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Determinants of Perception and Impact of Climate Change Induced Events on Livelihood of People in the Haor Area of Kishoreganj, Bangladesh

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Abstract: Bangladesh is prone to the danger of different natural calamities and is going to be most affected due to climate change-induced events in the upcoming decades. This study attempted to assess the farmers' awareness, perception and the impact of climate change on the livelihood of people living in the Haor area of Kishoregang, Bangladesh. A total of 230 respondents were interviewed in the study area (Khatkhal union) using the cluster sampling technique. Only 52.2% of farmers are found to be aware of climate change, 61.7% unaware and 47.8% did not know the consequences of rapid climate change. Climate change and the unavailability of flood control embankments are considered as the main reasons for flash floods. Due to the devastating flash flood that occurred in early April 2017; most of the farmers lost more than two-thirds of their standing crops. Flash flood has a large scale impact on soil degradation. As a consequence of these effects, crop production was observed to be reduced the following year. People from Khoishore village are affected by riverbank erosion while the people from Dalargaon village and Hasimpur village are severely affected by Riverbed fill up. Above 93%, people of three villages opined that there is a severe climate change impact on pisciculture, biodiversity and cultivable land.

Keywords: Perception; Impact of Climate Change; Haor Area; Kishoreganj; Bangladesh.

Introduction

Climate change refers to a change in global or regional climate patterns, in particular, a change is apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels. The Intergovernmental Panel on Climate Change (IPCC, 2007) forecasts that developing countries, like Bangladesh, will continue to be affected by extreme weather variability such as temperature, severe water shortage, and flood-inducing rainfall events during the coming decades. Bangladesh is generally viewed as a vulnerable country with respect to climate change especially in Haor areas because of its unique geographic location, the dominance of flood plains, high population density, elevated level of poverty and overwhelming dependency on nature and its resources and services.

Flash floods are a common incident in the Haor region in the pre-monsoon period, but poor management of the rivers and embankments and the decline in the navigability of the rivers have worsened the situation over the years (Ahmed, 2017). In April of 2017, the Haor people of seven north-eastern districts of Bangladesh—Habiganj, Netrakona, Sylhet, Sunamganj, Brahmanbaria, Kishoreganj and Moulvibazar farmers suffered massive destruction of paddy fields and lost

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their only food security crop—the Boro rice—due to flash flood caused by water of Indian Meghalaya state and unnatural excessive rainfall. These early flash floods in Haor areas are the result of climate change which is badly impacting the agricultural productivity, natural fish breeding, land use practice, lifestyles and livelihoods in the Haor areas (Seraj, 2017). The extreme climate events such as floods, droughts, cyclones, sea-level rise, salinity and soil erosion occur in Bangladesh almost every year, and sometimes more than once a year, affecting the crop agriculture sector adversely, particularly rice production (MoEF, 2005; Yamin et al., 2005). Due to heavy rainfall, flooding was reported in various northern districts of Bangladesh in particular, Jamalpur, Kurigram and Gaibandha districts and flash floods are reported in Sylhet and Sunamganj districts (Floodlist News, 2020). Also, Asaduzzaman et al. (2010); Yu et al. (2010); Hossain and Deb (2011) reported that the impacts of climate change are already occurring, as measured by increasing temperatures, variable rainfall and an increase in climate-related extreme events.

Wetlands or Haor areas are the most amentaceous ecosystem in the world (Moreno-Mateos et al., 2012, Li et al., 2020) and they proceed to be annihilated at an alarming rate and even their values and functions are poorly managed (Rebelo et al., 2010, Junk et al., 2013). Haor in Kishoreganj district is very much important from the geo-physical, economic, social and cultural points of view (Kishoreganj Zilla, 1993). A large amount of rice is produced in these Haor areas but the increased frequency of extreme weather events due to climate change will pose a significant risk to future food security (GOB-UNDP, 2009; Haweya, 2016). According to Ricart et al. (2019), factors such as personal experience, local knowledge, familiarity, and social-learning exchanges between farmers and the public may reduce agricultural systems' vulnerability. The study by Ferdushi et al. (2019) explored the awareness of lowland rice farmers with respect to climate change and they found the factors that are significantly associated with farmers' adaptation to climate change too. A few studies have been conducted on the economic prospect of rice in Haor areas (Ali et al., 2019; Islam et al., 2018; Kamruzzaman et al., 2018; Rahman et al., 2018; Kamruzzaman and Uddin, 2020). A number of studies have been completed on the attitudes and perception of wetlands in various parts of the world including Australia (Dobbie and Green, 2013), Bangladesh (Kabir et al., 2016), Nepal (Sah and Heinen, 2001), India (Ambastha et al., 2007), Kenya (Momanyi, 2005), Zimbabwe (Mandishona and Knight, 2019), Ethiopia (Moges et al., 2018), Rwanda (Nsengimana et al., 2017) and South Africa (Sinthumule, 2021). However, the literature suggests that fewer studies have been done on farmers' perception and the impact of climate change in other parts of Bangladesh (Ahmed, 2006; Basak et al., 2009; Khan et al., 2012; Uddin, 2012, 2014), but no studies are focused yet to determine the awareness, perception and the impact of climate change-induced events on the livelihoods of the people living in the Haor area of Mithamoin Upzilla in the Kishoreganj district in Bangladesh.

Methodology

Sources of Data and Study Area

For this study, a cross sectional survey has been conducted in Khatkhal union, Mithamoin Upazilla in Kishoreganj District, the central region (Agri. Ecological Zone) of Bangladesh followed by Bangladesh Meteorological Department (BMD), and Bangladesh Agricultural Research Council (BARC) in Bangladesh to provide a precise picture on the livelihood of Haor people about perception and the impacts of climate change. This region is one of the most affected areas compared to other parts of the country due to frequent climatic hazards such as floods, flash floods, and cyclones, etc. Mithamoin Upazilla is located 24013/ north to 24031/north latitude and 90056/east to 91016/ east longitude with an area of 222.92 sq. km to area 200.52 sq. km, located in between 24°22′ and 24°32′ north latitudes and in between 90°48′ and 91°01′ east longitudes. It is bounded by Tarail and Itna Upazillas on the north, Nikli, Katiadi and Kishoreganj Sadar Upazillas on the south, Austagram Upazilla on the east, Nikli and Karimganj Upazillas on the west.

Figure 1 represents the Haor in the Kishoreganj district, which is very much important from the geophysical, economic, social and cultural points of view (Kishoreganj Zilla, 1993). These Haor have a great significance to the agricultural production of the district and it is of food surplus (DAE, 2010). The total number of Haor in the district is 125 with an area of 134616 hectares and 4.42 million tonne of paddy is produced in these Haor areas (DAE, 2019).

Sample Size and Sampling Design

The study followed cluster sampling to select the respondents, in which a *union is* a cluster. Since the Haor area of Mithamoin Upazilla in Kishoregonj district is the Boro cropped area, the study dealt with

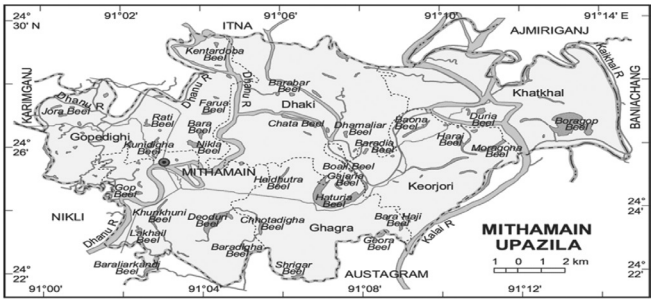

Figure 1: The basin under consideration for the study on the Haor area of Mithamoin Upazila, Kishoreganj.

the information of the livelihoods of the people living in the Haor area of Mithamoin Upazilla only. Data was collected from three randomly selected mouzas/ villages under each cluster. The selection procedure of the sample (local people including rice farmer, farmer cum fisherman, farmer cum businessman and day labour) is as follows:

a. First selecting one Mithamoin Upazilla purposively from Kishoregonj district.
b. Second, one cluster/union is selected randomly from seven clusters/unions under this Mithamoin Upazilla.
c. Finally, three vulnerable villages are selected randomly from one cluster/union.

The sample size needed is calculated using the following formula:

$$n = z^2\ [P(1\text{-}P)/d^2]*D_{\text{eff}}$$

where n = sample size, z = two-sided normal variate at 95% confidence level (1.96), P = indicator percentage, d = precision, D_{eff} = design effect.

To obtain data on indicators at a 7% precision and 95% confidence interval, assuming a design effect of 1.18 and the most conservative estimate of indicator percentage (50%), the minimum sample size required is 230. Therefore, at least 230 respondents are required to analyse the impact of climate change on the livelihoods of the people living in the Haor area of Mithamoin Upazilla in Kishoregonj district Boro rice farmers. It is a statistically representative sample.

A total of 230 individuals were interviewed from three villages, among them 80 individuals were from Khoishore village, 60 individuals from Dalargaon village and 90 individuals from Hasimpur village, which is sufficient to study any sort of indicators because such number of respondents in a mouza/village is widely used by Bangladesh Bureau of Statistics (BBS) and UNICEF for conducting Multiple Indicator Cluster Surveys (BBS-UNICEF, 2012-13).

Respondents

Primary data has been collected through the survey sampling method (questionnaire-based). The informants (local people including Boro rice farmer, farmer cum fisherman, farmer cum businessman and day labourer) comprising both men and women from each vulnerable village have been interviewed on the awareness and the perception of climate change on their livelihoods. If the husband is not alive or the husband has migrated, the female head will be the respondent in a household.

Figure 2 describes the methodology of the study with a flowchart to make a clear understanding of this work.

Statistical Analysis

In this study, various descriptive statistical analyses have been used to exhibit the climate change awareness, perception, livelihood and the impact of climate change-induced events of Haor area's people. SPSS (Statistical packages for Social Science), Windows version 25 was used for data entry, data processing, creating descriptive and frequency tables. High-quality charts were generated using Microsoft Excel 2013.

Results and Discussion

Results on Socioeconomic Characteristics of the Livelihood of the People

Table 1 shows that 53% of them were male. Among the respondents, 41.3% have their own farming land, 27.8% take the lease, 22.6% take sublease, 8.3% cultivate rice on mortgaged land and 12.6% on *khas* land. Apart from rice farming, the individuals were asked whether they are involved in other occupations. It was found that 28.7% are housewives, 10% are fishermen, 10.4% are wage labourer, 3% are agricultural labourer and 13.5% in other occupations. Among the respondents 77.4% are married, 3.9% unmarried, 1.3% separated/divorced and 17.4% are widowed/widower. Most of the respondents are illiterate (42.6%). And only 4.3% have education level S.S.C. or more, 34.3% are signatory and only 10% have primary level education. Most of the families have hanging latrines (71.4%). Only 10.3% have a sanitary latrine, 12.9% have '*kacha*' latrine and 5.4% use open places for sanitation. Regarding economic status, most of them are poor or very poor (92.5%), 7.0% are middle class and only 0.4% are rich.

The awareness and perception level of the respondents on climate changed induced events are presented in

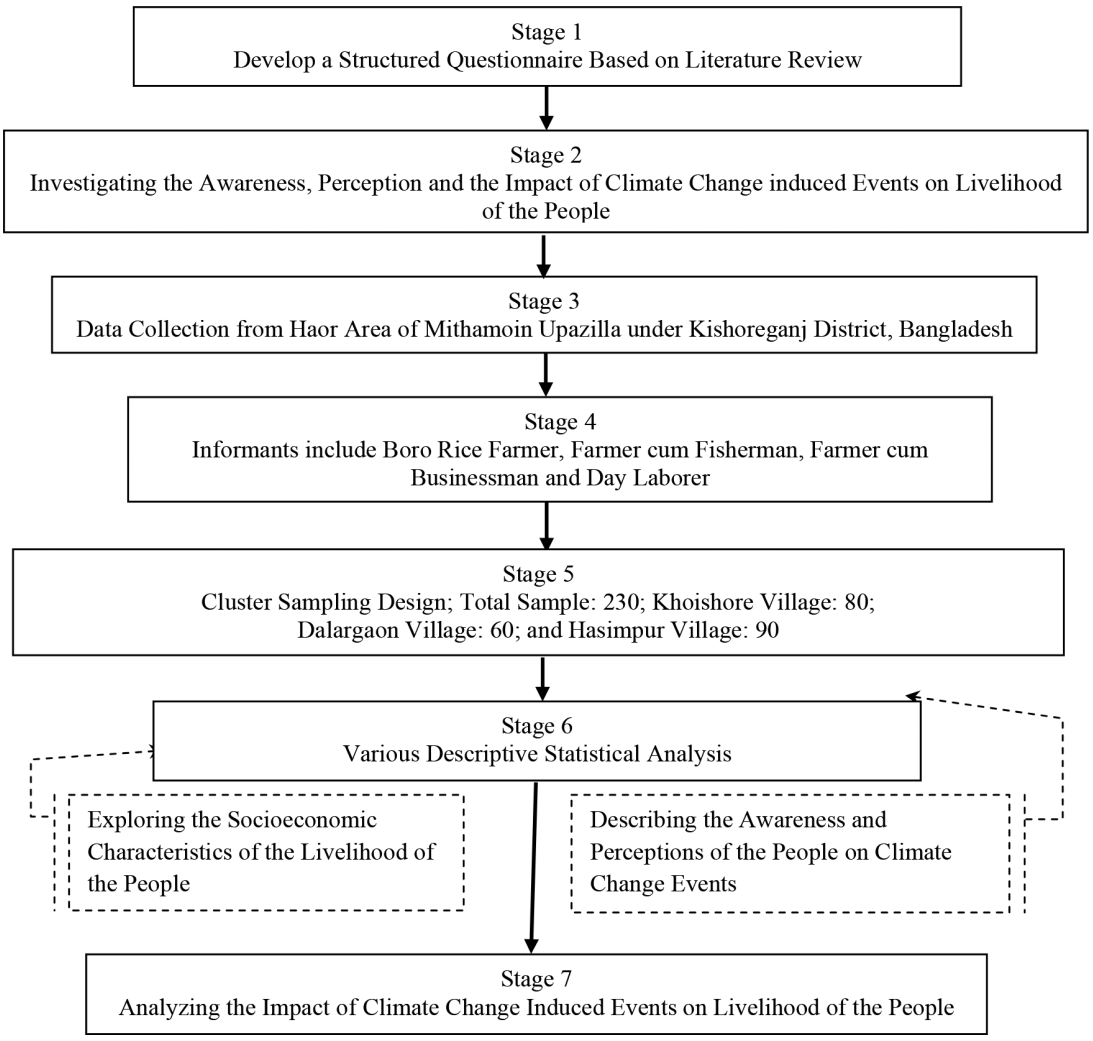

Figure 2: Flow chart of the methodology.

Table 2. It shows that only 4.8% of respondents are well aware about what is climate change, 19.6% know, 27.8% are not clear about the idea, 42.2% somewhat know and 5.7% do not know at all. However, no one is aware of the consequences of climate change. Only 19.6% know, 35.2% are not clear, 42.2 % somewhat know and 3% do not know at all. Regarding the question about why the climate is changing, only 0.4% are well aware, 13.5% just know about it, 28.7% are not clear, 13.9 % somewhat know and 43.5 % do not know about that at all. They were asked whether they are aware of the major climate events. For which only 10.4% responded that they do while 44.3% responded that they do not. The reasons behind climate change were also inquired. Only 3% were well aware and 7.4% know while 16.1% somewhat know and 45.7% do not know about the reasons at all. When asked about why flash flood is frequently occurring at the present time in their area, almost one-third of them (31.9%) had no idea about that at all, while 2.6% are well aware, 28.4% know and 10.9% somewhat know.

Figure 3 exhibits the frequency distribution of climate events that occurs in Mithamoin Upazilla, Kishoreganj. 99.1% respondents believe that flash flood occurs in their area, while 1.3% believe heavy rainfall, 30.4% believe riverbank erosion, 3% believe Sheela Brishty and 55.7% believe that riverbed fill up, while no one responded on the seasonal storm.

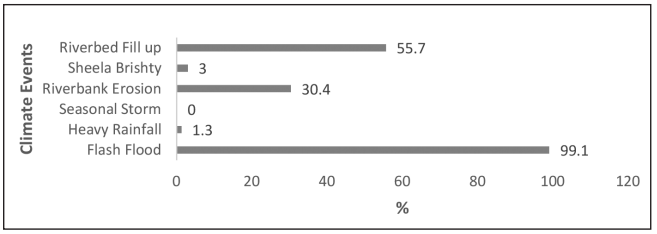

Figure 3: Frequency distribution of climate events.

Table 1: Frequency distribution of socioeconomic characteristics of the livelihood of the people

Characteristics	*Categories*	*Count*	*Percentage (%)*
Gender	Male	122	53.0
	Female	108	47.0
Farmer Type	Own	95	41.3
	Lease	64	27.8
	Sublease	52	22.6
	Mortgage	19	8.3
	Khas	29	12.6
Occupation (Apart from Agriculture)	Fishing	23	10.0
	Agricultural Labourer	7	3.0
	Wage Labourer	24	10.4
	Housewife	66	28.7
	Others	31	13.5
Marital Status	Married	178	77.4
	Unmarried	9	3.9
	Separated/Divorced	3	1.3
	Widowed/Widower	40	17.4
Education Status	Illiterate	98	42.6
	Signatory	79	34.3
	Primary	23	10.0
	Class VIII	20	8.7
	S.S.C.	8	3.5
	H.S.C.	1	0.4
	Graduate	1	0.4
Sanitation	Sanitary	23	10.3
	Hanging	160	71.4
	Kacha	29	12.9
	Open Places	12	5.4
Economic Status	Poor	211	92.5
	Middle Class	16	7.0
	Upper Class	1	0.4

Table 2: Awareness and perceptions of the people on climate change induced events

Climate Related Questions	*Well-Known*		*Known*		*Not Clear*		*Somewhat Know*		*Do not Know*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
What is climate change?	11	4.8	45	19.6	64	27.8	97	42.2	13	5.7
What are the consequences of climate change?	-	-	45	19.6	81	35.2	97	42.2	7	3.0
Why climate is changing?	1	0.4	31	13.5	66	28.7	32	13.9	100	43.5
What are the major climate events?	1	0.4	24	10.4	66	28.7	37	16.1	102	44.3
What are the reasons behind climate change?	7	3.0	17	7.4	64	27.8	37	16.1	105	45.7
Why flash flood is frequently happening at the present time?	6	2.6	65	28.4	60	26.2	25	10.9	73	31.9

Results on Perception levels of Climate Change Induced Events

The perception levels of climate change-induced event Flash Flood are shown in Table 3a, b.

Table 3a shows that 54.8% have the perception that flash flood occurs yearly, 38.2% think it is twice, 5.3% think it is thrice while 1.8% think it is throughout the year, which is obviously a misconception that they are confused with a seasonal flood. 64.9% thinks that people seasonally migrate due to flash flood. 20.3% of them believe that less than 5% of people seasonally migrate due to flash floods. While another 20.3% believe that it is 5-10%, 14.9% believe that it is 17-20% and 24.3% think that it is above 20%. 86% think that people in that region switch their job due to flash floods. 15.8% respondent thinks that less than 5% people do that, 19.9% believe that 5-10%, 29.6% believe that above 20% people switch their job. When the respondents were asked about whether their yield production reduces in the following year after the occurrence of flash floods, 96.1% responded yes. 12.3% of respondents believe that less than one-third people reduce their crop production, 16% believe that it is one-third to less than half of the people, 12.8% think of half to less than two-third, 47.5% think of more than two-third and 11.4% believe that their crop production is reduced. When they were asked about what percentage of people were affected by the damage of standing crops, 54.2% responded that all the farmers were affected, 20.3% believe that more than two-thirds of the farmers were affected while 8.8% think that less than one-third were affected. Two-third of the respondents (60.5%) think that people lost their property due to flash floods. And 16.1% believe that less than 5% were affected, 22.6% believe that 5-10%, 26.3% believe that 17-20% and 16.8% believe that above 20% of people lost their property due to flash floods. 98.7% of respondents think that due to flash floods income opportunities are reduced. 9.4% believe that it's for less than one-third people, 56.3% believe that it's for more than two-third and 11.6% believe that it's for all the people. When the respondents were asked if either they were affected by diseases during the time of the flash flood, Table 3b shows that 82% responded as yes. While 33.7% think less than 5% were affected by disease, 23% think 5-10%, 15.5% think more than 15.5%. 58.8% of the respondents think that during flash floods people were affected by diarrheoa, 33.7% by dysentery, 9.6% by chikungunya, 8.6% by malaria, 3.7% by allergy and 11.2% by other diseases. About 63.2% respondents think that people face a shortage

Table 3a: Perception levels of climate change-induced event Flash Flood

Characteristics	*Categories*	*Count*	*Percentage (%)*
Yearly Occurrence	Once	125	54.8
	Twice	87	38.2
	Three times	12	5.3
	Throughout the year	4	1.8
Seasonal Migration	Yes	148	64.9
	No	80	35.1
What Percentage of People Seasonally Migrated	Less than 5	30	20.3
	5-10	30	20.3
	11-16	30	20.3
	17-20	22	14.9
	Above 20	36	24.3
Job Switching	Yes	196	86.0
	No	32	14.0
What Percentage of People Switched Job	Less than 5	31	15.8
	5-10	39	19.9
	11-16	35	17.9
	17-20	33	16.8
	Above 20	58	29.6

Reduced Yield Production	Yes	219	96.1
	No	9	3.9
What Percentage of People Reduced Yield Production	Less than one-third	27	12.3
	One-third to less than half	35	16.0
	Half to less than two-third	28	12.8
	More than two-third	104	47.5
	Completely	25	11.4
What Percentage of People were Affected by the Damage of Standing Crops	Less than one-third	20	8.8
	One-third to less than half	20	8.8
	Half to less than two-third	18	7.9
	More than two-third	46	20.3
	Completely	123	54.2
Lost Property	Yes	138	60.5
	No	90	39.5
What Percentage of People Lost their Property	Less than 5	22	16.1
	5-10	31	22.6
	11-16	25	18.2
	17-20	36	26.3
	Above 20	23	16.8
Reduction of Income Opportunities	Yes	224	98.7
	No	3	1.3
What Percentage of People Lost Their Income Opportunities	Less than one-third	21	9.4
	One-third to less than half	24	10.4
	Half to less than two-third	27	12.1
	More than two-third	126	56.3
	Completely	26	11.6
Affected by Disease	Yes	187	82.0
	No	41	18.0

Table 3b: Perception levels of climate change-induced event Flash flood

Characteristics	*Categories*	*Count*	*Percentage (%)*
What Percentage of People were Affected by Disease	Less than 5	63	33.7
	5-10	43	23.0
	11-16	33	17.6
	17-20	19	10.2
	Above 20	29	15.5
Types of Disease	Allergy	7	3.7
	Diarrhea	110	58.8
	Dysentery	63	33.7
	Malaria	16	8.6
	Dengue	2	1.1
	Chikongunya	18	9.6
	Others	21	11.2

(*Contd.*)

Table 3b: (*Contd.*)

Characteristics	*Categories*	*Count*	*Percentage (%)*
Shortage of Drinking Water	Yes	144	63.2
	No	84	36.8
What Percentage of People Faced Shortage of Drinking Water	Less than 5	27	18.9
	5-10	33	23.1
	11-16	22	15.4
	17-20	30	21.0
	Above 20	31	21.7
Sources of Daily Uses of Water	Pond Water	25	11.0
	River Water	175	76.8
	Rain Water	35	15.4
	Purifying water with potash alum	8	3.5
	Boil Water	10	4.4
	Tube well Water	82	36.0
Drinking Water Sources	Pond Water	12	5.4
	River Water	87	39.4
	Rain Water	35	15.8
	Purifying water with potash alum	22	10.0
	Boil Water	22	10.0
	Tube well Water	139	62.3
Received Relief after Disaster	Yes	59	25.9
	No	169	74.1
What sort of Relief	Financial	25	42.4
	Food/Clothing	32	54.2
	Loan Waiver	-	-
	Help from Agriculture Office	-	-
	Others	2	3.4
From where People Learn about Climate Change	TV/Radio	58	25.9
	Newspaper	8	3.6
	Internet	2	0.9
	Govt. Campaign	3	1.3
	NGO	7	3.1
	Local Representative	43	19.2
	Others	103	46.0

of drinking water during the period of a flash flood. While 18.9% think that less than 5% face the problem of shortage of drinking water, 23.1% think 5-10%, 21% think 17-20% and 21.7% think more than 20% of people face a shortage of drinking water. The study reveals that the respondents found a shortage of drinking water during flash floods which is consistent with the study of Kabir et al. (2016). When respondents were asked about their sources of daily uses of water and drinking water during the time of flash floods, 76.8% of respondents expressed that people use river water for daily uses and only 36% think that people use tube well water. While 39.4% think that people use river water for drinking purposes and 62.3% think that people use tube well water. When they were asked about whether they receive any relief after a natural disaster, only 25.9% responded yes. They further expressed that the little relief they receive is mostly food/clothing (54.2%) and

financial (42.4%). They also expressed their frustration over not receiving any help from the agriculture office. And finally, when they were asked about from where they learn about climate change, 25.9% replied that from TV/Radio, 3.6% from a newspaper, 19.2% from local representatives and 46% from other sources.

The perception levels of climate change-induced event riverbank erosion is shown in Table 4. People from Khoishore village are affected by riverbank erosion. Among the respondents 39.1% believe riverbank erosion occurs once a year, 23.2% think twice, 4.3% think thrice and 33.3% think that it occurs more than three times in a year. 39.1% of the respondents think due to riverbank erosion people are seasonally migrated. Among them, 63% believe that more than 20% of people seasonally migrate. According to 60.9% of them, people switch their job due to riverbank erosion. Among them, 21.4% believe that less than 5% of people switch their job, while 52.4% think that more than 20% of people switch their job due to riverbank erosion. When they asked about whether people lost their cultivable land due to riverbank erosion, 97.1% responded yes. Among them, 17.6% believe that less than 5% of people lost their cultivable land, while 41.2% believe that more than 20% of people lost their cultivable land.

The perception levels of climate change-induced event Sheela Brishty is shown in Table 5. Only seven of the respondents identified Sheela Brishty as the major climate event in their area. Among them four responded that Sheela Brishty occurs every year, two think every two years and one thinks every four or more years. About the yearly occurrence of Sheela Brishty three of them think more than thrice a year, two of them think once, one of them thinks twice and another one of them thinks thrice a year. Among the seven of them, six of them believe due to Sheela Brishty, standing

Table 4: Perception levels of climate change-induced event riverbank erosion

Characteristics	*Categories*	*Count*	*Percentage (%)*
Yearly Occurrence	Once	27	39.1
	Twice	16	23.2
	Three times	3	4.3
	More than three times	23	33.3
Seasonal Migration	Yes	27	39.1
	No	42	60.9
What Percentage of People Seasonally Migrated	Less than 5	5	18.5
	5-10	5	18.5
	11-16	-	-
	17-20	-	-
	Above 20	17	63.0
Job Switching	Yes	42	60.9
	No	27	39.1
What Percentage of People Switched their Job	Less than 5	9	21.4
	5-10	7	16.7
	11-16	1	2.4
	17-20	3	7.1
	Above 20	22	52.4
Lost Cultivable Land	Yes	67	97.1
	No	2	2.9
What Percentage of People Lost Cultivable Land	Less than 5	12	17.6
	5-10	12	17.6
	11-16	7	10.3
	17-20	9	13.2
	Above 20	28	41.2

Table 5: Perception levels of climate change-induced event Sheela Brishty

Characteristics	*Categories*	*Count*	*Percentage (%)*
How Often Sheela Brishty Occurs	Every year	4	57.1
	Every two years	2	28.6
	Every three years	-	-
	Every four or more years	1	14.3
Yearly Occurrence	Once	2	28.6
	Twice	1	14.3
	Three times	1	14.3
	More than three times	3	42.9
Damage of Standing Crops	Yes	6	85.7
	No	1	14.3
What Percentage of People Faced Crop Damage	Less than 5	-	-
	5-10	3	50.0
	11-16	2	33.3
	17-20	1	16.7
	Above 20	-	-
Job Switching	Yes	3	42.9
	No	4	57.1
What Percentage of People Switched their Job	Less than 5	1	33.3
	5-10	1	33.3
	11-16	1	33.3
	17-20	-	-
	Above 20	-	-

Table 6: Perception levels of climate change-induced event Riverbed Fill Up

Characteristics	*Categories*	*Count*	*Percentage (%)*
Lost Cultivable Land	Yes	120	90.2
	No	13	9.8
What Percentage of People Lost Cultivable Land	Less than 5	22	18.3
	5-10	20	16.7
	11-16	16	13.3
	17-20	24	20.0
	Above 20	38	31.7
Job Switching	Yes	127	95.5
	No	6	4.5
What Percentage of People Switched their Job	Less than 5	14	11.0
	5-10	24	18.9
	11-16	42	33.1
	17-20	16	12.6
	Above 20	30	23.6
Cultivate Alternative Crops	Yes	69	51.9
	No	64	48.1
What Percentage of People Cultivate Alternative Crops	Less than 5	8	11.5
	5-10	16	23.2
	11-16	9	13.0
	17-20	17	24.6
	Above 20	19	27.5

crops damage happens. Three of them think 5-10% of people are affected by that and two of them think 11-16% of people are affected by that. According to the 4 respondents, people switch their job due to the effect of Sheela Brishty.

The perception levels of climate change-induced event Riverbed Fill Up is shown in Table 6. The people from Dalargaon village and Hasimpur village are severely affected by Riverbed fill up. Table 6 shows that 90.2% of respondents believe that due to riverbed fill up people's cultivable land are damaged with full of sediment and lack of irrigation facility. According to 95.5% of them, people switch their job due to riverbed fill up. 11% think that less than 5% people do that, 33.1% think that 11-16% people do that and 23.6% think that more than 20% people switch their job. When asked about whether they cultivate alternative crops like Aman rice, nut, pea, etc. due to riverbed fill up, 51.9% responded yes. According to 11.5% respondents, less than 5% people do that, 23.2% think 5-10% people do that, 24.6% think that 17-20% people do that and 27.5% people think that more than 20% people cultivate alternative crops due to riverbed fill up.

Results on the Impact of Climate Change-induced Events on Livelihood of the People

Table 7 shows the impact of the Flash Flood on the livelihood of the people. Behind the reasons for crop damage, 6.6% of respondents identified the late sowing, 78.0% identified the unavailability of flood control embankment, 32.2% identified the unavailability of flood control techniques like sluice gate and 29.1% of them identified the riverbed fill up. 43.6% of the respondents believe that all the crops are damaged due

Table 7: Impact of a flash flood on the livelihood of the people

Characteristics	*Categories*	*Count*	*Percentage (%)*
Causes of Crop Damage	Late Sown	15	6.6
	Unavailability of Flood Control Embankment	177	78.0
	Unavailability of Flood Control Technologies	73	32.2
	Riverbed Fill Up	66	29.1
What Percentage of Crops Damaged due to Flash Flood	Less than one-third	13	5.8
	One-third to less than half	23	10.2
	Half to less than two-third	13	5.8
	More than two-third	78	34.7
	Completely	98	43.6
What Percentage of Soil Degradation Happened	Less than one-third	38	16.8
	One-third to less than half	18	8.0
	Half to less than two-third	14	6.2
	More than two-third	61	27.0
	Completely	78	34.5
	No Damage Happened	17	7.5
Cost to Recover Degraded Land	Less than 10000 Tk.	24	11.5
	10000-20000 Tk.	48	23.1
	21000-30000 Tk.	55	26.4
	31000-40000 Tk.	25	12.0
	Above 40000 Tk.	56	26.9
What Percentage of Property they Lost	Less than one-third	26	11.5
	One-third to less than half	16	7.0
	Half to less than two-third	15	6.6
	More than two-third	63	27.8
	Completely	55	24.2
	No Damage Happened	52	22.9

to flash floods, 34.7% believe more than two-third and only 5.8% people think that less than one-third of crops are damaged due to flash floods. A similar result was found in a study by Khan et al. (2012).

With the heavy flow of sediment during the time of the flash flood, severe soil degradation also happens. According to 16.8% of the respondents, less than one-third of cultivable lands are affected by soil degradation, 27% think that it is more than two-third, 34.5% believe that complete damage of the cultivable land and 7.5 responded that no soil degradation occurs in their region. They were asked about the cost of recovering the degraded lands. 11.5% think that it is less than 10000 Tk, 23.1% think that 10000-20000Tk, 26.4% think that 21000-30000Tk, 12% think that 31000-40000 Tk and 26.9% think that more than 40000Tk. They were also asked if they lost any property due to a flash flood, for which 22.9% responded that there was no property loss, 24.2% responded that they completely lost their property, 27.8% think that more than two-thirds of property they lost and 11.5% think that they have lost less than one-third of the property. In another study in the Haor area by Ahmed (2017) stated that Haors are important areas for Boro rice cultivation but early flash floods often wash away standing crops and people lose their harvest which is found consistent along with the proposed study. Islam et al. (2011) also warned that the agricultural sector is most likely to face significant yield reduction in the future due to climate variability.

Table 8 shows the impact of riverbank erosion on the livelihood of the people. Due to riverbank erosion, 33.3% of the respondents lost less than one-third of their cultivable land, 31.9% lost more than two-thirds of the land, 7.2% completely and 8.7% did not lose any of their lands. Due to riverbank erosion, 17.6% of respondents were affected by the damage of less than one-third of their standing crops, 38.2% were affected by the damage of more than two-thirds of their standing crops, 17.6% were affected by complete damage and 5.9% did not face any standing crops damage. Respondents were also asked about whether any people migrated due to the damage of riverbank erosion. 17.6% of respondents think that less than one-third of people migrated due to riverbank erosion, 10.3% think half to less than two-thirds people, 26.5% think more than two-third, 5.9% think completely and 32.4% think none. It should be reminded that only the people of Khoishore village were affected by riverbank erosion. Due to riverbank erosion income opportunity of the villagers reduces. 16.2% of respondents think that less than one-third people's income opportunity reduced, 29% think that more than two-thirds people's, 17.6% think that all of the people income opportunities reduced due to riverbank erosion and 2.9% respondents think that none of the people's income opportunity reduced due to riverbank erosion. Some infrastructures and household belongings were damaged due to riverbank erosion. 24.6% of respondents think that people were affected by less than one-third of their infrastructures, 29% think it's more than two-third, 7.2% think that people were affected by complete damage of infrastructures and 17.4% think that no damage to infrastructure is done.

Table 10 shows the impact of riverbed fill up on the livelihood of the people. 9% of the respondent believe that farmers in the Khatkhal union lost less than one-third of their cultivable lands due to riverbed fill up, 15% think farmers lost one-third to less than half the lands, 34.6% believe that more than two-third, 30.1% believe that farmers completely lost their cultivable lands and 5.3% think that none has lost any land. When asked about what percentage of income opportunities reduced due to riverbed fill up it was found that 7.5% think it was less than one-third, 54.9% think that it was more than two-third, 16.5% think that completely and 3.8% think that no reduction of income opportunities. Due to riverbed fill up, fishermen are affected heavily. 29.5% of respondents think that due to riverbed fill up less than one-third loss happened in fishing, 29.5% think that more than two-third, 12.9% think that complete loss and 7.6% think that no loss in fishing happened due to riverbed fill up.

Table 11 shows the sector-wise negative impacts due to climate change. A total of 94.3% of respondents believe that there is climate change impact on crop production. 93.5% also opined that there is severe climate change impact on pisciculture. And 20.5% of the respondents think that impact of climate change on pisciculture is less than one-third, 166.7% think it is one-third to less than half, 46.1% think it is more than two-third and 10.2% think complete impact. When asked about whether there is any impact of climate change on biodiversity, 94.8% responded yes. And 13.3% of respondents believe that the impact of climate change on biodiversity is less than one-third, 51.4% believe that it is more than two-third and 17.4% believe that the impact is severe. Respondents were also asked if there is any impact of climate change on cultivable land and 96.1% responded yes. And 18.1% of respondents believe that the impact of climate change on cultivable land is less than one-third, 42.5% think it is more than two-third and 19.5% think that the impact is severe.

Table 8: Impact of Riverbank Erosion on the Livelihood of the People

Characteristics	*Categories*	*Count*	*Percentage (%)*
What Percentage of Loss of Cultivable Lands due to Riverbank Erosion	Less than one-third	23	33.3
	One-third to less than half	3	4.3
	Half to less than two-third	10	14.5
	More than two-third	22	31.9
	Completely	5	7.2
	None	6	8.7
What Percentage of Standing Crops Damaged due to Riverbank Erosion	Less than one-third	14	20.6
	One-third to less than half	11	16.2
	Half to less than two-third	1	1.5
	More than two-third	26	38.2
	Completely	12	17.6
	None	4	5.9
What Percentage of People Migrated	Less than one-third	12	17.6
	One-third to less than half	5	7.4
	Half to less than two-third	7	10.3
	More than two-third	18	26.5
	Completely	4	5.9
	None	22	32.4
What Percentage of Income Opportunity Reduced due to Riverbank Erosion	Less than one-third	11	16.2
	One-third to less than half	6	8.8
	Half to less than two-third	16	23.5
	More than two-third	21	30.9
	Completely	12	17.6
	None	2	2.9
What Percentage of Infrastructure Damage Happened	Less than one-third	17	24.6
	One-third to less than half	7	10.1
	Half to less than two-third	8	11.6
	More than two-third	20	29.0
	Completely	5	7.2
	None	12	17.4

Conclusion

This study assessed the awareness, perception level of Haor area's people and the impact of climate change-induced events from three villages of Mithamoin Upazilla in Kishoreganj. Almost half of the respondents (47.8%) of this study do not know about climate change and its consequences. Because of illiteracy and lack of awareness build-up programme, people's perception level about climate change and its consequences, reason is not found satisfactory. During the flash floods, people were largely affected by the damage to their standing crops. Most of the people lost two-third of all of their crops due to flash floods. After the flash flood, soil degradation occurs on a large scale. The unavailability of flood control embankment as the main reason for flash floods is found in this study. The people of Khoishore village are largely affected by riverbank erosion. As a result, many of them lost their property and infrastructure. While the people of Dalargaon and Hasimpur village suffered from riverbed fill up due to heavy sediment carried by a flash flood

Table 9: Impact of Sheela Brishty on the livelihood of the people

Characteristics	*Categories*	*Count*	*Percentage (%)*
What Percentage of Standing Crops Damaged due to Sheela Brishty	Less than one-third	1	14.3
	One-third to less than half	3	42.9
	Half to less than two-third	1	14.3
	More than two-third	-	-
	Completely	1	14.3
	None	1	14.3
What Percentage of Home Damage Happened due to Sheela Brishty	Less than one-third	2	28.6
	One-third to less than half	-	-
	Half to less than two-third	-	-
	More than two-third	1	14.3
	Completely	-	-
	None	4	57.1

Table 10: Impact of riverbed fill up on the livelihood of the people

Characteristics	*Categories*	*Count*	*Percentage (%)*
What Percentage of Loss of Cultivable Lands due to Riverbed Fill up	Less than one-third	12	9.0
	One-third to less than half	20	15.0
	Half to less than two-third	8	6.0
	More than two-third	46	34.6
	Completely	40	30.1
	None	7	5.3
What Percentage of Income Opportunity Reduced due to Riverbed Fill up	Less than one-third	10	7.5
	One-third to less than half	14	10.5
	Half to less than two-third	9	6.8
	More than two-third	73	54.9
	Completely	22	16.5
	None	5	3.8
What Percentage of Loss in Fishing Happened due to Riverbed Fill up	Less than one-third	39	29.5
	One-third to less than half	17	12.9
	Half to less than two-third	10	7.6
	More than two-third	39	29.5
	Completely	17	12.9
	None	10	7.6

and seasonal floods. And the flash flood was found the common cause for all three villages. Due to this climate change-induced events, crop production, biodiversity and fertility of the land are largely affected according to the people of those three villages.

So policy makers should develop effective strategies to educate the illiterate and aware people about climate change and its consequences on their livelihoods. Due to the devastating flash flood that occurred in early April 2017, most of the farmers lost more than two-thirds of their standing crops. Since the unavailability of flood control embankments is considered as the main reason for a flash flood, the government should take immediate steps to build up sustainable flood control

Table 11: Sector wise negative impacts due to climate change

Characteristics	*Categories*	*Count*	*Percentage (%)*
Climate Change Impact on Crop Production	Yes	217	94.3
	No	13	5.7
Climate Change Impact on Pisciculture	Yes	215	93.5
	No	15	6.5
What Percentage of Impact on Pisciculture due to Climate Change	Less than one-third	44	20.5
	One-third to less than half	36	16.7
	Half to less than two-third	14	6.5
	More than two-third	99	46.1
	Completely	22	10.2
Climate Change Impact on Biodiversity	Yes	218	94.8
	No	12	5.2
What Percentage of Impact on Biodiversity due to Climate Change	Less than one-third	29	13.3
	One-third to less than half	25	11.5
	Half to less than two-third	14	6.4
	More than two-third	112	51.4
	Completely	38	17.4
Climate Change Impact on Cultivable Land	Yes	221	96.1
	No	9	3.9
What Percentage of Impact on Cultivable Land due to Climate Change	Less than one-third	40	18.1
	One-third to less than half	25	11.3
	Half to less than two-third	19	8.6
	More than two-third	94	42.5
	Completely	43	19.5

embankments to prevent the damage of flash floods in the Haor area. Also, to help people to handle the impact of climate change-induced events on their livelihoods, the government and NGOs should come forward to arrange alternative income opportunities for the farmers and introduce effective adaptation strategies to them.

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