DETERMINANTS OF WOMEN FARMERS' ADAPTIVE CAPACITY TO CLIMATE CHANGE

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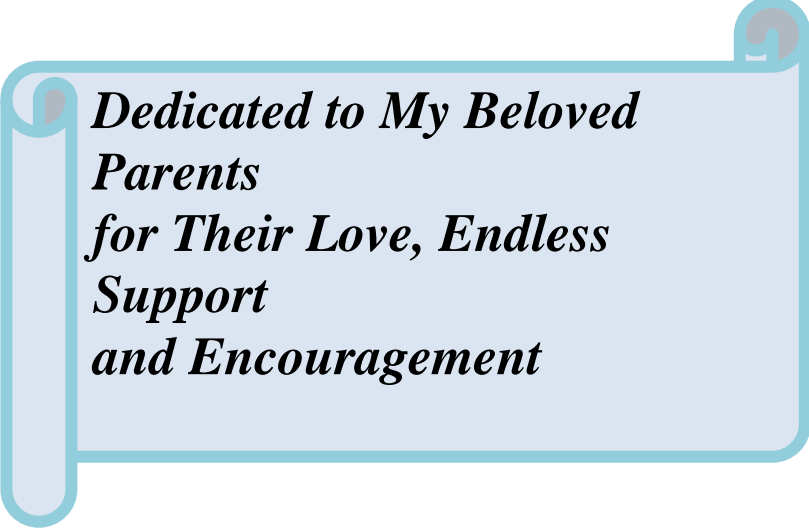Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh

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This is to certify that the research work entitled, **"DETERMINANTS OF WOMEN FARMERS' ADAPTIVE CAPACITY TO CLIMATE CHANGE"** conducted by **ANJUMAN AKTER** bearing Registration No. **11-04525 (July-December/2018)** under my supervision and guidance in the partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (M.S.) IN DEVELOPMENT AND POVERTY STUDIES** in the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka 1207, Bangladesh. 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 this study has been dully acknowledgement by her/him.

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Dedicated to My Beloved Parents
for Their Love, Endless Support
and Encouragement

ABBREVIATION AND ACRONYMS

WB   World Bank

GDP   Gross Domestic Product

et al.   Latin phrase et alia which means "and others."

NGO   Non Government Organization

FAO   Food and Agriculture Organization

SPSS   Statistical Package for Social Science

DAE   Department of Agricultural Extension

SD   Standard Deviation

SHGs   Self-Help Groups

AEO   Agriculture Extension Officer

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DETERMINANTS OF WOMEN FARMERS' ADAPTIVE CAPACITY TO CLIMATE CHANGE

BY

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ABSTRACT

The specific objective of the study was to find out the determinants of the women farmers' adaptive capacity to climate change. This study explored the factors influencing the adaptive capacity of women farmers and their contribution to climate change in the Northern region of Bangladesh. The study was conducted in two selected villages Alampur and Dodapar aunder jagannathpur union of Thakurgaon Sadar upazilla under Thakurgaon district. Data were collected from a proportionately random sample of 95 women farmers by using an interview schedule during the period from April, 2019 to May, 2019. Multiple Coefficient of Regression (β) was used in order to test the proposed hypotheses and data were analyzed by SPSS v.23to test the model significance. Five(5%)percent level of significance was used to test the significance level of each hypothesis. The findings revealed that the majority (76.8%) of the women farmers had a moderate level of adaptive capacity while (12.6%) and (10.5%) had low and high level of adaptive capacity, respectively with regards to climate change.Results also indicated that among seven selected characteristics of the women farmers, four namely perception towards climate change, education, family size and knowledge on climate change had significant positive contribution to their adaptive capacity and the rest three characteristics namely, age, farm size, annual family income had no significant contribution to their adaptive capacity concerning climate change. Therefore, the study recommends that smallholder women farmers should form farmer-based associations to share their perception; agricultural extension official should intensify contacts with farmers to educate them on modern agronomic practices to minimize climate change effect, and women farmers be given priority in terms of income generation projects of government and Non-Governmental Organizations in the region to increase their adaptive capacity to climate change.

CHAPTER I

INTRODUCTION

1.1General Background

Bangladesh is a South Asian developing country. It is the fifth most populous country in Asia and the seventh in the world. Its population growth rate is 1.36% and now its population is 150,790,000 (Economic Survey of Bangladesh, 2017). The population in Bangladesh is predominantly rural. Rural population (% of total population) in Bangladesh was reported at 64.96 %, among them 33.17% are rural women (World Bank, 2016). An overwhelming majority of rural population is mainly dependent on agriculture sector both for its employment and livelihood. Development of socio-economic condition of Bangladesh fully depends upon the development of the village.Agriculture is the single largest producing sector of the economy and it contributes about 14.79 percent to the total Gross Domestic Product (GDP) of the country.This sector accommodates around 45.1% labour force (BBS, 2017).

About 70 percent people live in rural areas in 15.4 million households and in about 85000 villages. About half (49%) of population of Bangladesh is women among them 45.6 percent are associated with the farming related economic activities (Agricultural Diary, 2012). About 20 to 70% of rural women are involved in agricultural production and post-harvest activities as economic activities. Participation rate for women in agriculture has increased by 136.025%, while overall adult participation has increased by 55.97% during the period from 1999-00 to 2016-17. During the same period participation of male has reduced drastically by 16.26%. During 2002-03 women spent almost 48 hour per week in the rural area and in urban area this was only 28 hour, while in 2016-17 it is 33 hour for both areas.

Woman constitutes about 48% of the total population in Bangladesh and majority of them living in rural areas can play a vital role if they are properly involved in income generating economic activities in rural aspects. Women's involvement in rural development, more particularly in agricultural development in Bangladesh, is the most important strategy designed to improve the social and economic life of specific group of farming community.

Bangladesh is now widely recognized to be one of the countries most vulnerable to climate change. Climate change is one of the emerging challenges for the world community. Agriculture is always vulnerable to unfavorable weather events and climate conditions.

Although due to natural calamities loss of food and cash crop is almost regular phenomenon. Bangladesh incurs annual loss of 1.81% of GDP due to extreme weather events. Total losses were 2.56 billion dollar a year from 1990 to 2017 (Anonymous, 2017).Natural hazards that come from increased rainfall, rising sea levels, and tropical cyclones are expected to increase as climate changes, each seriously affecting agriculture, water and food security, human health and shelter. Climate change is a global challenge that burdens all of humanity, but not equally. The world's poor, the majority of whom are women, are encumbered disproportionately. As the world confronts the borderless and multidimensional effects of climate change, we must understand the impact of climate change on women, as well as the importance of their agency in addressing its threats. Women are contributing to both adaptation and mitigation efforts in many parts of the world, and they are creating innovative and localized solutions to build resilient communities. In Bangladesh, investment in capacity building has to be and needs to be augmented to improve the adaptive capacity of organizations, institutions and individuals.

The Intergovernmental Panel (IPCC) on Climate Change observed that the occurrence of multiple stresses and low adaptive capacity makes Bangladesh one of the most vulnerable continents to climate change and variability. Across the tropical region of which Bangladesh is located, the agricultural productivity of women farmers is hindered by climatic stressors. Climate change and variability are predicted to unduly affect smallholder women farmers, making their lives more precarious. Generally, the agricultural activities of female farmers lack the needed resources vis-à-vis their male compatriots. This difference affects the efficient capacity of female farmers to adapt to the adverse effects of climatic stressors adequately. As a first step of that initiative, this study was designed to investigate the determinants of women's adaptive capacity towards climate change for informed policy formulation is therefore, necessary to improve upon the livelihood of women farmers. Therefore, this study sought to investigate the determinants of women farmers' capacity to adapt to the numerous effects of climate change and variability in Thakurgaon District.

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, droughts, irregular rainfall, high temperature, flash floods, etc. that resulted from global warming. Due to climate change, farmers` agriculture 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, the high temperature increasing abnormalities in rainy season patterns and rising sea levels are already having an instant effect on climate condition through reducing food production. Women produce over 50 percent of the world's food (FAO, 2011) and constitute about 43 percent of the agricultural labor force, both globally and in developing countries (Doss, 2014). But the limited capabilities of women farmers towards climate change can be overlooked. Rural women are the unprivileged category of society. Investment in capacity building has to be and needs to be augmented to improve the adaptive capacity of organizations, institutions and individuals. Women can play a vital role in our economy. Active participation with capacity of women farmers is important for the implementation of any development program.

Intending to investigate the difficult situation confronted by women farmers in climate change which significantly can contribute to agriculture production, the researcher undertook this piece of study entitled "**Determinants of women farmers' adaptive capacity to climate change".**

The purpose of this study was to know the answer to the following questions:

   i.   What were the characteristics of women farmers' in relation to their adaptive capacity concerning climate change?

  ii.   What is the extent of women farmers' adaptive capacity to climate change?

 iii.   What are the contribution of the selected factors to women farmers' adaptive capacity to climate change?

1.3 Objectives of the Study

The following specific objectives are formulated in order to get proper direction of the study:

i. To describe the selected characteristics of women farmers' in relation to their adaptive capacity concerning climate change.

ii. To determine the extent of women farmers' adaptive capacity with regard to climate change.

iii. To explore the contribution of the selected factors to women farmers' adaptive capacity to climate change.

1.4 Justification of the Study

Research studies investigating women farmers' adaptive capacity particularly in climate change are not very common. Few studies investigated the adaptive capacity to gender issue and few studies investigate the adaptive capacity to climate change issue; however,very few studies integrated climate change and their impact on women farmers' lives. Taking into this consideration, the study was initiated to fill these gaps. If women are to reap the benefits of adaptive capacity in society, it is vital to mitigate the adverse effect of climate change in all aspects of development and policy. Only through a process of determining the factors can be built that truly enables women's adaptive capacity in climate change. The study would create awareness to enhance adopting capacity where the hidden potential could be utilized fully for the development. As for the selection of the rural areas of Thakurgaon district for this study is concerned, women do practice several adaptive capacities here and it is easily accessible for the researcher.

1.5 Assumption of the Study

The researcher had the following assumptions in mind while undertaking this study:

1. The respondents had enough capacity to provide proper response of the question furnished in the interview schedule.

2. The responses furnished by the respondents were valid and reliable.

3. Information furnished by the respondents included in the sample was the representative opinion of the whole population of the study area.

4. The researcher who acted as the interviewer was well adjusted to the social and environmental condition of the study area. Hence, the respondents were free from hesitation and furnish the correct opinion.

5. All the data regarding the variables of the study were normally and independently distributed with mean and standard deviation.

1.6 Limitations of the Study

Since the study is an empirical one based on field-work through the interviews of women of two villages of Thakurgaon district, Bangladesh, it has some obvious limitations. These are as follows:

1. Data collection through primary source or through the interview was a time-consuming matter. The respondents sometimes were found non-cooperative with the interviewers.

2. Gathering information from some of the women was sometimes very difficult and extremely time-consuming. They did not give enough time to the interviewers.

3. Further, it was also found that women worker have a tendency to disclose lower income and higher expenses. They think that this would help them to get more credit. This is considered to be a limitation of the research study.

4. Contacting women to gather information was a very difficult task because of their involvement in household works, family maintenance also with gardening or other income-generating activities.

5. A survey was conducted with a relatively smaller sample size which might limit the generalizability of the findings.

CHAPTER II
REVIEW OF LITERATURE

This chapter is devoted to the review of past researches related to this study. The researcher made extensive effort to review the previous research works directly or indirectly relevance to the present study by different researchers in home and abroad. This study is mainly related with the determinants of women farmers' adaptive capacity with regard to climate change. The researcher tried to collect needed information by thorough searching of related theses, literature, periodicals and the Internet. However, determination of women farmers' adaptive capacity with regard to climate change was rarely available. To address the research objectives, this study therefore reviews the existing different literature. However, the literature reviewed were presented into three sections. The first section is concerned with the review of literature on the concept of adaptive capacity and shows how women develop their capacity . The second section identifies the salient factors that might influence women farmers' adaptive capacity and their relation. The third section proposes a conceptual framework of this study based on the discussion presented in first two sections.

2.1 Concept of Adaptive capacity

The concept of adaptive capacity has been increasingly adopted in scientific sustainability, research, and policymaking. The concept was popularized by IPCC (Abdul-Razak & Kruse, 2017), and from there on, it has gained attention in environmental sustainability and climate change research. The Fifth Assessment Report of the IPCC defines adaptive capacity in relation to climate change as the ability of systems, institutions, humans, and other organism to adjust to potential damage, to take advantage of opportunities, or to respond to consequences the Intergovernmental Panel on Climate Change (IPCC, 2014).

According to Jorgensrud (2014), adaptive capacity is the ability to design and implement effective adaptation strategies or to react to evolving hazards and stresses so as to reduce the likelihood of the occurrence and or the magnitude. The concept of adaptive capacity is highly used in relation to the vulnerability of social-ecological systems (Abdul-Razak & Kruse, 2017) for the purpose of this paper, adaptive capacity is the ability to adapt to changing conditions. Some scholars such as Adger (2006) and Houghton et al. (2001) suggest that adaptive capacity represents the potential of a system to adapt, rather than just adaptation. The process requires

the capacity to learn from previous experiences to cope with current climate and to apply those lessons to cope in future. Adaptations are the actions of individuals, communities and governments undertaken for the purpose of improving or protecting well-being (Adger *et al*.2005).Adaptive capacity is also defined as a system's ability to reduce the possible consequences of climate variability through prevailing opportunities or employing measures to deal with these consequences (FAO,2009). Adaptive capacity varies among systems and is influenced by natural, economic and human resources as well as social networks, political power and technology accessible to the system (Etwire *et al*,2013b)

Adaptation to climate change is a process that initially requires famers to perceive Therefore, adaptation to climate change is a process that initially requires famers to perceive that the climate has changed and then identify the necessary adaptations to be implemented (Mustapha,2012). In order to reduce the potential negative, director indirect effects of climate change on the agri-food system, populations must adapt and economic systems must be adapted to future climatic contexts (Sombroek,1992).However, this study only focuses at women farmers' capacity development to enhance their ability to adapt to the adverse consequences of climate stresses such as floods and drought.

2.2 Women's Capacity Development

Since introduced adaptive capacity has been considered as an important approach to develop. Development is a continuous process of improving one's particular skills and expertise. Capacity development facilitates individuals or organizations to locate local resources with a view to increase and manage development goals in a sustainable way (Stephen, Brien & Triraganon, 2006).Capacity development is not referred to a single entity rather it is important for all levels, from individuals to organizations as well as communities (Paul and Thomas, 2002). The emphasis should be on updating knowledge, skills and ability of people at various levels to be more effective to manage changes (Coutts, et al., 2005). Improving the capacity of individuals, groups, organizations and communities is necessary for rural development.

Amin and Hadi (1998) showed that age and years of schooling were positively correlated with buying capacity and decision making role in the household. Buying capacity and decision making role and power relation with the husband increased higher for the women who were

involved in credit based programs than for the women who were not involved. Khan (1999) reported that micro-finance programs are increasingly popular in Bangladesh. The paper examines the loan use pattern on women involved in wage employment and the benefits they gain from such loans. It is thus, argued that more employment opportunities should he created for women as these would help to promote economic and social empowerment.

Beguni and Biswas (1998) found that education, women's income and employment had positive impact on decision making power of women. Mobility of women was also positively related with education, women's income, employment and involvement with development institutions and mass media contact. Women's empowerment is the combined effect of multi-dimensional factors, such as disseminating ability, autonomy, mobility etc. Therefore, Earning an independent income through credit access has shown to lead to an increase in women's ability to increase 'voice' in the household decision making process(Kabeer,1998).

Banu (1996) in her study examined the relationship between women's access to training and their empowerment with special reference to Bangladesh situation Women empowerment was measured in terms of' raising awareness, self confidence, economic independence and decision- making process in the household. It was revealed that training had an impact on the behavioral predisposition. Skills of women were also developed through skill development training.

Chandramoni (2005) observed that involvement of women was essential in all stages of economic and social activities. Therefore, organizing women in self-help groups (SHGs) will enhance the Mains of women as the participant decision- maker and beneficiaries in the democratic, economic and cultural sphere of life.

Pankajam *et al*. (2005) found that the rural woman was disadvantages compared to her urban counterpart. The profile of rural women was that of illiterate, ignorant. Superstitious, suppressed and oppressed because of their limited skills. The rural women need to be trained, educated and organized so that she is empowered to be equal to her counterpart in the urban area.

Developing the capacity of women ensures that they receive sufficient trainings and develop certain capabilities to cope with sudden changes in demand.

2.3 Identification of Determinants of Women farmers' Adaptive Capacity and its Relation to Climate Change

There are some studies conducted by on the stated topic that will help to put light on the fact of determinants of women farmers' adaptive capacity with regard to climate change.

Abdul-Razak *et al*. (2017) in his study holds true for the agriculture sector of the Northern Region of Ghana which is largely rain-fed and dominated by smallholder farmers with minimal livelihood alternatives. The main research question of this paper is how the adaptive capacity to climate change of smallholder farmers in the Northern Region of Ghana can be characterised.The paper proposes an indicator-based framework for assessing the adaptive capacity of smallholder farmers in the Northern Region of Ghana along six main determinants of adaptive capacity: economic resources, social capital, awareness and training, technology, infrastructure and institutions.

Alhassan *et al*. (2018) investigated a study on the indigenous and research-based strategies of smallholder women rice farmers in adapting to climate variability. The results revealed that farmers perceived crop-related practices (mixed cropping and indigenous varieties) to be the most effective indigenous adaptation strategies while improved variety strategies (high yielding, early maturing and drought-resistant varieties) are the perceived most effective research-based adaptation strategies.

Alhassan *et al*. (2018) observed in a study on farmers' vulnerability to climate change and variability in the northern region of Ghana. The results revealed a significant difference in the vulnerability levels of female-headed and male-headed farming households. Female–headed households were more vulnerable to livelihood strategies, socio-demographic profile, social networks, water and food major components of the livelihood, whereas male-headed households were more vulnerable to health. The vulnerability indices revealed that female–headed households were more sensitive to the impact of climate change and variability. However, female-headed households have the least adaptive capacities. In all, female-headed farming households are more vulnerable to climate change and variability than male-headed farming households.

Al-Hassan *et al*.(2013) have conducted a study on the determinants of Choice of Indigenous

Climate related Strategies by Smallholder Farmers in Northern Ghana. The empirical results reveal that presence of a market, informal credit from friends and relatives, location of farmer, farmer-to-farmer extension, noticing of a decrease in rainfall and noticing an increase in temperature influence the choice of indigenous climate related strategies.

Alhassan *et al*.(2017) conducted a study that explored the factors influencing the adaptive capacity of smallholder women farmers to climate change and variability in the Northern region of Ghana. The empirical results revealed that membership of a farmer-based group, formal extension services, off-farm income, access to tractor, land ownership and participation in decision making significantly influence the adaptive capacities of female farmers to climate change and variability positively while farmers' age and hired labor have negative influence on the adaptive capacities of smallholder female farmers.

Apata and T. G. (2011) conducted in a study Sub-Saharan Africa (SSA) on the impacts of climate change on agriculture and factors influencing farmers'choice of adaptation measures. This analysis shows that 64.57% of farmers have adopted one or more of the major adaptation options identified through the research survey. Education of the head of household, livestock ownership and extension for crop and livestock production, availability of credit and temperature are factors influencing the choice of adaptation.

Defieta *et al*. (2014) on the other hand, showed that variations in adaptive capacity were caused by differences in information resources, physical and financial resources. It was also found out that despite their level of adaptive capacity, households employed measures to adapt to climate change and variability. Households with higher adaptive capacity employ more adaptation strategies.

Deressa (2009) conducted a study by farmers to adapt to climate change in the Nile Basin of Ethiopia, the factors that affect their choice of method, and the barriers to adaptation. The methods identified the include use of different crop varieties, tree planting, soil conservation, early and late planting, and irrigation. Results from the discrete choice model employed indicate that the level of education, gender, age, and wealth of the head of household; access to extension and credit; information on climate, social capital, agro-ecological settings, and temperature all influence farmers' choices. The main barriers include lack of information on adaptation methods and financial constraints.

Etwire *et al.*(2013)identified from a study that sex, age, farm size, access to formal agricultural extension, agro ecology and noticing of unpredictable temperatures were the factors influencing farmers' adoption of climate-related strategies introduced by research institutions. The empirical results imply that targeting females, increasing access to agricultural extension services and creating more awareness about changes in temperatures are important in promoting the adoption of climate- related technologies introduced by research.

Gbetibouo (2009) investigated the factors determining farmers' choice of adaptation strategies to climate change and variability in the Limpopo Basin of South African. The findings revealed that whereas farming experience, farm size, soil fertility, temperature, off-farm income, perceiving increased temperature and access to extension services positively influenced farmers' choice of adaptation strategies however interestingly;- wealth was found to exert to a negative influence on such decisions of farmers. Perceived change in rainfall, education level of women farmers and access to climate information were, however, not significant.

Hassan *et al.* (2008) analyzed a study on determinants of farm-level climate adaptation measures in Africa .The results indicate that specialized crop cultivation (mono-cropping) is the agricultural practice most vulnerable to climate change in Africa. Better access to markets, extension and credit services, technology and farm assets (labor, land and capital) are critical for helping African farmers adapt to climate change. Government policies and investment strategies must support education, markets, credit and information about adaptation to climate change, including technological and institutional methods, particularly for poor farmers in the dry areas of Africa.

 Lambrou and Piana (2006) argue that women's ability to adapt to climate change depends on their control over land and money,; access to credit and safeguards,; low dependency ratios,; good health,; personal mobility,; and household entitlements.

In another study, Tambo and Abdoulaye (2013) investigated how smallholder farmers in the Nigerian Savanna perceive and adapt to climate change. The results show that most of the farmers have noticed changes in climate and have consequently adjusted their farming practices to adapt. The main adaptation methods include varying planting dates, use of drought

-tolerant and early maturing varieties and tree planting. Some of the farmers are facing limitations in adapting because of a lack of information on climate change and the suitable adaptation measures and lack of credit. The study then concludes that adaptation to climate change in the region requires,- concerted efforts to design and promote planned adaptation measures that fit into the local context and also to educate farmers on climate change and appropriate adaptation measures.

Mabe *et al*. (2012) identified a number of factors on farmer's_ choice of adaptation strategies and reported that farming experience, farm income, access to phones, mixed farming, perception on reduction in rainfall amount and access to weather information significantly and positively affects the choice of at least five climate change adaptation strategies. Following the findings of this study, agricultural extension service should be intensified through organization of adult education programmers or field schools for farmers to educate them on some climate change adaptation strategies.

Nabikolo *et al.* (2012) stated that adaptation is considered an appropriate response to climate change and variability, especially for smallholder farmers. However, the response decisions and actions of male and female farmers may be influenced by various factors.Climate change adaptation decisions of female heads depended on and were sensitive to more covariates compared to the decisions of male heads of household. Furthermore, climate change adaptation decisions of female heads were influenced by more liquid household assets, while those of male heads were influenced by real estate, especially land. Additionally, beyond gender, other demographic factors appeared to play no significant role in the decision to adapt to climate change.

Obayelu *et al*.(2014) conducted a study on farmers' choices of adaptation to is for ensuring food security and poverty alleviation. The finding revealed that the factors explaining farmer's choices of climate change adaptation include age of the farmers, gender of the household head, years of education, years of farming experience, household size, farmers information on climate change, farmers access to credit, farm income, non-farm income, livestock ownership and extension contact.

Sani *et al*. (2016) found from a study on farmers' perceptions of climate change, its adverse effects on farmers' livelihood and adaptation strategies in sub-Sahara Africa.

Suhiyini Issah *et al*.(2017) conducted a study on the factors influencing the adaptive capacity of smallholder women farmers to climate change and variability in the Northern region of Ghana. The empirical results revealed that membership of a farmer-based group, formal extension services, off-farm income, access to tractor, land ownership and participation in decision making significantly influence the adaptive capacities of female farmers to climate change and variability positively while farmers' age and hired labor have negative influence on the adaptive capacities of smallholder female farmers.

Tambo and Abdoulaye (2012) have found from a study that climate change is a major problem undermining agricultural production in Africa. Consequently, efforts are being made to provide farmers with adaptation technologies, but little empirical research exists on the determinants of adopting such technologies. Results from the study indicate that among the key determinants of adoption are access to the technology, complementary inputs, extension services, and climate change information. We also show that off-farm income and wealth status of a household play a significant role in the adoption of climate change.

The finding showed that the choice of adaptation strategies differs between countries, regions, and households. At household level, most of the empirical evidence revealed that age, gender of household head, farming experience, household size, years of formal education, access to credit facilities, distance from market, access to extension services and access to off-farm income generating activities are the most important factors influencing farmers' decision regarding climate change adaptation and choice of adaptation strategies.

2.4 Relationships between the Selected Characteristics of Women Farmers' and Their Adaptive Capacity to Climate Change

Women farmers' adaptive capacity towards climate change largely depends on their ability to make independent decision and their access to the resources. Women having the ability to make independent decisions in other aspects of work and life are expected to be more capable of making decisions regarding climate change adaptation strategies.

2.4.1 Age and adaptive capacity

Akter (2000) in his study found that there was a significant positive relationship between age of the women and their participation in the decision-making role in the family.

Ali*et al.* (1986) observed that there was a positive and significant relationship between the age of the marginal farmers and their adoption of jute technologies.

Begum *et al.* (2000) in their study, found that there was no significant effect of age of women on their taking household decisions.

Bhowmick (2004) found that there a was significant but negative relationship between age and empowerment of the women beneficiaries of a selected NGO in Narshingdi district.

Biswas (2008) found that the age of the rural women had a significant but negative relationship with their accessibility to the family decision-making process.

Mehta and M. D.(2008) observed that age has a significant negative effect on the adaptive capacity of women farmers to climate change and variability.

Sarkar (2005) stated that there was a significant and positive relationship between the level of education of the women beneficiaries of concern Bangladesh and their level of empowerment.

2.4.2 Education and adaptive capacity

Akter (2000) in his study found that there was a positive significant positive relationship between the education of women and their participation in the decision-making in the family.

Hossain (2003) concluded that the education of the farmers had a significant and positive relationship with their adoption of modern Boro rice cultivation practices.

Kaur (1988) found that education influenced the opinion of the women about the adoption of vegetable gardening animal husbandry etc.

Mehta and M. D.(2008) observed that education has a significant negative effect on the

adaptive capacity of women farmers to climate change and variability.

Rahman (2001) conducted a study on knowledge, attitude, and adoption of the farmersregarding Aalok 6201 hybrid rice in Sadar upazila of Mymensingh district. He found that the academic qualifications of the farmers had a significant and positive relationship with their adoption regarding Aalok 6201 hybrid rice.

2.4.3 Family size and adaptive capacity

Halim and McCarthy (1985) reported that women performed different types of economic activities post-harvest, vegetable gardening, livestock care etc.

Mehta and Sonawane (2012) found that the family size of the farmers showed a negative relationship with their adoption of recommended mango cultivation practices.

Rahman (2001) conducted a study on knowledge, attitude and adoption of the farmers regarding Aalok-6201 hybrid rice in sadar upazila of Mymensingh district. He found that the family size of the fanners had no significant relationship with their adoption of Aalok-6201 hybrid rice.

Sheheli (2003) in her study concluded that the family size of the rural women had a significant positive relationship with their extent of use of indigenous technologies.

Singh (2010) found that the family size of the farmers showed a positive relationship with their adoption of potato cultivation practices.

2.4.3 Farm size and adaptive capacity

Asaduzzaman (2003) found no significant relationship between the farm size of rural women and their decision-making ability.

Bhaumik *et al.* (1996) in a study found that the socio-economic status of rural women had no significant relationship with their performance in decision-making process.

Bhowmick (2004) found that there was no significant relationship between farm size and empowerment of the women beneficiaries of a selected NGO in Narshingdi district.

Sarkar (2005) concluded that there was no significant relationship between the farm size of the women beneficiaries of CONCERN Bangladesh and their level of empowerment.

2.4.5 Annual income and adaptive capacity

Asaduzzaman (2003) found a significant relationship between the annual income of rural women and their decision-making ability.

Bhoumick (2004) found that there was a significant and positive relationship between annual income and empowerment of' the women beneficiaries of a selected NGO in Narshingdi district.

BRAC (1995) reported that the family income of rural women had a significant effect on their decision-making power status in the family and mobility. It was also found that individual contact of the rural women had a significant influence on their improvement of knowledge, attitude and skills.

CIRDAP's (1998) study found this condition that working women with access to personal income exhibit a greater degree of autonomy and participation in household decision-making, leading to better feeling of self-worth and high status within the households. The central message of this is that economic improvement of women is a fundamental issue for attaining a reasonable degree of empowerment.

Sarkar (2005) reported that there was no significant relationship between annual family income of the women beneficiaries of CONCERN l3anuiadesh and their level of empowerment.

2.4.6 Knowledge and adaptive capacity

Akter (2000) reported that there was a significant positive relationship between agricultural knowledge of the women and their participation in decision making in the family.

Azad (2003) mentioned from his research findings that there was a significant positive relationship between agricultural knowledge of the women and their participation in decision making role in the family regarding farming activities.

Bhowmick (2004) found that there was a significant and positive relationship between agricultural knowledge and empowerment of the women beneficiaries of a selected NGO in Narshingdi district.

Sarkar (2005) in his study stated that there was a significant and positive relationship between knowledge of the women beneficiaries of CONCERN Bangladesh and their level of empowerment.

2.4.7 Perception and adaptive capacity

Despite the fact that no direct study was found that support women's perception towards climate change and their adaptive capacity, it is however expected that women having a considerable level of knowledge about and experience at climate change events are more keen to adopt strategies to minimize adverse effects of climate change.

2.5 Conceptual Framework

Conceptual frameworks are often visual and allow those reading the framework to understand the flow of research. In other words, the conceptual framework is the researcher's understanding of how the particular variables in his/her study connect. Thus, it identifies the variables required in the research investigation. It is the researcher's "map" in pursuing the investigation. In scientific research, selection and measurement of variables constitute an important task. This study is concerned with the determinants of women farmers' adaptive capacity concerning climate change. It is evident from the past studies that every occurrence or phenomenon is the consequence of a number of variables, which may or may not be interdependent or interrelated with each other. In other words, no single variable can contribute wholly to an incident. Thus, Determinants of women farmers' adaptive capacity about climate change was the predicted or dependent variable and 7 selected characteristics of the women farmers' were considered as the causal or independent variables to the study. Considering the discussion, a conceptual framework has been developed for this study, which

is diagrammatically presented in Figure 2.1:

Causal variables		Focus variable
- Age - Education - Family Size - Farm Size - Annual Income - Knowledge on climate change - Perception towards Climate change	➡	Determinants of women farmers' adaptive capacity to climate change.
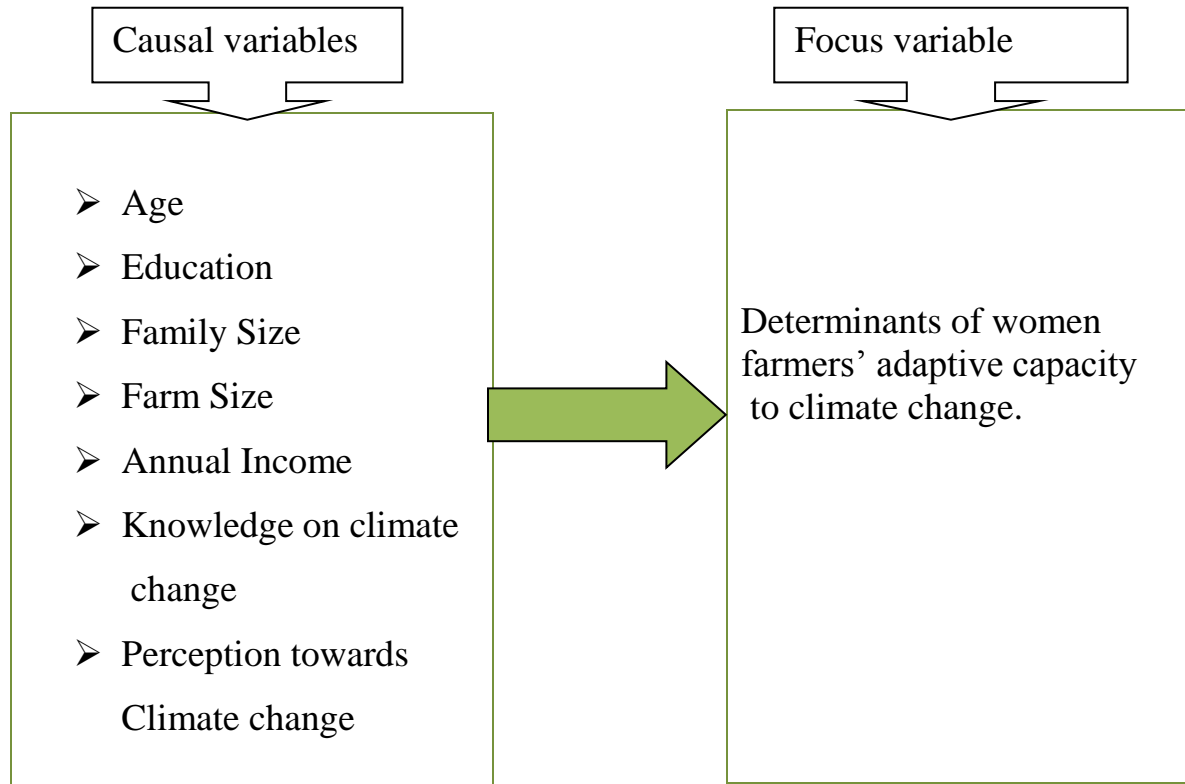
Figure :2.1 The conceptual framework of the study

CHAPTER III

MATERIALS AND METHODS

This chapter portrays the methodology and techniques utilized as a part of this study. Methodology is an indispensable and integral part of any study. Methodology is simply the means by which we collect and analyze data.This part is isolated into three areas. The primary area portrays the diagram of the research outline. The second area depicts the measurement of variables. At long last, the third area depicts the strategies applied in data analysis.

3.1 Locale of the study

Thakurgaon Sadar upazila of Thakurgaon district was selected purposively for this study. There are 22 unions in Thakurgaon Sadar upazila. The study was conducted at two villages of Jagannathpur union of Thakurgaon Sadar upazila under Thakurgaon district. There are 11villages in Jagannathpur union. Out of 11 villages two villages namely Alampur and Dodapara were selected purposively. The main reasons for selecting study area were as follows:

    i.   Easy accessibility and good communication facilities

    ii.   Expected better cooperation from the respondent since the area and language of the respondent is well known to the researcher.

    iii.   No such type of study was conducted previously in the study area.

A map of Thakurgaon district showing Thakurgaon Sadar upazila is presented in Figure 3.1 and a map of Thakurgaon Sadar upazila showing the study area is presented in Figure 3.2
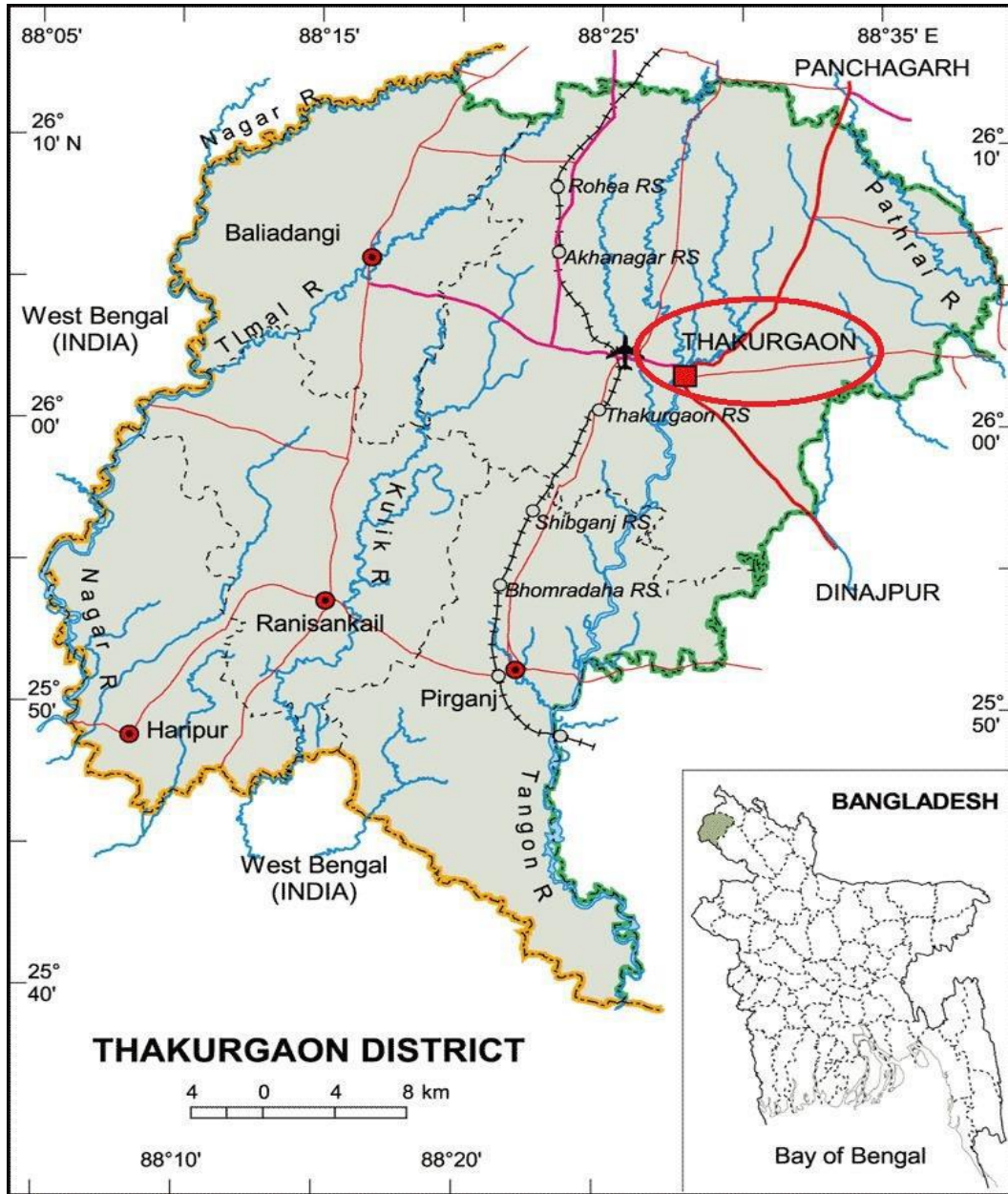
Figure 3.1 A map of Thakurgaon district showing Thakurgaon Sadar upazila

Figure 3.2 A map of Thakurgaon Sadar upazila showing the study area

3.2 Population and Sampling Frame

As the study concern about the rural women farmers who were affected by climate change involving in agriculture selected two villages constituted the population of the study. A list of rural women farmers of the study villages was prepared by the researcher with the help of Sub-Assistant AgricultureOfficer (SAAO) of Thakurgaon Upazila agriculture office.The researcher was able to interview 95 women farmer out of 349 based on their ability during the data collection period (April to may 19,2019) and their consent to participate in the survey. The lists

comprised of 349 farmers who served as a population of the study. Thus the total sample size was 95 of which 46 was from Alampur and the other 49 was from Dodapara.

The distribution of the sample farmers from the villages is shown in Table 3.1

Table 3.1 Distribution of population and sample of women farmers' of the selected villages

Name of the Villages	Population	Sample size
Alampur	169	46
Dodapara	180	49
Total	349	95

3.3 Instrument for Data Collection

Since the purposes of this study were to test the hypotheses and measure the variances, a cross-sectional survey method was adopted for this study. Hence, data were collected by using a structured interview schedule. Keeping the objectives in mind, the study adapted validated measurement items from prior studies, whenever possible. The previously prepared interview schedule was pre-tested and necessary modifications were carried out. In most instances, closed-form questions were used. Data for this study were collected through personal interviews by the researcher herself from April to May 19, 2019. Data were collected from the respondents in face-to-face situation using the structured questionnaire. Approved estimation things of each construct with their literature sources were exhibited in an English version of the interview schedule as joined in the Appendix-A.

3.4 Variables of the Study

A variable is an attribute that describes a person, place, thing, or idea. The value of the variable can"vary" from one entity to another. Research cannot be possible without taking into consideration measurable factors that are subject to change due to circumstances. Anything that can vary in research due to circumstances is called a variable. In a descriptive social research, selection and measurement of the variable constitute an important task. The variables should be determined in accordance with the research purpose and components. According to research objectives independent and dependent variables were used in this study.

Dependent variable:-

It is a variable that is the outcome or result or impact of different factors. This variable is frequently known as a criterion or reliant variable. The estimation of the reliant variable relies upon the estimation of alternate factors, that is, autonomous factors. In this study, 'Determinants of women farmers' adaptive capacity with regard to climate change was considered as the dependent variable.

Independent variables:-

These variable are regularly called indicator variables or predictor variables. In a trial setting, a researcher needs to control the variable or acquaint another variable with seeing its impact on the criterion variable. In this study, seven independent variables were used. These were: Age, Education, Family size and Farm size,Income, Knowledge and Perception.

3.5 Measurement of Variables

3.5.1 Measurement of Independent variable

3.5.1.1Age:

Ages of respondents were determined by the number of years from their date of birth to the date of the interview on the basis of their response. A score of one (1) was assigned for each year of one's age. Since Bangladeshi rural women usually do not keep record of their date of birth, the age mentioned by them seems to be estimation on guess. This variable has been shown in question no. 1 of the interview schedule presented in Appendix-A

3.5.1.2 Education:

Level of education was measured as the ability of an in individual respondent to read and write or the formal education received up to a certain standard. If a respondent did not attain formal education, his score was assigned as zero (0). A score of 0.5 was given to a respondent who only could sign his/her name. A score of one (1) was assigned for each year of schooling. If a respondent passed the S.S.C examination, his education score was given as 10, 12 for H.S.C., and so on. This variable appears in question no.2 in the interview schedule as presented in Appendix-A.

3.5.1.3 Family Size

The family size of a respondent was computed by the total number of her family members including herself, her husband, children and other dependents eating and staying together. This variable has been shown in the question no.3 of the interview schedule presented in Appendix-A.

3.5.1.4 Farm Size

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

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

Where,

A= Homestead area including pond

B= Own land under own cultivation

C= Land given to others as borga

D = Land taken from others as borga

E=Land taken from others as lease

The total farm size of each respondent was categorized into 4 types (Islam, 2007). The farmers who had land bellow 0.20 hectare were considered as a marginal farmer. The farmers who had land between >0.20 to 1.00 hectare were considered as small farmers; the farmers who had land >1.00 to 3 hectares were considered as medium farmers and farmers who had land 3 or above hectares were considered as large farmers. This variable appears in item number 3 in the interview schedule as presented in Appendix-A.

3.5.1.5 Annual family income

Annual income was measured in terms of total financial return of a household from agriculture (Crops, livestock, poultry and fish) and non-agriculture sources (service, business, day labor, and others) in one year. The value was expressed in Taka. According to their annual income, farmers-income was categorized as low income, medium income and high income. This variable appears in item number 5 in the interview schedule as presented in Appendix-A.

3.5.1.6 Knowledge on climate change

Knowledge of the women farmers towards climate change was measured on eleven basic open-ended questions. Two marks assigns for each question.Knowledge of rural farmers was determined by summing up the weights for their responses to all the eleven statements. Full marks was given for appropriate answer and partial score was given for partially correct answer whereas 0 (zero) score was given to wrong or no answer. This variable has been shown in the question no. 6 of the interview schedule.

3.5.1.7 Perception of climate change

Respondents' responses were captured by a five-point rating scale ranging from 'strongly agree' to 'strongly disagree' as follows against four statements.

Items	Score Assigned
Strongly disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly agree	5

The perception of climate change was determined by summing the scores of all the four items. Thus, the score could range from 12 to 60, where '12' indicates strongly disagreement and '60' indicates strongly agree. This variable appears in the question no. 7 in the interview schedule.

3.5.2. Measurement of dependent variables

The adaptive capacity of women farmers' in regard to climate change was measured on the basis of opinion provided by the respondents. The respondents' responses were captured using a five-point scale (1-5) ranging from 'strongly disagree' to 'strongly agree'.

Items	Score Assigned
Strongly disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly agree	5

The perceived adaptive capacity score of a respondent was obtained by adding the scores and it could range from 7 to 35, where '7' indicates no adaptive capacity and '35' indicates high perceived adaptive capacity. This variable appears in item number 8 in the interview schedule.

3.6 Data Processing and Analysis

3.6.1 Editing

Raw data were appropriately explored for omitting errors. The researcher made careful scrutiny when she completed an interview so that all data were included to facilitate coding and tabulation.

3.6.1 Coding and tabulation

The researcher consulted with the research supervisor and co-supervisor, made a detailed coding plan. All responses were given an in numerical scores. The respondent responses were transferred to a master sheet to facilitate tabulation. In accordance with the objectives of the research, all of the data were tabulated.

3.6.3 Categorization of data

For coding operation, the collected data were classified into various categories. These categories were developed for each of the variables based on their possible range (max and min). The procedure and categorization of a particular variable were further discussed in Chapter 4 in detail.

3.6.4 Method of data analysis

Both descriptive and inferential statistics were used to analyze the data. Descriptive statistics such as frequency distribution, percentage, range, mean, and standard deviation were used to present the general characteristics of the data set while inferential statistics like Multiple Coefficient of Regression (β) was used in order to test the proposed hypotheses. The SPSS v.23.0 was used to perform all these analyses.

Five (5%) percent level of significance was used to test the significance level of each hypothesis. If the computed value of (β) was equal to or greater than the designated level of significance, than the hypothesis was supported and it was concluded that there was a significant contribution

of the independent variables to the dependent variable. And if the computed value of (β) is smaller than the designated level of significance than the hypotheses were not supported. Therefore, it assumes that there was no significant contribution of the independent variables to the dependent variable.

3.7. Statement of the Hypothesis

In order to guide relevant data collection, analysis and interpretation of data, a set of hypothesis would be formulated for empirical testing. As defined by Goode and Hatt (1952), "Hypothesis is a proposition which can be put to test to determine its validity. It may seem contrary to, in accord with common sense. It may prove to be correct or incorrect. In any event, however, it leads to an empirical test." In a broad sense, the hypothesis may be divided into two categories, namely, research hypothesis (H1) and the null hypothesis (H0). In studying relationships between variables an investigator first formulates a research hypothesis which states anticipated relationships between the variables. On the other hand, for statistical tests, it becomes necessary to formulate a null hypothesis. A null hypothesis states that there is no contribution to the concerned variables. The following null hypothesis would be formulated to explore the relationship of the selected characteristics of the women farmer' with their adaptive capacity towards climate change.

CHAPTER IV

SOCIO-ECONOMIC CHARACTERISTICS OF THEWOMEN FARMERS

There were various characteristics of the women farmer that might have influenced adaptive capacity by the women farmer in climate change. Various socio-economic factors that were likely to affect the adaptive capacity by respondents but in this study selected seven characteristics were considered for research purpose. These are age, education, family size, farm size, Annual income, knowledge of climate change and perception towards climate change.

4.1 Selected Characteristics of Women Farmers

Seven factors were selected to describe and explore their contribution to determinants of women farmers' adaptive capacity about climate change. The salient features of these factors of the respondents, each of which constituted independent variables, are presented in Table 4.1

Table 4.1 Descriptive statistics of factors influencing the adaptive capacity of the women farmers

Categories	Measuring Unit	Observed range		Mean	Standard deviation
		Min	Max		
Age	Year	22	50	33.39	5.84
Education	Year of Schooling	0	17	7.84	3.46
Family size	No of persons	3	8	5.14	1.14
Farm size	Hectare	.07	4.50	.6113	.5532
Income	"000"taka	57.6	405.0	192.04	78.06
Knowledge	Score	6	20	11.89	2.19
Perception	Score	30	45	38.18	3.18

Each factor of the respondents have been categorized on the basis of possible range and discussed in the following sub-sections.

4.1.1 Age distribution of the respondents

The age of the rural women respondents has been varied from 22 to 50 years with a mean and standard deviation of 33.39 and 5.84 respectively.Considering the age, the farmers were classified into two categories namely "young", and "middle-aged". The distributions of the women farmers in accordance with their age are presented in Table 4.2.

Table 4.2 Distribution of the women farmers' according to their age

Categories	Range (Years)		Respondents'		Mean	Standard Deviation
	Score	Observed	Number	Percent		
Young Aged	Upto 35	22-50	55	57.9		
Middle-aged	36-50		40	42.1	33.39	5.84
Total			95	100		

Table 4.2 reveals that the young aged farmers comprised the highest proportion (57.9%) and the lowest proportion were made by middle-aged (42.1%). Data also indicates that the young aged farmers were generally more involved in farm activities than the middle-aged that might be due to the energetic, enthusiastic nature of young aged farmers. The young aged respondents had generally more knowledge about climate change.

4.1.2 Level of education of the respondents

The level of educational scores of the women farmers ranged from 0 to 17 with a mean and standard deviation of 7.84 and 3.46 respectively. Based on the educational scores, the farmer was classified into four categories. The distributions of women farmers according to their level of education are presented in Table 4.3

Table 4.3 Distribution of the women farmers' according to their level of education

Categories	Range (Years)		Respondents'		Mean	Standard Deviation
	Score	Observed	Number	Percent		
Illiterate (Do not read and write, can sign only)	.5		5	5.3		
Primary	Class I-V	0-17	27	28.4	7.84	3.46
Secondary	Class VI-X		47	49.5		
Above Secondary	>X		16	16.8		
Total			95	100		

Table 4.3 shows that farmer under the secondary education category constitutes the highest proportion (49.5 percent) followed by primary education (28.4 percent). On the other hand,(5.3 percent) were in can't read and write but can sign only category. Education broadens the horizon

of the outlook of farmers and expands their capability to analyze any situation related to climate change. An educated farmer is likely to be more responsive to the modern facts, ideas, technology and information of climate change. To adjust with the same, they would be progressive minded to adopt as well as involve with modern agril-base facilities of agriculture along with searching for the opportunities to improved our soil to produces more crops.

4.1.3 Family size of the respondents

Family size of the women farmer ranged from 3 to 8 with the mean and standard deviation of 5.14 and 1.14 respectively. According to family size the farmer were classified into three categories viz. small, medium and large family. The distribution of the respondents according to their family size is presented in Table 4.4.

Table 4.4 The distribution of the women farmers' according to their family size

Categories	Range (Years)		Respondents'		Mean	Standard
	Score	Observed	Number	Percent		Deviation
Small family	≤ 4 (Mean-1SD)		31	32.6		
Medium family	5-6 (Mean ± SD)	3-8	61	64.2	5.14	1.14
Large family	> 6 (Mean+1SD)		3	3.2		
Total			95	100		

Table 4.4 indicates that the medium-size family constitute the highest proportion (64.2 percent) followed by the large size family (3.2 percent). Only 32.6 percent of farmer had small size family. Such a finding is quite normal as per the situation of Bangladesh.

4.1.4 Farm size of the respondents

Farm size of the respondents' families ranged from .07 hectare to 4.50 hectare. The mean was 0.61 and a standard deviation was 0.5532. According to the farm size of the women farmer, they were classified into four categories as marginal (0 to 0.2 ha), small (0.21-1 ha), medium (1.01-<3 ha) and large (3 or above ha).

Table 4.5 Distribution of the women farmers according to their effective farm size

Categories	Range (Years)		Respondents'		Mean	Standard Deviation
	Score	Observed	Number	Percent		
Marginal farm	Up to 0.20 ha	.07-4.50	12	12.6	.61	.5531
Small farm	.21 to 1 ha		69	72.6		
Medium farm	1.01 to <3		13	13.7		
Large farm	3 or above		1	1.1		
Total			95	100		

Data presented in Table 4.5 demonstrate that farmers having small farm size constituted the highest proportion (72.6 percent) followed by the farmer having marginal farm size (13.7 percent). Only 1.1 percent of farmers had large farm size. The normal farm size of the farmers ofthe study area (0.42 ha.) was two and half times higher than that of the national average (0.15 ha.) of Bangladesh (BBS, 2017). The small women farmers are the more victim of adverse climate change on agriculture than the other two categories of the farmers.

4.1.5 Annual family income

Annual family income of the respondents ranged from 62.4-525thousand taka. The mean was 192.04 thousand Taka and the standard deviation was 78.0593.Based on annual family income, the respondents were categorized into three group namely low, medium and high annual income. The distribution of the women farmer according to their annual family income is presented in Table 4.6.

Table 4.6 Distribution of the women farmer according to their annual family income

Categories	Range ("000" Tk)		Respondents		Mean	Standard Deviation
	Score	Observed	Number	Percent		
Low Income	≤ 114 (Mean-1SD)	62.4-525	32	33.7	192.04	78.06
Medium Income	115-300 (Mean ± SD)		52	54.7		
Large Income	>300 (Mean+1SD)		11	11.6		
Total			95	100		

Table 4.6 indicates that the medium annual family income of the women farmer constituted the highest proportion (54.7 percent) followed by the small family income (33.7 percent). Remaining 11.6 percent of women farmers had high annual family income. This might be due to the fact that respondents are becoming an earning member that makes them capable besides their husband. This implies that women farmers who engage in on-farm and off-farm income generation activities such as agriculture, poultry farming, fishing, and services as supplementary sources of livelihood are more capable of adapting to climate change and variability.The respondents belonging to high annual income had large amount both from agriculture and non-agriculture sources.

4.1.6 Knowledge on climate change

The score of the knowledge on climate change ranged from 7-17 with a mean and standard deviation of 11.89 and 2.185, respectively. Based on knowledge on climate change farmers were classified into three categories namely low knowledge, medium knowledge and high knowledge on climate change (Table 4.7).

Table 4.7 Distribution of the women farmers according to their knowledge on climate change

Categories	Range (Score)		Respondents		Mean	Standard Deviation
	Score	Observed	Number	Percent		
Low Knowledge	≤ 10 (Mean-SD)		10	10.5		
Medium Knowledge	10-14 (Mean ±SD)	7-17	72	75.8	11.89	2.19
High Knowledge	> 14 (Mean+SD)		13	13.7		
Total			95	100		

Data presented in Table 4.7 shows that the majority (75.8%) of the respondents had medium knowledge on climate change while (13.7%) had high knowledge and (10.5%) of the farmers had low knowledge on climate change. The majority of the women farmers (89.5%) have medium to high knowledge of climate change on agriculture. Generally people having high uses of information sources assume that they have more information regarding climate change. A knowledgeable woman is always very keen to learn new things and also very keen to utilize

these things. So that her requirements regarding climate change activities observation also very high an d the result also showed this tendency.

4.1.7 Perception towards climate change of women farmers

The observed score of perception on climate change ranged from 30-45 with a mean and standard deviation of 38.18 and 3.18, respectively. On the basis of knowledge on climate change, farmers were classified into three categories namely low knowledge, medium knowledge and high knowledge on climate change (Table 4.8).

Table 4.8 Distribution of the women farmers according to their perception of climate change

Categories	Range (Score)		Respondents		Mean	Standard Deviation
	Score	Observed	Number	Percent		
Low Perception	≤ 35 (Mean -SD)		13	13.7		
Medium Perception	36-41 (Mean ±SD)	30-45	70	73.7	38.18	3.18
High Perception	> 41 (Mean +SD)		12	12.6		
Total			95	100		

Data presented in Table 4.8 shown that the majority (73.7%) of the respondents had medium perception on climate change while (12.6%) had high perception and (10.5%) of the farmers had low perception on climate change. The majority of the women farmers (87.4%) have low to high perception of climate change of agriculture.

Perception is a process by which individuals organize and interpret their sensory impressions in order to give meaning to their environment. In relation to adaptive capacity, perception affects their way of thinking on how they deal with situations like adaptive capacity to climate chage. But one thing's for sure, "life is all about perception. Positive versus negative. Whichever you choose will affect and more than likely reflect your outcomes."

CHAPTER V

EXTENT OF WOMEN FARMERS' ADAPTIVE CAPACITY TO CLIMATE CHANGE

Undoubtedly, the participation of women farmers' in agriculture production plays a very significant role in economic and social development in Bangladesh.Women are usually engaged in subsistence agriculture and labor-intensive activities that worsen their susceptibility to climatic change, as the capability of women to adapt to climate change-related is limited, the capability of women to adapt climate change must be increased. In general, women tend to have more limited access to the assets—physical, financial, human, social, and natural capital-that would enhance their capacity to adapt to climate change.Ways to reduce climate-related risks for women include improving their access to skills, education, and knowledge and their perception about climate change strengthening their ability to adapt to the adverse effect of climate change. Most of them are not must aware of their own abilities due to lack of education and restricted social mobility. But the limited capabilities of women farmers towards climate change can be overlooked.

If women farmers can perform their roles with adaptive capacity properly and skillfully, they will be able to adapt capacity to the adverse effect of climate change. In the present study, an attempt had been made to identify and analyze the extent of the adaptive capacity of women farmers' towards climate change.

5.1 Extent of Adaptive Capacity of Women Farmers towards Climate Change

Adaptive capacity is defined as a system's capability of adjusting to climate change and climate variability to restrain the likely harms, use prevailing opportunities, and/or endure the stresses. A society's adaptive capacity is its ability to amend its features and/or actions to enable it to withstand the harsh external conditions (IPCC,2014).Adaptation can be constrained or enabled by socio-institutional factors related to the physical, economic and social environment. Adaptive capacity refers to the conditions that enable people to anticipate and respond to change, and recover from and minimize the consequences of change (Adger and Vincent 2005). Capacity to innovate can be viewed as one component of adaptive capacity (Eakin and Lemos,2006). On the other hand, adaptations are the actions of individuals, communities and governments undertaken for the purpose of improving or protecting well-being (Adger et al. 2005).

Adaptive capacity is the ability of a system to adjust to climatic stressors and reduce the likely damages, by adopting available opportunities (Asante *et al.*2012)

Adaptive capacity, therefore, refers to the ability to adapt to changing conditions. The scores of adaptive capacity towards climate change of the respondents ranged from 14 to 28 against the possible range of 0-35 with an average of 22.18 and a standard deviation of 2.832. Based on the observed scores of adaptive capacity towards climate change, the respondents were classified into the three categories i.e. low adaptive capacity, medium adaptive capacity and high adaptive capacity. The distribution has been shown in Table 5.1.

Tablez 5.1 Distribution of the women farmers according to their adaptive capacity

Categories	Range (Score)		Respondents		Mean	Standard Deviation
	Score	Observed	Number	Percent		
Low	≤ 19 (Mean -SD)		12	12.6		
Moderate	20-25 Mean ± SD	14 -28	73	76.8	22.18	2.83
High	> 25 (Mean +SD)		10	10.5		
Total			95	100		

Finding shown in Table 5.1revealed that the majority (76.8%) of the women farmers had moderate while 12.6% and 10.5% had low and high agreed to adaptive capacity respectively with regard to climate change. From the above, it can be said that the women farmer who have moderately to highly agreed to adaptive capacity with regards to climate change were more conscious about the adverse effects of climate change. However, still 12.6% of women farmers possess lower agreed to stimulate their capacity to adapt to the adverse effects of climate change towards climate change on agriculture which need to change or improved their capacity taking various steps.

In the context of Bangladesh, the women farmers' here are coming forward accepting challenges of the different economic activities that helps to increase their adaptive capacity towards climate change. There are some factors that influenced them the most. The perception of climate change is an important factor of their adaptive capacity in climate change. Some other factors such as family size, knowledge and education are key significant determinants of women farmers'

adaptive capacity about climate change. Education of the women farmers influences them to engage in economic activity in this case the educated women enhance their capability to adapt as well as involve modern Agro-based facilities of agriculture along with searching for the opportunities to improved our soil to produces more crops. So,women farmers' with high adaptive capacity are less hit with the impact of climate change in agriculture.

CHAPTER VI

DETERMINANTS OF WOMEN FARMERS' ADAPTIVE CAPACITY TO CLIMATE CHANGE

From the review section, it can be known that different selected characteristics had a relationship with the adaptive capacity in climate change for example, Akter (2000), Bhowmick (2004), Sarkar (2005), Mehta and M. D.(2008), Rahman (2001) and so on. The purpose of this section is to explore the contribution of seven selected characteristics of the women farmers with their adaptive capacity in climate change. Multiple regression coefficients was figured so as to explore the contribution between the selected characteristics of the women farmers which are the causal variables of the study and their adaptive capacity with regard to climate change.

In order to determine the contribution of each of seven selected characteristics of the women farmers (age, education, family size, farm size, annual income, knowledge on climate change and perception of climate change with adaptive capacity by them in climate change, Multiple regression coefficients (β) was used.Multiple regression coefficients(β) been used to test the null hypothesis concerning the contribution between the concerned variables. Five percent level of significance was used as the basis for the rejection of any null hypothesis.

From the analysis, it was seen that some selected characteristics had significant relationship with the adaptive capacity by the women farmers in climate change. The results of the Multiple regression coefficients indicating the contribution between each of the selected characteristics of the women farmers and their adaptive capacity with regard to climate change are shown in Table 6.1

Table 6.1 Multiple regression coefficients of the selected factors indicating contribution to determinants of women farmers' adaptive capacity concerning climate change

Independent Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	R^2	Adj.R^2	F
	B	Std. Error	Beta					
Constant	6.218	3.521		1.766	.081			
Age	-.066	.045	$-.137^{NS}$	1.489	.140			
Education	.179	.078	$.219^{**}$	2.296	.024	.328	.274	6.073^{***}
Family size	.529	.231	$.212^{**}$	2.289	.025			
Farm size	-.035	.476	$-.007^{NS}$	-.073	.942			
Income	.002	.004	$.068^{NS}$	.695	.489			
Knowledge	.196	.098	$.195^{**}$	1.997	.049			
Perception	.295	.085	$.332^{***}$	3.487	.001			

NS Non-significant
***Significant at 1% level of significance
**Significant at 5% level of significance

Table 6.1 shows that there is a significant contribution of the respondents', education, family size, knowledge and perception on climate change to women's adaptive capacity. Of these, perception on climate change was the most important contributing factors (significant at the 1% level) followed by education, family size, and knowledge on climate change (significant at 5% level) while coefficients of other selected variables do not have any contribution women's adaptive capacity with regard to climate change. The value of R^2 is a measure of how the variability in the dependent variable is accounted for by the independent variables. So, the value of R^2= .328 means that independent variables account for 32.8% of the variation of women farmers' adaptive capacity to climate change. The F ratio is 6.073 which is highly significant (at 1% level of significance).

However, each predictor may explain some of the variances in respondents' adaptive capacity to climate change simply by chance. The adjusted R^2 value penalizes the addition of extraneous predictors in the model, but values.274 still shows that variance can be attributed to the predictor

variables. In summary, the models suggest that the respective authority should be considered the farmers' perception, education, family size and knowledge on climate change and in this connection, some predictive importance has been discussed below:

6.1 Significant Contribution of perception on climate change to adaptive capacity

From the multiple regression, it was concluded that the contribution of perception to the farmers adaptive capacity towards climate change was measured by the testing the following null hypothesis;

"There is no contribution of perception to the farmers adaptive capacity towards climate change"

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

a) The contribution of the perception was significant at 1% level (.001)

b) So, the null hypothesis could be rejected.

c) The β-value of perception is (0.332). So, it can be stated that as perception increased by one unit, farmers' adaptive capacity towards climate change increased by 0.332 units. Considering the effects of all other predictors are held constant.

So the perception of climate change of the women farmers had the highest significant positive contribution to their adaptive capacity on agriculture. Based on the above finding, it can be said that with the increase in the level of perception of women farmer's adaptive capacity towards climate change   also increased.

6.2. Significant contribution of level of Education to adapting capacity

From the multiple regression, it was concluded that the contribution of education to the farmers adaptive capacity towards climate change was measured by the testing the following null hypothesis;

"There is no contribution of the education to the women farmers' adaptive capacity towards climate change"

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

a) The contribution of the education was significant at 5% level (.024)

b) So, the null hypothesis could be rejected.

c) The β-value of education is (.219). So, it can be stated that as education increased by one unit, women farmers' adaptive capacity towards climate change increased by 0.219 units. Considering the effects of all other predictors are held constant.

So education has significant positive contribution to their adaptive capacity towards climate change. Based on the above finding, it can be said that with the increase of level the of education of women farmers' their adaptive capacity towards climate change also increased. Education broadens the horizon of the outlook of women farmers and expands their capability to analyze any situation related to climate change on agriculture. To adjust with the same, they would be progressive-minded to build their adaptive capacity in climate change. Educated farmers are expected to have more knowledge and information about climate change and the agronomic practices that they can use in response.

6.3 Significant Contribution of Family size to adaptive capacity

The contribution of family size to the farmers adaptive capacity towards climate change was measured by the testing the following null hypothesis;

"There is no contribution of the family size to women farmers' adaptive capacity towards climate change"

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

a) The contribution of the family size was significant at 5% level (.025)

b) So, the null hypothesis could be rejected.

c) The β-value of family size is (.212). So, it can be stated that as family size increased by one unit, women farmers' adaptive capacity towards climate change increased by 0.212units. Considering the effects of all other predictors are held constant.

So family size has a significant positive contribution to their adaptive capacity towards climate change.Based on the above finding, it can be said that with the increase of the number of family size of the farmers' their adaptive capacity towards climate change also increased.

6.4 Significant Contribution of knowledge on climate change to the women   farmers' adaptive capacity

From the multiple regression, it was concluded that the contribution of knowledge to the farmers adaptive capacity towards climate change was measured by the testing the following null hypothesis;

"There is no contribution of knowledge to the farmers' adaptive capacity towards climate change"

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

a) The contribution of the knowledge was significant at 5% level (.049)

b) So, the null hypothesis could be rejected.

c) The β-value of knowledge is (.195). So, it can be stated that as knowledge increased by one unit, women farmers' adaptive capacity towards climate change increased by 0.219 units. Considering the effects of all other predictors are held constant.

Based on the above finding, it can be said that knowledge on climate change of the women farmers' had a significant positive contribution to their adaptive capacity towards climate change. This implies that with the increase of knowledge of the farmers their adaptive capacity towards climate change   also increased. Knowledge on climate change farmers does influence their adaptive capacity and the farmers who have more knowledge expand their capability to analyze any situation related to constraints in climate change. So, they would be progressive minded to adopt many strategy against their constraints in climate change.

CHAPTER VII

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

This chapter exhibits the summary of findings, conclusions, and recommendations of the study

7.1 Summary of findings

The major findings of the study are summarized below:

7.1.1 Individual characteristics of the farmers

Findings in respect of the nine selected characteristics of the women farmers' are summarized below:

Age: The highest proportion (57.9 percent) of the respondents were young aged while 42.1 percent was middle-aged .

Level of Education: Secondary education constituted the highest proportion (49.5 percent) and the lowest 5.3 percent are can't read & write but can sign only. Besides only 16.8 percent above the secondary category.

Family Size: The highest proportion (64.2 percent) of the respondents had medium family size, while 32.6 percent had small and 3.2 percent had large family size.

Farm size: The highest proportion (72.6%) of the respondents had small farm size compared with 12.6 percent having marginal farm size and 13.7 percent having medium farm size.

Annual family income: The highest proportion (54.7%) of the respondents had medium annual family income compared with 33.7percent having low income and 11.6 percent having high annual family income.

Knowledge on climate change: The highest proportion (75.8%) of the respondents had medium knowledge compared with 10.5 percent having low knowledge and only 13.7 percent having high knowledge.

Perception on climate change: The highest proportion (73.7%) of the respondents had medium perception compared with 13.7 percent having low perception and only 13.7 percent having high perception.

7.1.2 Adaptive capacity of women farmers' towards climate change

The observed overall adaptive capacity score of the respondents towards climate change ranged from 14 to 28 against the possible range of $0 - 35$ with an average of 22.18 and a standard deviation of 2.832. Based on the observed scores of adaptive capacity towards climate change, the respondents were classified into the three categories i.e. low adaptive capacity, medium adaptive capacity and high adaptive capacity.

7.1.3 Contribution of the selected factors to the adaptive capacity of women farmers' towards climate change

There were seven hypotheses were proposed in the model. Four (4), out of seven i.e. education ($\beta=0.219$, $p<0.024$), family size ($\beta=0.212$, $p<0.025$), knowledge($\beta=0.195$, $p<0.049$), perception ($\beta=0.332$, $p<0.001$) were found to be statistically significant while three hypotheses, namely age,farm size and income were found to be unsupported.

7.2.Conclusion

Findings of the study and the logical interpretations of their meaning in light of other relevant facts provoked the researcher to draw the following conclusions:

    i.   The findings revealed that an overwhelming majority (89.4 percent) of the respondents had lower agreed to moderately agreed adaptive capacity towards climate change in the study area. Still there is a scope to improve women farmers' adaptive capacity through more involved with education, family size, perception and increasing knowledge.

    ii.   Perception was found to be the stronger predictor that impacts women's adaptive capacity towards climate change. Therefore, it can be concluded that when the perception of climate change is high, the adaptive capacity is also high.

iii.   Education of the farmers had a significant positive relationship with their adaptive capacity towards climate change. Findings also showed that the majority (77.9%) of the respondents had primary to the secondary level of education. Therefore, it may be concluded that the farmers having more education had more adaptive capacity.

iv.   Family size of the farmers had a significant positive role to their adaptive capacity towards climate change. Therefore it may be concluded that higher the family size higher the adaptive capacity by the women farmer.

v.   Knowledge on climate change of the respondents had a significant contribution to the farmers adaptive capacity towards climate change, consequently. The majority (75.8%) of the respondents had medium knowledge on climate change while (13.7%) had high knowledge and (10.5%) of the farmers had low knowledge on climate change. Knowledge helps the farmers to make more adaptive capacity towards climate change on agriculture which ultimately helps the farmers to follow coping strategies.

7.3 Recommendations

7.3.1 Recommendation for policy implications

On the basis of the observation and conclusions drawn from the findings of the study following recommendation is made:

i.   Farmers' perception of climate change had the highest contribution to the adaptive capacity of women farmers. The majority (87.4%) of the farmers had lower to highly perception about climate change. It is therefore, recommended that attempts should be taken by the concerned authorities to increase the women farmers' awareness on climate change effect by various programmes like awareness campaigns, training, communication education.

ii.   The level of education of women farmers had significant positive relationships with their adaptive capacity. It is therefore, recommended that women farmers' can take advantage of different printed materials i.e. book, booklets, leaflets, posters, newspapers. etc. So that they can get more knowledge easily and can increase positive attitudes towards climate change, it is, therefore, recommended

that (GOs and NGOs should take necessary steps to increase positive attitude towards climate change.

iii. The majority (75.8%) of the farmers of the study area had medium knowledge of climate change on agriculture. So to increase knowledge on climate change expert training is a prerequisite. Department of Agricultural Extension (DAE) along with NGO representatives, different social media and mass media can play a key role in this regard.

7.3.2 Recommendations for further study

A small and limited research work cannot provide unique and universal information related to the actual impact of improving socio-economic status of rural women farmers regarding climate change effects. Based on the scope and limitations of the present study and observation made by the researcher, the following recommendations are made for future study.

i. The present study was conducted in some selected villages of Thakurgaon sadar upazila under Thakurgaon district. It is recommended that similar studies should be conducted in other areas of Bangladesh which will be helpful for effective policy formulation.This study investigated the relationship of only seven characteristics of the farmers with their determinants of women farmers' adaptive capacity towards climate change. Therefore, it is recommended that further study should be conducted with other independent and dependent variables**.**

ii. In this research the author conducted surveys in all categories of women farmers who were affected by climate. So, further study can be taken with specific farmer groups or/and compare among those groups.

iii. The study based on determinants of women farmers' adaptive capacity to climate change. Further studies may be conducted on how existing gendered practices or knowledge determine women's ability to response to climate change.

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English Version of Interview Schedule
Department of Development&Poverty Studies
Sher -e-Bangla Agricultural University
Dhaka-1207

An interview schedule for a research study entitled
Determinants of Women Farmers' Adaptive Capacity With Regard to Climate Change

Name of the respondent: ……………   Serial no: ………………

District: …………………………………………………….

Village: …………………………………………………

(Please provide following information. Your information will be kept confidential and will be
used for research purpose only)

1. **Age**: How old are you? ------------------------- years.
2. **Level of education:** Please mention your level of education.
   a) I can't read and write……………………
   b) I can sign only ………………………………...
   c) I have passed ……………………………………class.

3. **Family size:** Please indicate the total members of your family including children.
4. **Farm size:** Please indicate your farm size including homestead.

SL. No.	Types of Land Ownership	Area of Land	
		Local unit(Decimal)	Hectare
1.	Homestead (A)		
2.	Own land under own cultivation(B)		
3.	Own land given to others to borga (C)		
4.	Land taken from others to borga (D)		
5.	Land taken from others on lease (E)		
Total			

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

5. **Annual income of family:** Please mention the amount of annual family income from the following sources:

Sectors of income	Sources of income	Amount of Taka (Thousand taka in BDT)
a) Agricultural	1.Crop	
	2.Livestock	
	3.Poultry	
	4.Fisheries	
Sub –Total (a)		
b) Non –Agricultural	5.Business	
	6.Service	
	7.Labor	
	8.Remittance	
	9.Other(specify please)	
Sub-Total (b)		
Total= (Sub-Total (a)+Sub-Total(b)		

6. **Knowledge on climate change:** Please answer the following questions. '2' for correct answer, '1' for partial correct answer and '0' for wrong or no answer.

SL no.	Questions	Score	
		Weighted	**Obtained**
1.	Have you ever heard about Climate Change? Tell me something about the climate change.	2	
2.	Would you think extreme weather events have any impacts on crop production?	2	
3.	What are the effects of climate change on temperature?	2	
4.	What type of impact mainly exerts on agriculture due to climatic events?	2	
5.	Mention the name of two short duration crops.	2	
6.	Mention two crops that are endangered due to salinity.	2	
7.	Mention the name of two varieties of saline resistant crop.	2	
8.	What are the effects of drought?	2	
9.	Mention the name of two drought resistant varieties.	2	
10.	What precautions should need to be followed at the time of climate change?	2	
11.	What should be done when you are affected by climate change (e.g. high temp. drought, heavy rainfall, flood)?	2	
Total		22	

7. Climate change perception: Please mention your degree of agreement or disagreement with the following statements.

SL No.	Items	Strongly agree (5)	Agree (4)	Undecided (3)	Disagree (2)	Strongly Disagree (1)
1.	Crops yield decreases due to climate change					
2.	Salinity increases because of climate change					
3.	Climate change hampers irrigation facility					
4.	Drought increases due to climate change					
5.	Quality of crops decreases because of climate change					
6.	Insect attack increases due to climate change					
7.	Weed infestation increases due to climate change					
8.	Market facilities hampers due to Climate change					
9.	Climate change negatively impacts labor price					
10.	Soil conservation becomes difficult due to climate change					
11.	Water level go deep due to climate change					
12.	Overall, climate change negatively impacts our livelihoods					
Total						

8. **Women farmers' adaptive capacity towards climate change:** Please mention your degree of agreement or disagreement with the following statements.

SL No.	Items	Extent of Women's capacity building towards climate change				
		Strongly agree (5)	Agree (4)	Undecided (3)	Disagree (2)	strongly disagree (1)
1.	There is enough information available on climate change impacts and adoption for me to do my farming					
2.	I am able to alter my work to adopt to impact or effects on climate change					
3.	I have financial resources to support my family to adopt to impacts or effects of climate change					
4.	I am able to work collectively with others of my community to adopt to the impacts or effects of climate change					
5.	I am able to use different climate change strategies (e.g. short duration crops, salinity resistance variety, drought resistance variety)to adopt to impact of climate change					
6.	I have family support to withstand shocks due to climate change					
7.	Overall, I am less vulnerable to impacts or effects of climate change					

Thanks for your kind co-operations.   Respondent's contact no:

Name and Signature of the enumerator: