Climate Change in Bhola District, Bangladesh: A Study of Coastal Households' Perception of Effects and Causes

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[Abstract : This study explores the climate change perception of the coastal rural people by investigating the people of Bhola district, one of the coastal districts of Bangladesh. The main objective of this paper is to analyze coastal households' perception about the effects and causes of climate change and to identify the determinants of their perception. For conducting the research, a total of 274 households were interviewed by a predesigned questionnaire through a systematic sampling technique. The result of chi-square test indicates that gender, education level, occupation, monthly income, access to the internet, and access to television are significantly related to their perception. For investigating the determinants of perception, the binary logistic regression is used. The results represent education level, monthly income, and access to television are significantly related to the perception of climate change. Therefore, this study suggests governmental and nongovernmental efforts and actions to promote the understanding of climate change issues among the rural coastal people of Bangladesh.]

Keywords : Perception, Climate Change, Coastal Households, Bangladesh.

1. Introduction

The long-term change in temperature and weather patterns, known as climate change, has become a severe challenge for the global social economy to attain sustainable development goals (SDGs) and is also the most tremendous threat for a low-lying country like Bangladesh (Huda, 2013). Because of its disaster-prone geographical status, high population density, social disparities, low elevation from the sea, inadequate infrastructure, and economic reliance on agriculture, the country holds the most vulnerable position in terms of climatic change (Younus and Harvey, 2014). Examining the period of 1999-2018, German watch's Global Climate Risk Index (CRI) 2020 reports that, Bangladesh ranked 7th position among the list of countries that are mostly affected by various natural calamities. This result emphasizes the fact that the richer countries face much higher monetary loss while the poorer countries are more vulnerable to climatic risks. Each year Bangladesh is confronted with various natural

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inversion, such as increased heat, irregularity in precipitation, frequent drought, haphazard cyclones, floods, rise in the sea level, soil erosion, salinity intrusion, etc. which hamper the development of the country by lagging behind both socially and economically (Nesha et al., 2014).

The Earth's surface is getting warmer day by day due to the increase in threat mospheric concentration of CO_2 driven by the growth of the global economy and global population (IPCC, 2014). By the extensive emission of greenhouse gases, the human contribution is clear for this global warming. According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), this unresisted emission of greenhouse gases leads to a long-lasting impact on the ecosystems and causes serious harm to human beings by increasing the likelihood of severe climatic events. Increasing temperature causes polar ice to melt continuously, which in turn increases the sea level. According to the Bangladesh Bureau of Statistics (BBS) 2020, Bangladesh possesses a land area of 147,570 square kilometers, among which 32% is the coastal area (47,211 square kilometers) with a very low-lying flat land. It was anticipated that the sea levels of Bangladesh would increase by up to 0.30 meters and up to 0.74 meters by the years 2050 and 2100 respectively. As a result, a large portion of productive land could be lost under the seawater in the southern region of Bangladesh. It will also affect the living of coastal people by reducing agricultural production, hampering food security, creating health hazards, and augmenting poverty (Haq and Ahmed, 2017). This increase in the sea level could force around 0.9 million people to lose their homes by 2050, and also the translocation of around 2.1 million people by 2100(Davis et al., 2018). As stated by the environmental specialists, one of the most tangible effects of climate change is the increasing salinity of land, which has become an antique problem for agriculture production in the southern region of Bangladesh (Rahman et al., 2017). In addition, increasing river erosion causes the area of agriculture production to decline day by day. Irregular precipitation and the increasing propensity of drought make life more difficult for the people of the coastal areas (Haq and Ahmed, 2017).

As a disaster-prone country, people in the southern region of Bangladesh suffer a lot from extreme climatic events. Because of the proximity to the coast of the Bay of Bengal, each year the living of the people in this area is confronted with disastrous impedance. However, human activities are the major influence on global climate warming. Hence, social awareness and responses can remarkably reduce the negative effects and loss from extreme climatic events (AGU,2014).Dealing with the climate change issues requires to observe the perception of society and analyze how this perception of climate change motivates them to respond individually. To face the climate change challenge, the government of Bangladesh has

already taken various actions and made adequate investments in adaptation measures. However, in the rural area of Bangladesh households are not properly informed about the terrible threat of climate change. Lack of knowledge and publicity makes them unaware of environmental protection (Kabir et al., 2016). Much of the governmental efforts to mitigate climate change effects can be faded away by this unconsciousness of rural people. Therefore, this study aims to explore the coastal households' perception about the effects and causes of climate change by investigating the determinants of those perceptions. The findings of this study can assist the policymakers to develop policies regarding improving household perception and thereby mitigating environmental catastrophe. Hence, the objectives of this study are-

1. To observe the coastal rural households' perception about the causes and effects of climate change.
2. To examine the association between socio-demographic factors of rural households and their climate change perception.
3. To find out the determinants of their climate change perception.

The rest of this study is structured as follows: relevant articles are reviewed in section 2; description of the survey area, data collection, and methodological procedures are presented in section 3; discussion of the survey results are displayed in section 4, and finally conclusion and recommendations in section 5.

2. Literature Review

Because of the severity of its impacts, climate change has become a widespread concern of the international community. Researchers all around the world are expressing their intent in several prospects of climate change issues. The objective of this study is to peruse the rural households' perception of climate change and their individual responses to mitigate its ominous effects. Therefore, in this section studies on climate change perceptions are reviewed as some influential papers.

The vulnerability of one country cannot be generalized from the findings of other national contexts. Several studies related to climate change perception were carried out in the context of Bangladesh. Almost all of these studies indicated an increase in temperature and decrease in annual rainfall as the primary effects of climate change. However, the effect of climate change is different across countries and regions. Several factors such as regional differences in socio-economic conditions, or climatic impact on a particular country are responsible for significant dissimilarities in the perception and adaptive responses across countries (Alam, 2016; Brulle et al., 2012).The relationship between climate change perception and socio-demographic characteristics of potential respondents was explored

by some researchers. To examine the factors determining farmers' perception of climate change, Uddin et al. (2017) researched on the coastal farmers of Bangladesh. Using a logit model they mentioned several factors, such as educational background, family information, farming information, and information on training received as significant determinants of farmers' perception of climate change. Roco et al. (2014) also showed education, age, and access to weather information as some influential factors to form the perception of climate change. Hence, there is substantial evidence that the perception of climate change is significantly related to some socio-demographic variables such as age, gender, education level, and monthly income of the households. A contradictory result was found by some other researchers that the variable age has no significant effect in determining the perception of climate change among the survey respondents (Akanda and Howlader, 2015). A study by Shields and Zeng (2012) found that the knowledge on climate change differs in response to gender differences in China. Conducting research on the indigenous community of Bangladesh Huda (2013) also reported that males are more likely to accept that the climate is changing than females. Contrarily, few studies claimed that the environmental concern is higher among females than males (McCright, 2010; Haq, 2013; and Kabir et al., 2016). Besides, it was also asserted by the findings of scholarly articles that training and seminars can play an important role in enhancing public concern about climatic issues.

In order to reduce the risks associated with climate variability, the adjustments in human behavior or environment system are referred to as adaptation strategies (Wheeler et al., 2013).Households' responses to climate change depend on their perceptions, derived from their daily interactions with the environment and reliance on weather conditions to assure nourishment. Inappropriate perception may lead to misleading actions. Various studies have been conducted previously regarding climate change perception. Researchers examined the significant link between climate change perception and corresponding adaptive activities in response to several countries; such as, in the USA (Mase et al., 2017; Gordon et al., 2013), Australia (Wheeler et al., 2013), China (Yu et al., 2013), Chile (Roco et al., 2014), Thailand (Manandhar et al., 2015), Vietnam (Dang et al., 2014; Schad et al., 2012), India (Dey et al., 2017), Malaysia (Alam et al., 2012), Sri Lanka (Esham and Garforth, 2013), South Africa (Elum et al., 2017; Gandure et al., 2013), Tanzania (Kangalawe et al., 2016), Zambia (Mulenga et al., 2017),and so on.

From the articles reviewed above, we can conclude that the perception of climate change is highly related to the socio-demographic characteristics of the respondents. Therefore, researchers mostly studied the relationship between the perception of climate change and the background information

of the potential respondents. However, studies on climate change perception of coastal rural households are very rare in Bangladesh. Households with appropriate perceptions are willing to take actions to mitigate the harmful effects of extreme climatic events, while some are unwilling by thinking of climate change as a natural consequence. Therefore, taking rural households of Bangladesh as the research object, the purpose of this study is to observe their perception of the causes and effects of climate change and examine the determinants of such perception.

3. Methodology

3.1 Overview of the Study Area

Bangladesh encompasses 19 coastal districts that are more prone to extreme climatic events. As required for the objective of this study, primary data were collected from Sadar Upazila (sub-district) of Bhola district, one of the coastal districts of Bangladesh. The district of a 1,776,795 population comprises seven Upazilas with an area of 3,403.5 square kilometers. Bhola Sadar Upazila has 13 unions (local level government administrative unit) from which two unions namely- Bapta and Ilisha were randomly selected to carry out this study(Bangladesh Bureau of Statistics, 2020).

3.2 Sample Size, Data collection and Analysis

Cochran (1977) formula is used to determine the sample size. That is,

$$n = \frac{Z^2 pq}{e^2}$$

Where, n= sample size, Z= Z score, (p)(q) = estimate of variance, e= margin of error. With 90% confidence, assuming p=0.5 and $\pm$5% precision the minimum valid sample size is 271.

Systematic sampling technique was followed to select the respondents from different characteristics. A predesigned questionnaire was used to survey on the selected households in June 2021. A total of 274 households were selected from two villages of Bapta union and one village from Ilisha union of Bhola Sadar Upazila. The first household from each village is selected randomly, then every fifth household is selected for face-to-face interview. The respondents of the direct interview were the head of the households or senior members in absence. A short introduction to climate change was given to each respondent. Oral consent was obtained from the selected respondents before starting the interview. The data collection process was always monitored by the author to ensure the quality and accuracy of data. In the first section, the respondents were asked about their socio-demographic information, and then in the next sections, they were asked questions regarding their perception of climate change. Collected data were analyzed and summarized to conclude about their perception of climate

change and its determinants. STATA software version 14 was used for the analysis of data.

3.3 Test and Empirical Model

This qualitative study uses some descriptive statistics to examine the coastal households' perception of the causes and effects of climate change. Chi-square test is used to clarify the association between socio-demographic characteristics of the respondents and their perception. Besides, a binary logistic regression model is used to examine the significant determinants of households' perception of climate change.

4. Results and Discussion

4.1 Households' Perception of Climate Change

The survey was conducted among a total of 274 respondents living in the coastal and rural areas of Bangladesh. The respondents of the survey were the head or the senior member of the households. Most of them were males (82.48%) and only a small number of females (17.52%). The respondents were on average 43.06 years old with a standard deviation (SD) of 12.69 years. This is similar to the finding of other researchers who conducted surveys on the sample of people from other locations of Bangladesh. The educational information of the respondentsshows that the majority of them were from high educational backgroundswith about 25.18% completing their SSC/HSC level, 24.09% in the secondary level, and about 21.53% having higher degrees. As seen in the occupational structure, 29.56% of respondents were in government or private service, next to service was farming (25.18%) and business (21.9%). More than half of the respondents' (56.93%) monthly household income was less than 20000 BDT with an average income of 18764.08 BDT per month, implying that the respondents largely came from a moderate socioeconomic background (1 USD = 85 BDT approximately) (Table 1).

In order to perceive the knowledge on climate change, the respondents were asked a dichotomous ('yes/no' response) question regarding whether or not they heard about climate change. They were interrogated for further details about their knowledge of climate change after getting a positive response initially. Table 2 shows that the majority of the respondents (81.39%) heard about climate change from some sources and only a few (18.61%) had no idea about it. Among various sources, media has played the most important role in unveiling climate change issues. Almost 80% of the knowledgeable respondents mentioned radio, TV, or newspaper as the source of their knowledge about climate change. Kabir et al. (2016) also obtained similar results. Based on the literature reviewed, the respondents (n=223) were then queried about the type of climate change events that they had experienced within the past 10 years. Almost all the respondents

(99.55%)replied positively that they have perceived a series of climaticvariations in the form of change in temperature, precipitation, occurrence of drought, floods, and so on.This result isconsistent withthe findings of Uddin et al. (2017).

Table 1 Demographic characteristics of the respondents (n=274)

Variable	Frequency (%)
Gender	
Male	226 (82.48)
Female	48 (17.52)
Age (Mean ± SD) in years	43.06 ± 12.69
Educational information	
No formal education	33 (12.04)
Primary level	47 (17.15)
Secondary level	66 (24.09)
SSC/HSC	69 (25.18)
Degree/Masters/Equivalent	59 (21.53)
Occupational information	
Housewife	38 (13.87)
Business	60 (21.9)
Day laborer	18 (6.57)
Service holder	81 (29.56)
Farmer	69 (25.18)
Others	8 (2.92)
Monthly household income (BDT)	
(In Bangladeshi Taka, 1 USD=85 BDT approx..)	
Below 10,000	27 (9.85)
10,000 to 20,000	129 (47.08)
20,000 to 30,000	77 (28.1)
Above 30,000	41 (14.96)

Source: Author's field survey in 2021.

As stated by their study, majority of the respondents agreed that they had experienced various climate change events over past years. Again, the study of Anik and Khan (2012) postulated a different scenario of the perception of climate change among rural people.Since their study was conducted especially on fishermen and farmers, most of the respondents were uneducated, or had a lower level of education, and therefore, only 10% of them were well informed about climate change (Huda, 2013).However, Table 1 shows that the respondents in this research were largely service holders with a high level of education, hence the difference between the results of these two studies.The Majority of them (95.5%)indicated increasing heat as a consequence of climate change.

Table 2 Respondents' perception of climate change

Variable	Frequency (%)
Have you heard about 'climate change'?	
No	51 (18.61)
Yes	223 (81.39)
What is the main source of your information on climate change? (Multiple response)	
DAE	26 (11.71)
NGO	11 (4.95)
Union Parishad	8 (3.6)
Other governmental institutions	10 (4.5)
Radio / TV / Newspaper	177 (79.73)
Internet/Facebook	40 (18.02)
In public	81 (36.49)
Educational institutions	33 (14.86)
Others	3 (1.35)
Have you experienced any change in weather pattern in last 10 years?	
No	1 (0.45)
Yes	222 (99.55)
Type of change in weather pattern (Multiple response)	

Increased heat	212 (95.5)
Increased precipitation	10 (4.5)
Decreased precipitation	141 (63.51)
Irregular precipitation	77 (34.68)
Increased thunder	78 (35.14)
Increased incidence of floods	16 (7.21)
Increased cyclone	20 (9.01)
Increased river erosion	24 (10.81)
Increased tendency of drought	69 (31.08)
Increased salinity	6 (2.7)
Irregular seasonal variation	45 (20.27)
Increased cold in winter	1 (0.45)
Less cold in winter	60 (27.03)
Increased fog falling in winter	3 (1.35)
Decreased fog falling in winter	8 (3.6)
Others	5 (2.25)
Main reason behind climate change	
Natural	103 (46.19)
Man-made	98 (43.95)
Both	22 (9.87)

Source: Author's field survey in 2021.

Besides, more than half ofthe respondents (63.51%)mentioned a decrease in the amount of precipitation and 35.14% thought that the occurrence of thunder has increased than before. The respondents also mentioned irregular precipitation (34.68%), increased tendency of drought (31.08%), less cold in winter (27.03%), irregular seasonal variation (20.27%), and many other changes in the weather pattern as some consequences of climate change. When they were asked (n=223) to mention the main reason behind climate change, 46.19% of the respondents believed that climate change is a natural phenomenon, and they have nothing to control it. However, 43.95% of the respondents conceived climate change as a consequence of the blindfold activities of mankind. Some respondents (9.87%) felt that the

change in climatic conditions is not only a natural circumstance but also an aftereffect of the reckless behavior of human beings. Deforestation, excessive carbon emission, mismanagement of industrial wastage,etc. were some causes mentioned by them (Table 2).

4.2 Association between Socio-demographic Factors and Perception of Climate Change

The data presented in Table 3 shows the association between various socio-demographic characteristics and climate change perception of the survey respondents. Where cross tabulation was used to examine the association between such variables. According to the survey results, respondents' age was not a significant factor in determining the perception of climate change. Because of the strong educational and financial background of the respondents in the survey area, people may acquire more knowledge on climate change issues irrespective of their age. The study of Akanda and Howlader (2015) also did not find a strong correlation between ages and the perception of climate change. On the contrary, conducting research on other parts of Bangladesh, some researchers found a significant association between these two variables. Huda (2013) claimed that the young aged people have more knowledge on climate change than the old aged people. On the other hand, the study of Kabir et al. (2016) reported that environmental concern is higher among the older group of people than the younger group. However, other socio-demographic variables such as, gender, education, occupation, and household monthly income were found to be significantly associated with the perception of climate change which is similar to the findings of other related studies. That is, males have higher knowledge (84.07%) on climate change than females (68.75%). Respondents with a higher level of education and more incomehavea better understanding of climate change issues than others.Knowledge on environmental issues is also related to the available access to television and the internet of the respondents in the survey area. In this study, the significant association between access to television, the internet, and the perception of climate change indicated that the people with higher access to television and the internet were more likely to believe that the climate is changing.

Table 3 Association between respondent's socio-demographic variables and perception of climate change

Variable	Climate change perception	Statistics

	No (%)	Yes (%)	Total (%)	
Age category				
Below 30 years	10 (18.87)	43 (81.13)	53 (100)	χ^2= 0.12
Age 30-45 years	20 (17.7)	93 (82.3)	113 (100)	df = 3
Age 46-60 years	15 (19.23)	63 (80.77)	78 (100)	p = 0.99
Above 60 years	6 (20)	24 (80)	30 (100)	
Total	51 (18.61)	223 (81.39)	274 (100)	
Gender				
Female	15 (31.25)	33 (68.75)	48 (100)	χ^2= 6.13
Male	36 (15.93)	190 (84.07)	226 (100)	df = 1
Total	51 (18.61)	223 (81.39)	274 (100)	p = 0.01
Education				
No formal education	8 (24.24)	25 (75.76)	33 (100)	χ^2 = 11.7
Primary level	13 (27.66)	34 (72.34)	47 (100)	df = 4
Secondary level	17 (25.76)	49 (74.24)	66 (100)	p = 0.02
SSC/HSC	8 (11.59)	61 (88.41)	69 (100)	
Degree/Masters/ Equivalent	5 (8.47)	54 (91.53)	59 (100)	
Total	51 (18.61)	223 (81.39)	274 (100)	
Occupation				
Home maker	13 (34.21)	25 (65.79)	38 (100)	χ^2= 24
Business	6 (10)	54 (90)	60 (100)	df = 5
Day laborer	9 (50)	9 (50)	18 (100)	p = 0.001
Service holder	11 (13.58)	70 (86.42)	81 (100)	
Farmer	12 (17.39)	57 (82.61)	69 (100)	
Others	0 (0)	8 (100)	8 (100)	
Total	51 (18.61)	223 (81.39)	274 (100)	
Household monthly income				

Below 10,000	9 (33.33)	18 (66.67)	27 (100)	χ^2= 12.41
10,000 to 20,000	30 (23.26)	99 (76.74)	129 (100)	df = 3
20,000 to 30,000	10 (12.99)	67 (87.01)	77 (100)	p = 0.01
Above 30,000	2 (4.88)	39 (95.12)	41 (100)	
Total	51 (18.61)	223 (81.39)	274 (100)	
Access to television				
No	26 (26)	74 (74)	100 (100)	χ^2= 5.67
Yes	25 (14.37)	149 (85.63)	174 (100)	df = 1
Total	51 (18.61)	223 (81.39)	274 (100)	p = 0.02
Access to internet				
No	39 (21.67)	141 (78.33)	180 (100)	χ^2= 3.23
Yes	12 (12.77)	82 (87.23)	94 (100)	df = 1
Total	51 (18.61)	223 (81.39)	274 (100)	p = 0.07

Source: Author's field survey in 2021.

4.3 Determinants of Households' Perception of Climate Change

In the multivariate analysis, a binary logistic regression model was constructed to predict the perception of climate change since the dependent variable of the model is whether the respondents heard about climate change or not. Among various independent variables, only the level of education, monthly income, and access to television had a significant effect on households' perception of climate change. Table 5 shows the results of the logistic regression model which postulated that, at the 5% level of significance, respondents' education level had a positive and significant effect on their perception of climate change. That is, respondents' who have completed SSC or a higher educational level were more likely to accept the changes in climatic condition than the respondents with secondary or lower levels of education. The significance of education in influencing the perception of climate change was also claimed in the studies of other researchers (Uddin et al., 2017; Kabir et al., 2016; Akanda and Howlader, 2015; Huda, 2013).

Again, monthly household income was also found to be positively and significantly (at 5% level) related to the perception of climate change. Households with monthly income above 20000 had greater knowledge on climate change compared to the households with monthly income below 20000. Because of higher educational attainment and more access to

information, richer groups of the society tended to become more aware of climatic issues than the lower-income group.

Regarding access to information of the respondents, access to television was another important independent variable in predicting the perception of climate change. The results displayed in Table 5 show, at the 1% level of significance, a positive and significant relationship between access to television and the perception of climate change. This implies that the respondents who had access to television, understand that the climate is changing more frequently than the respondents who did not have access to television (Table 4).

Table 4 Determinants of perception of climate change from logistic regression analysis

Variables	Perception of climate change
Age (0=age 36 and above, 1= age less than 36)	0.376 (0.408)
Gender	0.960 (0.930)
Level of education (0= Secondary and below, 1=SSC and above)	1.126** (0.452)
Occupation (Base category: Home maker)	
Business	1.349 (1.084)
Day laborer	0.215 (1.008)
Service holder	0.231 (0.986)
Farmer	1.444 (1.056)
Monthly income (Base category: below 10000)	
10000 to 20000	0.634 (0.510)
20001 to 30000	1.269** (0.585)
Above 30000	2.262** (0.890)
Access to internet (0=No, 1=Yes)	-0.273 (0.480)
Access to television (0=No, 1=Yes)	1.286*** (0.444)
Constant	-2.048*** (0.784)

Source: Author's field survey in 2021.

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.

5. Conclusion and recommendations

A low-lying country like Bangladesh is in a vulnerable position concerning climate change issues (Uddin et al., 2017). People all around the country are not yet aware of this emerging phenomenon. Selecting the people fromthe Bhola district as a research object, this paper attempts to explore the perception of climate change among the people of the rural and coastal areas of Bangladesh.According to the findings of this study, majority of the survey respondents (81.39%) have heard about climate change from different sources, mainly from radio/TV/ newspaper (80%). Increase in temperature, decrease in annual precipitation, and increase in the occurrence of thunderare the top three changes in the weather patternsas mentioned by the knowledgeable respondents that they have noticed within last 10 years.Nevertheless, when querying about the cause of climate change, only 43.95% of them reported this climate variability as a consequence of human deeds and the rest believed this as a natural phenomenon or both.Although the results of thechi-square test reveal significant association between various socio-demographic variables and the perception of climate change, the logit model demonstrates that, level of education, monthly income, and access to television are the significant determinants of households' climate change perception.In conclusion, rural and coastal households have average knowledge about the effects and causes of climate change.

Thus, government as well as other non-governmental organizations should come forward and take proper initiatives to encourage higher education among the people of the rural and coastal areas of Bangladesh.Various promotional activities, such as training programs and seminars should be initiated on regular basis. Expanding publicity on the impacts of climate change and the respective adaptive strategies via television can help to increase environmental awareness.The government should adopt proper fiscal policies like, increasing expenditure on adaptive activities and imposing more taxes on the activities that cause environmental degradation. Since climate change is a huge concept, and this study used only the people from Bhola district, regular research and field studies on other aspects of climate change selecting other areas of Bangladesh are essential to enhance the public perception and awareness of climate change. There is also scope for further studies based on promoting adaptive strategies for addressing climate change issues.

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