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Farmer's Perception and Agricultural Adaptation Strategies to Climate Change: A Study on Coastal Area of Feni District, Bangladesh

Priyanka Saha*
Md. Shamimul Islam**
Ayesha Aktar***

Abstract: *Climate change has become the most pressing issue for Bangladesh's coastal districts over the last few years. Climate change has a substantial effect on agricultural industries. As a result, adaptation is the primary policy for alleviating the destructive effects of climate change. This study will demonstrate farmers' observations of climate change and their adaptation techniques, and the elements that determine their adaptation decisions. The investigation was conducted in Sonagazi Upazila, Feni district's sole coastline location. Four unions were chosen for data gathering because they were connected to the Bay of Bengal. 315 individuals were interviewed, and a semi-structured questionnaire was used to acquire data. Descriptive statistics were used to ascertain public observations of climate change and adaptation alternatives. The factors influencing the farmer's decision to adopt an adaptation strategy were analyzed using a Binary Logistic model. The study demonstrates that Sonagazi farmers employ a diversity of adaptation tactics responding to climate change. Crop variety, mulching, mixed cropping, crop rotation, tree planting, and irrigation efficiency are some of these measures. From binary Logistic model, it is cleared that only farming experience and education level of the farmers have positive influence on adaptation decisions.*

Key words: *Farmer's Perception, Agricultural Adaptation Strategies, Climate Change, Coastal Area, Feni District.*

1. Introduction

Climate change is a major global concern since it is one of the most significant environmental changes affecting ecosystems and human life. It has ramifications in many economic areas, including forestry, agriculture, water resources, fishing,

* Post Graduate in Economics, Department of Economics, Comilla University, Cumilla-3506
** Professor, Department of Economics, Comilla University, Cumilla–3506
*** Lecturer, Department of Economics. Comilla University, Cumilla–3506

and health (IPCC, 2007).Climate change has become a more difficult issue in underdeveloped countries in recent years. Bangladesh is likewise a country that is sensitive to climate change. Sonagazi, the only coastal area of Feni, is most affected due to climate change. Over the last three decades, the area has experienced about 200 climate-related disasters, including extreme heat, flooding, and storms. Thousands of people have died as a result of these disasters, and homes and livelihoods have been destroyed. Agriculture is the backbone of Bangladesh's economy, yet it is particularly subject to climate change and fluctuation. As a result, farmers' adaptation methods are crucial for dealing with harsh weather and climatic volatility. Climate change adaptation is a process that begins with farmers realizing that the climate has changed and advances to determining the necessary adaptations (Mustapha et al., 2012). However, adaption measures are unlikely to be effective unless farmers have adequate information about the impacts of climate change. Farmers' adaptation potential is unpredictable due to socioeconomic factors. Many farmers confront adaptation challenges because of their education, land size, agricultural income, experiences, and so on.

Agriculture has played an important role in the nation's progress and economic well-being. Despite the fact that the agriculture sector's percentage of total GDP has decreased, the sector remains strong and vital to all other sectors. Farmers' increased reliance on the unpredictable rainfall renders agriculture productivity fragile. The study attempts to evaluate the impact of climate change on agriculture, specifically in Bangladesh's coastal region.Little research on agricultural adaption techniques has been undertaken in Bangladesh's coastal area. As a result, the following problem assertions are made in the paper.

- How do the farmers observe climate change, and how do they react in the agricultural sector?
- Do their adaptive policies take into consideration in the future?

Bangladesh is still highly vulnerable to climate change, and her smallholder farmers are generally poor. There are 19 coastal districts in Bangladesh. Feni is one of them and Sonagazi Upazila is only the coastal area of Feni. Agriculture employs over 70% of Sonagazi's population. Sonagazi is prone to climate calamities like as cyclones, heavy rains, and cold waves. Crop yield is also influenced by salinity water. As a result, many crops rot quite quickly. Farmers' livelihoods are impacted when they receive a low return on agriculture

investment. Farmers have altered their farming practices in response to climate change.In production, they employ several adaptive techniques. The Sonagazi adaptation strategy study is critical because few farmers will utilize larger-scale adaption techniques unless they are satisfied that they are the best option for income creation. The majority of farmers use adaptation strategies solely to recover their losses. However, because there are little resources to draw on in times of crisis, the benefits of adaptation can then be better reaped by all farmers without increasing costs for others. The purpose of the study is to identify the native adaptation strategy for agriculture by farmers in the coastal area. The specific objective of the study is-

- to know about the farmer's observation of the climate change and impact of adaptation barriers faced by the farmers in the coastal area.
- to analyze the issues that influencing farmer choices to adapt to climate change.

2. Literature Review

In Bangladesh due to their heavy reliance on climate-sensitive small-scale agriculture, smallholder farmers in various agro-based areas face a serious threat from climate variability and change. According to Rezvi (2018), a 4°C increase in temperature brought on by climate change will significantly affect Bangladesh's food production, resulting in a 28% decline in rice production and a 68% decrease in wheat production. Findings indicate that one of the most obvious effects of climate change is the continual drift of the rain-fed rice season (Aman), which is brought on by drought and delayed monsoons. If current trends continue, the harvest of rice and wheat may decrease by 8% and 32%, respectively, by 2050. Amounting to 30 to 50 percent of agricultural land is still unusable due to salinity, water logging, and aridity. Salinity harmed 1.1 million hectors of land in these coastal areas. By 2050, rising salinity will cause an 8% decrease in rice yield and a 32% decrease in wheat production. A significant water shortage for rice irrigation will be caused by the rising salinity proportion. Groundwater aquifers in Bangladesh's southern and coastal regions are also impacted by saline water. Islam (2017) investigated the effectiveness of government institutions in agricultural climate change adaptation from the perspectives of farmers and institutional practice of communities in Bangladesh's drought-prone districts. He learned that traditional institutions are essential for creating place-based capacity for agriculture mitigation and adaptation strategies

through their communities of practice. Delaporate & Maurel (2017) examined how much different techniques are used by rural households in Bangladesh to deal with risks to agricultural productivity brought on by weather-related shocks. They found that a 1% decrease in agricultural income increased the likelihood of adaptation by over 3%.The wealthier households can decrease agricultural revenue by changing crop kind and variety as well as switching from livestock to crop production, notwithstanding the minor sign of the income variable. No differences were seen in terms of education. The ability of bigger households to transfer members away, for example, to diversify their income, makes adaptation easier than it is for smaller households.

At the same time, Masud et al. (2017) looked into how farmers in Malaysia's agricultural sector were seeing the effects of socioeconomic variables and adaptation barriers on their exposure to climate change. According to their research, factors like age, education level, farm revenue, farm experience, restricted access to agricultural extension, lack of funding, limited access to agricultural markets, and farm size all have a significant impact on adaptability strategies. Farmers are willing to address climate change concerns by taking the appropriate adaptation measures and have a positive attitude toward adapting to it. Farmers are unable to implement recommended climate change adaptation practices due to a number of adaptation hurdles.

Akinnagbe and Irohibe (2014), Enete et al. (2010), and Mahouna et al. (2017) studied how African farmers adapted to climate change. Farms have developed crop adaptation strategies like crop planting, cultivation diversification, crop pattern and crop calendar changes, mixed crops, improved irrigation efficiency, soil conservation adoption, planting (forest) and agro-forestry, and animal adaptation strategies like production adjustments, branding, and farming. Climate change threatens the new breed's survival and adaptation. Labor mobility and revenue diversification helped farmers adapt. Enete et al. (2010) identified climate change adaptation hurdles for smallholder farmers in southern Nigeria. Land constraints, such as inadequate obtainability, high costs, and poor ownership systems (tenure), inadequate climate change information and agricultural extension service delivery, high farm input and processing facility costs, high irrigation facility costs, and insufficient financial resources were cited as factors impeding farmers' ability to adapt to climate change impacts.Mahouna et al. (2017) used a multinomial logistic regression analysis to assess the factors impacting households' climate change adaptation choices.

Benin farmers understand climate change and respond to climate change by diversifying crops and livestock, using organic fertilizer, mulching, better

varieties, chemical fertilizers, and pesticides, agro forestry, and permanent plantations.

There are few researchers in this field as it is a contemporary issue and good research works are still limited in Bangladesh, focusing on the adaptation strategies in agricultural sector. This study will provide light on the agricultural sector after the world wide Covid-19 disaster. Additionally, it will assist the government, relevant agencies, and other stakeholders in creating policy for the sector's future development.

3. Methodology

3.1. Study Area

In Bangladesh, there are 19 coastal districts. Feni is one of the coastal districts in Bangladesh's south-eastern region. Sonagazi is an Upazila (subdistrict) in the Chittagong Division's Feni District. It is located in the district's southern region and is the district's only Upazila with a coastline on the Bay of Bengal. Sonagazi is well-known for its natural setting. 40% of the people of Sonagazi involve in agriculture. About 36.40% of income comes from agriculture in Sonagazi Upazila. In this paper we want to show the impact of climate change in agriculture to the Feni district's coastal area and the farmer's adaptation strategies. For this reason among 9 unions we select 4 unions which are connected with the Bay of Bengal directly. They are Char Darbesh, Char Chandia, Amirabad, and Sonagazi. These unions are selected for data collection based on their agricultural production and coastal zone in Sonagazi. Char Chandia union is a highly affected area by climate change. For agricultural purposes, each union is divided into 3 blocks. Within 3 blocks, 1 block represents the others in every union. Among 9 unions, 7 unions are mostly dependent on agriculture. These are Char Chandia, Char Darbesh, Sonagazi, Amirabad, Matiganj, mangalkandi & Char Majlishpur. Char Chandia and Sonagazi unions largely depend on agriculture.

1.2. Sample size and data collection tools:

Four unions (Char Chandia, Char Darbesh, Amirabad, and Sonagazi) are selected for data collection based on their agricultural production and the coastal zone in Sonagazi. The population of farmers who engage farming in these unions were known by the help of the department of agricultural expansion (DAE) in Sonagazi. According to DAE the total population were 6300. We have selected the sample size by using the random table.In this study we were using 4 explanatory variables and according to Hair et al. (2018), Tabachnick and Fidell (1989), the sample to variable ratio suggest that 15:1, whereas 20:1 or 30:1 are preferred. Therefore 30 samples per variable are quite enough to predict consistent result. Hence, at least data from 120 respondents should be collected for drawing conclusions for the population. From the total population of these

four upazilas 5% population are taken as purposively to determine sample size for the study and respondents are interviewed randomly in that area.

Data were accumulated by face-to-face structured interviews. In a structured interview, the respondents are asked a set of predetermined questions. The data collected pertains to farmers' personal information, farmers' opinions of climate change, and farmers' adaptation techniques to climate change.

3.3.Data Analysis

For the purpose of data interpretation, the Statistical Package for Social Sciences (SPSS) was utilized. The data was summarized and classified using means, percentages, and frequencies. The binomial Logit model was used to investigate the factors influencing farmers' decisions to adapt or not to adapt to climate change. The dependent variable in this example was dichotomous, i.e. farmer's decision to adapt or not to climate change. Muzamhindo (2015) and Fosu-Mensah (2010) argue that the binary Logit model is acceptable in this instance for the reason that it think through the link amid a binary dependent variable and a collection of independent variables.

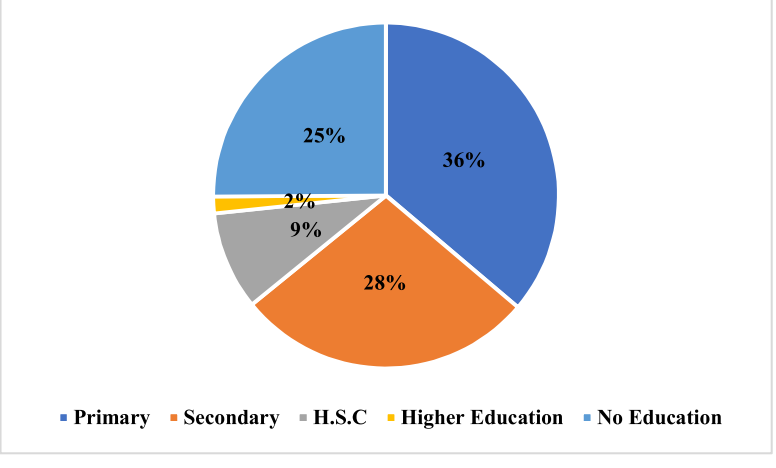
4. Findings and Analysis

4.1. Descriptive Analysis

4.1.1. Socioeconomic Characteristics of Farmers

The respondents' socioeconomic characteristics were collected. Gender, age, education level, farming experience, land size, and agricultural revenue were considered. Concerning gender, all respondents were male. Farmers ranged in age from 24 to 70 years (44 years on average).

Figure 1: Education level of the respondent



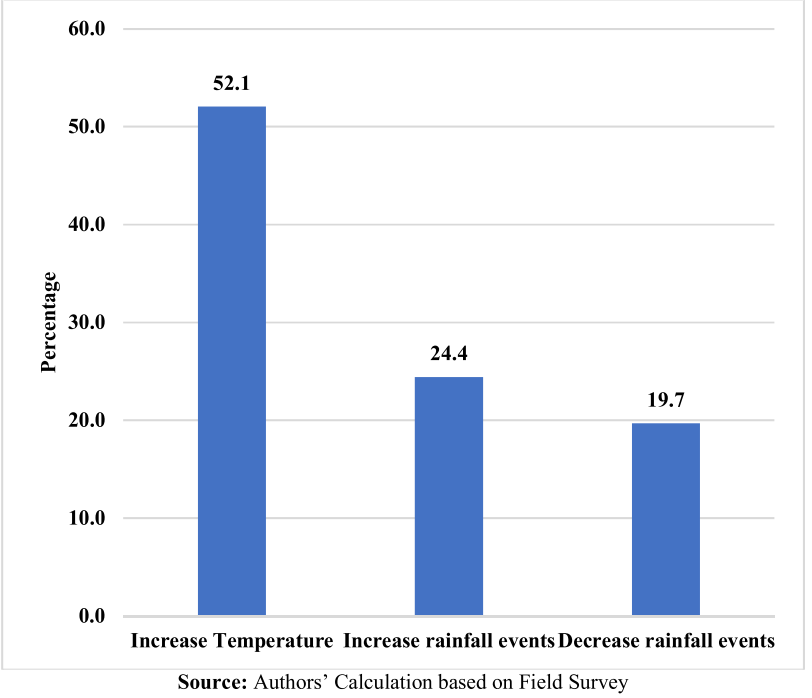
Source: Authors' Calculation based on Field Survey

For education, 36.2% completed primary education, 27.9% completed secondary, 9.2% completed H.S.C, only 1.6% completed higher education, and around 25.1% were illiterate.

4.1.2. Farmer's Perception Regarding Climate Change

Farmers obviously notice climate change, according to data analysis. About 97.1% of the respondents had gotten regular information on expected temperature and rainfall. Among them, 36.8% of respondents got information from television, agriculture expansion officer informed 41.6% of respondents, 12.7% were informed by a neighbor, 0.3%were from shopkeepers, and 5.1% got information from relatives about it 0.6% got information from other sources.

Figure 2: Farmer's perception of climate change



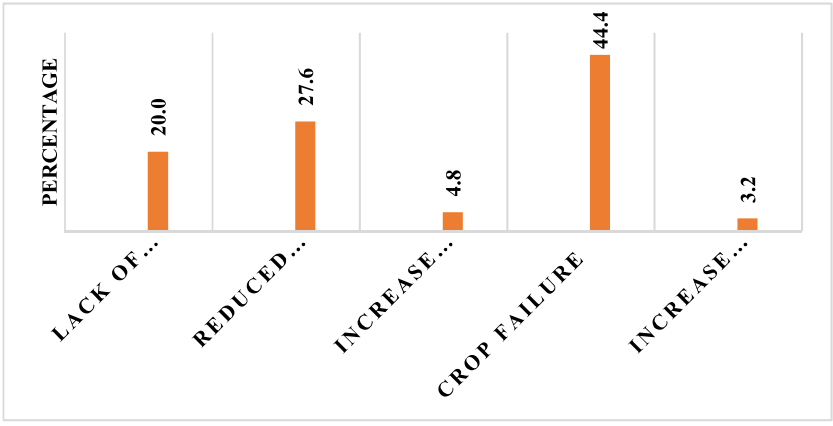
Source: Authors' Calculation based on Field Survey

There were 5 points Likert scale for understanding the level of climate change for the study. But when the respondents were asked about the level of change, they claimed only 3 levels. Most of the respondents claimed that the climate was changed at a moderate level. About 32.1% of the respondents claimed that the climate had changed highly. Mostly, 64.8% said that the climate has changed at a moderate level, where only 3.2% claimed that the climate has changed at a few levels.

4.1.3. Effects of Climate Change

Climate change is affecting agriculture and livelihood. The respondents of Sonagazi found 5 kinds of effects for climate change in their area. They lacked potable water, reduced cropping season, increased the frequency of spate, crop failure, and increased land degradation. Figure 3 shows the effect of climate change.

Figure 3: effects of climate change



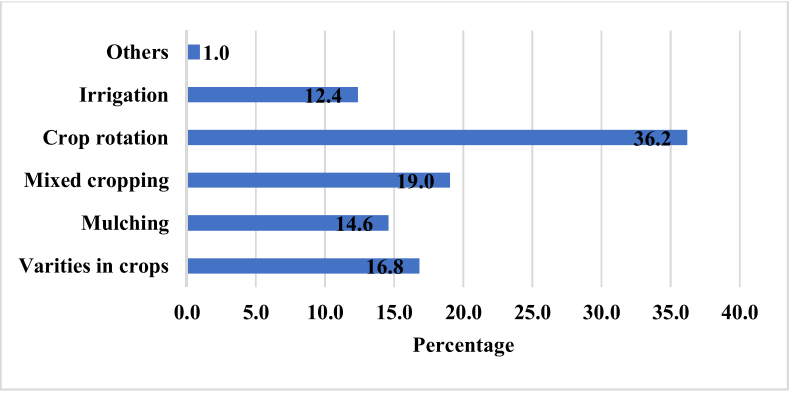
Source: Authors' Calculation based on Field Survey

To understand the effects of climate change, the respondents had 5 points on the Likert scale. On that, 71.4% was found who claimed that there are moderate levels of effects of climate change. 25.1% of the respondents claimed an extremely level of the effect of climate change. Only 3.5% of respondents were found who observed a few levels of the effects of climate change. So the respondents of Sonagazi argued that climate has changed and negatively impacts agriculture and livelihood.

4.1.4. Farmer's Strategies for Adaptation to Climate Change

The respondents of Sonagazi have used a variation of ways to adapt to climate change. All respondents' primary occupation is farming. According to survey data obtained from 315 farmers, all farmers saw and responded to climate change. When asked if they have responded to climate change through adaptation, respondents indicated that they were utilizing several adaptation procedures to mitigate the unfavorable effects of climate change. Among these are crop variety, mulching, mixed cropping, crop rotation, tree planting, and irrigation.

Figure 4: Adaptation strategies used by farmers



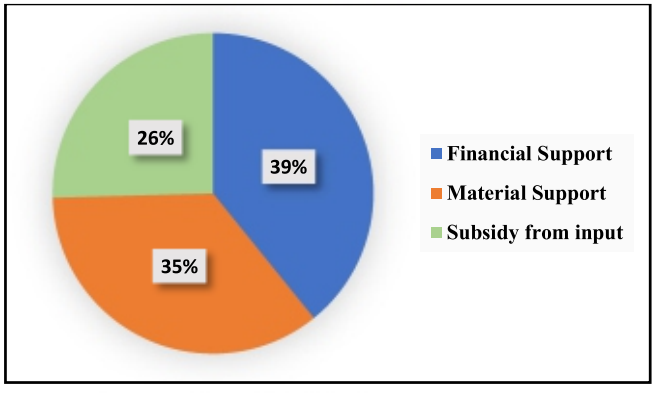
Source: Authors' Calculation based on Field Survey

In this study total 315 farmers was examined, we provided a pictorial description of the results. The graph shows that most of the respondents about 36.2% used crop rotation for farming adjustments. About 19% of respondents have used mixed cropping strategies. Strategies like used different types of cropvarities, Mulching Irrigation and others are taken by 16.8%, 14.6% 12.4% and 1% respectively.

4.1.5. Support for Adaptation Strategies

Most of the farmers were poor. They cannot take any costly adaptation strategy in their farming ways to need help from others to support them. In the study area, most of the respondents, about 92.4%, get support for their adaptation strategies, where 7.6% don't get any support for adaptation. They take adaptation strategies at their own cost.

Figure 5: Support for adaptation



Source: Authors' Calculation based on Field Survey

4.2. Empirical Analysis

4.2.1. Determinant of the Farmer's Choice of Adaptation Strategies

Many of the respondents didn't get any support from others. Many of them could not improve their condition, and the support didn't get any benefit. So that most of the respondents faced adaptation barriers. They were decided whether or not to take adaptation decision. The factor that affects respondent's decision to adapt or not were education, experience, land size, agriculture income, and gender.The binary logistic model is used to investigate the features affecting farmer's judgments to adapt or not. So the binary Logistic regression outcomes are presented in Table 1.

Table 1: Determinants that influence the decision to adapt to climate change

Explanatory Variable	Odds ratio	S.E.	Sig.
Education	1.327	.137	.000
Exp.	.043	.019	.028
Land	.153	.180	.397
Agri_income	.01	.059	.151
Constant	-4.349	1.662	.009

Number of respondents = 315
Prob> Chi^2= 0.005
Pseudo R^2 = 0.5788
% of correct prediction= 85.4%

The logistic regression model had a statistically significant coefficient of determination (p 0.05). The model explained 61% (Nagelkerke R^2) of the variance in farmers' climate change adaptation decisions and classified 85.4% of options correctly. According to the binary logistic regression results, educational attainment and agricultural experience influence farmers' decisions to adjust to climate variability positively and significantly.

The chi-square test is significant at 1%. The overall F test is also significant at 1%. Then the model can be written as:

Adaptation decision = -4.349+1.327 edu+0.043 exp+0.153 land+0.01 agri income

Here the dependent variable is in binary form and this equation shows the relationship with independent variable. Here the probability of choosing an adaptation approach are increased by 1.327 points as a result of education levels' beneficial effects on this strategy.The probability of making an adaptation

decision rise by 0.043 points for every unit increase in farming experience. When land area increases by 1 unit, the probability of choosing to adapt increase by 0.152 points, which is a little but favorable effect on decisions. A unit increase in agricultural revenue raises the probabilities of making an adaptation decision by 0.01 points, which is a positive but minor effect.

In conclusion, it can be claimed that literate farmers may make more adaptation decisions for developing various adaptation techniques because they have greater expertise with farming practices.

5. Conclusions

Sonagazi, the coastal region of Bangladesh, is at present under stressed from climate burdens that exacerbate vulnerability to climate change and diminish adaptation capability. The most defenceless area is the Char Chandia union. The spate affects only this union. So the cultivated land has been degraded. The other unions are embanked for spate so that the seawater can't degrade the cultivable land. The adverse consequences of climate change have particularly affected crop production. According to our result most of the crops are collapse due to increasing temperature. To cope with these effects, the farmers have adopted different strategies for crop production. The adaptation strategy that most of the farmers are used is crop rotation. And that's why farmers are likely to produce Maize instead of Boro paddy. As our findings we observe that they want to grow Maize because of unexpected rainfall in winter, and Maize is more cost-effective than boro. They have also tried to develop traditional adaptation strategies. The farmers of Char Chandia union don't like to take any future adaptation decisions though this union is a highly affected area than others. Most of the farmers in this union were illiterate and have only primary education and lack of technological knowledge. They don't want to take different adaptation strategies instead of traditional ones because they don't know about it and fear of using new technology. Finally, The findings reveal that only the most experienced and educated individuals can describe climate change adaption methods. The study suggested here some policy which would be helpful for future research.

1. Farmers should be trained or oriented modern agricultural policy which will help them to backup for climate destruction in coastal areas of Bangladesh.
2. Among different adaptation strategies crop rotation should be more acceptable for the farmers.

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