

ADAPTIVE BEHAVIOUR OF RICE FARMERS AGAINST CLIMATE CHANGE INDUCED FLASH FLOOD IN HAOR AREAS: EMPHASIZING THEIR SOCIOECONOMIC TRAITS

ABSTRACT

In the face of recent devastating flash floods in 2016 and 2017 in the north-east wetlands of Bangladesh, locally known as haor, where 70% of the crops were damaged as an effect of climate change; the study was undertaken to identify the farming practices well adapted to this varied conditions. The socioeconomic traits of the farmers that ultimately shape adaptive behaviour against this frequent flash flood damage were also assessed. Data were collected from 10 July to 20 August, 2017 by using a pre-tested structured interview schedule from 115 randomly selected farmers of four flash flood affected villages under two upazilas namely Tahirpur and Bishwambarpur of Sunamganj district. A mixed method research design was followed during data collection to calculate necessary logistic analysis and interpretations. Findings revealed that, use of short duration variety; practicing varietal diversification by growing short duration varieties in the low lands and allocation of Kanda land for long duration modern variety; and shifting harvesting maturity by farmers were proven significant adaptive practices of rice farming, while 80% of the respondents were low to moderate adaptor. Pearson's correlation analysis explained that, adaptation of these farming practices varied significantly with the variation in farmers' level of education, farm size, annual family income, communication exposure, agricultural training experience and perception on climate change while their age showed negatively significant relationship and family size showed a non-significant relationship. It was further revealed through Chi-square analysis that, farmers' with higher level of education, farm size, annual family income, communication exposure and perception on climate change are likely to have a more favorable adaptive behaviour towards the farming practices to face flash flood damage.

Keywords: Adaptive farming practices, climate change, haor farmers, boro rice, flash flood

1. INTRODUCTION

The widespread and potential impact of climate change on environment makes it an important concern for agricultural food production and in case of Bangladesh, where lives and livelihoods, depend mainly on agriculture; is exposed to a great danger as the country is one of the most vulnerable countries due to climate change [1]. Bangladesh's climate has been changing for a couple of decades and these changes on average temperature and precipitation have a baseline impact on the productive capacity of agricultural activity; altering the underlying yield expectations and risk regimes faced by farmers [2]. As Bangladeshi economy is based predominantly on agriculture, forestry, and fishing; climate change is expected to decrease agricultural Gross Domestic Product (GDP) by 3.1% each year, a cumulative 36 billion dollars in lost value-added for the period 2005-2050 [3]. This change in climate has its worsened effect on crop production system in the haor areas unlike other parts of the country due to its unique physical setting and hydrology. The haor areas of Bangladesh produces a significant amount of rice mainly in boro season; where about 0.71 million ha of net cultivable land is available producing more than 5.25 million tons of rice each year [4]. But the change in rainfall pattern and sudden rainfall often results in pre-monsoon flash flood that is the prime form of hazard in haor areas; caused by combination of local rainfall and run-off from the Assam and Meghalaya Hills range in India that results in immense damage to crops, lives and properties every year.

As most of the haor areas remain water logged for six to seven months in a year; there is hardly any scope to grow other rice except boro variety in dry season. It was found that, average area coverage of boro rice in the haor area was almost 85% while only 15% area was allocated for aman rice and rabi crops [5]. But the farmers have to regularly face flash flood damage and often loss their almost

55 ripen *boro* rice just before harvesting. In 2017 flash flood inundated the north eastern haor region of
56 the country in a devastating form. Flood started on 28th March affecting six districts (Sylhet,
57 Moulavibazar, Sunamganj, Habiganj, Netrokona and Kishoreganj) in the north east region and
58 destroyed nearly-ready-for-harvesting *boro* rice in about 183,795 ha areas [6]. According to a report in
59 The Daily Star (14th April, 2017), flash flood **damaged** the haor areas relatively earlier that results in
60 destroying over one lakh hectare of land [7]. So, it is inevitable for the haor farmers to undertake
61 some adaptive strategies to fight against this devastating flash flood damage.

62 Adaptation to particular climate changes seem to be the most appropriate and responsive way for
63 farmers to lower the negative impacts of climate change [8]. In Bangladesh, research and
64 development programs are designed to provide technological solutions to farmers through
65 cooperative extension systems and other means to implement various coping strategies, which have
66 been identified as potential avenues to face climate change effects on crop production [9]. The haor
67 farmers are adapting various farming practices as a response to mitigate the flash flood damage to
68 secure their rice production but the relative success is less. In this situation, the adaptive capacities of
69 the targeted farmers need to be gradually increased and thus, it is necessary to know their extent of
70 adaptation of different farming practices and relevant socioeconomic traits that influence their
71 adaptive **behaviour**. However, the empirical research findings regarding these strategies have not
72 clearly documented how farmers adapt their farming practices in relation to the continuous and
73 sudden changes in climatic events, nor identified what are the important socioeconomic factors which
74 contribute or hinder their adaptation [10]. Hence, it was revealed that use of adaptation strategies are
75 influenced by socioeconomic characteristics of the farmers [11]. Wisner et al., [12] also reported that,
76 the vulnerability of agriculture is not determined by the nature and magnitude of environmental stress
77 like climate change per se, but by the combination of societal capacity to mitigate, cope with or
78 recover from environmental changes more or less regarded as climate change which further supports
79 the influence of different socioeconomic traits on the adaption of coping strategies by haor farmers. Ali
80 [13] identified several dimensions of adaptation of farming practices in Bangladesh while focusing on
81 human and ecological systems and found that socioeconomic development activities were linked with
82 the process of farming practices adaptation. It was also reported that several socioeconomic
83 responses were adopted by the smallholder farmers to adapt with the climatic and associated non-
84 climatic variability [14]. Therefore, it is necessary to identify the strategies that are best suited to
85 support farmers against climate change resultant flash flood in the haor areas and to identify the
86 socioeconomic traits significantly affecting haor farmers' adaptive **behaviour** regarding their responses
87 to climate change impacts.

88 In view of this context, the study was conducted with the following objectives: i) to identify adaptive
89 practices of haor farmers in rice production against flash flood hazard; ii) to quantify their extent of
90 adaptation of these farming practices; iii) to determine and describe some important socioeconomic
91 traits; and iv) to explore the relationship between these selected socioeconomic traits and their extent
92 of adaptation of selected farming practices.

94 **2. MATERIALS AND METHODS**

95 **2.1. Study Area**

96 The study was carried out in four villages of two upazilas namely Tahirpur and Bishwambarpur of
97 Sunamganj district covering north-eastern haor areas. The Sunamganj district is located between
98 Latitude 25.080624 and Longitude 91.421356 while it is located at Bangladesh country with the gps
99 coordinates of 25° 4' 50.2464" N and 91° 25' 16.8816" E. This district was selected purposively as it
100 contains 95 haors [15] and is one of the severely flash flood affected districts. On the other hand,
101 Tahirpur and Bishwambarpur were two regularly flash flood affected haor upazilas where almost 60-
102 70% people live on agriculture. Due to 2010's flash flood, 10337 ha crop land in Tahirpur upazila [16]
103 and 3020 ha crop land in Bishwambarpur upazila [17] were destroyed.

105 **2.2. Collection of Data**

106 115 randomly selected haor farmers from four villages constituted the sample of the study and were
107 interviewed using a pre-tested structured interview schedule during 10 July to 20 August, 2017 to
108 collect necessary data.

110 **2.3. Analytical Techniques**

111 Farmers' adaptive **behaviour** was determined by assigning their extent of adaptation of different
112 farming practices. For this purpose, twelve different adaptive practices in response to flash flood
113 hazard in haor basin area were first identified through **Focus Group Discussions (FGD)** and **Key**
114 **Informant Interviews (KII)**. Then the farmers were asked to score these selected twelve adaptive

farming practices using a four-point rating scale to determine the Weighted Average Index (WAI) score for each of these practices. Lastly, the practices were ranked according to their individual WAI score. Here, the observed WAI score ranged from 0.104 to 2.191 against the possible range from 0 to 3 where 0 means no adaptation and 3 means highest adaptation of an individual practice. The Weighted Average Index (WAI) formula is as follows:

$$WAI = \frac{\sum fi}{\sum f} \quad \text{..... (i)}$$

Where,

f = frequency of response

w = weight of each score and

i = score (3 = full adaptation; 2 = moderate adaptation; 1 = low adaptation; 0 = no adaptation)

Finally correlation analysis techniques were used to express the influence of independent variables on dependent variable. Here, some socioeconomic traits of the haor farmers were selected as independent variables which included their age, level of education, family size, farm size, annual family income, communication exposure, agricultural training experience and their perception on climate change; while the dependent variable was extent of adaptation of selected farming practices by the haor farmers. Association between the individual socioeconomic traits with farmers' adaptation was measured using an Adaptation Practice Index (API) formula with a three-point rating scale. API of a category under a given trait ranges from 115 to 345, where 115 indicating low adaptation and 345 indicating high adaptation.

The Adaptation Practice Index (API) formula was as follows:

$$API = A_l \times 1 + A_m \times 2 + A_h \times 3 \quad \text{..... (ii)}$$

Where,

A_l = Frequency of farmers having low adaptation

A_m = Frequency of farmers having moderate adaptation

A_h = Frequency of farmers having high adaptation

The data collected were subjected to analysis using SPSS (Statistical Package for Social Science) software package version 20 including descriptive statistics- such as mean, frequency, standard deviation, range, percentage and Pearson's product moment correlation and Chi-square analysis. The chosen significant levels were equal to or lower than 0.05 level of probability.

3. RESULTS AND DISCUSSION

3.1. Adaptive farming practices for rice production against flash flood risk in haor areas

Within the course of time, haor farmers have manipulated different adaptive practices to evaluate the potentiality and efficiency of these practices under their field condition. Though the extent of adaptation of these farming practices vary in different contents; they had recognized some specific practices as most significant to secure their only crop *boro* rice under the context of pre-mature and mature stage damage by flash flood attack. The selected twelve adaptive practices were namely cultivation of short duration high yielding *boro* rice varieties, change in planting time of rice seedling, practice of varietal diversification, transplanting older seedlings, shifting harvesting maturity, growing rabi crops, use of raised seedbed during water logged condition, growing short duration vegetables, making necessary drainage system, fishing and selling them in the market, duck rearing and poultry farming. Selected farming practices were ranked according to their observed Weighted Average Index (WAI) score and were shown chronologically in Figure 1.

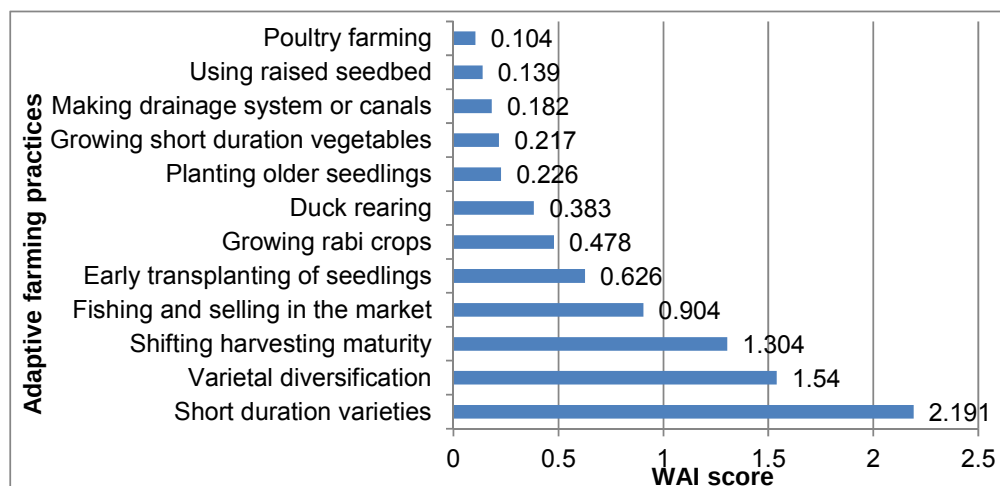


Fig. 1. Rank order of different adaptive farming practices

Results revealed that, the observed WAI score ranged from 0.104 to 2.191 against the possible score of 0 to 3. Here, farmers had given 1st rank to the cultivation of short duration high yielding *boro* rice varieties with the highest WAI score that means majority of the farmers are growing different short duration *boro* rice varieties like BRRI dhan 28, BINA dhan 10 along with some local varieties. The least one with lowest WAI score was poultry farming as there was scarcity of rearing place and feeding material for the poultry in case of long term waterlogged condition in haor areas.

3.2. Characteristics profile of the haor farmers

Profile of different characteristics of the haor farmers is presented in Table 1. From the table it is found that, the highest portion of the respondents (68.7%) was medium to old aged while highest (29.6%) portion of them had only primary education. Again, highest (75.7%) portion of the farmers had medium sized family but most of them (45.2%) were marginal to small farmers. In addition to that, majority (75.6%) of the farmers had very low to low income while highest (88.7%) portion of them had very low to low extension media contact with no agricultural training experience (80.9%). On the other hand, majority (86.1%) of the farmers had a low to moderate perception while most of them were moderate adaptor against climate change (80.0%).

Table 1. Characteristics profile of the haor farmers

Table 2: Characteristics profile of the rural farmers						
Age						
Young		Middle		Old	Mean	SD
31.3%		33.9%		34.8%	46.29	13.974
Level of education						
Illiterate	Can sign only	Primary	Secondary	Higher secondary	Mean	SD
23.5%	22.6%	29.6%	22.6%	1.7%	3.761	3.76
Family size						
Small		Medium		Large	Mean	SD
15.7%		75.7%		8.7%	6.52	2.535
Farm size						
Marginal	Small	Medium		Large	Mean	SD
0.9%	44.3%	39.1%		15.7%	1.75	1.98
Annual income						
Very low	Low	Medium		High	Mean	SD
44.3%	31.3%	20.9%		3.5%	54571.30	54655.15
Extension media contact						
Very low	Low	Moderate		High	Mean	SD
20.9%	67.8%	7.8%		3.5%	13.17	3.52

Agricultural training experience					
No 80.9%	Low 19.1%	Medium 0%	High 0%	Mean 0.19	SD 0.39
Perception on climate change					
Low 22.6%	Moderate 63.5%	High 13.9%	Mean 15.80	SD 3.75	
Extent of adaptation					
Low 31.3%	Moderate 48.7%	High 20%	Mean 8.3	SD 4.009	

3.3. Socioeconomic traits influencing farmers' adaptive behaviour in boro rice cultivation

Data were analyzed with a view to test the association or correlation between farmers' socioeconomic traits as independent variable with their adaptive behaviour as dependent variables. Here, the null hypothesis of the study was socioeconomic traits of the haor farmers has no significant relationship with their extent of adaptation of different adaptive practices (H_0) while the alternate hypothesis was socioeconomic traits of the haor farmers has significant relationship with their extent of adaptation of the adaptive practices (H_1). The findings are presented in Table 2 with the estimated Pearson's correlation and Chi-square values with the corresponding P -levels from the Chi-square test of independence.

Table 2. Correlation analysis of traits influencing farmers' extent of adaptation

Dependent variable	Independent variables	Correlation co-efficient (r)	Chi-square value (X^2)	P -value
Adaptation of farming practices by haor farmers	Age	-.205*	5.876	.21
	Level of education	.298**	12.377	.14
	Family size	.028	7.557	.11
	Farm size	.234*	21.222**	.002**
	Annual family income	.743**	102.691**	.000**
	Communication exposure	.458**	32.306**	.000**
	Agricultural training experience	.234*	6.364*	.041*
	Perception on climate change	.532**	65.491**	.000**

*significant at $P = 0.05$ level of probability; **significant at $P = 0.01$ level of probability

In case of Pearson's correlation co-efficient test analysis, when the calculated r value is greater than tabulated value then the null hypothesis is rejected and there is significant correlation between two variables. Here, results revealed that age of the farmers had a negatively significant relationship with their adaptation, while level of education had a positive significant relationship. Similarly, farmers' farm size, annual family income, communication exposure, agricultural training experience and their perception on climate change had a positively significant relationship with adaptation of selected farming practices and thus null hypothesis (H_0) was rejected. On the contrary, family size had a non-significant relationship with their adaptation. Findings from Billah [18], Karim [19] and Mahmood [20] also supported the significance in relationship between these socioeconomic traits with farmers' adaptation. These findings can explain a meaningful correlation between farmers' socioeconomic traits with their adaptive behaviour. It is proven that, individuals with a relatively higher academic qualification are tend to possess a more favourable mindset towards new production practices as it somewhat gives them a wider exposure to training and communication facility that develops a favourable perception in adapting them. On the other hand, individuals with larger farm size, higher income, training and a favourable perception are likely to have more opportunity and capability in adapting different practices in their own field situation. Thus the obtained correlation matrix model suggests that, any desirable change in farmers' age, level of education, farm size, annual family income, communication exposure, agricultural training experience and their perception on climate change will results in significant variation in their extent of adaptation of farming practices that in turns develops their adaptive behaviour against flash flood hazard.

Again, the selected socioeconomic traits of haor farmers were fitted in the Chi-square test analysis for determining the degree of association between the variables and results are also given in Table 2. Here, when the calculated P -value is lower than tabulated value (0.05 at 0.05 and 0.01 at 0.01 levels

of probability); then the null hypothesis (H_0) is rejected. Results revealed that, among the eight socioeconomic characteristic; farmers' level of education, farm size, annual family income, communication exposure, and perception on climate change had significant relationships or associations with their adaptation and thus null hypothesis (H_0) was rejected. On the contrary; farmers' age, family size and agricultural training experience showed no association with their extent of adaptation of different farming practices. Findings suggest that, farmers' with higher level of education, farm size, annual family income, communication exposure and perception of climate change are likely to have a more favorable adaptive behaviour towards the farming practices to face the flash flood damage in case of *boro* rice production.

3.4. Association between individual socioeconomic trait of the farmers with their adaptive behaviour along with their Adaptation Practice Index (API) score through Chi-square test

The observed count and expected count under each category of personality traits along with the calculated API score were discussed below at 4 Degrees of Freedom (df):

Table 3. Association between age of the respondents and their adaptation of farming practices

S.L. No.	Age categories	Overall adaptation by the farmers			Total	API
		Low	Moderate	High		
1.	Young (18-35)	6 (11.3)	20 (17.5)	10 (7.2)	36 (115)	76
2.	Middle (36-50)	14 (12.2)	18 (19)	7 (7.8)	39 (115)	71
3.	Old (>50)	16 (12.5)	18 (19.5)	6 (8)	40 (115)	70
Total		36	56	23	115	

Pearson Chi-Square value = 5.876; Insignificant relationship

In Table 3 the association between farmers' age and their adaptive behaviour was explained. Here, the calculated value of X^2 (5.876) was observed as insignificant as the calculated P -value is greater than 0.05 at 0.05 level of probability. Hence, the null hypothesis (H_0) cannot be rejected and it was concluded that adaptation of farming practices by the farmers did not vary significantly with the variation of their age. Adaptation Practice Index (API) score of these three categories indicated that, young farmers had highest adaptation (API =76) followed by middle aged farmers (API=71) and old aged farmers (API=70). This indicates that, the young farmers might be more likely to adapt different farming practices with the change of climate.

Table 4. Association between level of education of the respondents and their adaptation of farming practices

S.L. No.	Education categories	Overall adaptation by the farmers			Total	API
		Low	Moderate	High		
1.	Illiterate (0)	12 (8.5)	12 (13.1)	3 (5.4)	27 (115)	45
2.	Can sign only (0.5)	10 (8.1)	13 (12.7)	3 (5.2)	26 (115)	45
3.	Primary level (1-5)	10 (10.6)	18 (16.6)	6 (6.8)	34 (115)	64
4.	Secondary level (6-10)	4 (8.1)	12 (12.7)	10 (5.2)	26 (115)	58
5.	Higher secondary and above (>10)	0 (0.6)	1 (1.0)	1 (0.4)	2 (115)	5
Total		36	56	23	115	

Pearson Chi-Square value = 12.3777; insignificant relationship

In Table 4, the association between farmers' level of education and their adaptive behaviour was shown. Here, the calculated value of X^2 (12.377) was observed insignificant as the calculated P -value is greater than 0.05 at 0.05 level of probability. Hence, the null hypothesis (H_0) was accepted and it was concluded that adaptation of farming practices by the farmers did not vary significantly with the variation of their level of education. Adaptation Practice Index (API) score of these categories indicated that, highest adaptation (API=64) was occurred among the farmers with primary education followed by secondary education category (API=58) and then both illiterate and can sign only categories (API=45) while the lowest score (API=5) was in higher secondary education category. This indicates the fact that, the more farmers are educated the more they might be likely to adapt these farming practices in response to climate change.

Table 5. Association between family size of the respondents and their adaptation of farming practices

S.L. No.	Family size categories	Overall adaptation by the farmers			Total	API
		Low	Moderate	High		
1.	Small (1-4)	8 (5.6)	8 (8.8)	2 (3.6)	18 (115)	76
2.	Medium (5-9)	22 (27.2)	46 (42.4)	19 (17.4)	87 (115)	71
3.	Large (>9)	6 (3.1)	2 (4.9)	2 (2.0)	10 (115)	70
Total		36	56	23	115	

Pearson Chi-Square value = 7.557; Insignificant relationship

The association between farmers' family size and their adaptive behaviour was explained in Table 5. Here, the calculated value of X^2 (7.557) was observed insignificant as the calculated P -value is greater than 0.05 at 0.05 level of probability. Hence, the null hypothesis (H_0) cannot be rejected and it was concluded that adaptation of farming practices by the farmers did not vary significantly with the variation in their family size. Adaptation Practice Index (API) score of these categories indicated that, highest adaptation (API=76) was occurred among the farmers with small family size followed by medium family size (API=71) and then large family size categories (API=70). This indicates the fact that, farmers with small family size might be more likely to adapt these farming practices in response to climate change.

Table 6. Association between farm size of the respondents and their adaptation of farming practices

S.L. No.	Farm size categories	Overall adaptation by the farmers			Total	API
		Low	Moderate	High		
1.	Marginal (up to 0.02)	0 (0.3)	1 (0.5)	0 (0.2)	1 (115)	2
2.	Small (0.021-1)	16 (16)	31 (24.8)	4 (10.2)	51 (115)	90
3.	Medium (1.01-3)	16 (14.1)	20 (21.9)	9 (9.0)	45 (115)	83
4.	Large (>3)	4 (5.6)	4 (8.8)	10 (3.6)	18 (115)	42
Total		36	56	23	115	

Pearson Chi-Square value = 21.222** ; Significant relationship

Table 6 showed the association between farmers' farm size and their adaptive behaviour. Here, the calculated value of X^2 (21.222**) was observed significant as the calculated P -value is less than 0.01 at 0.01 level of probability. Hence, the null hypothesis (H_0) was rejected and it was concluded that adaptation of farming practices by the farmers varied significantly with the variation in their farm size. Adaptation Practice Index (API) score of these categories indicated that, highest adaptation (API=90) was occurred among the farmers with small farm size followed by medium farm size (API=83) then large farm size (API=42) and finally marginal size categories (API=2). This indicates the fact that, farmers with larger farm size are more likely to adapt these farming practices significantly in response to climate change.

Table 7. Association between annual income of the respondents and their adaptation of farming practices

S.L. No.	Annual family income categories	Overall adaptation by the farmers			Total	API
		Low	Moderate	High		
1.	Very low income (up to 30000)	36 (16)	20 (24.8)	1 (10.2)	51 (115)	79
2.	Low income (31000-55000)	6 (11.3)	30 (17.5)	0 (7.2)	36 (115)	66
3.	Medium income (56000-150000)	0 (7.5)	6 (11.7)	18 (4.8)	24 (115)	66
4.	High income(>150000)	0 (1.3)	0 (1.9)	4 (0.8)	4(115)	12
Total		36	56	23	115	

Pearson Chi-Square value = 102.691** ; Significant relationship

The association between farmers' annual family income and their adaptive behaviour was explained in Table 7. Here, the calculated value of X^2 (102.691**) was observed significant as the calculated P -value is less than 0.01 at 0.01 level of probability. Hence, the null hypothesis (H_0) was rejected and it was concluded that adaptation of farming practices by the farmers varied significantly with the variation in their annual family income. Adaptation Practice Index (API) score of these categories indicated that, highest adaptation (API=79) was occurred among the farmers with very low annual income followed by both low and medium annual income (API=66) and finally high annual family income categories (API=12). This indicates the fact that, as most of the farmers in haor areas are

poor and very few has a high annual income; they try to utilize their limited income in best ways to adapt suitable practices even if they face some difficulties in adapting these farming practices in response to climate change.

Table 8. Association between communication exposure of the respondents and their adaptation of farming practices

S.L. No.	Communication exposure categories	Overall adaptation by the farmers			Total	API
		Low	Moderate	High		
1.	Very low contact (up to 10)	12 (7.5)	12 (11.7)	0 (4.8)	24 (115)	36
2.	Low contact (11-17)	24 (24.4)	40 (38)	14 (15.6)	78 (115)	146
3.	Medium contact (18-21)	0 (2.8)	4 (4.4)	5 (1.8)	9 (115)	23
4.	High contact (>21)	0 (1.3)	0 (1.9)	4 (0.8)	4 (115)	12
Total		36	56	23	115	

Pearson Chi-Square value = 32.306^{**}; Significant relationship

Table 8 explained the association between farmers' communication exposure and their adaptive behaviour. Here, the calculated value of X^2 (32.306^{**}) was observed significant as the calculated P -value is less than 0.01 at 0.01 level of probability. Hence, the null hypothesis (H_0) was rejected and it was concluded that adaptation of farming practices by the farmers varied significantly with the variation in their communication exposure. Adaptation Practice Index (API) score of these categories indicated that, highest adaptation (API=146) was occurred among the farmers with low media contact followed by very low media contact and then to medium extension media contact (API=23) and finally high communication exposure categories (API=12). This indicates the fact that, as most of the farmers in haor areas has limited access to media and information sources; they usually depend on their peer group and local leaders to develop a positive mindset and attitude towards a new practice and try to utilize their limited media contact at best ways in order to adapt these farming practices in response to climate change.

Table 9. Association between agricultural training experience of the respondents and their adaptation of farming practices

S.L. No.	Agricultural training experience categories	Overall adaptation by the farmers			Total	API
		Low	Moderate	High		
1.	No training (0)	33 (29.1)	45 (45.3)	15 (18.6)	93 (115)	168
2.	Low training (1-3)	3 (6.9)	11 (10.7)	8 (4.4)	22 (115)	49
3.	Medium training (4-8)	0	0	0	0 (115)	0
4.	High training(>8)	0	0	0	0 (115)	0
Total		36	56	23	115	

Pearson Chi-Square value = 6.364^{*}; Significant relationship

The association between farmers' training experience and their adaptive behaviour was explained in Table 9. Here, the calculated value of X^2 (6.364^{*}) was observed significant as the calculated P -value is less than 0.05 at 0.05 level of probability. Hence, the null hypothesis (H_0) is rejected and it was concluded that adaptation of farming practices by the farmers varied significantly with the variation in their agricultural training experience. Adaptation Practice Index (API) score of these categories indicated that, highest adaptation (API=168) was occurred among the farmers with no training experience and then to low training experience (API=49) category. This indicates the fact that, as most of the farmers in haor areas has limited access to training facility in addition with their usual disinterest towards the training programs; they usually depend on their peer group and local leaders to develop a positive attitude towards a new practice and try to utilize their own ideas and perception at best ways in order to adapt these farming practices in response to climate change.

Table 10. Association between respondent's perception on climate change and their adaptation of farming practices

S.L. No.	Perception on climate change categories	Overall adaptation by the farmers			Total	API
		Low	Moderate	High		
1.	Low perception (up to 12)	12 (8.1)	14 (12.7)	0 (5.2)	26 (115)	40
2.	Moderate perception (13-20)	24 (22.6)	41 (35.5)	8 (14.6)	73 (115)	130
3.	High perception (>20)	0 (5.0)	1 (7.8)	15 (3.2)	16 (115)	47
Total		36	56	23	115	

Pearson Chi-Square value = 65.491^{**}; Significant relationship

The association between farmers' perception on climate change and their adaptive behaviour was shown in Table 10. Here, the calculated value of X^2 (65.491^{**}) was observed significant as the calculated *P*-value is less than 0.01 at 0.01 level of probability. Hence, the null hypothesis (H_0) was rejected and it was concluded that adaptation of farming practices by the farmers varied significantly with the variation in their perception on climate change. Adaptation Practice Index (API) score of these categories indicated that, highest adaptation (API=130) was occurred among the farmers with moderate perception and then to high perception (API=47) category followed by low perception (API=40) category. This indicates the fact that, farmers having more favourable and clear perception are more prone to adapt these farming practices which can contest the loss due to climate change.

4. CONCLUSION AND RECOMMENDATIONS

The trend of climate change related hazards like early flash flood is tend to be aggravated in the future which seeks urgent evaluation to secure crop production in the haor areas. As majority (80%) of the haor farmers had low to moderate adaptation while only 20% had high adaptation towards different farming practice; it creates major drawback in case of their capability to face flash flood hazard. Various adaptation strategies were used by the farmers where use of short duration variety ranked first followed by practicing varietal diversification and shifting harvesting maturity. Though adaptation of these farming practices varied significantly with the variation of the farmers' level of education, farm size, annual family income, communication exposure, agricultural training experience and perception on climate change while their age showed negative significant relationship and family size showed non-significant relationship; by emphasizing these aspects, adaptive behaviour of haor farmers can be diversified in a desired way through guiding and supporting these identified characteristics while minimizing the negative factors. These results could guide the Government, policy makers, extension service providers and development organizations with important insights which shades light on the new empirical evidence about farmers' personality traits-behaviour-adaptation relationship; that can be used to facilitate and guide the adaptation mechanism of haor farmers at desired direction with potentiality to build their resiliency to changing climatic condition and resulting environmental impacts on crop production system in haor areas.

Consent Disclaimer:

As per international standard or university standard written patient consent has been collected and preserved by the author(s).

Ethical Disclaimer: NA

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