A STUDY ON FACTORS AFFECTING THE ADOPTION OF CLIMATE SMART AGRICULTURE PRACTICES IN NORTHERN PARTS OF BANGLADESH

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DECEMBER 2020

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BY

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Reg. No. 18-09155

A thesis

Submitted to the Department of
Management & Finance

Sher-e-Bangla Agricultural University, Dhaka

In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE (MS)

IN

MANAGEMENT & FINANCE

SEMESTER: JULY-DEC, 2020

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CERTIFICATE

This is to certify that the thesis entitled **" A STUDY ON FACTORS AFFECTING THE ADOPTION OF CLIMATE SMART AGRICULTURE PRACTICES IN NORTHERN PARTS OF BANGLADESH"** submitted to the Department of Management & Finance, Faculty of Agribusiness Management, Sher-e- Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka in partial fulfillment of the requirements for the degree of Master of Science (M.S.) in Management & Finance, embodies the result of a piece of bona fide research work carried out by **MD. MONIRUL ISLAM, Registration No. 18-09155** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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DEDICATED TO

MY

BELOVED PARENTS

ACKNOWLEDGEMENT

All praises are due to Almighty Allah, the Great, Gracious and Merciful, Whose blessings enabled the author to complete this research work successfully. Guidance, help and co-operation have been received from several persons or authority during the tenure of the study, the author is grateful to them all who made a contribution to this research work. Although it is not possible to mention all by names it will be an act of ungratefulness if some names are not mentioned here for their immense contribution to the accomplishment of this study.

In particular, the author takes the opportunity to express his deepest sense of gratitude his honorable supervisor **Associate Professor Dr. Md. Sadique Rahman**, Department of Management & Finance, Sher-e-Bangla Agricultural University, Dhaka for his continuous inspiration, valuable suggestions, constructive criticism, constant guidance and intensive supervision through the period of the study and preparation of this thesis without his intense co-operation this work would not have been possible.

The author deems proud privilege to extend his extreme gratefulness and best regards to his venerable **Co-supervisor Mosammod Mahamuda Parvin,** Associate Professor, Department of Management & Finance, Sher-e-Bangla Agricultural University, Dhaka for her keen interest, valuable advice, creative suggestions, co- operation and encouragement to bring this thesis up to its present standard.

It is also a great pleasure for the author to express hearty appreciation and regard to all teachers of Department of Management & Finance, Sher-e- Bangla Agricultural University, Dhaka for their affectionate feelings and valuable suggestions during the research work.

The author would like to express his deepest respect and boundless gratitude to Ministry of "National Science & Technology" for its funding to prepare my research.

The author deeply acknowledges the cooperation and sincere help of Upazila Agriculture Officer, Agriculture Extension Officer of Godagari Upazila and Bagatipara Upazila, entrepreneurs and SAAOs of Kakonhat and Kakfoo union. The author also expresses his heartfelt gratitude to the respondents of the study area who patiently provided the information during the interview with the author.

The author expresses his grateful thanks to all staff and employees of the Department of Management & Finance, Sher-e-Bangla Agricultural University, Dhaka for their co-operation and encouragement to prepare this thesis.

Last but not least, the author expresses his deepest sense of gratitude, indebtedness and profound respect to his beloved mother, uncles, brothers, sister, relatives and friends for their blessings, encouragement and moral support in all phases of this academic pursuit from beginning to the end. At the end, I beg pardon to my well-wishers, for my inability to provide them all of the time they might have wanted from me.

The Author

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ACRONYMS

BBS	Bangladesh Bureau of Statistics
UNFPA	United Nations Population Fund
GDP	Gross Domestic Product
CSA	Climate-smart agriculture
GHG	greenhouse gas emissions
FAO	Food and Agriculture Organization
CCAFS	Climate Change Agriculture and Food Security
RDRS	Rangpur Dinajpur Rural Service
AWD	Alternative Wetting & Drying HYV
IPM	Integrated Pest Management
ICT	Information and Communication Technology
SPSS	Statistical Package for Social Sciences
BNFE	Bureau of Non-formal Education
MNL	Multiple Linear Regression

A STUDY ON FACTORS AFFECTING THE ADOPTION OF CLIMATE SMART AGRICULTURE PRACTICES IN NORTHERN PART OF ANGLADESH

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ABSTRACT

Climate-smart agriculture (CSA) is an effective approach of transforming and reorienting agricultural development under in the context of climate change. The objectives of the study were to determine and describe some characteristics of the farmers and to determine the determinants of the adoption of CSA. Data was collected from 100 farmers of 3 villages from each one union of two district. These Unions namely Kakonhat and Kakfoo in Godagari and Bagatipara Upazilla under Rajshahi and Natore district were purposefully selected due to easy communication as well as easy contact with the farmers. Data were collected during the period from September 13 to September 20, 2020. Descriptive statistics, multinominal regressions (MNL) were employed for analysis. 63.8% farmers partially adopted the CSA, while 23.1 and 13.1 percent of them did not adopted and fully adopted the CSA, respectively. Education, annual income, training received, and family size were key determinant of the adoption of CSA. To increase the adoption of CSA, the policy makers could invest on improving facility of education received (e.g. farmers field schools) and enhancing farmers' to receive more income by producing more drought resistant rice variety, enhancing farmers training receive facility from different training organization and lastly motivating them for using IPM to reduce their production cost and improve their productivity.

CHAPTER 1

INTRODUCTION

1.1 General Background

Bangladesh is a South Asian developing country. It is the fifth most populous country in Asia and eight in the world. Its population growth rate is 1.1% and now its population is 164,689,383 (Sep, 2020) and according to UNFPA the population of Bangladesh at 2050 will be 254,100,000. So this increasing population requires more food as a results dependence over agricultural sector is increasing day by day. Agriculture is the single largest producing of the economy and contributes about 12.68 percentage to the total Gross Domestics Products (GDP) of the country. This sector accommodates around 45.1 percentage labor forces (BBS, 2017). GDP growth rate of Bangladesh mainly depends on the performance of the agricultural sector.

When it's come to the adoption of new technology, farmers are faced with choices and trade-offs. Difference in the adoption decision are often due to the fact that farmers have different cultures, different resource endowments, different objectives, different preferences, and different socio economic background. It follows that some farmers adopt with new technology while others do not. Rogers defined the rate of adoption as "the relative speed with which an innovation is adopted by members of the social system". In such a context, farmer decision regarding the adoption of innovation can be explained by using the theory of maximization of expected utility. Following this theory a farmer will adopt a given new technology if the expected utility are obtained from the technology exceeds that of the old one.

Farmers do adopt a mix technology to deal with a multitude of agricultural production constraints. This implies that the adoption decision is inherently multivariate and attempting univeriate modeling is exclude useful economic information about interdependent and simultaneous adoption decisions. When farmers face multiple innovations, they consider the way these different technologies interact and take this interdependencies into account in their adoption decisions.

Ignoring these interdependencies can lead to inconsistent policy recommendations. Adoption of CSA technologies has become a major consideration to most farmers in Rajshshi district.

Adoption in this respect is defined as a process of implementing CSA techniques after being aware of the presence of the technologies in one's environment which is heavily affected by climate variability. The study applied a Multinomial Regression Model to investigate determinants of CSA technology.

A diverse set of potential household-level determinants of adaptive capacity such as family size, age, gender and education level of the family head are considered. Considering the inconsistent estimates culminating from single equation statistical model, where information on a farmers adoption of one CSA does not alter the likelihood of the farmer adopting another CSA. The multiple regression model approach simultaneously models the influence of the set of explanatory variables on each of the different practices, while allowing for the potential regression between unobserved disturbances, as well as the relationship between the adoptions of different practices. One source of regression may be complementarities (positive regression) and substitutability (negative regression) between different practices. Failure to capture unobserved factors and interrelationships among adoption decisions regarding different practices will lead to bias and inefficient estimates. The econometric specification in this study examines the determinants of multiple adoption decisions of CSA, using a multiple regression model. This does not only improve the precision of the estimation results, it also provides consistent standard errors of the estimates and enables an analysis of interrelations between the different adoption decisions.

The three pillars of CSA: Productivity: CSA aims to sustainably increase agricultural productivity and incomes from crops, livestock and fish, without having a negative impact on the environment. This, in turn, will raise food and nutritional security. A key concept related to raising productivity is sustainable intensification. Adaptation: CSA aims to reduce the exposure of farmers to short-term risks, while also strengthening their resilience by building their capacity to adapt and prosper in the face of shocks and longer-term stresses. Particular attention is given to protecting the ecosystem services which ecosystems provide to farmers and others. These services are essential for maintaining productivity and our ability to adapt to climate changes. Mitigation: Wherever and whenever possible, CSA should help to reduce and/or remove greenhouse gas (GHG) emissions. This implies that we reduce emissions for each calorie or kilo of food, fiber and fuel that we produce.

That we avoid deforestation from agriculture and that we manage soils and trees in ways that maximizes their potential to acts as carbon sinks and absorb CO_2 from the atmosphere.
Climate-smart agriculture (CSA) is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. CSA aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible.

CSA is an approach for developing agricultural strategies to secure sustainable food security under climate change. CSA provides the means to help stakeholders from local to national and international levels identify agricultural strategies suitable to their local conditions. CSA is one of the 11 Corporate Areas for Resource Mobilization under the FAO Strategic Objectives. It is in line with FAO vision for Sustainable Food and Agriculture and supports FAO goal to make agriculture, forestry and fisheries more productive and more sustainable.

Climate-smart agriculture (CSA) may be defined as an approach for transforming and reorienting agricultural development under the new realities of climate change (Lipper et al. 2014). The most commonly used definition is provided by the Food and Agricultural Organization of the United Nations (FAO), which defines CSA as “agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals”. In this definition, the principal goal of CSA is identified as food security and development (FAO 2013; Lipper et al. 2014); while productivity, adaptation, and mitigation are identified as the three interlinked pillars necessary for achieving this goal. Key characteristics of CSA: CSA addresses climate change: Contrary to conventional agricultural development, CSA systematically integrates climate change into the planning and development of sustainable agricultural systems (Lipper et al. 2014). CSA integrates multiple goals and manages trade-offs: Ideally, CSA produces triple-win outcomes: increased productivity enhanced resilience and reduced emissions. But often it is not possible to achieve all three. Frequently, when it comes time to implement CSA, trade-offs must be made.

This requires us to identify synergies and weigh the costs and benefits of different options based on stakeholder objectives identified through participatory approaches.

CSA maintains ecosystems services: Ecosystems provide farmers with essential services, including clean air, water, food and materials. It is imperative that CSA interventions do not contribute to their degradation. Thus, CSA adopts a landscape approach that builds upon the principles of sustainable agriculture but goes beyond the narrow sectorial approaches that result in uncoordinated and competing land uses, to integrated planning and management (FAO 2013). Despite the attention paid to agricultural development and food security over the past decades, there are still about 820 million undernourished and 1 billion malnourished people in the world. At the same time, more than 1.6 billion adults are overweight and one third of all food produced is wasted. Before 2050, the global population is expected to swell to more than 9.7 billion people (United Nations 2015). At the same time, global food consumption trends are changing drastically, for example, increasing affluence is driving demand for meat-rich diets. If the current trends in consumption patterns and food waste continue, it is estimated we will require 60% more food production by 2050 (Alexandratos and Bruinsma 2012). CSA helps to improve food security for the poor and marginalized groups while also reducing food waste globally (CCAFS, 2013).

1.2 Justification of the Study

Climate smart agriculture is getting popularity among the farmers of Bangladesh by the introduction of new hybrid varieties coupled with growing market demand as well as food have opened a tremendous potentiality of rice, wheat, maize, sugarcane and people also practices both of IPM and agroforestry which increase their productivity and increase income to make their life comfortable for a long period. The government is also supporting this growth. Needless to say that research is necessary to determine pattern of diffusion of climate smart agriculture in order to formulate long-term strategy on crops production. As no research in the field of diffusion-adoption of this technology has been identified so far, the researcher deemed it timely necessity to undertake the present study entitled "Factors affecting the adoption of Climate Smart Agriculture Practices in northern part of Bangladesh".

1.3 Specific Objectives of the Study

The following specific objectives were set forth in order to proper direction to the study:

1. To access the socio economic profile of the farmer.
2. To identify the factors affecting the adoption of climate smart agriculture (CSA) practices.

1.4 Assumptions of the Study

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

1. The responses furnished by the respondents were reliable. They expressed the truth about their opinion and interest.
2. The researcher who acted as interviewer was adjusted to social and environmental conditions of the study area. Hence, the data collected by him from the respondents where free from bias.
3. The respondents included in the sample for this study were competent enough to furnish proper responses to the queries included in the interview schedule.
4. Views and options furnished by climate smart agriculture included in the sample selected those of the population of the study.

1.5 Limitations of the Study

Considering the time, money and other necessary resources available to the researcher and to make the study manageable and meaningful, it became necessary to impose certain limitations as noted below:

1. Population for the present study were kept confined within the heads of the climate smart agriculture families as because they were the major decision makers in the determinants of the adoption of climate smart agriculture.

2. Characteristics of climate smart agriculture farmers are many and varied but only few were selected for investigation in this study as stated in the objectives. This was done to complete the study within limited resources.

3. The study was confined mainly to determinants of the adoption of climate smart agriculture.

4. Facts and figures were collected by the investigator applied to the present situation in the selected area.

CHAPTE II

REVIEW OF LITERATURE

To find out the adoption of climate smart agriculture and its relationship with selected characteristics of the farmers were the main task of the study. This Chapter contains synthesis of selected literature those were related to the present study. The researcher made an elaborate search of available literature for this purpose. There was no literature directly related to the present study. Therefore, the present researcher searched relevant studies conducted by different scientist and authors on the adoption of CSA. The finding of such studies related to the extent of adoption of CSA the farmers and other partial studies have been reviewed and partially discussed in this Chapter.

2.1 Literature Review on content of Adoption of Climate Smart Agriculture

Milton et al. (2019) narrated in his research paper namely Factors affecting to adoption of climate smart agriculture practices by coastal farmers in Bangladesh and found that the majority of farmers have better perception of climate change and the adaptation options. This study has identified 15 different CSA practices that have been adopted by the coastal farmers. These practices include saline tolerant varieties, submergence-tolerant varieties, drought-resistant varieties, an early variety of rice, sorjan method, pond side vegetable cultivation, watermelon cultivation, sunflower cultivation, plum cultivation, relay cropping, urea deep placement, organic fertilizer, mulching, rainwater harvesting, and seed storage in plastic bags. Among the all CSA practices adoption of seed storage in plastic bag/Glass bottle, vegetable cultivation by pond side, and sunflower cultivation are more promising. The results of logit specify the farmers level of education, occupation, family size, cultivated farm size, farming experience, cattle ownership, annual income, market difficulty, access to farm information, training experience, organization affiliation, and perception of climate change, all have a statistically significant impact on the different adaptation strategies. These significant variables are expected to enhance farmers' adaptive capacities which have potential policy implications. The present study has emphasized only crop sector of the CSA practices. Future research will be incorporated livestock, fisheries, and forestry sector in the CSA to have accurate effect of adoption of CSA.

Roberto et al. (2019) conducted a research on Determinants of adoption of climate smart agriculture technologies in rice production in Vietnam and reported that showed that gender, age, number of family workers, climate-related factors, farm characteristics, distance to markets, access to climate information, confidence on the know-how of extension workers, membership in social/agricultural groups and attitude toward risk were the major factors affecting the decision to adopt CSATs. However, the effects of these factors on the adoption of CSATs varied across three provinces. These technologies when adopted tend to increase NRI but the increase is much greater when these are combined.

Victor et al. (2019) narrated a research on Determinants of the Adoption of Climate-Smart Agricultural Practices by Small-Scale Farming Households in King Cetshwayo District Municipality, South Africa. The majority (56.6%) of the sampled farmers fell in the medium category of users of CSA practices, while the lowest proportion (17.7%) of the sampled farmers fell in the high category. Educational status, farm income, farming experience, size of farmland, contact with agricultural extension, exposure to media, agricultural production activity, membership of an agricultural association or group and the perception of the impact of climate change were found to be statistically significant and positively correlated with the level of CSA adoption. Furthermore, off-farm income and distance of farm to homestead were statistically significant but negatively correlated with the CSA level of adoption. This paper argues that climate change-related education through improved extension contact and exposure to mass media can strengthen integrated farm activities that bolster farm income. Additionally, farmer associations or groups should be given adequate attention to facilitate CSA adoption as a means to climate change mitigation and resilience.

Nazrul et al. (2019) conducted a research on Adoption of climate smart agriculture in promoting sustainable agriculture. This paper explores the suitability of adopting CSA practices for promoting sustainable agriculture in order to attain global food and nutritional security. It also explores the links among the components of CSA (productivity, adaptation and mitigation) and their contribution to achieving the goal of sustainable agricultural development.

Despite the potential of CSA to attain sustainable agriculture, poor connections exist among the components of CSA at the field level. More importantly, the concept is sometimes poorly understood by various levels of stakeholders.

Hasan et al. (2018) narrated a research on Impact of climate-smart agriculture adoption on the food security of coastal farmers in Bangladesh and identified seventeen CSA practices viz. saline-tolerant crop varieties, flood-tolerant crop varieties, drought-resistant crop varieties, early maturing rice, vegetables in a floating bed, sorjan method of farming, pond-side vegetable cultivation, the cultivation of watermelon, sunflower or plum, relay cropping, urea deep placement, organic fertilizer, mulching, use of pheromone trap, rain water harvesting and seed storage in plastic bags or glass bottles in Kalapara upazila in Patuakhali, Bangladesh.

Kamrul et al. (2018) studied a research namely Impact of climate-smart agriculture adoption on the food security of coastal farmers in Bangladesh. This study investigated the impact of adoption of CSA practices on the household food security of coastal farmers in southern Bangladesh. Factors determining household food security were also explored. The farmers adopted on average seven out of these CSA practices. Among the sampled households, 32% were assessed as food secure, 51% were mildly to moderately food insecure and 17% were severely food insecure. Adoption of CSA practices was positively associated with household food security in terms of per capita annual food expenditure ($\beta = 1.48$ Euro, $p = 0.015$). Increasing the adoption of CSA was important to enhance food security but not a sufficient condition since other characteristics of the farmers (personal education, pond size, cattle ownership and market difficulty) had large effects on food security. Nevertheless, increased adoption of saline-tolerant and flood-tolerant crop varieties, pond-side vegetable cultivation and rainwater harvesting for irrigation could further improve the food security of coastal farmers in southern Bangladesh.

Billah and Hossain (2017) narrated a study on Role of Climate Smart Agriculture Technologies in Sustainable Crop Production by the Coastal Farmers of Bangladesh and also reported cultivating HYV, zero tillage, crop diversification, crop rotation, intercropping, mulching, improved irrigation, use of stress tolerant varieties, integrated farming system, rain water conservation, agroforestry, box ridges, AWD method, pit planting and short duration varieties as existing CSA technologies practiced by the coastal farmers. Climate-smart-agricultural practices have significant role on food security through sustainable crop production in Bangladesh.

Onyeneke et al. (2017) conducted a research on Status of climate-smart agriculture in southeast Nigeria and identified five broad and important practices relevant to climate smart agriculture practices namely, adjusting agricultural production systems, mobility and social networks, farm financial management, diversification on and beyond the farm, and knowledge management and regulations.

Afrin et al. (2017) conducted a research on Adoption of climate smart agricultural techniques at Jaintapur Upazila of Sylhet district. It was found that about 84% of respondents are involved in this eco-friendly technique in order to cope with adverse effect of climatic change in terms of food security. Farmers in the study area are achieving remarkable success in controlling pest in the paddy field by using this method as an alternative to pesticides. This modern technology has become very popular to the farmers as it has reduced production cost to a great extent and enhanced rice production significantly. Previously, farmers were using toxic insecticides in the fields to eradicate the insects which have far reaching effects on environment and on human health. By using Perching method, farmers were producing toxic insecticides free crops and vegetables with lowest cost and at the same time helping to maintain balance of the environment. As a result, the method was getting immense popular in various places of Jointapur upazila in Sylhet district.

Vera et al. (2017) narrated a research on Understanding the factors affecting adoption of Climate Smart Agriculture in Southern Malawi and found that farmers who reported observing changes in moisture levels in their areas for the 20 -year period prior to the survey were found to have lower probability of adopting four CSA strategies as compared to those who reported not observing any changes in moisture in the same time period. Importantly, being a lead farmer, which proxied ample access to climate smart agriculture extension messages and training access, acreage used in agricultural production and observing an increase in incidences of floods in a 20-year period prior to this study increased the probability of adopting more than two CSA strategies. Interestingly, household income was found not to affect number of CSA strategies adopted. The study recommends that relevant stakeholders should provide farmers with CSA-related extension message if more farmers are to adopt multiple CSA techniques.

Imdadul Haque (2017) narrated a research on Determinants of the adoption of climate smart agriculture and found that 58.1% farmers partially adopted the CSA, while 23.8 and 18.1 percent of them had not and fully adopted the CSA, respectively. Education, organizational participation, access to ICT and farmers perceptions on the effects of CSA were key determinant of the adoption of CSA and all variables collectively explained 47.7% variation in the adoption of CSA. It is concluded that farmers' learning, training, knowledge development and skills improvement are crucial to CSA adoption. To increase the adoption of CSA, the policy makers could invest on improving capacity of farmers organizations (e.g. farmers field schools) and enhancing farmers' access to ICTs such as mobile phones and television with a view to get oriented to the latest CSA practices and technologies like alternative wetting and dry methods.

Alam et al. (2017) conducted research on Perceptions of climate smart agriculture and local adaptation policies of hazard-prone rural households in Bangladesh. Households acknowledged the impact of climate smart agriculture on their livelihood assets, leading in an enhanced sense of vulnerability and resilience building. The research identified that significant approaches for adaptation include adopting new varieties of crops, altering planting times, homestead gardening, planting trees, and migration.

Carolina Hoyos (2016) narrated a research on Small holder farmers perception and adaptation on the Climate Smart Agriculture practices in eastern India, Bihar. This study evidenced the complexity of technology adoption, it found interesting examples of how different constraints limit CSAT appropriation. Farmers are facing challenges in regards to climate change. Although cropping systems may change in order to adapt to new challenges, this study confirms that household food security remained as a priority and technologies should ensure succeeding in it.

Alam et al. (2016) evaluated the determinants of household adaptation decisions and the obstacles to adaptation of Bangladesh's 380 hazard-prone vulnerable households and concentrated on the impact of institutional access and social capital on adaptation decisions as a means of supporting and sustaining local adaptation. The results showed that family units were implementing adaptation policies, such as crop diversification, tree planting (adopted by big and medium-sized farmers) and household gardening and migration (adopted by tiny and landless farmers), just as hurdles to adaptation were observed heterogeneously among farming communities where access to credit and lack of information were observed of appropriate adaptation strategies.

Mamun et al. (2015) evaluated the pattern of three major climate smart agricultural factors (e.g. IPM uses, Agroforestry practices and rain water reservation) for Rajshahi, Bangladesh using time series data for the period 1972-2010 and evaluated the connection between the factors and the yield of three major rice plants (e.g. BRRI-56, BRRI-66, BRRI-71). Ordinary Least Squares (OLS) findings disclosed the important impacts of climate factors on rice yields, and these impacts differ between the three rice plants. The research also assessed local understanding and resource- based adaptation methods taken by farmers, such as changes in transplantation moment, changes in crop patterns, digging of ponds, choice of short-lived species, etc., to minimize the impact of climate differences on rice production, as well as suggesting the necessity and growth of determinants-tolerant of rice variety.

Chowdhury et al. (2015) tried to investigate the prospective effect of climate smart agriculture on the output of three distinct rice plants in Bangladesh (i.e., Aus, Aman and Boro). On the basis of country-level time series data for the period 1972-2014, a multiple regression analysis using the OLS technique is used to evaluate the climate-crop yield interrelations. They discovered that all climate factors had a substantial effect on the output of rice over the period under research, peak temperature is statistically important, and the yield of all three rice plants is badly affected, and rainfall is found to be important for all rice yields with beneficial impacts on Aus and Aman rice and adverse effects on Boro. They stressed the significance of adapting temperature-tolerant rice varieties and suggest that sustainable agriculture can play a crucial role in mitigating adverse effects of climate smart agriculture practices.

Rashid et al. (2014), in order to achieve viable adaptation alternatives in a climate vulnerable region, conducted a research to understand perception and adaptation of climate smart agriculture policies at community level are essential. Findings revealed that the climate is unpredictable and with no favorable outlook or aspect connected with this shift, variability has risen over time. Due to water-logging, local individuals viewed changes in precipitation patterns, leading in delayed rice planting, reduced yield and damaged sesame and mungbean plants. The prolonged summer periods with rising average temperatures led in lower crop development length, higher pest infestations, and lower returns. Communities are adapting to this evolving situation by adopting elevated yields of salt- tolerant rice varieties, introducing fresh plants such as sesame and mungbean, and adopting tilapia, carp and prawn rice-fish plants instead of brackish water shrimp.

Very few research were conducted with this study of adoption of Climate Smart Agriculture in Bangladesh. Most of the farmers do not know the factors that affecting their adoption of climate smart agriculture practices. Even though they don’t know about the proper implication of CSA technologies to increase their production. So, my study will identify the factors affects the adoption of Climate Smart Agriculture (CSA) practices in Bangladesh. Findings will help the policymakers to identify the factors affecting adoption which will also help to formulate the future policy. Finding may also help the extension workers to rearrange the extension techniques. This study will also help the farmers to be aware of climate change with their productivity in future time.

2.2 Gaps in the existing literature

There are few studies on farmers' perception of climate smart agriculture, adaptation strategies and barriers to adaptation in Bangladesh (For example, Vera et al. 2017; Alam et al. 2017; Rashid et al. 2014; BBS, 2017, 2014, 2013; FAO. 2013;). However, limited of the studies on adaptation were accomplished at north- western drought-prone areas of Bangladesh (Milton et al. 2019; Hasan et al. 2018). Most of the studies were conducted at outside of Bangladesh (Roberto et al. 2019; Victor et al. 2019; Onyeneke et al. 2017; Vera et al. 2017; Carolina Hoyos, 2016). From this literature review we can see most of the research were conducted by researcher in west, south side and particularly were conducted in outside of Bangladesh. But climate smart agriculture practices are dearth in the northern part of Bangladesh. So I conducted my research in that area to enhance the adoption knowledge of climate smart agriculture to the farmers of northern part of Bangladesh.

CHAPTER III

METHODOLOGY

Methodology deserves a very careful consideration in conducting scientific research. Importance of methodology in conducting any research cannot be undermined. Methodology enables the researcher to collect valid and reliable information and to analyze them properly to arrive at correct decisions. Keeping this point in view, the researcher took utmost care for using proper methods in all the aspects of this piece of research work. Methods and procedures followed in conducting this study has been described in this chapter.

3.1 The Locale of the Study

Kakonhat and Bagatipara unions of Godagari and Bagatipara Upazilla under Rajshshi and Natore district was purposefully selected due to easy communication as well as easy contact with the farmers who practices or not practices CSA practices and technologies. . This Godagari Upazilla is situated at about 26.4 Km from Rajshshi town and Bagatipara Upazila is situated at about 21.6 km from Natore town. According to the guidance of the research supervisory committee two Union with CSA as the more cultivated crop were to be the study area of the present research. Six villages were selected randomly by taking two from each selected unions. Thus, Dorgapara, Joykrishnopur, Brammon Nagar were selected from Godagari Upazila of Rajshahi district and Kafko, Perabaria and Begunia were selected from Bagatipara Upazila of Natore district showing the study area have been presented in figure 3.1and 3.2 for Godagari Upazila In Rajshahi district and 3.3 and 3.4 for Bagatipara Upazila in Natore district respectively.

3.2 Population and Sampling Design

The farmers of the selected villages were the population of the study. The total numbers of farmers in these six villages were 200 and half of the populations were selected randomly from each village as the sample of the study. Out of 100, 77 CSA practicing and 23 not practicing CSA farmers were the sample of the study. If anyone included in the original sample were unavailable during data collection, the next farmers regarding that list were considered turn by turn for collecting data. The distribution of populations, sample and reserve list are shown in the Table 3.1.

Figure 3.1 A map of Rajshahi district showing Godagari upazila

Figure 3.2 A map of Godagari Upazila showing Kakanhat Pourosabha

Figure 3.3 A map of Natore district showing Bagatipara upazila

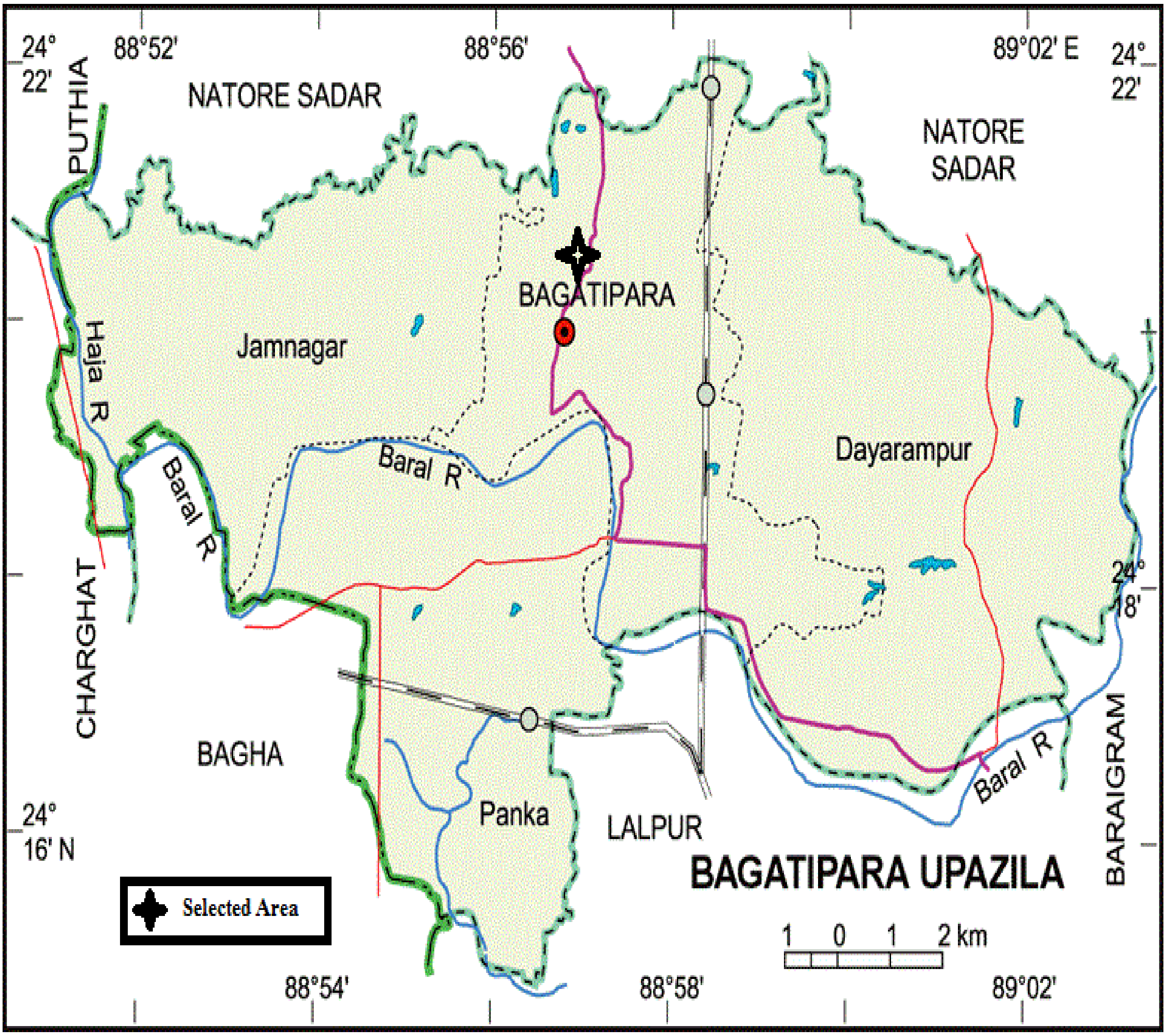

Figure 3.4 A map of Bagatipara Upazila showing Bagatipara Sadar Union

Table 3.3 Distribution of populations and sample

District	Upazila	Village	Sample Size	Population
Rajshahi	Godagari	Dorgapara	26	52
		Joykrishnopur	22	44
		Brammon Nagar	8	16
Natore	Bagatipara	Kakfoo	18	36
		Perabaria	17	34
		Begunia	9	18
Total			**100**	**200**

3.4 Instruments for Data Collection

In order to collect reliable and valid Information from the CSA farmers, an interview schedule was prepared carefully keeping the objectives of the study in mind. The interview schedule contained both open and closed form questions.

Appropriate schedule was also developed to operationalize the selected characteristics of the CSA farmers. The draft interview schedule was prepared in English version and was pre-tested with CSA farmers. This pre-test facilitated the researcher to examine the suitability of different questions and statements in general. The interview schedule may be seen at Appendix-A.

3.5 Measurement of Variable

A variable is any characteristic, which can assume varying, or different values in successive individual cases (Ezekiel and Fox, 1959). An organized research usually contains at least two important variables, viz. an independent and a dependent variable. An independent variable is that factor which is maintained by the researcher in his attempt to ascertain its relationship to an observed phenomenon. A dependent variable is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variable (Townsend, 1953). According to the relevant research area, the researcher selected 10 characteristics of the CSA farmers as independent variable and adoption of CSA as the dependent variable.

3.6 Measurement of independent variables:

The independent variables of the study were 10 selected characteristics of the CSA growers. These were, age, education, farm size, training received , farmers experience, family size, access to credit, IPM practices, annual income, severity of extreme. The procedures followed in measuring the independent variables are briefly discussed below:

3.6.1 Age

In the study, all categories of farmers of the study area were classified into different age groups. First group ages range between 20-30 years. Second group ages range from 31-50 years and the last group were selected who are more than 51 years. This variable appears in the interview schedule as presented in Appendix-A.

3.6.2 Education

Education was measured in terms of successful years of schooling. Education for all farmers were categorize into four groups. First group present illiterate group (0-1). Second group indicated primary education (2-5), third group represent high school or secondary school (6- 10) and last group refers college or more (12). This variable appears in the interview schedule as presented in Appendix-A.

3.6.3 Family size

In this study, family size were divided into three separate group namely small family (up to 4 person), medium family (5-7 person) and lastly large family (more than 7 person). This variable appears in the interview schedule as presented in Appendix-A.

3.6.4 Farm size

The farm size of a CSA farmer referred to the total area of land, on which his family carried out farming operations, in terms of full benefit to his family. The farm size was measured in hectares for each CSA farmers using the following formula:

The data were first recorded in term of local unit i.e. bigha and then converted to hectare. Total farm size of each respondent was categorized into 5 types (Islam, 2007). The farmers who had land bellow 0.02 hectare were considered as landless farmer. The farmers who had land between 0.02-.20 hectare were considered as marginal farmers ; the farmers who had the land between 0.2-1.00 hectare were considered as small farmers; the farmers who had land between 1.01-3.0 hectare of land considered as medium farmers and above 3 hectare considered as large farmers. This variable appears in the interview schedule as presented in Appendix-A.

3.6.5 Training received

In the study, all categories of farmers of the study area were classified into different training receive group. The first group indicated lower training received group (less than 4 days), second group were medium training received group (5-7 days) and last group of training receive group is high training receive group (above 8 days). This variable appears in the interview schedule as presented in Appendix-A.

3.6.6 Severity of extreme events

In this study, severity of extreme event were classified into different category namely extreme severe (4), moderate severe (3), low severe (1) and lastly none for zero. This variable appears in the interview schedule as presented in Appendix-A.

3.6.7 Access to agriculture related credit

This independent variable are categorized into only two types. The farmers who receive agriculture related credit were defined yes and on the other hand the farmers who didn't receive any agriculture related credit mentioned it no. This variable appears in the interview schedule as presented in Appendix-A.

3.6.8 Total experience of the farmers

In this study, total experience of farmers were categorized into different experienced group. The first group namely lower experienced group (less than 20 years), second group indicated medium experienced group (21-30 years) and lastly higher experienced group (more than 31 years). This variable appears in the interview schedule as presented in Appendix-A.

3.6.9 IPM practices

This independent variable are categorized into two different group. The first group were the farmers who were practicing IPM is indicated by (1) and the farmers who didn't practicing IPM mentioned it by (0). This variable appears in the interview schedule as presented in Appendix-A.

3.6.10 Total annual income of the farmers

In this study, the annual income of farmers are divided into different categorized. The first category were the group of farmers whose annual income is less than 56000 tk, second category referred the farmers group whose income is ranges from 57000-250000 tk and the last group were categorized into the group of farmers whose income is more than 251000 tk. This variable appears in the interview schedule as presented in Appendix-A.

3.8 Statement of the Hypotheses

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 broad sense, hypothesis may be divided into two categories, namely, research hypothesis ($H1$) and null hypothesis (H_A). In studying relationships between variables an investigator first formulates research hypothesis which states anticipated relationships between the variables. On the other hand, for statistical test, it becomes necessary to formulate null hypothesis. A null hypothesis states that there is no contribution with the concerned variables. The following null hypothesis would be formulated to explore the relationship of the selected characteristics of the growers with their adoption of CSA. There is no significant contribution with the selected characteristics of the growers and their adoption of CSA.

H_0: There is no contribution of independent variable on the adoption of CSA practices.

H_A: There is a contribution of independent variable on the adoption of CSA practices.

3.9 Instrument for Data Collection

In order to collect relevant information an interview schedule was carefully designed keeping the objectives of the study in mind. The interview schedule was designed in English to ensure easy communication between the researcher and the respondent. The interview schedule initially prepared was pre-tested by administering the same to ten CSA farmers of the study area. The pre-test was helpful to identify faulty questions and statements in the draft schedule. Necessary additions, corrections alterations and adjustments were made in the schedule on the basis of the pre-test experience. The schedule was multiplied in its final form for the collection of data. An English version of the interview schedule has been presented in the Appendix I

3.10 Collection of Data

The researcher himself collected data from the CSA farmers by using the interview schedule. The interviews were conducted individually in the houses of the respondents during their leisure period. Only ten CSA farmers of the original list were not available during interview and hence ten CSA farmers were replaced from the reserve list. Prior information was given to the respondents before going to them for interviewing. The researcher took all possible care to establish rapport with them. While any respondent faced difficulty in understanding any question, the researcher took utmost care to explain the issue. He obtained excellent cooperation from the respondents and others concerned during the time of interview. The entire process of collecting data took 07 days from 12th September to 20th September , 2020.

3.11 Data Processing

A detail coding plan was prepared. Data were coded into a coding sheet. These were then compiled, analyzed in accordance with the objectives of the study. Qualitative data were converted into quantitative form by means of suitable scoring techniques for the purpose of analysis.

3.12 Categorization of respondents

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

3.13 Model Specification

In order to assess the factors influencing choice of adaptation strategies Logit or Probit models can be used to explain categorical variables (Wooldridge, 2009). Farmers can adopt more than one adaptation strategies. MNL model estimates simultaneously all binary logit among categories or choices performing all possible comparisons (Alauddin and Sarker, 2014). In this study MNL model was employed since the choice of adaptation was more than one. It was assumed that all the categories were mutually exclusive.

The model for each category of the outcome variable is specified as,

$$\ln Y\, i((n \mid b) = \ln \frac{\text{Prob}\,(Y=n \mid x)}{\text{Prob}\,(Y=b \mid x)}$$

Here, b is the reference category and n is the number of categories. The model needs a base category to interpret the log-odds ratio. So, we can get n-1 (log-odds ratios). The probability (Yi) of choosing one strategy j among a total of n alternatives conditional upon explanatory variables xi takes the following form,

$$\text{Prob}\,(Y_i \mid X_i) = \frac{e^{\beta j x i}}{\Sigma^{n}_{k=1}\ e^{\beta j x i}}$$

This MNL model as formulized in Greene (2003) estimates the utility from choosing one particular strategy (as shown in the numerator) relative to the sum of utilities from different choices (expressed in the denominator) (Alam et a 2016). MNL model requires that the odds ratio does not have impact on other probabilities; which is the assumption of independence of irrelevant alternatives (IIA) in order to get an unbiased and consistent estimator. The choice of adaptation strategies is assumed to be influenced by socio-economic factors, institutional accessibility and livelihood status.

For each strategy the complete model is specified as follows;

$$\text{In}\,(Y_{i(j/b)}|X_i) = \beta_{0\,Yi} + \beta_{1Yi}X_{1i} + \beta_{2Yi}X_{2i} + \beta_{3Yi}X_{3i} + \beta_{4Yi}X_{4i} + \beta_{5Yi}X_{5i} + \beta_{6Yi}X_{6i} + \beta_{7Yi}X_{7i} + \beta_{8Yi}X_{8i} + \varepsilon i$$

Where,

Yi = CSA Practices

X1i = Age

X2i = Education

X3i = Family Size

X4i = Farm Size

X5i = Training received on CSA

X6i = Access to credit

X7i = Farmer's total experience

X8i= Farmer's Annual Income

β0……… β8 = Coefficient of the respective variable

εi = Error Term

In order to determine the probability of each CSA practices is computed from the MNL model. There are four main CSA practices such as drought resistant rice variety, green manuring, agro-forestry and use of IPM. The study also tested the collinearity using the correlation matrix with all the explanatory variables and multicollinearity through Variance Inflation Factor (range of VIF is 1.05-2.60) and did not find any problem.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter provides results on socio-demographic character, livelihood status, knowledge on CSA practice throughout the year, farmers' perception on climate smart agriculture, adaptation choices, problems to adaptation and MNL model for assessing the factors determining adaptation choices in different phases.

4.1. Socio-demographic characteristics

4.1.1 Age Distribution

In the study, all categories of farmers of the study area were classified into different age groups as presented in table 4.1.1. It is evident from the table that most of the farmers were middle aged in the study area. Out of the 77 sample farmers 7.8 percent belonged to the age group of 20-30 years, 61 percent belonged to the age group of 31-50 years and 31.2 percent fell into the age group of above 51 for adopter of CSA practices. Out of total 23 sample farmers 0 percentage belonged to the group of 20-30 years, 73.9 percentage belonged to the group of 31-50 years and 26.1 percentage fell into the age group of above 50 years old. This finding imply that majority of the sample farmers were in the most active age group of 31-50 years indicating that they provided more physical efforts for farming. Again the age distribution of the farmers scores ranged from 20 to More than 51 respectively.

Table 4.1.1 Age Distribution

Age Category	Adopter Percentage %	Non-Adopter Percentage %
20-30 Years	7.8	0
31-50 Years	61	73.9
Above 51 Years	31.2	26.1
Total Sample	77	23

Source: Field Survey, 2020.

4.1.2 Educational status

Education increases the efficiency of man. Education of farmers helps to adopt due to climate change. Bangladesh it has, an adult literacy rate of 70.20% (BER, 2019). Table 4.1.2 shows for CSA adopter 2.6 percent farmers were illiterate, 19.5 percent farmers had primary education, 59.7 percent farmers had completed secondary level education, 18.2 percent farmers had completed their higher secondary level education. And for non-adopter 1.3

percent farmers were illiterate, 10.4 percent farmers had primary education, 18.2 percent farmers had completed secondary level education, zero percent farmers had completed their higher secondary level education. Literacy status is good at the study area compared to the national level literacy status. Again the education level of the farmers scores ranged from 0 to More than 12 respectively.

Table 4.1.2 Education Level Distribution

Education Level	Percentage % of Adopter	Percentage % of Non-Adopter
Illiterate (0-1)	2.6	1.3
Primary education (1-5)	19.5	10.4
High School (6-10)	59.7	18.2
College (12)	18.2	0
Total Sample	77	23

Source: Field Survey, 2020.

4.1.3 Gender Distribution

The proportion of women in the agricultural labour force increased from less than 20 per cent to 33.6 per cent of the total (Asaduzzaman 2010, citing Bangladesh Bureau of Statistics, various years). Table 4.1.3 depicts that for CSA adopter 96.1 percent of farmers were male and 3.9 percent were female. And for CSA non adopter 91.3 percentage of farmer were male and 8.7 percentage of farmer were female.

Findings shows that women are less involved in agriculture compared to national data it means women empowerment is limited here.

Table 4.1.3 Gender Distribution

Particulars	Percentage of CSA adopter	Percentage of CSA non-adopter
Male	96.1	91.3
Female	3.9	8.7
Total Sample	77	23

Source: Field Survey, 2020.

4.1.4 Family Size

In the study, all categories of farmers of the study area were classified into different age groups as presented in table 4.1.4. It is evident from the table that most of the farmers were medium family in the study area. Out of the 77 sample farmers 39 percent belonged to the group of small family, 57.1 percent belonged to the group of Medium family and 3.9 percent fell into the group of large family for adopter of CSA practices. And out of total 23 sample farmers 43.5 percentage belonged to the group of Small family, 56.5 percentage belonged to the group of Medium family and zero percentage fell into the age group of large family. This finding imply that majority of the sample farmers were Medium family. Again the family size distribution of the farmers scores ranged from 1 to More than above respectively.

Table 4.1.4 Family Size distribution

Particulars	Percentage of CSA adopter	Percentage of CSA non-adopter
Small (Up to 4 persons)	39.0	43.5
Medium (5-7 persons)	57.1	56.5
Large (More than 7 persons)	3.9	0
Total Sample	77	23

Source: Field Survey, 2020.

4.1.5 Farm Size

Table 4.1.5 indicates that for CSA adopter the medium farm holder constitutes the highest proportion 53.2 percent followed by small farm holder 41.6 percent, whereas 5.2 percent was large farm holder. Again for CSA non-adopter the small farm holder constitute the highest proportion 78.3 percent followed by medium farm holder 21.7 percent where other holding zero percent. The findings of the study reveal that majority of the CSA farmers were small to medium sized farm holder. Again the farm size distribution of the farmers scores ranged from 0.02 to more than 3 respectively. This findings also indicates the farmer with marginal farm size has very little scope to experiment about new technologies as their earnings depend on mainly in agriculture.

Table 4.1.5 Farm Size distribution

Particulars	Percentage of CSA adopter	Percentage of CSA non-adopter
Landless (<0.02 ha)	0	0
Marginal (0.021-0.20 ha)	0	0
Small (0.21-1.00 ha)	41.6	78.3
Medium (1.01-3.0 ha)	53.2	21.7
Large (>3.0 ha)	5.2	0
Total Sample	77	23

Source: BBS, 2014.

4.1.6 Knowledge on CSA Practice

The score of the knowledge on climate smart agriculture ranged from 0 to more than 1.5 respectively. On the basis of knowledge on climate smart agriculture farmers were classified into four categories such as, low knowledge, medium knowledge, high knowledge and very high knowledge on climate smart agriculture. The distribution of the farmers according to their knowledge on climate smart agriculture scores is shown in the table 4.1.6. Findings shown that for CSA adopter has maximum very high knowledge 74% where for CSA non-adopter has medium knowledge 73.9 percent.

Table 4.1.6. Knowledge on CSA Practice

Particulars	% of CSA adopter	% of CSA non-adopter
Poor Knowledge (0-0.5)	0	13
Medium Knowledge (0.51-1)	1.3	73.9
High Knowledge (1-1.50)	24.7	8.7
Very High Knowledge (>1.51)	74	4.3
Total Sample	77	23

Source: Field Survey, 2020.

4.1.7 Farmers Perception on climate smart agriculture

4. 1.7.1 Farmers Perception on Improve Productivity

The observed perception scores of the respondents ranged from 1 to 5. The mean scores were 4.83 with the standard deviation of 0.44. Based on their perception, the respondents were classified into five categories namely, strongly agree, agree, no opinion, disagree, strongly disagree.

The distribution of the farmers according to their perception shown in the Figure no 4.1.7.1 that shows 76% of farmers strongly agree that CSA practices improve productivity.

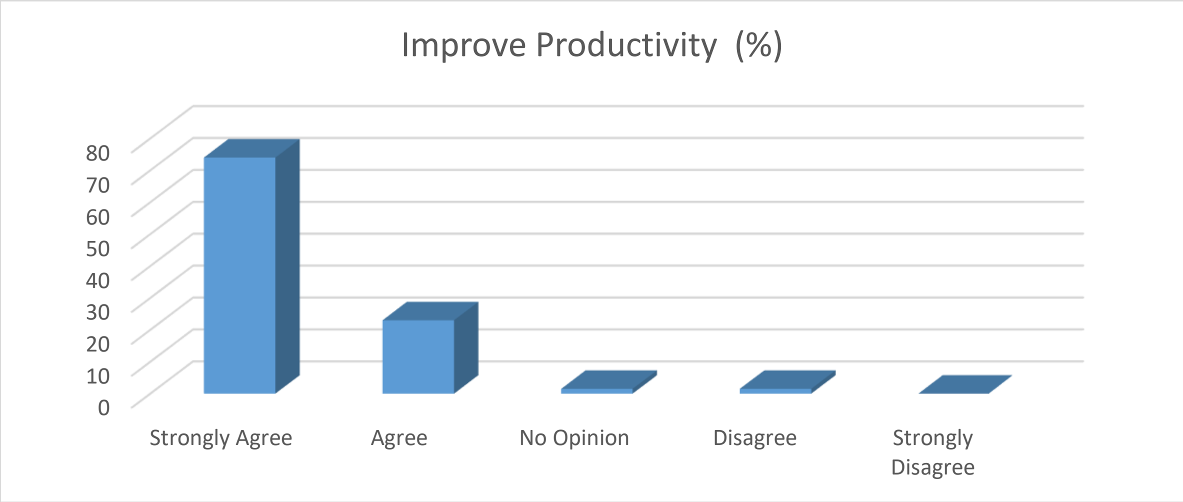

Figure 4. 1.7.1-Farmers perception on improve productivity

4. 1.7.2 Farmers Perception on environment friendly

The observed perception scores of the respondents ranged from 1 to 5. The mean scores were 4.83 with the standard deviation of 0.44. Based on their perception, the respondents were classified into five categories namely, strongly agree, agree, no opinion, disagree,

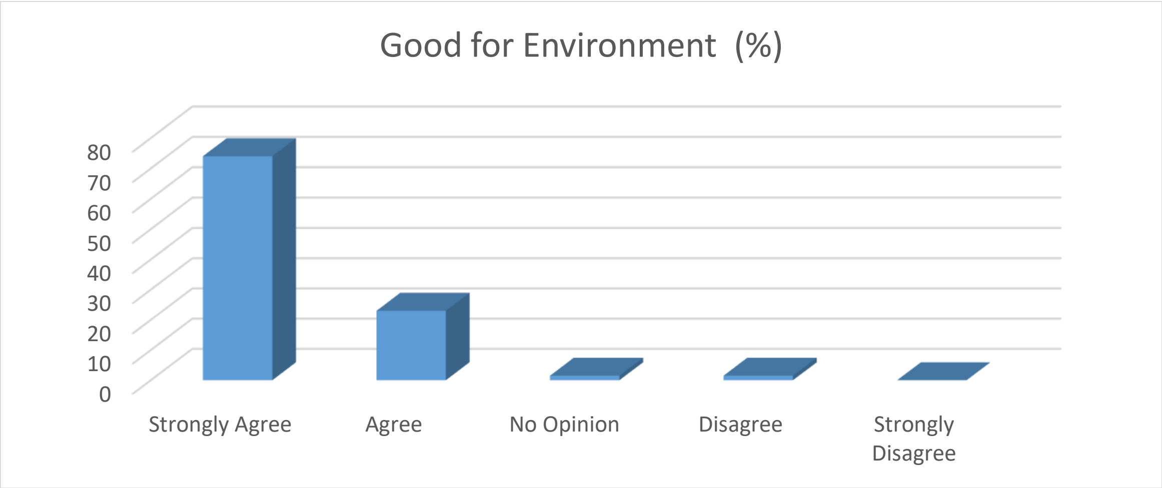

Figure 4.1.7.2-Farmers perception on good for environment

strongly disagree. The distribution of the farmers according to their perception shown in the Figure no 4.1.7.2 that shows 74% of farmers generally agree that CSA practices have a great impact on sound environment.

4.1.7.3 Farmers Perception Labor intensiveness

The observed perception scores of the respondents ranged from 1 to 5. The mean scores were 4.64 with the standard deviation of 0.48. Based on their perception, the respondents were classified into five categories namely, strongly agree, agree, no opinion, disagree, strongly disagree. The distribution of the farmers according to their perception shown in the Figure no 4.1.7.3 that shows 64.9% of farmers strongly agree and 35.1% of the farmer are agree that CSA practices are more or less depends on labor.

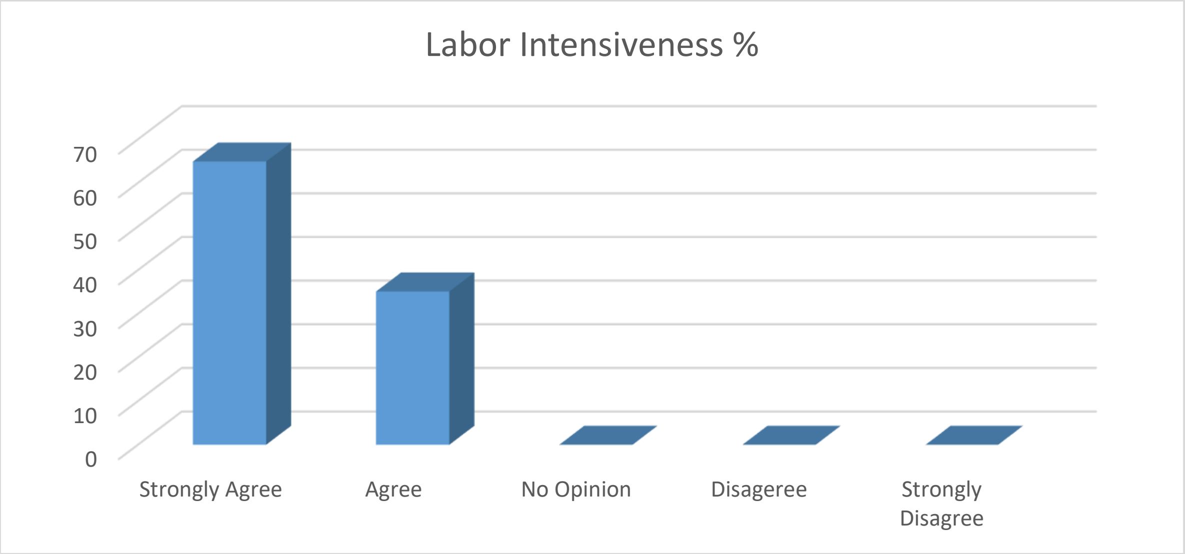

Figure 4.1.7.3-Farmers perception on Labor intensiveness

4.1.7.4 Farmers Perception on required special skill

The observed perception scores of the respondents ranged from 1 to 5. The mean scores were 4.36 with the standard deviation of 0.48. Based on their perception, the respondents

Figure 4.1.7.4-Farmers perception on required special skill

were classified into five categories namely, strongly agree, agree, no opinion, disagree, strongly disagree. The distribution of the farmers according to their perception shown in the Figure no 4.1.7.4 that shows 36.4% of farmers strongly agree and 63.6% of the farmer are agree that CSA practices need special skill.

4.1.7.5 Farmers Perception on increase income

The observed perception scores of the respondents ranged from 1 to 5. The mean scores were 4.89 with the standard deviation of 0.34. Based on their perception, the respondents were classified into five categories namely, strongly agree, agree, no opinion, disagree, strongly disagree.

The distribution of the farmers according to their perception shown in the Figure no 4.1.7.5 that shows 90.9% of farmers strongly agree and 7.8% of the farmer are agree that CSA practices has a great impact on increasing income of farmers.

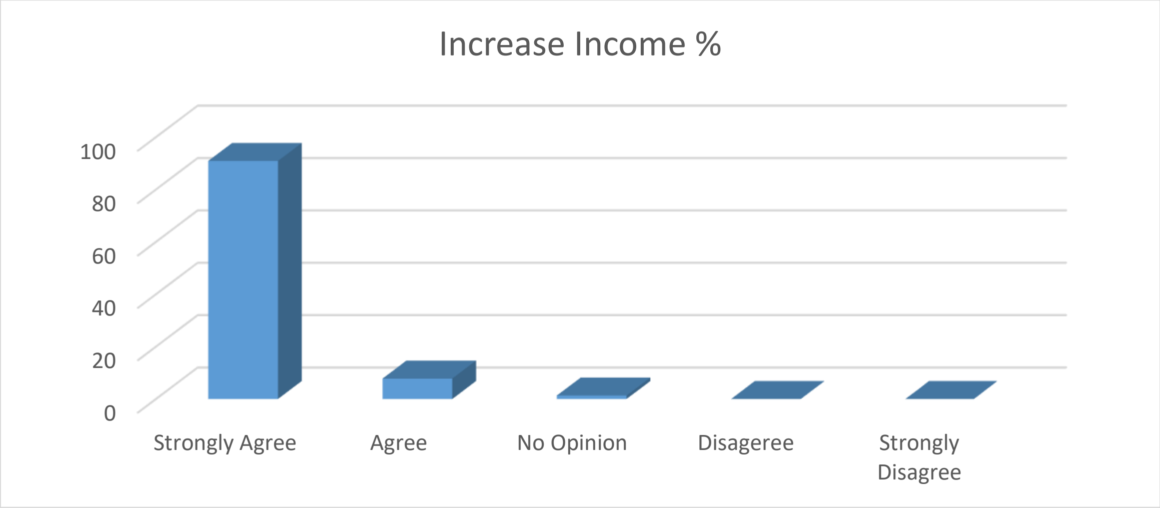

Figure 4.1.7.5-Farmers perception on Increase Income

4.1.7.6 Farmers Perception on require high investment cost

The observed perception scores of the respondents ranged from 1 to 5. The mean scores were 3.92 with the standard deviation of 0.50. Based on their perception, the respondents were classified into five categories namely, strongly agree, agree, no opinion, disagree, strongly disagree. The distribution of the farmers according to their perception shown in the Figure no 4.1.7.6 that shows 6.5% of farmers strongly agree, 81.8% of the farmer are agree, 9.1% people have no opinion and only 2.6% farmer were disagree with this perception. So from this we can say that CSA practices has a great impact on require high investment cost.

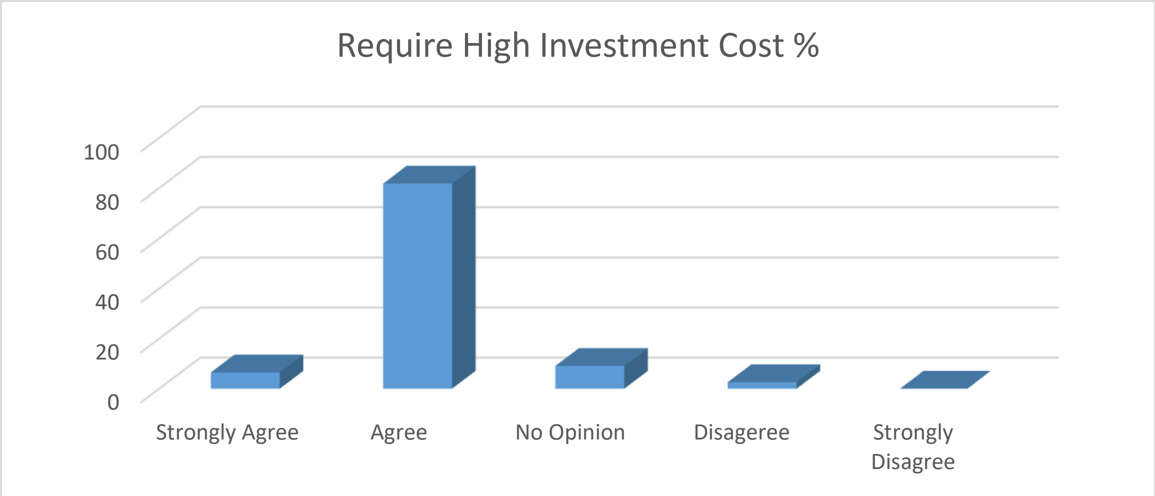

Figure 4.1.7.6-Farmers perception on high investment cost

4.1.7.7 Farmers Perception on CSA improve soil structure, protects the soil from erosion and nutrient losses

The observed perception scores of the respondents ranged from 1 to 5. The mean scores were 3.35 with the standard deviation of 0.50. Based on their perception, the respondents were classified into five categories namely, strongly agree, agree, no opinion, disagree, strongly disagree. The distribution of the farmers according to their perception shown in the Figure no 4.1.7.7 that shows zero percent of farmers strongly agree, 36.4% of the farmer are agree, 62.3% people have no opinion and only 1.3% farmer were disagree with this perception. So from this we can say that most of the people were neutral about the perception of CSA improve soil structure, protects the soil from erosion and nutrient losses.

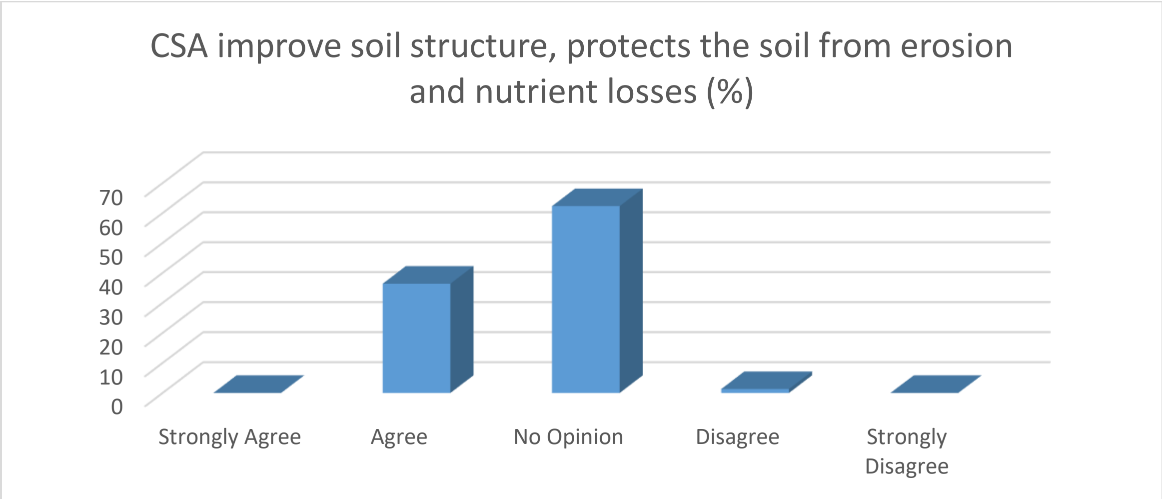

Figure 4.1.7.7-Farmers perception on CSA improve soil structure, protects the soil from erosion and nutrient losses.

4.1.7.8 Farmers Perception on Crop residues on soil surface enhance water holding capacity

The observed perception scores of the respondents ranged from 1 to 5. The mean scores were 2.76 with the standard deviation of 0.79. Based on their perception, the respondents were classified into five categories namely, strongly agree, agree, no opinion, disagree, strongly disagree. The distribution of the farmers according to their perception shown in the Figure no 4.1.7.8 that shows 1.3 percent of farmers strongly agree, 16.9% of the farmer are agree, 40.3% people have no opinion, only 40.3% farmer were disagree and 1.3% farmer were strongly disagree with this perception. So from this we can say that most of the people have no opinion or disagree with the perception of crop residues on soil surface enhance water holding capacity.

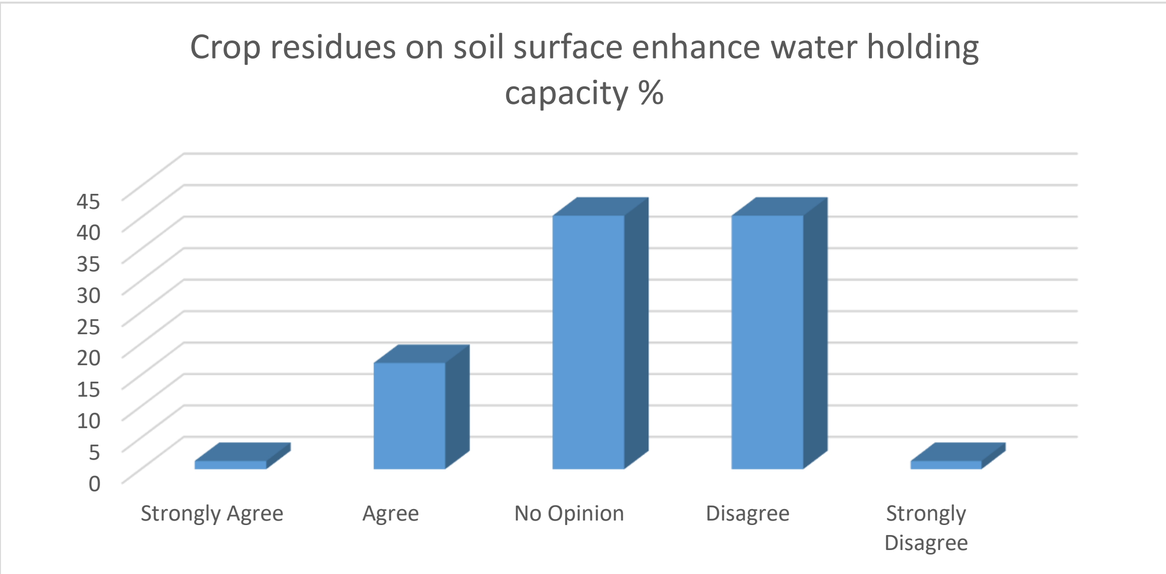

Figure 4.1.7.8-Farmers perception on crop residues on soil surface enhance water holding capacity.

4.1.8 Farmers training received on CSA practices

Table 4.1.8 indicates that for CSA adopter most of the farmer in middle range that means 55.8% of farmer received training for 5 to 7 days where CSA non adopter didn't received training on CSA practices. On the other hand 23.4 % of farmer are in lower level and only 20% of farmer received more days training. The findings of the study reveal that majority of the CSA farmers were small to medium training holder.

Table 4.1.8 Farmers training received

Particulars	% for CSA adopter	% for CSA non-adopter
Low (Less than 4 days)	23.4	0
Medium (5-7 days)	55.8	0
High (Above 8 days)	20.8	0
Total Sample	77	23

Source: Field Survey, 2020.

4.1.9. Access to agriculture related credit

Table- 4.1.9 shows that out of the total sample, for CSA adopter farmers only 14.3% farmers hold agricultural related credit and remaining 85.7% farmer didn’t receive any kind of agricultural credit from any organization. This findings refers most of the farmer are self-sufficient and not depends on agricultural credit or loan. Again for CSA non adopter farmer only 17.4 % of farmers received agricultural related loan where remaining 82.6% farmers didn’t received any kind of agricultural related credit.

Table-4.1.9 Access to agriculture related credit

	% for CSA Adopter		% CSA non-adopter	
Particulars	YES	NO	YES	NO
Access to Ag. Related credit	14.3	85.7	17.4	82.6

4.1.10 Farmers experience in Agriculture

In the study, all categories of farmers of the study area were classified into different experience groups as presented in table 4.2.10. It is evident from the table that most of the farmers were medium family in the study area. Out of the 77 sample farmers 27.3 percent belonged to the group of lower experienced, 45.5 percent belonged to the group of Medium experienced and 27.3 percent fell into the group of Large experienced group for adopter of CSA practices. And out of total 23 sample farmers 43.5 percentage belonged to the group of lower experienced, 43.5 percentage belonged to the group of Medium experienced and 13 percentage fell into the age group of Large experienced group. This finding imply that majority of the sample farmers were Medium experienced.

Table 4.1.10 Total experience in Agriculture

Particulars	Percentage for CSA adopter	Percentage for CSA non-adopter
Lower Experienced (<20 years)	27.3	43.5
Medium Experienced (21-30 years)	45.5	43.5
Higher Experienced (>31 years)	27.3	13
Total Sample	77	23

Source: Field Survey, 2020.

4.1.11 Access to CSA related information

Accurate weather forecasting and its accessibility to farmers play a very important role, particularly in determining planting and harvesting times of crops. However, table 4.2.11 shows that for CSA adopter the major source of getting information was from Extension worker and that is 61%, where other farmer got information from radio & TV (2.6%), NGO worker (15.6%), Neighbor (1.3%) , Service Provider (5.2%) and 14.3% farmer got information from others source like through mobile phone. One the other hand for CSA non-adopter, Most of the farmers got information from NGO worker (29.1%), Others services like mobile phone (20.1%), extension worker (17.4%), radio & TV (8.7%) and from neighbor (2.6%) respectively.

Table 4.1.11. Access to CSA related information

Particulars	% for CSA adopter	% for CSA non-adopter
Radio & Television	2.6	8.7
NGO Worker	15.6	29.1
Extension Worker	61	17.4
Neighbor	1.3	2.6
Service provider	5.2	20.1
Others	14.3	6.1
Total Sample	77	23

4.1.12 Soil type of land

Table-4.1.12 represent the soil type of the land in that area. It shows that most of the farmers said that the soil type of their land is loam and sandy loam as they are under the area of drought. From this table we can see 7.8 % soil were sandy, 48.4 % loam, 40.4% were sandy loam and remaining 3.9% were in other category with the mean 3.44 & standard deviation 0.69 for CSA adopter farmers. On the other hands CSA non adopter farmers claimed that most of the soil type were loam in that area and that is 47.8% where remaining were sandy (8.7%), sandy loam (30.4%), and others (13%) respectively.

Table 4.1.12 Soil type of land

Particulars	% for CSA adopter	% for CSA non-adopter
Sandy	7.8	8.7
Loam	48.4	47.8
Sandy Loam	40.4	30.4
Others	3.9	13
Total Sample	77	23

4.1.13 Annual income status

Almost 20.80 percent of the population live in poverty, and 10.30 percent of the population live in extreme poverty (BER, 2020). The $1.90/person/day Purchasing Power Parity (PPP) line is the current definition of extreme poverty (World Bank, 2011). For CSA adopter it is evident from the table 4.2.14 that 5.2% farmers are below the extreme poverty line, which indicates that their yearly income below Tk. 56000.

Most of the farmer's yearly income belonged to the category of Tk. 57000-250,000 and it is 50.6% and we can also see 44.2% of the farmer income was above 251000tk. It refers that most of the farmers were well sufficient by following climate smart agriculture practices. On the other hand, for CSA non-adopter table 4.2.13 also shows 24.4% farmers were below the poverty line that is huge under consideration. Again remaining 56.5 & were under the category of 57000-250000 and 19.1% were the category number 3 (More than 251000). So from this we can conclude that the farmers who practicing climate smart agriculture are more advanced and sufficient than farmers who weren't practicing climate smart agriculture.

Table 4.1.13. Annual income status

Level of Income (Tk)	% for CSA adopter	% for CSA non-adopter
Less than 56000	5.2	24.4
57000-250000	50.6	56.5
More than 251000	44.2	19.1
Total Sample	77	23

Source: Field Survey, 2020.

4.1.14 Problems regarding climate smart agriculture

In the study area farmers appear some barriers to adaptation such as lack of water availability, lack of credit facility, transportation problem, lack of modern technology, lack of market facility etc. (Figure 4.1.14).

Firstly, from the figure-4.1.14 we can see that 84.5% farmers faced problem of water availability very highly where 11.3% were response high, 2.7% were medium and 1.5% were low.

Secondly, from the figure-4.1.14 we can see that 56.1% farmer faced the credit problem very highly where remaining 38.3% farmers faced problem highly, 3.9% were response it medium and 1.7% farmers were response it lowly.

Thirdly, from the figure-4.1.14 we can see that for transportation problem 44.8% farmers faced it very highly, 40.6% farmers claimed it high, 10.2% farmers claimed it moderate and remaining 4.4% farmers claimed it low.

Fourthly, from the figure-4.1.14 we can see that for lack of modern technology, 38.8% farmers faced that problem very highly, 49.3% farmers claimed it highly, 9.8% farmers claimed it medium and remaining 2.1% farmers claimed it as a low problem.

Lastly, from the figure-4.1.14 we can see that 32.3% farmers faced the lack of market facility very highly, 38.6% farmers claimed it highly, 21.4% farmers claimed it medium and remaining 7.7% farmers claimed it lowly.

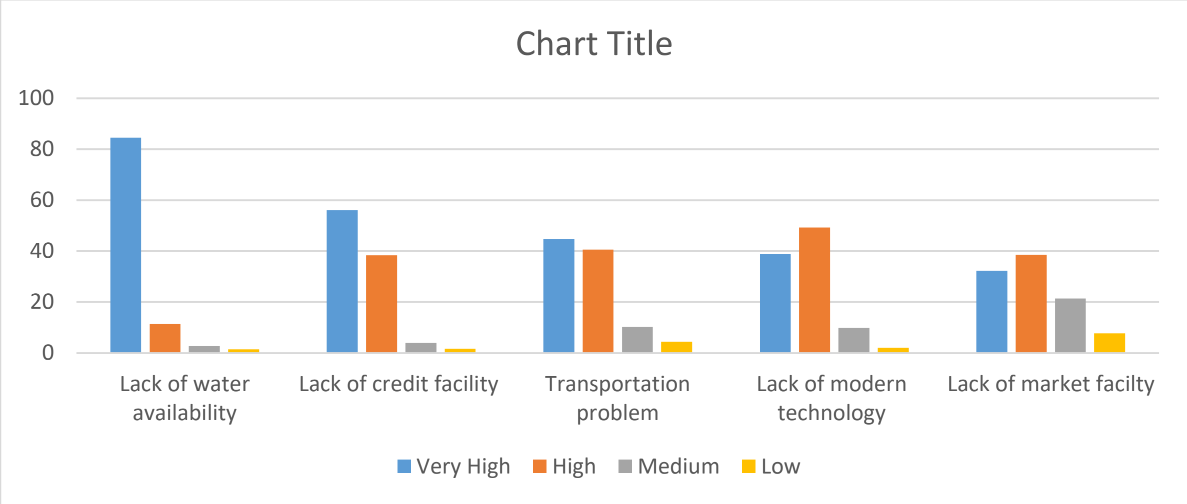

Figure 4.1.14-Farmers problems regarding climate smart agriculture

4.1.15 Distribution of the CSA farmers according to their adoption of CSA

Data contained in the Table 4.1.15 revealed that the majority (63.8%) of the farmers had medium adoption as compared to 23.1% and 13.1% having low and high adoption respectively. The majority (81.9 percent) of the farmers had in low to medium adoption.

Table 4.1.15 Distribution of adoption of CSA practices

Particulars	CSA practices adopter (percent)
Low adoption (<2)	23.1
Medium adoption (3-5)	63.8
High adoption (>6)	13.1
Mean	49.36
Standard Deviation	2.19
Total Sample	100

4.2 Econometric Model Results

Table 4.2 presents the results of the MNL model of estimated parameters and marginal effects. Overall, the model offers a good fit with factors predicting the adoption of adaptation strategies by the study households. The chi-square statistics (LR–74.21) indicate the strong explanatory power of the model. Goodness of fit of the model given by the McFadden pseudo R^2 of 0.261 also indicates reasonable explanatory power of the model (Table 4.11). Moreover, most of the explanatory variables in the model were found to be statistically significant with an expected sign (see discussion below).

Table: 4.2 Estimated results from MNL model.

Explanatory Variable	**CSA Practices (Dependent variable)**			
	Drought Resistant Rice Variety	Green Manuring	Agro-forestry	IPM Practices
	Coefficient	Coefficient	Coefficient	Coefficient
Constant	-2.548 (0.199)	-13.167 (0.047)*	-5.374 (0.280)	-11.095 (0.008)**
Age	0.031 (0.562)	-0.06 (0.523)	-0.052 (0.438)	0.050 (0.526)
Education	0.546 (0.643)	0.574 (0.004)**	0.133 (0.079)	0.588 (0.003)**
Family Size	-1.425 (0.049)*	-1.334 (0.932)	-1.339 (0.915)	-1.165 (0.079)
Farm Size	-0.174 (0.257)	0.463 (0.391)	-1.224 (0.934)	-0.276 (0.863)
Training Received	0.841 (0.081)	0.105 (0.134)	0.683 (0.026)*	0.814 (0.042)*
Access to Credit	0.713 (0.308)	0.153 (0.302)	1.459 (0.867)	-0.243 (0.613)
Total Experience	-0.775 (0.545)	1.187 (0.646)	-0.057 (0.103)	-0.459 (0.632)
Annual Income	0.513 (0.013)**	0.748 (0.371)	0.070 (0.048)*	0.334 (0.004)**

Log likelihood = -117.1453

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

Pseudo R^2 = 0.261

LR (Chi-square) = 74.21

Table-4.2 shows that education, family size, training received and total income has effect on the adoption of climate smart agriculture practices.

4.2.1 Significant contribution of education to the farmers' adoption of climate smart agriculture

From the MNL model, it was concluded that the contribution of education to the farmers adoption of climate smart agriculture was measured by the testing the following null hypothesis;

"There is no contribution of education to the farmer's adoption of climate smart agriculture".

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

The p-value of independent variable education for green manuring is 0.004 which is significant at 1% level of significance that means we will reject the null hypothesis. It indicates that the education has effects on adoption of green manuring.

Again, the p-value of independent variable education for IPM practices is 0.003 which is significant at 1% level of significance that means we will reject the null hypothesis. It indicates that the education also has effects on adoption of IPM use.

This study found a significant positive relationship between farmer's adopting the strategy of green manuring and IPM practices for education.

4.2.2 Significant contribution of family size to the farmers' adoption of climate smart agriculture

From the MNL model, it was concluded that the contribution of family size to the farmers adoption of climate smart agriculture was measured by the testing the following null hypothesis;

"There is no effects of family size to the farmers adoption of climate smart agriculture".

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

The p-value of independent variable family size for drought resistant rice variety is 0.049 which is significant at 5 % level of significance that means we will reject the null hypothesis. It indicates that the family size has effects on adoption of drought resistant rice variety.

This study found a significant positive relationship between farmer's adopting the strategy of drought resistant rice variety for family size.

4.2.3 Significant contribution of training received to the farmers' adoption of climate smart agriculture

From the MNL model, it was concluded that the contribution of training received to the farmers adoption of climate smart agriculture was measured by the testing the following null hypothesis;

"There is no contribution of training received to the farmers adoption of climate smart agriculture".

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

The p-value of independent variable training received for agro-forestry is 0.026 which is significant at 5% level of significance that means we will reject the null hypothesis. It indicates that the training received has effects on adoption of agro-forestry. Again, the p-value of independent variable training received for use of IPM is 0.046 which is significant at 5% level of significance that means we will reject the null hypothesis. It indicates that the training received also has effects on adoption of IPM use.

This study found a significant positive relationship between farmer's adopting the strategy of agro-forestry and IPM practices for training received.

4.2.4 Significant contribution of annual income to the farmers' adoption of climate smart agriculture

From the MNL model, it was concluded that the contribution of annual income to the farmers adoption of climate smart agriculture was measured by the testing the following null hypothesis;

"There is no contribution of annual income to the farmers adoption of climate smart agriculture".

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

The p-value of independent variable annual income for drought resistant rice variety is 0.013 which is significant at 1% level of significance that means we will reject the null hypothesis. It indicates that the annual income has effects on adoption of drought resistant variety. Again the p-value of independent variable annual income for IPM practices is 0.004 which is significant at 1% level of significance that means we will reject the null hypothesis. It indicates that the annual income also has effects on adoption of IPM use.

Further the p-value of independent variable annual income for Agro-forestry practices is 0.048 which is significant at 5% level of significance that means we will reject the null hypothesis. It indicates that the annual income also has effects on adoption of Agroforestry practices.

This study found a significant positive relationship between farmer's adopting the strategy of Drought resistant variety, IPM practices and Agro-forestry practices for annual income.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

5.1.1 Characteristics of the farmers

Age Distribution

The age distribution of the farmers scores ranged from 20 to More than 51 respectively. For CSA adopter farmers 7.8 percent belonged to the age group of 20-30 years, 61 percent belonged to the age group of 31-50 years and 31.2 percent fell into the age group of above 51 for adopter of CSA practices. Again for CSA non-adopter farmers zero percentage belonged to the group of 20-30 years, 73.9 percentage belonged to the group of 31-50 years and 26.1 percentage fell into the age group of above 50 years old. This finding imply that majority of the sample farmers were in the most active age group of 31-50 years indicating that they provided more physical efforts for farming

Education

The level of educational scores of the CSA farmers ranged from 0 to more than 12 respectively. Again mean and standard deviation for CSA non-adopter is 2.56 and 0.58 respectively. Respondent under secondary education category constitute the highest proportion (59.7 percent) for CSA adopter and (18.2 percent) for CSA non-adopter followed by primary (19.5 percent) for CSA adopter & (10.4 percent) for CSA non-adopter. On the other hand, Illiterate is in the lowest by 2.6 percent for CSA adopter and 1.3 percent for CSA non-adopter farmers.

Family Size

The family size distribution of the farmers scores ranged from 1 to More than above 7 respectively. For CSA adopter farmers 39 percent belonged to the group of small family, 57.1 percent belonged to the group of Medium family and 3.9 percent fell into the group of large family for adopter of CSA practices.

Again for CSA non-adopter farmers 43.5 percentage belonged to the group of Small family, 56.5 percentage belonged to the group of Medium family and zero percentage fell into the age group of large family. This finding imply that majority of the sample farmers were Medium family.

Farm size

The farm size of the CSA farmers ranged from 0.02 ha to 3.00 ha respectively. The researcher found that the medium farm holder for CSA adapter constitutes the highest proportion (53.2 percent) followed by small farm holder (41.6 percent), whereas 5.2 percent was large farm holder. The researcher also found that the small farm holder for CSA non-adapter constitutes the highest proportion (78.3 percent) followed by medium farm holder (21.7 percent), whereas zero percent was large farm holder. The findings of the study reveal that majority of the CSA adopter and non-adopter farmers were small to medium sized farm holder.

Knowledge on CSA Practices

The score of the knowledge on climate smart agriculture ranged from 0 to more than 1.5 respectively. Findings shown that for CSA adopter has maximum very high knowledge 74% where for CSA non-adopter has medium knowledge 73.9 percent.

Training received on CSA practices

The training received distribution of the farmers scores ranged from 1 to more than above 8 respectively. For CSA adopter most of the farmer in middle range that means 55.8% of farmer received training for 5 to 7 days where CSA non adopter didn't received training on CSA practices. On the other hand 23.4 % of farmer are in lower level and only 20% of farmer received more days training. The findings of the study reveal that majority of the CSA farmers were small to medium training holder.

Farmers experience in Agriculture

The total experience in agriculture distribution of the farmers scores ranged from less than 20 to More than 31 respectively. For CSA adopter farmers 27.3 percent belonged to the group of lower experienced, 45.5 percent belonged to the group of Medium experienced and 27.3 percent fell into the group of Large experienced group for adopter of CSA practices. For CSA non-adopter farmers 43.5 percentage belonged to the group of lower experienced, 43.5 percentage belonged to the group of Medium experienced and 13 percentage fell into the age group of large experienced group. This finding imply that majority of the sample farmers were Medium experienced.

Access to agriculture related credit

For CSA adopter farmers only 14.3% farmers hold agricultural related credit and remaining 85.7% farmer didn't receive any kind of agricultural credit from any organization. This findings refers most of the farmer are self-sufficient and not depends on agricultural credit or loan. Again for CSA non adopter farmer only 17.4 % of farmers received agricultural related loan where remaining 82.6% farmers didn't received any kind of agricultural related credit.

Access to CSA related information

For CSA adopter the major source of getting information was from Extension worker and that is 61%, where other farmer got information from radio & TV (2.6%), NGO worker (15.6%), Neighbor (1.3%) , Service Provider (5.2%) and 14.3% farmer got information from others source like through mobile phone. One the other hand for CSA non-adopter, Most of the farmers got information from NGO worker (29.1%), Others services like mobile phone (20.1%), extension worker (17.4%), radio & TV (8.7%) and from neighbor (2.6%) respectively.

Annual income

For CSA adopter 5.2% farmers are below the extreme poverty line, which indicates that their yearly income below Tk. 56000. Most of the farmer's yearly income belonged to the category of Tk. 57000-250,000 and it is 50.6% and we can also see 44.2% of the farmer income was above 251000tk.

It refers that most of the farmers were well sufficient by following climate smart agriculture practices. On the other hand for CSA non-adopter 24.4% farmers were below the poverty line that is huge under consideration. Again remaining 56.5& were under the category of 57000-250000 and 19.1% were the category number 3 (More than 251000). So from this we can conclude that the farmers who practicing climate smart agriculture are more advanced and sufficient than farmers who weren't practicing climate smart agriculture.

5.1.2 Farmer adoption of climate smart agriculture

Farmer adoption of climate smart agriculture scored varied from less than 2 to more than 6 respectively. Among the CSA farmers, the highest 58.1 percent CSA farmers belong to the group of medium and the lowest percentage 18.1 percent in high adoption followed by low (23.8 percent) by the CSA farmers in adoption of climate smart agriculture.

5.1.3 Contribution of the selected characteristics of the farmers' perception in adoption of CSA

There is a significant contribution of education and annual income of CSA farmers and both of these were the most important contributing factors (significant at the 1% level of significance). Family size, and training received were also the important contributing factors (significant at the 5% level of significance).

5.2 Conclusions

The findings and relevant facts of research work prompted the researcher to draw following conclusions:

Among the CSA farmers, the highest proportion (63.8 percent) belonged to the group of medium adoption compared to 13.1 percent and 23.1 percent in high and low adoption of climate smart agriculture respectively. Therefore, it may be concluded that there is scope to increase the extant of adoption of CSA by the farmers.

Education of the farmers had the highest contribution to adoption of CSA farmers in Rajshahi and Natore district. It is therefore, concluded that if the education increases the adoption of climate smart agriculture will also increase.

Annual income of the farmers also had the highest contribution to adoption of CSA farmers in Rajshshi and Natore district. It is therefore, concluded that if the annual income increases the adoption of climate smart agriculture will also increase.

Training received is the next contributor to the farmers' adoption of climate smart agriculture. The majority of the CSA farmers were small to medium training holder. It is therefore, concluded that if the farmers receive training on CSA practices then it will increases the adoption of climate smart agriculture will also increase.

Family size is the next and final contributor that has impact on the farmers' adoption of climate smart agriculture. The majority of the CSA farmers were in medium family. It is therefore, concluded that family size had a great impact on the adoption of climate smart agriculture.

5.3 Recommendations

5.3.1 Recommendations for policy implications

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

- Most of the farmer are feeling lack of proper education. They don't have enough knowledge about climate change. In that cases, Government and different NGO should take a necessary step to enhance their education system.
- BRRI and BINA already have developed various drought-tolerant varieties, saline-tolerant varieties, flood tolerant varieties, short duration varieties etc., the results revealed that a large part of the farmers are cultivating local varieties and also, they are damaged economically. It may be that they are not well concerned to adopt HYVs to cope up with the adverse effects of climate change. So, DAE, BADC and NGOs can be involved in introducing these varieties to the farmers so that they are encouraged to adopt the varieties quickly.
- Famers are feeling lack of irrigation especially supplementary irrigation at Aman season. Policymakers should place more emphasis on Aus and Aman rice (as they are mainly rain-fed crops) by allowing supplementary irrigation to increase overall rice production. BADC can play vital role to ensure the facility of irrigation.
- Lack of training facility is another problem of farmers. They have received very few trainings on agriculture. Again, they are not concern about climate changes because of they don't have proper training on climate change related program. So in that condition farmers needs proper knowledge about climate changes by receiving training. So different GO, NGO and service provider should provide different training facility to the farmers.
- Necessity of Agricultural Information Centers (AIC) is at high priority basis because farmers have been suffering lack of proper information and inefficient use of technology. We found that most of the farmers have lack of knowledge concerning appropriate adaptation, AIC can provide proper knowledge of adaptation strategies.

- Lack of finance is a common phenomenon of our farmers. Policymakers have to reconsider about the financial facility of farmers because farmers are maker of the nation; their sound existence is the sign of wellbeing. Commercial Banks can provide loan without any interest to small and landless farmers because they are more vulnerable to climate change or any natural calamities. But real scenario is different farmers go to rural usury for finance and they victims with the high interest rate; they get impoverished day by day and vicious cycle of poverty. To survive our farmers government should be attentive on financial facility of farmers and create an easiest way of providing loan to small and landless farmers.
- Household access to weather information could also enhance adaptation and reduce the adverse effects of climate change. However, the analysis shows that more than 80% of the farmers in the study area do not get any information regarding weather while the remaining farmers get mostly inaccurate and irregular weather forecasts. Weather forecasts should be made available regularly through cell phone systems, television and/or radio. The Bangladesh Space Research and Remote Sensing Organization (BSRRSO) can take a leading role in this activity.
- Extension service should be more available, farmers do not get enough service from DAE. They can disseminate the modern technologies to the farmers to minimize the impacts of climate change. More access of modern technologies to farmers can bring wellbeing economically.

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Appendix - I

An English Version of Interview Schedule
Dept. of Management and Finance
Sher-e-Bangla Agricultural University
Interview Schedule

A Study on factors affecting the adoption of Climate Smart Agriculture (CSA) / Conservation Agricultural (CA) practices in northern part of Bangladesh

Sample no.: --------------

1. General information:

Name: ………………………………………… **Upazila:** …………………

District: …………………. **Contact No:** …………………………..

2. Respondents profile:

Sl#	Relationship	Age (yrs)	Education (yrs)	Main occupation*	Family size	Working people
1	**Self**					
2						

*Occupation code: 1 =Agriculture, 2= service, 3=business, 4= unemployed, 5=others

3. Farm Size:

Land type	Area (ha.)
Own cultivated land	
Sharecrop out	
Sharecrop in	
Lease out	
Lease in	
Homestead	
Pond	

Explain clearly about climate smart / conservation agricultural practices. After explanation start the following section.

4. Do you ever heard (aware) about CSA/CA practices? Yes (1) / No (0)
If yes, from where: ……………………………………

5. Knowledge on CSA/CA practices: Please answer the following question

SL. NO	Questions	Full Marks	Marks Obtained
1	What do you mean by CSA/CA?	(2)	
2	Mention two examples of CSA/CA practices.	(2)	
3	**What is zero tillage?**	(2)	
4	**What is cover crop?**	(2)	
5	**What is zero/minimum tillage**	(2)	
6	What is green manure?	(2)	
7	How to use crop residue in crop field?	(2)	
10	What are the benefits of guti Urea?	(2)	
11	What are the advantages of AWD (Alternative Wetting and Drying)?	(2)	
12	What is the benefit of Agro-forestry?	(2)	
13	What are the advantages of IPM?	(2)	
14	What do you mean by drought resistant variety?	(2)	

6. Do you adopted the following practices in your crop field?

Sl#	Practices	Yes (1)	If yes, land area (ha.)	No (0)
1	**Zero tillage**			
2	**Minimum tillage**			
3	**Crop rotation**			
4	**Cover crop**			
5	**Crop residue**			
6	Construction of mini-pond in crop field			
7	Drought resistant rice variety			
8	Green manuring			
9	Agro-forestry			
10	Use of IPM			
11	Use AWD			
12	Unpuddled rice transplanting system by strip and raised bed method			
13	Rain water harvesting			

7. Farmers' perception on CSA/CA (IF #6 is 'NO' then ignore this question):

Sl#	Farmers perception	Extent of farmer's perception				
		Strongly agree (5)	Agree (4)	No Opinion (3)	Disagree (2)	Strongly Disagree (1)
1	Improve productivity					
2	Reduces pesticide application cost					
3	Good for environment					
4	Labour intensive					
5	Required special skill					
6	Increase income					
7	Require high investment cost					
8	CA/CSA improves soil structure, protects the soil from erosion and nutrients losses					
9	Crop residues on the soil surface enhance water holding capacity					
10	Conservation tillage/reduced tillage protects soil surface					
11	Cover crops protects soil from moisture and limited weed growth					

8. Other information about respondent's (last one-year information):

Questions	**YES**	**NO**	**If yes**	
			times	**days**
a. Have you received any agriculture related training?				
b. Did you visited extension office/SAAO for advice?				
c. Have you received any training on CSA/CA?				
d. Did you visit extension office/SAAO for CSA/CA advice?				
e. Are you confident about SAAO advice?				
f. Do you think **CSA** practices are available in your area?				
g. Do you have any bank account?				
h. Did you receive any agriculture related credit?				

i. Are you a member in any societal organization?				
j. Did you experience any health-related issues which hamper your activity?				
k. Did you experience any labour crisis to work in your field?				
l. Is there any IPM club in your village?				
m. Is there any climate field school in your village/upazila?				
n. 1. Are you a member of IPM club?				
n.2. Are you a member of climate field school?				
o. Do you have electricity in your house?				
p. Do you have pacca road in your village?				
q. Do you have any service provider in your village/upazila?				
r. Availability of climate related information in your area.				
s. How many months in a year you can consume from your own production? (months)				
t. Distance of your home to local market (km).				
u. Distance to upazila agriculture office from home (km).				
v. Distance of your home to highway (km).				
w. Your total experience in agriculture (years).				
x. How long you are practicing CSA/CA? (years)				
y. How do you get information related to CSA/CA? *				
z. Housing condition of the respondent.**				
aa. Severity of extreme events like drought in your upazila.***				
bb. Soil type where you adopted CSA/ CA.****				

Code: ***Information**: 1 Radio, 2 TV, 3 NGO Workers, 4 Extension Workers, 5 Neighbor, 6 newspaper, 7 service provider, 8 others; ****House condition:** 1 building, 2 tin shed, 3 others; *****Events**: 3 extreme severe, 2 moderate, 1 low, 0 none; ****Soil: 1 clay, 2 sandy, 3 loam, 4 sandy loam, 5 others

9. Annual Income

	Source of income	Income (Tk.)		Source of income	Income (Tk.)
Agricultural	Rice		Occupational	Service	
	Wheat			Business	
	Fruits and vegetables			Remittance	
	Livestock and poultry			Others (if any)	
	Fisheries				
	Others				

10. Annual expenditure:

Consumption expenditure: ……………………….. Tk/yr

Non consumption expenditure: ……………………… Tk/yr

11. Problems and suggestion regarding CSA/CA

a. Are there any problems of using CSA/CA practices? Mention them

i…………………………………………………………………

ii…………………………………………………………………….

iii……………………………………………………………….....

b. Suggestions for future development/adoption of CSA/CA.

i…………………………….………………………………………

ii…………………………………………………………………….

iii…………………………….…………………………………….

Thanks for your kind co-operation