >11	9	9.8		
Total	92	100.0		

Results presented in the Table 4.11 indicates that 82.6 percent respondents having moderate knowledge which were higher where 7.6 percent and 9.8 percent respondents had poor knowledge and good knowledge respectively. It may be indicated that most of the rural farmers had secondary level of education and that's why they had moderate knowledge on climate change.

4.1.11 Knowledge on livelihood

Knowledge on livelihood scores of the farmers ranged from 5-13 against the possible range of 0-20. The average score and standard deviation were 8.21 and 1.726 respectively.

Table 4.12 Distribution of the respondents according to knowledge on livelihood

Categories (score)	Respondents number	Percent	Mean	SD
Poor knowledge (1-6)	12	13.0	**8.21**	**1.726**
Moderate knowledge (7-11)	73	79.3		
Good knowledge >11	7	7.6		
Total	92	100.0		

Information presented in the Table 4.12 indicates that 79.3 percent respondents having moderate knowledge which were higher where 13.0 percent and 7.6 percent respondents had poor knowledge and good knowledge respectively. It seemed that livelihood knowledge was moderate due to most of their educational background were secondary level.

4.2 Climate change effects on rural farmers` livelihood

Climate change effects on rural farmers` livelihood had two selected dimension as basic right and quality of life. Basic rights had seven selected sub dimension viz. a) Changes in nutrition consumption, b) Changes in body weight, c) Changes in clothe value, d) Changes in housing condition, e) Changes in sources of drinking water, f) Changes in level of education, g) Changes in treatment and quality of life as Changes in poverty level. The changes Result of different sub dimension were presented in bellow:

a) Changes in nutrition consumption

Results presented in the Table 4.13 reveal that the changes in nutrition consumption of the respondents were highest in low level consumption, it was 52.2 percent and medium consumption was closer to the low consumption as 31.5 percent. The mean difference value was -.065 and t-value was -.904.

Table 4.13 Distribution of the respondents according to their perceived changes in nutrition consumption

Categories (score)	Respondents number	Percent	Mean difference	t-value (29 df)
Low consumption (up to 0)	48	52.2	-0.065	-0.904^{NS}
Medium consumption (.01-1.00)	29	31.5		
High consumption (>1.00)	15	16.3		
Total	92	100		

Information contained that the most of the respondents were poor in nutrition consumption. It might be due to lower income of the respondents.

b) Changes in body weight

Results presented in the Table 4.14 amplify that most of the respondents were low changes in body weight as 59.8 percent, compare to 26.1% as medium change and 14.1% as high change. The mean difference value was -.370 and t-value was -2.748.

Table 4.14 Distribution of the respondents according to their perceived changes in body weight

Categories (score)	Respondents number	Percent	Mean difference	t-value (29 df)
Low (up to 0)	55	59.8	-.370	-2.748***
Medium (.01-1.00)	24	26.1		
High (>1.00)	13	14.1		
Total	92	100		

The scenario reveals that low nutrition consumption have an influence on the respondents body weight.

c) Changes in clothe value

Results displayed in the Table 4.15 show that majority of the respondents (48.9%) were low changes in their clothe value. The mean difference value was .335 and t-value was 1.817.

Table 4.15 Distribution of the respondents according to their perceived changes in clothe value

Categories (score)	Respondents number	Percent	Mean difference	t-value (29 df)
Low (up to 0)	45	48.9	0.335	1.817
Medium (.01-1.00)	29	31.5		
High (>1.00)	18	19.6		
Total	92	100		

It seems that about half portion of the respondents had low changes in their clothing as most of the respondents first of all they are trying to ensure their daily food from their minimum earning.

d) Changes in housing condition

Results presented in the Table 4.16 show that majority of the respondents had poor housing. It was 71.7 percent among the respondents. The mean difference value was .178 and t-value was 1.734. It implies that the respondents did not concentrate more for fashionable housing as majority of them were economically less sound. Changes in poor housing condition of the respondents was high due to the climate change effects of the study area.

Table 4.16 Distribution of the respondents according to their perceived changes in housing condition

Categories (score)	Respondents number	Percent	Mean difference	t-value (29 df)
Poor housing (0-1)	66	71.7	0.178	1.734
Medium housing (2-3)	23	25.0		
Good housing (above 3)	3	3.3		
Total	92	100		

25.0 percent respondents had medium housing condition and a non considerable number of respondents (3.3 percent) had good condition. These people might have partial effects due to climate change.

e) Changes in source of drinking water

Data presented in the Table 4.17 amplify that most of the respondents had low changes in source of drinking water. The mean difference value was .213 and t-value was 1.867.

Table 4.17 Distribution of the respondents according to their perceived changes in source of drinking water

Categories (score)	Respondents number	Percent	Mean difference	t-value (29 df)
Low (0-1)	73	79.3	0.213	1.867
Medium (2-3)	19	20.7		
High (above 3)	0	0		
Total	92	100		

Among the respondents 79.3 percent had low changes, 20.7 percent respondents had medium changes and there were no high changes among the respondents. It is mentionable that the study areas sources of drinking water existing condition was good. Therefore it was less space to uplift their sources of drinking water.

f) Changes in level of education

Results displayed in the Table 4.18 indicate that most of the respondents had low changes in level of education. Among the respondents 44.6 percent had low changes in level of education, 33.7 percent respondents had medium changes and 21.7 percent had high changes in level of education of the respondents. The mean difference value was 4.554 and t-value was 10.123.

Table 4.18 Distribution of the respondents according to their perceived changes in level of education

Categories (score)	Respondents number	Percent	Mean difference	t-value (29 df)
Low level of education (0-4)	41	44.6	4.554	10.123***
Medium level of education (5-8)	31	33.7		
High level of education (> 8)	20	21.7		
Total	92	100		

It seems that low changes in level of education of the respondents was high due to the location of the study area where most of the area were in remote place and all are char land.

g) Changes in treatment

Results presented in the Table 4.19 reveal that majority of the respondents had low changes in treatment. The mean difference value was .185 and t-value was 2.62.

Table 4.19 Distribution of the respondents according to their perceived changes in treatment

Categories (score)	Respondents number	Percent	Mean difference	t-value (29 df)
Low treatment (up to 0)	54	58.7	0.185	2.262***
Medium treatment (.01-2.00)	38	41.3		
High treatment (above 2)	0	0		
Total	92	100		

58.7 percent respondent was low changes in treatment, 41.3 percent were medium changes in treatment and there were no high changes in treatment. It seems that low changes in treatment of the respondents were high due to the location of the study area and climate change effects on their livelihood.

h) Changes in quality of life (poverty level)

Results presented in the Table 4.20 indicate that medium poverty level and its changes were high in changes in quality of life. The respondents of 60.9 percent were medium poverty level, 39.1 percent respondents were low poverty in changing quality of life, and high poverty level was not found.

Table 4.20 Distribution of the respondents according to their perceived changes in quality of life (poverty level)

Categories (score)	Respondents number	Percent	Mean difference	t-value (29 df)
Low poverty level (up to 0)	36	39.1	-.261	-3.529***
Medium poverty level (.01-1)	56	60.9		
High poverty level (>1)	0	0		
Total	92	100		

Due to the climate change rural farmers were involved in different activities to lead their life and in order to improve their poverty level.

i) Changes in rural farmers` livelihood

Results contained in the Table 4.21 show that majority of the respondents (49.5+43.0) lead either low changes or medium changes in their livelihood condition.

Table 4.21 Distribution of the respondents according to their perceived changes in rural farmers` livelihood

Categories (score)	Respondents number	Percent	Mean difference	t-value (29 df)
Low changes(up to -5)	46	49.5	5.70	11.961***
Medium changes(6-10)	40	43.0		
High changes (>12)	7	7.5		
Total	92	100		

The low changes of farmers` livelihood were 49.5 percent compare to medium and high changes were 43 and 7.5 percent respectively. The mean difference value was 5.70 and t-vale was 11.961. It may be due to the climate change, rural farmers were affected by different climatic indicators.

4.22: Distribution of study group and control group respondents level of climate change effects on rural farmer`s livelihood based on their changed value

Changed variables		Livelihood indicator		
		Study group mean value difference (SMVD)	**Control group mean value difference (CMVD)**	**t-test value**
Climate change effects on rural farmer`s livelihood	Changes in nutrition consumption	-.065	.267	-1.459
	Changes in body weight	-.370	.467	-2.679***
	Changes in clothe value	.435	.167	1.216
	Changes in housing condition	.978	.467	2.350***
	Changes in sources of drinking water	.413	.700	-1.725
	Changes in level of education	4.554	5.200	-1.131
	Changes in treatment	.185	.467	-1.755
	Changes in quality of life	-.261	.300	-.722
Total		5.869	7.735	-2.167***

t value (1% significance) = 2.046

change effect= Mean score of study group -Mean score of control group

= 5.58-7.435

= -1.866

The score of change effect found -1.855 and t-value of total mean value difference of study and control group was -2.167

The effect of climate change on rural farmer`s livelihood had 8 sub dimension like as changes in nutrition consumption, changes in body weight, changes in clothe value, changes in housing condition, changes in sources of drinking water, changes in level of education, changes in treatment, changes in quality of life.

From each sub dimension were compared to study group mean value difference and control group mean value difference and t- value was found. The change in body weight and changes in housing condition t-value was -2.679 and 2.350 which was significance difference compared to study and control group mean value difference. Finally, total study group mean value difference and control group mean value difference was 5.869 and 7.735. t-value was -2.167. There was a significant difference between study group and control group respondents` livelihood.

4.3: Contribution of selected characteristics of the respondents livelihood conditions

Table 4.23: Multiple regression coefficients of contributing variables related to effect of climate change among farmers` livelihood by changing their basic rights

Dimension	Independent variables	B	*p*	R^2	Adj. R^2	F	*p*
Changes in basic rights	Age	-.049	.101	0.760	0.727	23.085	.000***
	Education	.911	.000***				
	Family size	-.331	.013**				
	Effective farm size	-.137	.860				
	Farmers` category	.357	.277				
	Annual family income	.027	.038**				
	Media contact	.066	.603				
	Food sufficiency	-1.362	.064*				
	Training experience	.079	.450				
	Knowledge on climate change	.345	.005***				
	Knowledge on livelihood	-.162	.325				

*** Significant at p<0.01. ** Significant at p<0.05. * Significant at p<0.1.

Table 4.23 show that there is a significant contribution of respondents education, family size, annual family income, food sufficiency and knowledge on climate change to change in basic right of the respondents.

Of these, education and knowledge on climate change is the most important contributing factor (significant at the 1% level of significance) and family and annual family income is the second most contributing factor (significant at the 5% level of significance). Food sufficiency (significant at the 10% level of significance) are related to change in livelihood condition through changing in basic right of the respondents. Seventy six percent (R^2=0.760) of the variation in the changes in basic right of the respondents can be imposed to their age, education, family size, effective farm size, farmers` category, Annual family income, media contact, food sufficiency, training experience, knowledge on climate change, knowledge on livelihood. The F value indicates that the model is significant (p=0.000). Adjusted R-square value (.727) indicates the addition of future predictors in the model and shows the variance in nutrition consumption of the respondents and the models were suitable. It may be due to the higher rate of education and medium annual income along with medium family size had a significant influence on rural farmers` livelihood.

Table 4.24 : Multiple regression coefficients of contributing variables related to effect of climate change among farmers` livelihood by changing their quality of life/ poverty level

Dimension	**Independent variables**	**B**	***p***	**R^2**	**Adj. R^2**	**F**	***p***
Changes in Quality of life/poverty level	Age	.011	.126	0.317	0.223	3.377	0.001***
	Education	-.005	.791				
	Family size	.011	.034**				
	Effective farm size	-.493	.035**				
	Farmers` category	.092	.251				
	Annual family income	.000	.975				
	Media contact	.079	.012**				
	Food sufficiency	.370	.041**				
	Training experience	-.023	.363				
	Knowledge on climate change	.098	.025**				
	Knowledge on livelihood	-.133	.001***				

*** Significant at p<0.01. ** Significant at p<0.05. * Significant at p<0.1.

Table 4.24 also amplify that education, family size, Annual family income and training experience of the respondents had significantly contributed to the changes in poverty level of the respondents to improve livelihood condition. Knowledge on livelihood was the most important contributed factor (significant at the 1% level of significance) in changing quality of life. Family size, effective farm size, media contact, food sufficiency and knowledge on climate change were the second important contributing factor (significant at the 5% level of significance) in changing quality of life of the respondents. Family size and training experience had a great influence in changing poverty level to maintain quality life. 31.7% (R^2=.317) of the variation in the changes in poverty level of the respondents can be imposed to their age, education, family size, effective farm size, farmers` category, Annual family income, media contact, food sufficiency, training experience, knowledge on climate change, knowledge on livelihood. The F value indicates that the model is significant (p=0.001).

Adjusted R-square value (.223) indicates the addition of future predictors in the model and shows the variance in quality of life of the respondents and the models were suitable. It seems that family size, effective farm size, media contact, food sufficiency, knowledge on climate change and knowledge on livelihood had a significant influence on rural farmers` livelihood by changing their quality of life.

Table 4.25: Multiple regression coefficients of contributing variables related to climate change effects on rural farmers` livelihood

Dependent variable	Independent variables	B	*p*	R^2	Adj. R^2	F	*p*
Climate change effects on rural farmers` livelihood	Age	-.039	.281	0.600	0.545	10.924	.000***
	Education	.768	.000***				
	Family size	-.306	.050**				
	Effective farm size	.902	.428				
	Farmers` category	-.075	.848				
	Annual family income	.004	.833				
	Media contact	.177	.087*				
	Food sufficiency	-.671	.445				
	Training experience	.009	.045**				
	Knowledge on climate change	.025	.005***				
	Knowledge on livelihood	-.054	.784				

*** Significant at p<0.01. ** Significant at p<0.05. * Significant at p<0.1.

Table 4.25 also reveals that there was a significant contribution of respondents education, family size, media contact, training experience and knowledge on climate change in changing their livelihood of the respondents.

Among these, education and knowledge on climate change was the most important contributing factor (significant at the 1% level of significance) and family size and training experience were the second most contributing factor (significant at the 5% level of significance). Media contact related to change in rural livelihood due to the climate change effects (significant at the 10% level of significance). Education and knowledge on climate change of the respondents had a great influenced in changing rural`livelihood.

Sixty percent (R^2=0.600) of the variation in the changes in rural farmers of the respondents can be imposed to their age, education, family size, effective farm size, farmers` category, Annual family income, media contact, food sufficiency, training experience, knowledge on climate change, knowledge on livelihood. The F value indicates that the model is significant (p=0.000). Adjusted R-square value (0.545) indicates the addition of future predictors in the model and shows the variance in rural farmers` livelihood of the respondents and the models were suitable. It may be indicates that education, family size, media contact, training experience and knowledge on climate change had also significant influence on rural farmers` livelihood due to climate change effects.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents summary of major findings, conclusion and recommendation of the study.

5.1 Summary of Findings

The major findings of the study are summarized bellow:

5.1.1 Selected characteristics of the farmers

Findings in respect of the 11 selected characteristics of the farmers are summarized below:

Age: The middle age (46.7%) respondents group was higher than the young (25%) and old aged (28.3) group.

Level of education: The highest proportion of the respondents was in secondary education level (37.0%) followed by can sign only education level (22.8%). The lowest number of the respondents was higher secondary education level (7.6%) followed by primary education (13.0%) and those who had no education level (19.6%).

Family size: The majority of the respondents were medium sized family (63.0%) compared to the respondents having small (15.2%) and large sized family (21.7%) respectively.

Effective farm size: Most of the respondents had small farm size (45.7%) followed by marginal, Medium (34.8%), and large farm size (19.6%) respectively.

Farmers` category: Most of the respondents were early adopter (39.1%) and early majority (39.1%) followed by innovator (8.7%), late majority (7.6%) and laggard (5.4%).

Annual family income: The respondents having medium annual family income (52.2%) were higher than respondents having high family annual income (26.1%) and low family annual income (21.7%).

Agricultural extension media contact: The respondents having low use of agricultural extension media contact (51.1%) were higher than the respondents having medium (23.9%) and high use of agricultural extension media contact (9.8%) respectively.

Food sufficiency: The respondents having low food storage (70.7%) were higher than the respondents having medium (18.5%) and high food storage (10.9%) respectively.

Training experience: The respondents having no training experience (38.0%) and low training experience (35.9%) were higher than the respondents having medium (5.4%) and high training experience (20.7%) respectively.

Knowledge on climate change: The respondents having moderate knowledge on climate change (82.6%) were higher than the respondents having poor (7.6%) and good knowledge on climate change (9.8%) respectively.

Knowledge on livelihood: The respondents having moderate knowledge on livelihood (79.3%) were higher than the respondents having poor (13.0%) and good knowledge on livelihood (7.6%) respectively.

5.1.2 Climate change effects on rural farmers` livelihood

There were significant differences in most of the component of farmers` livelihood. Changes in body weight, changes in clothe value, Changes in housing condition, Changes in sources of drinking water, Changes in level of education, Changes in poverty level had greatly significant difference and changes in nutrient consumption and changes in treatment had non significant among the study group due to climate from 2013 to 2016.

a) Changes in nutrition consumption: The respondents having low changes in nutrition consumption (52.2%) was higher than medium (31.5%) and high nutrition consumption (16.3%).

b) Changes in body weight: The respondents having low changes in body weight (59.8%) was higher than medium (26.1%) and high changes in body weight (14.1%).

c) Changes in clothe value: The respondents having low changes in clothe value (48.9%) of the respondents were higher than medium (31.5%) and high changes in clothe value (19.6%).

d) Changes in housing condition: The respondents having poor changes in housing condition (71.7%) of the respondents were higher than medium (25.0%) and good changes in housing condition (3.3%).

e) Changes in source of drinking water: The respondents having low changes in source of drinking water (79.3%) of the respondents were higher than medium (20.7%) and high changes in source of drinking water (0%).

f) Changes in level of education: The respondents having low changes in level of education (44.6%) of the respondents were higher than medium (33.7%) and high changes in level of education (21.7%).

g) Changes in treatment: The respondents having low changes in treatment (58.7%) of the respondents were higher than medium (41.3%) and high changes in treatment (0%).

h) Changes in quality of life (poverty level): The respondents having medium poverty level (60.9%) in changes in quality of life of the respondents were higher than low (39.1%) and high changes (0%) in quality of life or poverty level.

i) Climate change effects on rural farmers` livelihood: The respondents having low changes (49.5%) on their livelihood were higher than medium (43.0%) and high changes (7.5%).

5.1.3 Contribution of the selected characteristics of the respondents livelihood conditions

1. There was a significant contribution of the respondent education, family size, annual family income and knowledge on climate change to change in basic right.

2. There was a significant contribution of the respondent family size, effective farm size, media contact, food sufficiency, knowledge on climate change and knowledge on livelihood to change in quality of life or poverty level.

3. There was a significant contribution of the respondent education, family size, media contact, training experience, knowledge on climate change to change in rural farmer` livelihood due to climate change effects.

Seventy six percent (R^2=.760), 31.7% (.R^2= .317) of the variation to change in basic right and changes in quality of life of the respondents respectively were attributed to the age, level of education, family size, effective farm size, farmer`s category , family annual income , media contact, food sufficiency, training experience, knowledge on climate change, and knowledge on livelihood of the respondents. And 60% ($R^2$= .600) of the variation to the total contribution changes in rural farmers` livelihood due to the climate change effects.

5.2 Conclusions

Findings of the study enabled the researcher to formulate the following conclusions:

- Findings reveal that the changes in nutrient consumption were lower in study group than control group due to climate change and no significant difference was observed. Due to climate change, nutrient consumption of study group was reduced.

- Findings indicate that the changes in body weight were lower in study group than control group due to climate change and significant difference was observed.

- Findings reveal that the low changes in clothe value were higher in study group and significant difference was observed between study and control group respondents due to climate change.

- Findings reveal that the poor changes in housing condition were higher in study group and significant difference was observed between study and control group respondents due to climate change.

- Findings reveal that the low changes in source of drinking water were higher in study group and significant difference was observed between study and control group respondents.

- Findings indicate that the low changes in level of education were higher in study group and significant difference was observed between study and control group respondents.

- Findings reveal that the low changes in treatment were higher in study group and significant difference was observed between study and control group respondents due to climate change.

- Findings reveal that the moderate changes in quality of life through poverty level were higher in study group and significant difference was observed between study and control group respondents due to climate change.

- Findings indicated that low changes of rural livelihood were higher in study group and significant difference was observed between study and control group.

- Findings indicate that the respondents education, family size, annual family income and food sufficiency had significant contribution to the changes in basic rights of the respondents in the study group. It may be concluded that the changes in basic rights due to climate change is likely to be influenced by the respondents` education, family size, annual family income and food sufficiency.

- Findings show that the respondents` family size, effective farm size, media contact, food sufficiency, knowledge on climate change and knowledge on livelihood had significant contribution to the changes in quality of life of the respondents in the study group. It may be concluded that the changes in quality of life due to climate change is likely to be influenced by the respondents` family size, effective farm size, media contact, food sufficiency, knowledge on climate change and knowledge on livelihood

- Findings reveal that the respondents` education, family size, media contact, training experience, knowledge on climate change had significant contribution to the changes in rural livelihood of the respondents in the study group. It may be concluded that the changes in farmers` livelihood condition due to climate change is likely to be influenced by the respondents` education, family size, media contact, training experience, knowledge on climate change

5.3 Recommendation

5.3.1 Recommendation for policy implication

On the basis of the findings and conclusion of the research some recommendations have been formulated. These are following

- The study indicated that the effect of climate change of the respondents enabled them to develop their livelihood condition. To develop the rural farmers` livelihood condition from climate change effect, the government should take more initiatives through increasing awareness of the farmers about climate change so that they can lead their life safely from climate change effect.
- The findings of the research indicate that the changes in different indicators of livelihood were attributed to the farmers` age, level of education, family size, effective farm size, farmer`s category , family annual income , media contact, food sufficiency, training experience, knowledge on climate change, and knowledge on livelihood. It may be recommended that the government should considered the farmers` age, level of education, family size, effective farm size, farmer`s category , family annual income , media contact, food sufficiency, training experience, knowledge on climate change, and knowledge on livelihood during providing any program or training for the farmers.
- The findings of the study revealed that the changes in nutrient consumption, changes in body weight, changes in housing condition, changes in level of education, changes in medical treatment of the respondents were lower in study group than control group which resulted due to the climate change effects. It may be concluded that government should consider the livelihood condition of the farmers which affected by the climate change. Intergovernmental panel on climate change is doing work with climate change affected people. So they should take step to the rural farmers of improving their livelihood condition.
- The research findings indicate that the level of education of the farmers had significant contribution to the effects of climate change to change quality of life,

it may be recommended that the government along with IPCC should provide educational facilities to the farmers of villages so that they can get more knowledge on climate change to maintain their livelihood condition.

- The research findings indicate that the knowledge on climate change and livelihood of the farmers had significant contribution to the effect of climate change. So it may be recommended that the government should arrange more training through different GO & NGO organization such as Department of Agricultural Extension (DAE), and intergovernmental panel on climate change (IPCC) on different changes in livelihood aspects, so that all farmers can get the facilities to apply their knowledge in climate change situation.

5.3.2 Recommendation for further research

- The present research was undertaken in the sadar upazila of Faridpur district. The findings of the study are needed to be tested in the other areas of the country
- The present research was undertaken to measure the effects of climate change were considered as the rural farmers` livelihood in this study. Further research should be conducted to assess the effect of specific climate change indicators
- The present study was conducted on the basis of the recall data furnished by the respondents. Further research should be carried out without using recall data.
- The present research was carried out considering unequal number of respondents in study and control group. Further research should be conducted taking similar number of respondents in study and control group.
- Contribution of only eleven selected characteristics of the respondents to the effect of climate change was examined. It may be recommended for further research to examine the contribution of other socio-economic characteristics of the farmers to the effect of climate change
- The present research was carried out eight indicators to measure the effect of climate change. Further research undertaking should be carried out to measure the effect of climate change with different indicators.

REFERENCES

Adger, W. N. (2010). Climate change, human well-being and insecurity. New Political Economy, 15(2**)**, 275-292.

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. Organisation for Economic Co-operation and Development (OECD).

Agricultural Research Council. In: Bangladesh Country Almanac. (2005). BCA v. 3.0 : CIMMYT.

Ahmed, A.U. (2006). Bangladesh Climate Change Impacts and Vulnerability: A Synthesis. Dhaka : Climate Change Cell, Bangladesh Department of Environment.

Ahmed, A. U. and Mirza, M. Q. (2000). Review of Causes and Dimensions of Floods with Particular Reference to Flood '98: National Perspectives. In Q. C. Ahmed, K. A. A, S. H. Imam, and M. Sarker (eds.), Perspectives on Flood 1998 (pp. 67-84). Dhaka: University Press Limited.

Ahsan, S., Ali, M.S., Hoque, M.R., Osman, M.S., Rahman, M., Babar, M.J., Begum, S.A., Rahman, D.M. and Islam, K.R. (2011). 'Agricultural and Environmental Changes in Bangladesh in Response to Global Warming', in R. Lal, M.V.K. Sivakumar, S.M.A. Faiz, A.H.M.M. Rahman and K.R. Islam (eds), Climate Change and Food Security in South Asia, Springer, Netherlands, pp. 119–34.

Alam, M.R., Ali, M.A.M., Hossain, A., Molla, M.S.H. and Islam, F. (2009). Integrated approach of pond based farming systems for sustainable production and income generation. Bangladesh J. Agric. Res. **2009**, 34, 577–584.

Ali, A. (2003). Storm Surge Flood in Bangladesh. Paper presented at the Launch Workshop of the Research Project on Impact of Climate and Sea Level Change in the Indian Sub-Continent (CLASIC), on 30 January 2003, organized by the Bangladesh University of Engineering and Technology (BUET), Dhaka.

Bele, M.Y., A.M. Tiani, Somorin, O.A. and Sonwa, O.A. (2013). Exploring vulnerability and adaptation to climate change of communities in the forest zone of Cameroon. Climatic Change, **119(3-4)**: 1-15.

CEGIS (2005). Coastal Land Use Zoning in the Southwest: Impact of Sea Level Rise on Landuse Suitability and Adaptation Options, Dhaka : Centre for Environmental and Geographic Information Services (CEGIS). Conducted for the Sustainable Environment Management Programme, Ministry of Environment and Forests.

Chambers, R. and G.R. Conway, (1992) Sustainable Rural Livelihoods: Practical Concepts for the 21st Century. Institute of Development Studies (IDS), IDS, Brighton, UK, 29 pp.

Chowdhury, A. (2002). Disasters: Issues and Responses. In: Bangladesh Environment: Facing the 21st Century. (2nd ed.) Ed. Gain, P. Dhaka : Society for Environment and Human Development (SEHD). 217 –235.

Daily Star (2011). Climate change: Pressure on urbanization. Retrived on: http:// www.the dailystar.net/ new Design /news-details.php? nid=193545. Accessed on July 10, 2011.

Das, K. (2009). Climate Change Scenarios and Sea Level Rise Estimates for the California 2009, Climate Change Scenarios Assessment. California Climate Change Center, Publication NumberCEC-500-2009-014-F. 2009;64.

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

Douglas, I., K. Alam, M.A. Maghenda, Y. Mcdonnell, L. McLean, and J. Campbell, (2008). Unjust waters: climate change, flooding and the urban poor in Africa. Environment and Urbanization, **20(1)**: 187-205.

Edward, H. A. (2004).Vulnerability of national economies to the impacts of climate change on fisheries. Fish and Fisheries, **10**: 173-196.

FAO. **(**2003). Conceptual framework for national, agricultural, rural development, and food security strategies and policies, by K. Stamoulis and A. Zezza. Rome.

FAO. (2008). Food and Agricultural commodities production [Online]. Available: http://faostat.fao.org/site/339/default.aspx [Accessed 1 June 2011].

Field, C.B., V. Barros, T.F. Stocker, D. Qin, D. Dokken, K. Ebi, M. Mastrandrea, K. Mach, G. Plattner, and Allen, S. (2012) Managing the risks of extreme events and disasters to advance climate change adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, UK, and New York, NY, USA.

Glantz, M. H. (2010). Coping with a Changing Climate: Consideration for Adaptation and Mitigation in Agriculture, FAO, Rome.

Goode, W. J. and Hatt, P. K. (1952). Methods in Social Research. New York: Megraw-Hill Book Company, Inc.

Haque, S. (2007). Summary of Discussion and lessons Learnt. 2nd International Workshop on Community Based Adaptation to Climate Change. Organised by: Bangladesh Centre for Advanced Studies, IIED & The Ring. Radission Water Garden Hotel, Dhaka, 24th – 28th February, 2007.

Haque, M. E. (2002). Performance of rice IPM farmers under Farmer Field School in the department of Agricultural extension, Phd Thesis, Bangabandhu Sheikh Mujibur Rahman Agricultural University. Pp.127-133

Hossain, M. and Deb, U. (2011). 'Crop agriculture and agrarian reforms in Bangladesh: present status and future options', in MK Mujeri & S Alam (eds), Sixth Five Year Plan of Bangladesh 2011–2015: Background Papers, Bangladesh Institute of Development Studies & Ministry of Planning, Dhaka, vol. 2, pp. 1–24.

Hulme, D. (2000). Impact assessment methodologies for microfinance: theory, experience and batter practice. World development. 68: 79-98.

IPCC (2007). Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2012). Summary for Policymakers. In V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.): Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Cambridge: Cambridge University Press.

IPCC (Intergovernmental Panel on Climate Change). (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.

International Fund for Agricultural Development (IFAD) and United Nations Environmental Programme (UNEP). (2013) Smallholders, Food Security and the Environment, Rome, Italy.

Islam, S.M.R., Huq, S., and Ali, A. (2002). "Beach erosion in the eastern coast line of Bangladesh." In Bangladesh Climate Change Country Study: Assessment of Vulnerability and Adaptation to Climate Change. Bangladesh Centre for Advanced Studies and Department of Environment, Dhaka.

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

Islam, M.A. (2007). Farmers' Knowledge and Practices in Using IPM Crop Production. ***M.S. (Ag.Ext.Ed.) Thesis,*** Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Karim, Z., Hussain, S.K.G., and Ahmed, A.U. (1999). Climate Change Vulnerability of Crop Agriculture. In: Vulnerability and Adaptation to Climate Change for Bangladesh. Eds. Huq, S., Karim, Z., Asaduzzaman, M., & Mahtab. Dordrecht/Boston/London : Kluwer Academic Publishers. 39 – 54.

Kerlinger, T. (1973). Foundation of Behavioural Research: Educational and Psychological Inquiry. New York: Holt, Richart and Winston, Inc.

Khan, I.A., Ali, Z., Asaduzzaman, M., Rashid, B. and Harunur, M. (2010). The social dimensions of adaptation to climate change in Bangladesh. Development and climate change discussion paper ; no. 12. Washington, DC: World Bank.

Kumssa, A. and Jones, J.F. (2010). Climate change and human security in Africa. International Journal of Sustainable Development and World Ecology, **17(6)**, 453-461.

Kundzewicz, Z.W., Kanae, S., Seneviratne, S.I. Handmer, J., Nicholls, N., Peduzzi, P., Mechler, R., Bouwer, L.M., Arnell, N., Mach, K., Muirwood, R. and Brakenridge, G.R. (2014). Flood risk and climate change: global and regional perspectives. Hydrological-Sciences Journal. Abingdon, UK: Taylor & Francis. 2014; 59(1): 1-28.

Lancet (2011). Editorial: A commission on Climate Change. Vol: 373: 1659.

Leary, N., Adejuwon, J., Barros, V., Burton, I., Kulkarni, J. and Lasco, R. (2008). Climate change and adaptation. Earthscan/James & James, London, UK; Sterling, VA, USA, pp. 376.

Mallick, B., Rahman, K.R. and Vogt, J. (2011). Coastal livelihood and physical infrastructure in Bangladeshafter cyclone Aila. Mitig Adapt Strateg Glob Change 16:629–648.

Mazumder, M. S. U. (2015). What impact does microfinance have on rural livelihood? A comparison of governmental and non governmental programs in Bangladesh. World Development. **68.** 336-354.

Midgley, G.F. and Thuiller, W. (2011). Potential responses of terrestrial biodiversity in Southern Africa to anthropogenic climate change. Regional Environmental Change, **11**, 127-135.

Mohal, N. and Hossain, M. M. A. (2007). Investigating the impact of relative sea level rise on coastal communities and their livelihoods in Bangladesh. Draft Final Report. Dhaka : Institute of Water Modelling (IWM) and Center for Environmental and Geographic Information Services (CEGIS). Submitted to UK Department for Environment Food and Rural Affairs in May 2007.

Mohal, N., Khan, Z.H., and Rahman, N. (2006). Impact of Sea level Rise on Coastal Rivers of Bangladesh. Dhaka : Institute of Water Modeling (IWM). Assessment conducted for WARPO, an organization under Ministry of Water Resources.

Moniruzzaman, M. (2012). Impact of climate change in Bangladesh: water logging at south-westcoast. In: Filho WL (ed) Climate change and the sustainable use of water resources, climatechange management. Springer, Berlin, pp 317–336.

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

NAPA (Formulation of the Bangladesh Programme of Action for Adaptation to Climate Change (2005a). Document Sectoral Consultant Report (Fisheries). Bangladesh Agriculture Research Council, Dhaka, Bangladesh.

NAPA (2005b). National Adaptation Programme of Action (NAPA) Final Report. Dhaka : Ministry of Environment and Forest, Government of the People`s Republic of Bangladesh.

Nasreen, M. (2012). *Women and Girls Vulnerable or Resilient?* Institute of Disaster Management and Vulnerability Studies, *University of Dhaka, Dhaka-1000.*

Nasreen, M., Hossain, K. M., and Azad, M. A. K. (2013). Climate Change and Livelihood in Bangladesh: Experiences of people living in coastal regions.*Proce. of Int. Con. of Building Resilience*, 1-25.

Nicholls, R.J., Wong, P.P., Burkett, V.R., Codignotto, J.O., Hay, J.E., McLean, R.F., Ragoonaden, S., Woodroffe,C.D. (2007) Coastal systems and low-lying areas. In: Parry ML, Canziani OF, Palutikof JP, vander Linden PJ, Hanson CE (eds) Climate change (2007): impacts, adaptation and vulnerability.Contribution of Working Group II to the Fourth Assessment Report of the IntergovernmentalPanel on Climate Change, Cambridge University Press, Cambridge, pp 315–356.

Olsson,L., Opondo, M., Tschakert, P. (2014). Climate change 2014: livelihoods and poverty. Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change. Cambrige University press. Cambridge.

Ostfeld, R.S., (2009). Climate change and the distribution and intensity of infectious diseases. Ecology, **90(4)**, 903- 905.

OXFAM (2009). Disaster Risk Reduction, Climate change and livelihood of the poor and marginalized people. A Framework for Oxfam GB Bangladesh.

Paavola, J. (2008). Livelihoods, vulnerability and adaptation to climate change in Morogoro, Tanzania. Environmental Science & Policy, **11(7)**, 642-654.

Paul, B.K. (2009). Why relatively fewer people died: The case of Bangladesh's Cyclone Sidr. Natural Hazards 50: 289-304

Pit, M., and Khandker, S. (1998). The impact of group based credit programs on poor households in Bangladesh: Does the gender of participants matter? Journal of political economy. 106(5), 958-996.

Pouliotte, J., Smit, B. and Westerhoff, L. (2009). 'Adaptation and development: Livelihoods and climate change in Subarnabad, Bangladesh', Climate and Development, vol. 1, no. 1, pp. 31–46.

Quadir, D.A. (2003). The impact of climate variability on the yield of rain-fed rice of Bangladesh, Dhaka.

Quinn, C.H., Ziervogel, G., Taylor, A., Takama, T. and Thomalla, F. (2011). Coping with multiple stresses in rural South Africa. Ecology and Society, **16(3)**,2.

Rahman, R., Khan, M. F., Nishat, B., Mukherjee, N. and Ahmed, S. (2011). Indicators to Assess Impacts on Hydro- Meteorology. Dhaka: International Union for Conservation of Nature.

Rahman, A. and Mallick, D. (2011). Climate Change Impacts on Agriculture and Food Security – Adaptation and Mitigation Options in National Policies and Strategies, Workshop Presentation, BCAS, Dhaka.

Rahman, M. (2008). Impact of Climate Change on Command Area Development of Teesta Barrage Project, IWFM, BUET, Dhaka, Bangladesh.

Ray, P. (1996). Extension Communication and Management. Naya Prakash,206 Bidhan Sarani, Calcutta, India.

Reid, H., Simms, A. and Johnson, V. (2007). Up in smoke? Asia and the Pacific: The threat from climate change to human development and the environment. New Economics Foundation : London.

Reid, P. and Vogel, C. (2006). Living and responding to multiple stressors in South Africa--Glimpses from KwaZulu- Natal. Global Environmental Change, 16(2), 195-206.

Reza, A. A. (2007). Impact of Information and Communication Technologies (ICTs) use as perceived by the farmers of Bangladesh. MS thesis. Sher-e Bangla Agricultural University, Dhaka

Rogers, E. M. (1962). *Diffusion of Innovation*, New work: The free press.

Roudier, P., Sultan, B., Quirion, P. and Berg, A. (2011). 'The impact of future climate change on West African crop yields: What does the recent literature say?', Global Environmental Change, vol. 21, no. 3,1073–83.

Shahid, S. and Behrawan, H. (2008). 'Drought risk assessment in the western part of Bangladesh', Natural Hazards, vol. 46, no. 3, pp. 391–413.

Selvaraju, R., Subbiah, A.R., Baas, S., and Juergens, I. (2006). Livelihood adaptation to climate variability and change in drought prone areas of Bangladesh: Developing institutions and options. Asian Disaster Preparedness Centre, Food And Agriculture Organization Of The United Nations: Rome.

Thomas, D.S.G., Twyman, C., Osbahr, H. and Hewitson, B. (2007). Adaptation to climate change and variability: farmer responses to intra-seasonal precipitation trends in South Africa. Climatic Change, **83(3)**, 301-322.

Thomas, T.S., Mainuddin, K., Rahman, C.C.A., Haque, A., Islam, N., Quasem, S. and Sun, Y. (2013) Agriculture and adaptation in Bangladesh: current and projected impacts of climate change. IFPRI-Discussion-Papers. Washington, USA: International Food Policy Research Institute. 2013. (1281).

Tirado, M., Clarke, R., Jaykus, L., McQuatters, G.A. and Frank, J. (2010). 'Climate change and food safety: A review', Food Research International, vol. 43, no. 7, pp. 1745–65.

UNDP, (2007) Human Development Report 2007/8. Fighting climate change: Human solidarity in a divided world. United Nations Development Programme (UNDP), New York, NY, USA, pp. 1-399.

UNFCCC, (2007). Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries, www.unfccc.org.

WHO, (2002). The World Health Report 2002: Reducing Risks, Promoting Healthy Life, World Health Organization, Geneva.

WHO (2008) Climate change and health: Resolution of the 61st World Health Assembly.Accessed on:June 24, 2011.

World Bank (2000). Bangladesh Climate Change and Sustainable Development. Washington DC: The World Bank Group.

Yamane, T. (1967). Elementary sampling theory. Prentice- Hall Inc. Englewood Cliffs, New Jersy.

Yongyut, T., Rob, A., and Eric, A. (2009) Projecting forest tree distributions and adaptation to climate change in northern Thailand. JENE.Vol. 1(3): 055-063.

Young, K., Ulloa, C., Luteyn, J. and Knall, S. (2002). Plant Evolution and Endemism in Andean South American: *An Introduction. Bot. Rev*. 68: 4-21.

APPENDIX

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

EFFECTS OF CLIMATE CHANGE ON RURAL FARMERS` LIVELIHOOD

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. Effective farm size

Please state the following information

Type of land	Farm area (in decimal /acre /hectare)
(a). Homestead area	
(b). Own cultivated area	
(c). Cultivated area leased in	
(d). Area under share cropping	
(e). Pond area	
Total area= (a+b+c+1/2d+e)	

5. Farmer's category based on their innovativeness

Please indicate your position under following farming category

a) Innovator (Willing to take risk, have the highest social status, have financial liquidity)…….

b) Early adopter (Highest degree of opinion leadership, higher social status, financial liquidity, advanced education)……..

c) Early majority (Adopt an innovation after innovator and early adopter, have above average social status, seldom hold position of opinion leadership)……

d) Late majority (Adopt an innovation after the average participant, have below average social status, little financial liquidity, little opinion leadership)……

e) Laggard (show little to no opinion leadership, tend to be focused on tradition, lowest social status, lowest financial liquidity)…….....

6. Annual family income

Please state the income of your family during last year

i) Agriculture income……Taka

ii) Income from livestock/ fisheries……..Taka

iii) Income from Non agricultural source (s)……..Taka

Total income (i+ii+iii)…….Taka

7. Agricultural extension Media contact

Please indicate the extent of contact in following sources

Sl	Name of information sources	Extent of contact				
		Regularly	**Frequently**	**Occasionally**	**Rarely**	**Not at all**
1.	Contact/model farmers					
2.	Social Worker					
3.	Agricultural input(seed / fertilizer / pesticide / equipment) dealers					
4.	SAAO					
5.	NGO Worker					
6	Union / upazilla level agricultural organization					
7	Agricultural program through mass media (radio/TV)					
8	Agricultural features in printing media (daily newspaper, leaflet, booklet, magazine etc)					

8. Food sufficiency

Please mention the amount of your reserve food

I have food reserve in my stock for…… **Meals/ days/ Months/ Years**

9. Training experience

Have you participated in any agro-based training program

Yes……../ No…… (If yes, furnish the following information)

Sl. No.	Name of the training	Sponsoring Organization	Day (s)
1			
2			
3			

10. Knowledge on climate change

Please answer the following questions

Sl.	Questions	Full Marks	Marks obtained
1.	Have you ever heard about Climate Change?	2	
2.	What are the elements of climate change?	2	
3.	Which month does the temperature highest and lowest?	2	
4.	What are the effects of temperature?	2	
5.	Which month do we call the rainy season ?	2	
6.	When does the rain fall highest?	2	
7.	Why does flood occur?	2	
8.	What is the effects of flood?	2	
9.	When do we call drought?	2	
10.	What is the effect of drought?	2	

11. Knowledge on livelihood

Please answer the following questions

Sl.	Questions	Full Marks	Marks obtained
1.	What do you know about livelihood?	2	
2.	What are the components of livelihood?	2	
3.	What amount (kcal) of nutrition is essential for a adult per day?	2	
4.	Can you cite an example of a balance diet?	2	
5.	How many clothes are sufficient for a person per year?	2	
5.	What is hygienic sanitation system?	2	
6.	What can occur if someone enjoy unhygienic sanitation facility?	2	
7.	What do you know about different types of doctor?	2	
8.	What do you think how much money is needed to maintain good life per person per day?	2	
9.	What are the sources of pure drinking water?	2	
10.	How does one person`s educational background effect on her/ his livelihood?	2	

12. Climate change effects on rural farmers` livelihood:

a) Effects on basic right

i) Please mention your daily food consumption behavior and present body weight

	Name of meal	Menu and amount (g)	Nutrition value (g)	Total nutrition value (g)	Respondent's Present body weight (kg)
2013	Breakfast				
	Lunch				
	Supper/dinner				
	Others (if any)				
2016	Breakfast				
	Lunch				
	Supper/dinner				
	Others (if any)				

Score 1 for each 100cal nutrition consumption ability per head per day, and for per 1kg body weight.

(ii). Please state preceding year your used number of clothes in preceding year and its value

Year / Number of clothes	2 clothes x value	3 clothes x value	4 clothes x value	More than 4 clothes and value
In 2013				
In 2016				

Score 1 assign for BDT1000 value change

(iii). Please state your housing condition

Year / Category of house	Slum house (1)	Two thatch tin shade with bamboo and/or timber fence boundary (2)	Two thatch tin shade with tin fence boundary (3)	Four thatch tin shade with bamboo and/or timber fence boundary (4)	Four thatch tin shade with tin fence boundary (5)	Semi-pucca building (6)	Pucca building (7)
In 2013							
In 2016							

(iv). Please state your present sources of drinking water

Year / Category of drinking water	Direct tap water(1)	Boil tap water (2)	Deep/shallow/tube well water (3)
In 2013			
In 2016			

(v). Please state your present level of education: Ref. 3

(vi). Following what type of physician usually you visit for taking treatment

Year / Category of physician	Pir/ Fakir (1)	Homeopath medicine seller (2)	Allopathic Medicine Seller (3)	Trained village medical practitioners (4)	MBBS doctor (5)	Specialist doctor (6)
In 2013						
In 2016						

b) Effect on quality of life by change in poverty level

Please indicate your present poverty position

Category of poverty	In 2013	In 2016
a. Moderate poverty (income less than160tk but more than255tk per person per day)		
b. Extreme poverty (income less than 160tk per person per day)		
i. Ultra poor (food and assets poverty)		
ii. Hard core poor (minor ethnicity and live in unfavorable location like hilly area)		
iii. Poorest of the poor (most extreme hardship, people with limited rights and capabilities)		

Score 1 assign for moderate poor, 2 for ultra poor, 3 for hard core poor and 4 for poorest of the poor.

Thank you very much for your cooperation

Signature of the interviewer

Date: