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Understanding Adaptation Techniques of Mango Producers under a Changing Climate: A Micro-Econometric Analysis from Chapai Nawabganj District

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Abstract:
Bangladesh has been taken into consideration as a climate vulnerable country and the impacts of climate change increase threats of adverse condition in agricultural production. This study is primarily based on assessing farmer's adaptive capacities to adaptation techniques, its determinants and problems of taking adaptations. It's an empirical study that is conducted on the basis of 100 mango producers lived in the Chapai Nawabganj district. Adaptive Capacity Index (ACI) is utilized to calculate the adaptive capacity of farmers and using Multiple Regression Model (MRM) the determinants of adaptive capacities are identified based on OLS method. Another comprehensive index called Problem Confrontation Index (PCI) is also applied to rank the problems confronted by farmers to take adaptation techniques. The findings of this study reveal that farmer's average adaptive capacity is moderate in degree in the study area which is 0.64 and 73% farmers are moderate level adapters. In addition, regression analysis reveals that the variables education, training, family size and weekly mango orchard visit have significant impact on the adaptive capacities of mango producers lived in the study area. It is also found that "lack of agricultural loan" ranked top and appears to be the most intense trouble of the mango producers to take adaptation techniques in the region studied. Finally, this study suggests that government should formulate proper policy to enhance adaptive capacities of farmers in Bangladesh.

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1. Introduction

Climate change has become an emerging threat for both the advanced and growing countries particularly for the environmentally vulnerable countries like Bangladesh. It's indispensable that the effect of climate change is rigorously associated with existing unfavorable conditions of agriculture (McCarthy et al. 2001). In response, farmers are to be dependent on a variety of adjustments of agricultural practices to manage with the emerging climate change (Uddin et al., 2014). Basically, the adjustments of agronomic practices, production process, and reallocation of resources in response to threats of changing climate are known as climate change adaptations in agriculture (Easterling et al., 2007). Additionally, farmers taking a few specific adaptation techniques have received rigorous attentions of researchers including, making a change in the planting period, practicing soil and water conservation methods, utilizing heat and drought resistant seeds, using modern fertilizers and pesticides, irrigation system as well as heterogeneity of non-farm workings in response to changing climate (Howden, et al., 2007; Rosegrant and Cline, 2003; Eckhardt et al., 2009). Generally, Bangladesh has been taken into consideration as quite sensitive to climate change and one of the most disaster-prone nations in today's world (World Bank, 2011; Mondal et al., 2012; Ministry of Disaster Management and Relief, 2013). Climate related disasters consisting of drought, heavy rainfall, cyclone, severe flood is very common in Bangladesh. As a result, the climate changing condition severely affects the livelihoods of regions highly depending upon agriculture. Economy of northern region of the country is highly dependent on agriculture producing several cash crops and horticulture crops.

One of the most popular fruits in Bangladesh is Mango (*Mangiferaindica L.*) that's often recognized as 'King of fruits' (Purseglove, 1972). It is reported that, it has been produced for more than 4000 years (Candolle, 1984). In Bangladesh, mango is one of the main horticulture crops occupying a vast area around 37,830 hectares of land which's responsible for1161685 metric ton annual production(MT) (BBS, 2016). Three districts of the country particularly Rajshahi, Chapai Nawabganj and Dinajpur are well known as the prime mango cultivating districts. Due to being a seasonal cash crop in the North-West region of the country, Mango often dominates a large portion of the economy of both Rajshahi and Chapai Nawabganj areas. It is also evident that these two districts are famous for with a variety of above 500 delicious edible mangoes where nearly 85% local people are heavily relied on mango production along with the business associated with it (Dhaka Tribune, 2018a). Within the country, Chapai Nawabganj is referred to as the capital of mango cultivation. During the dry season, this fruit business vitally dominates economic condition of this district. The area belongs to vast farmlands that are having most of the mango orchards with diverse types of mango trees. Almost 152,285 MT of mango is produced in the district occupying the land of 44,430 hectares (BBS, 2015). It is worth emphasizing that, climate condition of the Chapai Nawabganj district is characterized by high temperature, high humidity in summer as well as low rain in rainy season. The unexpected sultry weather due to change in climate may cause mangoes to immature dropping and it eventually affects the expected yield of mangoes. On the other hand, not only the season of flowering but also the season of fruiting, these plants require suitable rain fall and temperature. Excessive rainfall is also creating hindrance to plant's growing soil system often spurring the development of pests, diseases of these plants (Nirdayana, et al. 2013). Besides, inflorescence size number of flowers per inflorescence is highly associated with temperature (Dambreville et al., 2013 and Sukhvibul et al., 1999). Meanwhile, there is no alternative to take adaptation techniques for mango cultivators to minimize the threat of unfavorable weather condition. Though a good number of literatures on climate change, its impact on agriculture (Bandara and Cai, 2014; Dissanayake et al., 2019; Morton, 2007; Wang et al., 2013) and identifying the probable agricultural adaptations

(Deressa et al., 2009; Gunathilaka et al., 2018; Jawid and Khadjavi, 2019) exists, still there's very little empirical study based on measuring agricultural adaptation in the farm level and degrees of farmer's adaptive capacities to adaptation techniques in managing with climate change in terms of mango production. Likewise, this is not enough information on how efficiently farmers have been capable to cope up with the adaptation techniques. As a result, it is very necessary to quantify the adaptive capacity level of such adaptation techniques at household level especially among the smallholder farmers that seems to be challenging because of the differences in type, its intensity and the adaptive scale. Therefore, the study aims to understand specific adaptation techniques of mango producers focusing measurement of degree of adaptation, identifying determinants of adaptation level and addressing the problems of taking adaptations.

The present study contributes comprehensively to the existing stock of the knowledge. As far to the best of our knowledge, it's supposed to be completely new study to assess the adaptation capacities of mango producer in Bangladesh. The findings of the present study help policymakers to take proper policies regarding climate change adaptations among the mango producers in Bangladesh.

The rest of the paper has been organized as follows. In the following section, the related literatures based on the topic of this study are reviewed comprehensively. In the section 3, this study describes sampling technique, data collection procedures and analytical techniques applied in this study to achieve the objectives. Results and findings of this study are described in the Section 4. Finally, Section 5 and 6 report the concluding notes and limitations of the study respectively.

2. Review of Related Literatures

Climate change is a threat for agricultural production because changing climate is inversely associated with the agricultural outcome. Some previous studies drew attentions to reveal the effect of climate change on the agricultural production (Gornall et al., 2010; Arora, 2019 and Juetal., 2013). Almost all the previous studies reported the negative effect of climate change on agricultural output. Wang et al. (2009) quantified the relationship among climate variables such as temperature as well as rainfall; and net crop revenue in China. They also revealed higher temperature is negatively associated with crop revenue where higher rainfall is to be positive. On the other hand, high temperature is found negatively associated with crop revenue in Kenya (Mariara & Karanja, 2007). In response, farmers need to take climate change adaptations to reduce the threats of changing climate. Evidences indicate that the climate adaptation capacities have positive impact on the agricultural production. It is mostly mentioned that, a farmer is having much more capacity to adjust to the climate change rather than more the quantity of rice-bags he or she can obtain (Mabe et al., 2012). In addition, various levels of adaptation capacities are found among the farmers and the capacities vary with demographic and socioeconomic characteristics of farmer.

One of the Studies by Deressa et al. (2009) shows that household head's age grows the probability of such climate change adaptation especially through the process of planting trees along with enhancing irrigation. Hassan and Nhemachena (2008) indicated the less experienced farmers who are no longer more likely to well adapt the climate change adaptation than the one more experienced. In addition, some studies supported there's a positive connection in between the household head's age and the decision of farming households' to adapt (Deressa et al., 2009; Hassan and Nhemachena, 2008) while on the contrary, several studies found the negative relationship between the household head's age

and the adoption of advanced agricultural practices (Anley et al., 2007; Nyangena, 2008). Generally, it's expected that farmers' higher level of education results in more access to knowledge on improved technologies. Therefore, farming households particularly the household head having higher level of education are supposed to be more capable to adopt climate change adaptation techniques (Deressa et al., 2009). Studies based on adapting the advanced agricultural technologies further reported that, positive effects were noticeable between household size and adoption. Huge labor force followed by a large number of families would facilitate the households adopting agricultural technologies that were labor intensive (Croppenstedt et al., 2003; Deressa et al., 2009). Again, a study argued that within the rural areas in Bangladesh labor's opportunity cost might tend to be low since farm households associated with greater labor were more likely for taking up the adaptations (Hassan and Nhemachena, 2008). Information of extension agents supports farmers to take their decisions on how or even when they should use innovations inclusive of climate change adaptation techniques. Deressa et al. (2009) and Hassan, Nhemachena (2008) mentioned a positive connection between the adaptation to climate change and the access of farmers to extension services. Furthermore, farmers can gather knowledge on advanced farm management practices, innovations facilitated from the farmer's association and mostly social networks thereby resulting into more likelihood of adoption to climate change (Abdulai and Huffman, 2014). Yet it's often argued farm's production activities may be impeded by not only by non-farm income but also by the engagement in non-farm activities (Abdulai and Huffman, 2014).

Climate change adaptation techniques together with their determinants are examined based on several analytical techniques. Binary logistic regression model is very common used for identifying determinants of the climate change adaptation decision (Uddin et al., 2014). In addition, perceptions of climate change adaptation techniques are also assessed by previous researchers. Ali et al. (2019) tried to assess indigenous knowledge through farmer's perception with the adaptation to climate change in the country of Pakistan on the basis of three methods including weighted averages index, problem cataloging index and constraint index methods.

Very few studies paid attentions in order to address climate change adaptations among the mango producers. For the investigation of Indonesian mango farmer's adaptation behavior to climate change, Esperanza et al. (2018) used qualitative design where the data analysis process was based on the depiction of causal loop diagram.

Analysis of adaptive capacities of farmer to adaptation strategies, its determinants and problems of adaptations is an emerging issue for environmental policymakers. A large number of studies have been carried out previously on climate change adaptations among the farmers producing different crops. But very few studies are conducted on this important issue on mango producers in the world. To the best of our knowledge, it is the first attempt to address the climate change adaptation capacities of the mango producers in Bangladesh. Therefore, authors found an ample scope to conduct study focusing this issue.

3. Methodology

3.1 Sample Selection and Data Collection Method

The current study followed by the cross sectional study setting is conducted based on primary data that are collected from mango producers in Chapai Nawabganj district. Multistage random sampling method is utilized to select the sample for this study. Firstly, the mentioned district of Bangladesh is selected purposively with a view to focusing on the main

objective of this study. Area of the district is 1702.56 sq km particularly located at the north-western portion of the Rajshahi division bounded by West Bengal state of India on the north, south and east. It is previously mentioned that, there are a lot of mango trees which are very unique of their own kinds and the district's farmlands are poured with mango orchards. Almost 152,285 MT of mango is produced in the district occupying 44,430 hectares of land (BBS, 2015). Chapai Nawabganj district consists of five thanas- Gomastapur, Nawabganj Sadar, Nachole, Bholahat & Shibgonj. Secondly, among the five thanas Gomastapur the area of 318.13 sq km is selected on random basis. Thirdly, Rohonpur, Alinagar and Boalia villages are selected randomly from Gomastapur thana to select the respondents. Finally, required data of 100 respondents are randomly collected with the use of Fisher's Random Table (Fisher et al., 1943) from three villages. In Table 1 the collected data are distributed by the selected thana, villages along with the number of selected respondents.

Table 1: Selection of Sample

Thana	Village	Sample
Gomostapur	Rohonpur	40
	Alinagar	30
	Boalia	30
Total = 1	3	100

The required information is collected administering well-structured questionnaire using face to face interview method that helped to collect relevant information to achieve the objectives of this study. Data are collected from mango producers within 30th April to 20th June, 2020 taking the season of mango production under consideration. A comprehensive pilot survey has been conducted and found respondents with approximately the similar weather conditions, problems, market, adaptation techniques, soil conditions as well as same socioeconomic traits. Additionally, the collected data have been cleaned before processing. Finally, the data have been processed utilizing MS-Excel 7, Stata 14 and SPSS 22 software.

3.2 Analytical Techniques

3.2.1 Measurement of Farmer's Adaptive Capacities to Adaptation Techniques

The definition of adaptive capacity to climate change refers to the ability of either an individual or a system to cope up with the variability of climate change so that the potential damages can be minimized or it becomes possible to cope up with the probable consequences (Klein, 2002). The capacity of utilizing adaptation techniques differs from one farmer to another, producer to producer based on the basis of their particular characteristics (Klein, 2002). It is assumed that producers are rational in characteristics and they employed themselves to reduce the threat changing climate. The adaptive capacity of mango producers is assessed in the current study utilizing the attributes of producers like knowledge, usage, availability, consultation and accessibility (Asante, 2011 and Nakuja et al., 2012). The adaptation strategies considered in the current study are the use of irrigation, fertilizers, fruit bag, pesticides, grafting mango trees, agricultural advices, changing dates of fertilizer and pesticides and pest controlling. The lowest degree of the attainment of each attribute of the factors affecting the adaptive capacities was scored 0.25. On the other hand, the highest degree was given a score of 1. Here, the score level for a producer with the higher degree of the attainment of each attribute is 0.75. Finally, 0.50 and 0.20 respectively are the score levels for high degree and low degree of attainments.

The adaptive capacity (AdapCap) of the nth producer to the mth adaptation technique has been calculated using the equation (1):

$$AdapCap_{nm} = \frac{K_{nm}+U_{nm}+V_{nm}+A_{nm}+C_{nm}}{N_A} \quad \ldots (1)$$

Whereas, $AdapCap_{nm}$ denotes adaptive capacity of nth producer to the mth adaptation technique; K_{nm} denotes knowledge of the nth producer on the mth adaptation technique. Here, U_{nm} denotes the utilization level of mth adaptation technique by nth producer; V_{nm} denotes availability of innovations on mth adaptation technique to nth producer; A_{nm} denotes accessibility of innovations on mth adaptation technique to nth producer; C_{nm} denotes level of consultation on mth adaptation technique by nth producer; finally, N_A denotes sum of applicable attributes. In addition, the average adaptive capacity $AveAdapCap_m$ of producers to mth adaptation technique is calculated following the Equation (2),

$$AveAdapCap_m = \frac{\sum AdapCap_{mn}}{N} \ldots (2)$$

Here, N represents the number of observations. According to the calculation, degree of adaptive capacities is measured by the way in which the n producer is less adaptive to adaptation technique m if the adaptive capacity measured falls within the range of $0 < AdapCap_{nm} < 0.33$. The ranges for moderate and high adaptive capacities are $0.33 \leq AdapCap_{nm} < 0.66$ and $0.66 \leq AdapCap_{nm} \leq 1.00$ respectively.

3.2.2 Determinants of Adaptive Capacity

To identify the determinants of the adaptive capacities of mango producer, Multiple Regression Model (MRM) is applied in this study (Khanal and Wilson, 2019). The factors affecting the adaptive capacities of mango producers are identified on the basis of OLS method. The Multiple Regression Model utilized in this study is given below:

$$Y_i = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + u_i \quad \ldots (3)$$

Where,

Y_i = Adaptive Capacity of ith Farmer (Value calculated from Adaptation Index)

X_i = A set of n traditional and non-traditional determinants of adaptive capacities to adaptation strategies taken by farmers in which $X_1 \ldots X_n$ include variables like age, education, experience, family size, and different control variables. β_0 is the intercept and $\beta_1 \ldots \beta_n$ represent the parameters estimated in the regression model.

The specific form of the above Multiple Regression can be stated by the following Equation (4):

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + + u_i \quad \ldots (4)$$

In the above Equation (4), it is specified that Y_i is the adaptive capacity of ith mango producer measured by the adaptive capacity index; β_0 is the intercept or constant and $\beta_1 \ldots \beta_6$ are the parameters to be estimated; $X_1, X_2 \ldots X_6$ are the explanatory variables that affect adaptive capacities of farmer and u_i is the stochastic disturbance term. The regression function expressed by the Equation (4) is a Linear Multiple Regression model and this equation is

possible to estimate by using the Ordinary Least Square (OLS) method. A brief description of these explanatory variables is given in this section. Variables name, variables type, measurement techniques of variables and expected sign of variables are given here by the Table 2.

Table 2. Description of Major Explanatory Variables

Name of Variables	Type	Measurement
Age (X_{1i})	Continuous	Measured in year.
Education (X_{2i})	Continuous	Includes individual's education in "years of schooling completed".
Experience (X_{3i})	Continuous	Measured in year.
Family Size (X_{4i})	Continuous	Number of family member.
Agriculture Training (X_{5i})	Dummy	'1' for respondents receive agriculture training and '0' for not.
Weakly Land Visit (X_{6i})	Continuous	Number of visit of mango orchard in a weak.

3.2.3 Problem Confrontation Index (PCI)

This study has taken initiatives to identify and rank the problems faced by mango producers to take adaptation strategies to cope up with changing climate. Survey respondents were told to rate each of their perceptions of each constraint based on a four-point Likert scale that's ranging from "not encountered" to "high". Frequencies for each level of response for each issue were multiplied by a weight of from 0 to 3 (0 for not encountered, 1 for low, 2 for moderate and 3 for high). And this ranking was conducted using the Problem Confrontation Index (PCI) which is adopted from Ndamani and Watanabe (2015). Lastly, all the issues were ranked on the premise of their estimated PCI value. The PCI value was estimated by using the formula below:

$$PCI = P_n \times 0 + P_1 \times 1 + P_m \times 2 + P_h \times 3 \quad \ldots (5)$$

Where,
PCI= Problem Confrontation Index
P_n= Frequency of mango producers who rated the problem as not encountered
P_1= Frequency of mango producers who rated the problem as low
P_m= Frequency of mango producers who rate the problem as moderate
P_h= Frequency of mango producers who rated the problem as high

4. Results and Discussion

4.1 Mango Producer's Adaptive Capacity to Adaptation Techniques

Degree of the mango producer's adaptive capacity to a variety of adaptation techniques is represented here in Table 3. Among all the eight adaptation techniques use of pesticides and fertilizers are found at having high degree of adaptive capacities of mango producers whereas left six strategies are found at having moderate degree of adaptive capacities. The result of the above Table 3 reports that the average level of adaptive capacity is found at 0.64 denoting moderate degree. In addition, the highest level of adaptive capacity (0.75) is associated with the strategy of use of modern pesticides in contrast the lowest (0.54) is associated with use of fruit bags. Table 4 reveals 73% of total respondents are found as moderate level adapters. On the other hand, 27% of the respondent has high level of adaptive capacity.

Table 3: Degree of Adaptive Capacity of the Mango Producers

Adaptation techniques/strategies	Adaptive capacity	Rank	Degree of adaptive capacity
Pesticides	0.75	1	High
Fertilizers	0.70	2	High
Irrigation	0.65	3	Moderate
Changes the time of using fertilizers and pesticides	0.64	4	Moderate
Mango grafting	0.63	5	Moderate
Agricultural decisions	0.60	6	Moderate
Pest controlling	0.59	7	Moderate
Fruit bag	0.54	8	Moderate
Average	0.64	-	Moderate

Source: Computation from field data (2020)

Table 4. Percentages of Degree of Adaptive Capacities of the Respondents

Adaptive Capacity	Frequency	Percentage
Low Adapters	0	0
Moderate Adapters	73	73.00
High Adapters	27	27.00

Source: Computation from field data (2020)

4.2 Determinants of Adaptive Capacities of Mango Producers

Table 5 reveals the result found from the OLS estimation of regression model for identifying the determinants of adaptive capacities of mango producers. Table 5 reveals that variables such as education, family size, training and weekly land visit have significant impact on the adaptive capacities of mango producers lived in the study area. The coefficient of variable, education is positive which denotes additional schooling is associated with the higher level of adaptive capacities of mango producers. Evidence shows there is a link between farmer's higher level of education and better access to information on advanced technologies. Therefore, farming households with the household head's higher level of education are more likely to adopt the climate change adaptation techniques (Deressa et al., 2009).

Table 5: Results of Assessing Determinants of Adaptive Capacities of Mango Producers

Variable	Coefficient	Robust Std. Err.	t-ratio	p>|t|
Constant	4.519	0.259	17.47	0.000
Age (X_{1i})	0.006	0.004	1.47	0.144
Education (X_{2i})	0.030**	0.013	2.23	0.028
Experience (X_{3i})	-0.004	0.005	-0.76	0.450
Family Size (X_{4i})	0.062***	0.019	3.19	0.002
Training (X_{5i})	0.390***	0.141	2.77	0.007
Weakly Land Visit (X_{6i})	0.089***	0.333	2.65	0.010

N=100 and $R^2 = 0.31$

Note: *** and **significant at 1% and 5% level of significance

Source: Computation from field data (2020)

Result of OLS estimation shows that the mango producers who have agriculture related training are likely to more capable to apply adaptation techniques. That means trained respondents have more adaptive capacities than respondents who have no training. In addition, the coefficients of variables, family size and weekly land visit are also found not only positive but also significant impact on farmer's adaptive capacities. The findings of the study indicate that higher family size is associated with the higher adaptive capacities of farmers. Studies related on the adoption of advanced agricultural technologies report that household size has positive impacts on adoption. It's mentioned that a large family having a greater

labor force would support a household with the adoption of labor intensive agricultural technology (Croppenstedt et al., 2003; Deressa et al., 2009). In the same manner, it is also revealed that, if the number of visit to mango orchard increases then the adaptive capacity of producer will rise.

4.3 Results of Problem Confrontation Index

On basis of the result of PCI formula, there's a list of all the problems identified presenting in Table 6. The list has been arranged according to rank-order. Finally, the result indicates it's the "lack of agricultural loan" which ranked top appearing to be the most acute problem of the mango farmers in such area studied in the matter of adaptation of climate change to adaptation techniques. "Uncertainty of weather" is marked as the second serious issue. The results also indicate that "lack of availability of labor, lack of modern agricultural equipment, lack of irrigation, lack of land fertility, lack of mango cultivating land, lack of agricultural information and lack of stable mango garden ownership" are placed as third, fourth, fifth, sixth, seventh, eighth and ninth severe problem respectively.

Table 6. Identification of the Problems Faced by the Mango Producers to Take Adaptation Techniques and Their Rank

	Degree of problems					
Problems	**High**	**Medium**	**Low**	**Not at all**	**PCI**	**Rank**
Lack of agricultural loan	80	16	4	0	276	1
Uncertainty of weather	76	18	6	0	270	2
Lack of availability of labor	64	36	0	0	264	3
Lack of modern agricultural equipment	72	18	6	4	258	4
Lack of irrigation	56	28	16	0	240	5
Lack of land fertility	48	40	4	4	232	6
Lack of mango cultivating land	52	30	12	6	228	7
Lack of agricultural information	44	44	8	4	228	8
Lack of stable mango garden ownership	4	0	56	40	68	9

Source: Computation from field data (2020)

5. Conclusion

This study aims to understand the adaptive capacities of mango producers under a changing climate. Comprehensive statistical methods as well as econometric models are applied to assess the adaptive capacities of farmers to various adaptation techniques, determinants of adaptive capacities and degree of problems faced by farmers to take adaptation strategies as well. The findings of the study show that the producers are highly adaptive to using fertilizers, pesticides as well as the changing time of using irrigation, fertilizers, and pesticides. It's also revealed that producers seem to be moderately adaptive to using agricultural decisions, mango grafting, and pest controlling and fruit bag. In this study, the value of average adaptive capacity is 0.67 that indicates the adaptation level for the producers in terms of climate change adaptation techniques is high. It is found from the regression analysis that the variables education, training, family size and number of weekly visit to mango orchards have significant impact on the adaptive capacities of mango producers lived in the study area. Based on the result of PCI formula, the problems faced by mango producers to take adaptation techniques were identified and ranked. It's found that, the first and most likely the severe difficulty of the mango producers in that area studied was "lack of agricultural loan" in terms of adapting the adaptation techniques of climate change. "Uncertainty of weather" was identified as the second most severe difficulty. The results also indicate that "lack of availability of labor, lack of modern agricultural equipment, lack of irrigation, lack of land fertility, lack of mango cultivating land, lack of agricultural information

and lack of stable mango garden ownership" are categorized as the rest of the problems ranking as third, fourth, fifth, sixth, seventh, eighth and ninth respectively. The present study contributes comprehensively to the existing stock of the knowledge. To the best of the author's knowledge, this is the first attempt to assess the adaptation capacities of mango producer in Bangladesh. The findings of the present study help policymakers to take proper policies regarding climate change adaptations among the mango producers in Bangladesh. Authors have taken initiatives to provide some specific policies that are recommended as follows: First, some effective policies should be made by the policy makers which can train producers on the basis of adaptation techniques and those can aid them to adjust well despite of having a climate change issue in the research area. Second, for attaining a lofty production of mangoes, some successful appendix learning on adaptation techniques should be done which are well available for the producers. Third, also to adapt the climate change, government has to take some steps. This can be done by raising the dimensions of scientists and staffs of agriculture who can enlarge the promotion of productive technologies and help the farmers. Four, policy makers, government and non-government authorities should consider the determinants of adaptive capacities to formulate policies to improve the adaptive capacities of farmer. Five, the discoveries of the study also show that the variable, agriculture training should be increased by the authority so that it may help to increase the adaptive capacities of farmer. And lastly, problems found in this study and their rank should be considered by the policy makers and government to develop the adaptation related policies.

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