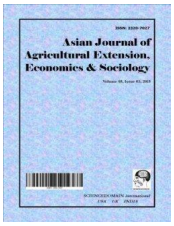

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Farmers' Perception towards Harmful Effects of Climate Change on Agriculture

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Authors' contributions

This work was carried out in collaboration between all authors. Author MHK designed the study, wrote the protocol and wrote the first draft of the manuscript. Author MSA reviewed the experimental design and all drafts of the manuscript. Authors MSI and MMA collected data, managed the statistical analyses and searches literature of the study. All authors read and approved the final manuscript.

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ABSTRACT

The main objectives of the study were to determine farmers' perception towards harmful effects of climate change on agriculture in Bangladesh and to identify the factors that influence farmers' perception towards harmful effects of climate change. The study was conducted in four villages under Kazipur upazila of Sirajgonj district. Data were collected by using interview schedule from randomly selected 113 respondents. The findings revealed that an overwhelming majority (89.4%) of the respondents had lower to moderately agreed perception towards harmful effects of climate change on agriculture. Among nine selected characteristics, organizational participation, extension media contact and knowledge on climate change had a significant positive contribution to the farmers' perception towards harmful effects of climate change on agriculture. It is recommended that to minimize the harmful effects of climate change on agriculture initiative should be taken to improve farmers' perception through more involving with organizational participation, extension media contact and increasing knowledge.

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Keywords: Farmers perception; climate change effects; Bangladesh agriculture.

1. INTRODUCTION

Bangladesh is the fifth most populous country in Asia and the seventh in the world. Its population growth rate is 1.36% and current population is 150,790,000 [1]. So, this population requires more food as a result of dependence on the agricultural sector. Agriculture is the single largest producing sector of the economy and its contribution about 14.79% to the total Gross Domestic Product (GDP) of the country. This sector accommodates around 45.10% labour force [1]. GDP growth rate of Bangladesh mainly depends on the performance of the agricultural sector. Although due to natural calamities loss of food and cash crop is an almost regular phenomenon. Bangladesh incurs an annual loss of 1.81% of GDP due to extreme weather events. Total losses were 2.56 billion dollars a year from 1990 to 2017.

Agriculture is always related to weather events and climate conditions. Despite technological advances such as improved crop varieties and irrigation systems, weather and climate are important factors, which play a significant role in agricultural productivity. The impacts of climate change on food production are global concerns and for that matter, Bangladesh, where lives and livelihoods depend mainly on agriculture, is exposed to great danger. This is because; the country is one of the most vulnerable countries to climate change, which have negative effects on the agriculture sector.

Climate is generally average conditions of a certain region, including temperature, rainfall and wind. On earth, the climate is most affected by latitude, the tilt of the earth axis, the movement of the earth wind belts, and the difference in temperature of land and sea, and topography. Climate change may refer to a change in average weather conditions, or in the time variation of weather around longer-term average conditions. The climate of Bangladesh can be characterized by high temperatures, heavy rainfall, high humidity, and fairly marked three seasonal variations like hot summer, shrinking winter and medium to heavy rains during the rainy season. In general, maximum summer temperatures range between 38 and 41°C (100.40 and 105.80°F). April is the hottest month in most parts of the country. January is the coolest month when the average temperature for most of the country is 16– 20°C (61–68°F) during the day and around 10°C (50°F) at night. According to [2] due to the climate change affect sea level in the coastal region of Bangladesh has been predicted to rise up to 80 cm by 2100.

Climate change accelerated the intensity and frequency of occurrences of salinity, storms, drought, irregular rainfall, high temperature, flash floods, etc. that resulted from global warming. Due to climate change, farmers` agriculture affected adversely. The marginal people and poor are affected mainly by salinity and flood in Bangladesh. More intense and more frequent extreme weather events such as flood and droughts, the temperature increasing abnormalities in rainy season patterns and rising sea levels are already having an instant effect through reducing food production. To minimize the harmful effects of climate change on agriculture, it is necessary to use more and more adaptation strategies by the farmers, which is related with their perception towards climate change effects in agriculture. In this context, the present study entitled farmers perception towards harmful effects of climate change on agriculture has been conducted with a view to the following objectives.

1.1 To describe some selected characteristics of the farmers;
1.2 To determine farmers' perception towards harmful effects of climate change on agriculture and
1.3 To identify the factors that influence farmers' perception towards harmful effects of climate change on agriculture.

2. METHODOLOGY

2.1 Study Area

The study was conducted at Kazipur upazila under Sirajgong district of Bangladesh where people were affected by climate change especially flood. As a locale to the proposed study, two unions namely, Maizbari and Natuarpara under Kazipur upazila of Sirajgonj district were selected purposively. Four villages from both unions were selected randomly as the locale of the study.

2.2 Population and Sampling

The Researcher himself with the help of Upazila Agriculture Officer, Local leaders and concerned Sub-Assistant Agriculture Officer (SAAO) was

collected an updated list of the population of the study. The total numbers of farm families head in the selected villages were 1293. According to [3] formula, the sample size was 113 at 9% precision level, 50% degree of variability and the value of the standard normal variable (Z)=1.96 at 95% confidence level. The given formula is stated as:

$$n = \frac{Z^2P(1-P)N}{Z^2P(1-P)+Ne^2}$$

Where

n = sample size
N = population size
e = the level of precision
Z = the value of the standard normal variable given the chosen confidence level (e.g. Z = 1.96 with a confidence level 95%)
P = the proportion or degree of variability

The sample was then selected from the four villages by considering a proportionate random sampling procedure. A reserve list of 12 farm families head (about 10% of the sample) was kept purposively if any respondent was unavailable at the time of data collection. The distribution of population and sample was shown in Table 1.

2.3 Selection and Measurement of Variables

In a descriptive social research, selection and measurement of the variable is a momentous task. An organized research usually contains at least two identical elements viz. independent variable and dependent variable. Considering study nature, the location of study, time and other logistic support, we selected farmers' nine characteristics/independent variables for analysis of the study. These are Age, Educational background, Farm size, Annual family income, Organizational participation, Agricultural extension contact, Training exposure, Knowledge of climate change and Cosmopoliteness. On the other hand, the dependent variable of the study was Farmers' perception towards harmful effects of climate change on agriculture. The measurement techniques of both independent and dependent variables are discussed as follows.

2.4 Measurement of Independent Variables

Age of the farmers was measured in terms of actual years from his birth to the time of interview. Level of education was measured as the ability of an in individual respondent to read and write or the formal education received up to a certain standard. It was expressed in terms of year of schooling. Farm size of the respondents was measured as the size of his farm on which he continued his farm practices during the period of the study. Annual family income indicates total earning of a farmer and the members of his family both from agriculture and other socially acceptable regular means such as business, service etc. It was expressed in thousand taka during the previous year. Training received was measured by a total number of days of agricultural training received by the respondents` farmer in his/her life. Organizational participation of a respondent was measured by computing an organizational participation score according to his/her nature and duration of participation in five (5) selected different organizations up to the time of interview. The extensive media contact of a respondent was measured on the basis of the response of the farmers against the extent of his using of selected seven media. Knowledge of the farmers towards climate change was measured on 10 basic open ended questions. Of a respondent was measured in terms of his nature of visits to the six (6) different places external to his own social system.

2.5 Measurement of the Dependent Variable

Farmers' perception towards harmful effects of climate change on agriculture was the dependent variable of the study. Perception is the activity through which an individual becomes aware of

Table 1. Distribution of population and sample of farmers of the selected villages

Name of the unions	Name of the villages	Population	Sample size	Reserve list
Maizbari	Paikortoli	308	26	3
	Salavora	342	30	3
Natuarpara	Natuarpara	316	28	3
	Ghoragacha	327	29	3
	Total	**1293**	**113**	**12**

the harmful effects of climate change on agriculture and was measured by using 14 statements about various aspects of harmful effects of climate change on agriculture. The farmers were requested to give their responses to these 14 statements. A modified 5-point Likert type scale was used to measure the extent of perception of the farmers. A necessary score such as 4 for 'strongly agree', 3 for 'agree', 2 for 'neutral', 1 for 'disagree' and 0 for 'strongly disagree' was assigned to each of the statement to measure the perception level of the farmers. To find out overall perception level of a farmer, total scores of the 14 statements were added together. Thus, the perception score of a respondent could range from 0 to 56, where 0 indicated highest levels disagree with the harmful effects of climate change on agriculture and 56 indicated the highest level of agree with the harmful effects of climate change on agriculture.

2.6 Collection and Processing of Data

Data were collected by the researcher himself through face to face interview. A well-structured interview schedule (questionnaire) was developed based on the objectives of the study. The schedule contained both open form and closed form questions. The interview schedule was pre-tested with 20 farmers by the researcher. Necessary additions, corrections and modifications were made in the schedule on the basis of the pre-test results. The final data were collected from the selected 113 farmers with using questionnaire. Questions were asked systematically and explanation was made whenever necessary. The respondents were interviewed at their leisure time so that they can give accurate information in a cool mind. To build rapport and motivation in the interview situations, the researcher endeavoured to provide conditions that maximum trust maintained each respondent's interest and minimized the status difference. The final data were collected from 1 January to 30 January 2018.

After the completion of data collection, data were coded, compiled, tabulated and categorized according to the objectives of the study. The entire individual respondent's data were transferred into a master sheet for facilitating the required analysis. Local units were converted into standard units. In the case of qualitative data, the appropriate scoring technique was followed to convert the data into the quantitative form.

2.7 Analysis of Data

Descriptive statistical measures, including number, percentage distribution, range, average, and standard deviation were used. To find out the contribution of identified characteristics on the farmers' perception towards harmful effects of climate change on agriculture, multiple regression model was used.

The model used for this analysis can be explained as follows:

$$Y_i = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + e$$

Where Y_i is the farmers' perception towards harmful effects of climate change on agriculture; x_1 is their age; x_2 is educational background; x_3 is organizational participation; x_4 is farm size; x_5 is an annual household income; x_6 is knowledge on climate change; x_7 is training experience, x_8 is agricultural extension contact; and x_9 is cosmopolites. b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8 and b_9 are regression coefficients of the corresponding independent variables, and "e" is random error, which is normally and independently distributed with zero (0) mean and constant variance.

3. RESULTS AND DISCUSSION

3.1 Selected Characteristics of the Farmers

The salient features of the selected characteristics of the farmers like possible and observed range, number and percent distribution, mean, standard deviation and categorisation are presented in Table 2.

The highest percentage of the farmers was middle aged, the secondary level of education and small farmers. In case of annual family income, training received and organizational participation, the dominant group were in the low category. Most of the farmers had medium extension contact and a medium level of knowledge in agriculture. Majority of the farmers had medium cosmopoliteness.

3.2 Farmers' Perception towards Harmful Effects of Climate Change on Agriculture

Farmers' perception towards harmful effects of climate change on agriculture of the respondents

Table 2. Distribution of the respondents according to their characteristics (N=113)

Variables (measuring unit)	Range		Categories	Respondents		Mean	SD
	Possible	Observed		Number	Percent		
Age (Years)	-	20-70	Young (up to 30)	18	15.90	49.27	12.08
			Middle Aged (31-50	58	49.60		
			Old (> 50)	37	34.50		
Education (Year of schooling)	-	0-16	Illiterate (0- 0.5)	28	24.80	3.79	3.61
			Primary (1-5)	30	26.50		
			Secondary (6-10)	47	41.60		
			Above Secondary (>10)	8	7.10		
Farm size (Hectare)	-	0.09-2.16	Marginal (0.02-0.20)	26	23.0	0.42	0.33
			Small (0.21-1.0)	79	69.9		
			Medium (>1.0)	8	7.10		
Annual family income ('000') Taka	-	46-531	Low (up to 177)	73	64.60	177.71	130.12
			Medium (>177-354)	26	23.0		
			High (>354)	14	12.40		
Training received (No of days)	-	0-15	No (0)	41	36.30	4.25	4.20
			Low (1-7)	42	37.20		
			Medium (>7)	30	26.50		
Organizational participation (Score)	0-15	0-12	No (0)	41	36.30	2.91	2.84
			Low (1-4)	46	40.70		
			Medium (5-8)	24	21.20		
			High (>8)	2	1.80		
Extension media Contact (Score)	0-28	10-24	Low (upto 13)	27	23.90	16.72	3.59
			Medium (14-19)	54	47.80		
			High (>19)	32	28.30		
Knowledge on climate change (Score)	0-20	12-18	Low (up to 13)	24	21.20	14.12	1.53
			Medium (14-15)	52	46.10		
			High (>15)	37	32.70		
Cosmopoliteness (Score)	0-21	9-19	Low (up to 11)	29	25.70	13.15	2.30
			Medium (12-15)	63	55.70		
			High (>15)	21	18.60		

Table 3. Distribution of the farmers according to their perception

Categories	Respondents'		Mean	SD
	Number	Percent		
Lower agreed (up to 35)	21	18.60	37.05	3.19
Moderately agreed (35-40)	80	70.80		
Highly agreed(Above40)	12	10.60		
Total	**113**	**100**		

ranged from 28 to 45 against the possible range 0-56. The average perception was 37.05 with a standard deviation of 3.19. Based on the perception scores, the respondents were classified into three categories (mean±sd) as lower agreed, moderately agreed and highly agreed which has been shown in Table 3.

Findings revealed that the majority (70.80%) of the respondents had moderately agreed with perception while (18.60%) and (10.60%) having lower and highly agreed perception categories respectively with the harmful effects of climate change on agriculture. From above, it can be said that the respondents who have moderately to highly agreed perception towards the harmful effects of climate change on agriculture were more conscious about harmful effects of climate change on agriculture. However, still, 18.80% farmers possess lower agreed perception towards harmful effects of climate change on agriculture which need to change or improved their perception through taking various steps.

3.3 The Contribution of the Selected Characteristics of the Respondents to Their Perception towards Harmful Effects of Climate Change on Agriculture

The contribution of the selected characteristics of the respondents to their perception towards harmful effects of climate change on agriculture has been shown in Table 4. The table shows that only three characterises viz., organizational participation, extension media contact and knowledge on climate change were positive and significant contribution with their perception towards the harmful effects of climate change on agriculture. The remaining characteristics such as age, education, farm size, annual family income, training received and cosmopoliteness have no significant contribution with their perception towards harmful effects of climate change on agriculture.

Multiple regression analysis was computed to find out contributing independent variables of farmers perception towards harmful effects of climate change on agriculture. All the 9 variables, when considered together, the predictability co-efficient (R^2) were 67.60. This means that all the 9 variables put together would bring 67.60% variation of perception to their harmful effects of climate change on agriculture. Among these 9 variables, organizational participation, extension media contact and knowledge on climate change on agriculture showed positive and significant influence on farmers' perception towards harmful effects of climate change on agriculture. The results indicated that a unit increase in organizational participation, extension media contact and knowledge on climate change would results in 0.56, 0.16 and 0.16 units increase in the extent of farmer's perception towards harmful effects of climate change on agriculture respectively. The F value was found significant. Hence, it may be concluded that the selection of analysis was appropriate.

Data presented in Table 4 revealed that organizational participation of the farmers was positive and significantly contributed (significant at 1% level, $p<0.01$) with their perception towards harmful effects of climate change on agriculture. This finding indicated that farmers' have more organisational participation increased the farmers' perception towards harmful effects of climate change on agriculture. The finding is similar to the studies of [4,5] and [6].

It was revealed from the analysis that knowledge on climate change on agriculture of the farmers was positive and significantly contributed (significant at 5% level, $p<0.05$ towards harmful effects of climate change on agriculture. This finding means that increase of knowledge on climate change of the farmers will also increase their perception towards harmful effects of climate change on agriculture. Knowledge helps farmers to make favourable possess- as which ultimately help them to take adaptation strategies. The finding is similar to the study of [7,8] and [4].

Table 4. Multiple regression coefficients of the contributing variables related to the farmers' perception towards harmful effects of climate change on agriculture

Dependent variable	Independent variable	β	ρ	R^2	Adj.R^2	F
Farmer' perception towards harmful effects of climate change on agriculture	Age	-0.042	0.313	0.67	0.65	31.02
	Education	0.003	0.964			
	Farm size	-0.003	0.961			
	Annual family income	-0.025	0.718			
	Training received	0.086	0.291			
	Organizational participation	0.566	0.000**			
	Extension media contact	0.168	0.025*			
	Knowledge on climate change	0.164	0.021*			
	Cosmopoliteness	-0.025	0.719			

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

From the analysis, it is also indicated that extensive media contact of the farmers was positive and significantly contributed (significant at 5% level, p<0.05) with their perception towards harmful effects of climate change on agriculture. It means that the more the extension media contact of the farmers the more is their perception level towards the harmful effects of climate change on agriculture. Alternatively, it can be said that with the increase of extension media contact of the farmers will increase their perception towards harmful effects of climate change on agriculture. The finding is similar to the studies of [9,10] and [11].

4. CONCLUSIONS AND RECOMMENDATIONS

From the above findings and discussion, it may be concluded that the overwhelming majority of the farmers were moderately agreed on perception to lower agreed perception towards harmful effects of climate change on agriculture. Only a few framers had highly agreed with perception towards harmful effects of climate change on agriculture. Therefore, still, there has scope to improve farmers' perception scenario by taking various steps. Organizational participation, extension media contact and knowledge on climate change of the farmers were important in making more favourable perception towards harmful effects of climate change on agriculture. The result concluded that the establishment of more organization and farmers' involvement with those will increase farmers' favorable perception towards the harmful effects of climate change on agriculture. Extension media contact also helped farmers to make more favorable perception towards harmful effects of climate change on agriculture. Therefore, the extension agent should increase their contact with the farmers. Knowledge helps the farmers to make favourable perception. So, more training, meeting and demonstration program should arrange in order to make favourable perception of the farmers towards negative effects of climate change. All these initiative probably will help the farmers to make favourable perception which ultimately help them to take more adaptation strategies to minimize the harmful effects of climate change on agricultural production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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