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Original Research Article

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ADAPTIVE BEHAVIOR OF THE RICE GROWERS AGAINST CLIMATE CHANGE INDUCED FLASH FLOOD IN HAOR AREAS: EMPHASIZING ON THEIR SOCIO-ECONOMIC TRAITS

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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% crops were damaged as the effect of climate change; the study was undertaken to identify the farming practices well adapted to this varied conditions. The socio-economic traits of the farmers that ultimately shape adaptive behavior against the 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 small and marginal farmers were 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 about climate change while their age showed negative significant relationship and family size showed non-significant relationship. In was further revealed through Chi-square analysis 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 behavior towards the farming practices to face the flash flood damage.

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

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1. INTRODUCTION

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The widespread and potential impact of climate change on environment makes it an important concern for agriculture 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 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 are producing a significant amount of rice mainly in *boro* season where about 0.71 million ha of net cultivable land is available that produces more than 5.25 million tons of rice each year [4]. The change in rainfall pattern and sudden rainfall often results in pre-monsoon flash flood that has been the prime form of hazard in the haor areas which is caused by the combination of local rainfall and run-off from the Assam and Meghalaya Hills range in India causing 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 the flash flood damage and often loss their

Comment [001]: This title may be reconstructed as "Adaptive Behaviours of Rice Farmers Against Climate Change Induced Flash Flood in Haor Areas in Bangladesh"

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almost ripen *boro* rice just before harvesting. In 2017 flash flood inundated the north eastern haor region of the country in a devastating form. Flood started on 28th March affecting six districts (Sylhet, Moulavibazar, Sunamganj, Habiganj, Netrokona and Kishoreganj) in the north east region and destroyed nearly-ready-for-harvesting *boro* rice in about 183,795 ha areas [6]. According to a report in The Daily Star (14th April, 2017), flash flood attacked the haor areas relatively early that results in destroying over one lakh hectare of land [7]. As a result, it is inevitable for the haor farmers to undertake some adaptive strategies to fight against the devastating flash flood damage. Adaptation to particular climate changes seem to be the most appropriate and responsive way for farmers to lower the negative impacts of climate change [8]. In Bangladesh, research and development programs are designed to provide technological solutions to farmers through cooperative extension systems and other means to implement various coping strategies, which have been identified as potential avenues to face climate change effects on crop production [9]. The haor farmers are adapting various farming practices as a response to mitigate the flash flood damage to secure their rice production but the relative success is less. In this situation, the adaptive capacities of the targeted people need to be gradually increased and thus, it is necessary to know their extent of adaptation of different farming practices and relevant socio-economic traits that influence their adaptive behavior. However, the empirical research findings regarding these strategies have not documented how farmers adapt their farming practices in relation to the continuous and sudden changes in climatic events, nor identified what are the important socio-economic factors which contribute or hinder their adaptation [10]. Here, it was revealed that use of adaptation strategies are influenced by socio-economic characteristics of the farmers [11]. Wisner et al., [12] also reported that, the vulnerability of agriculture is not determined by the nature and magnitude of environmental stress like climate change per se, but by the combination of the societal capacity to mitigate, cope with or recover from environmental changes more or less regarded as climate change which further supports the influence of different socio-economic traits on the adaption of coping strategies by the haor farmers. Ali [13] identified several dimensions of adaptation of farming practices in Bangladesh while focusing on human and ecological systems and found that socio-economic development activities were linked with the process of farming practices adaptation. It was also reported that several socio-economic responses were adopted by the smallholder farmers to adapt with the climatic and associated non-climatic variability [14]. Therefore, it is necessary to identify the strategies that are best suited to support farmers against climate change resultant flash flood in the haor areas and to identify the socio-economic traits affecting the haor farmers' adaptive behavior regarding their responses to climate change effects. In view of this context, the study was conducted with the following objectives: i) to identify adaptive practices of haor farmers and their extent of use of in rice production against flash flood hazards; ii) to quantify their extent of adaptation of these farming practices; and iii) to determine and describe their socio-economic traits; and 4. To explore the relationship between these selected socio-economic traits and their extent of adaptation of the selected farming practices.

2. MATERIAL AND METHODS

2.1. Study Area

The study was carried out in four villages of two upazilas namely Tahirpur and Bishwambarpur of Sunamganj district covering haor areas. Sunamganj district was selected purposively as it contains 95 haors [15] and is one of the severely flash flood affected districts. On the other hand, Tahirpur and Bishwambarpur were two regularly flash flood affected haor upazilas where almost 60-70% people live on agriculture. Due to 2010's flash flood, 10337 ha crop land in Tahirpur upazila [16] and 3020 ha crop land in Bishwambarpur upazila [17] were destroyed.

2.2. Collection of Data

Data were collected from 115 randomly selected farmers from the four villages as the sample for the study and were interviewed using a pre-tested structured interview schedule during 10 July to 20 August, 2017.

2.3. Analytical Techniques and Software used

Farmers' adaptive behavior was determined by assigning farmers extent of adaptation of different farming practices. For this purpose, twelve different adaptive practices in response to flash flood hazard in haor basin area were first identified through FGDS and KIIs. Then the farmers were asked to score this selected twelve adaptive farming practices using a four-point rating scale to determine the Weighted Average Index (WAI) for each of the practices. Lastly, the practices were ranked according to their individual WAI score. Here, the observed WAI ranged from 0.104 to 2.191 against the possible

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range from 0 to 3 where 0 means no adaptation and 3 means highest adaptation of an individual practice.

The WAI formula is as follows:

$$WAI = \frac{\sum f_i w_i}{\sum f_i} \dots\dots\dots (i)$$

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 socio-economic 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 their extent of adaptation of selected farming practices. Association between the individual socio-economic 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 API formula was as follows:

$$API = A_l \times 1 + A_m \times 2 + A_h \times 3 \dots\dots\dots (ii)$$

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 at 0.01 and 0.05 levels 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 identified twelve adaptive practices through FGD's and KII's 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, harvesting rice at 80% 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 the observed Weighted Average Index (WAI) score and were shown in Figure 1.

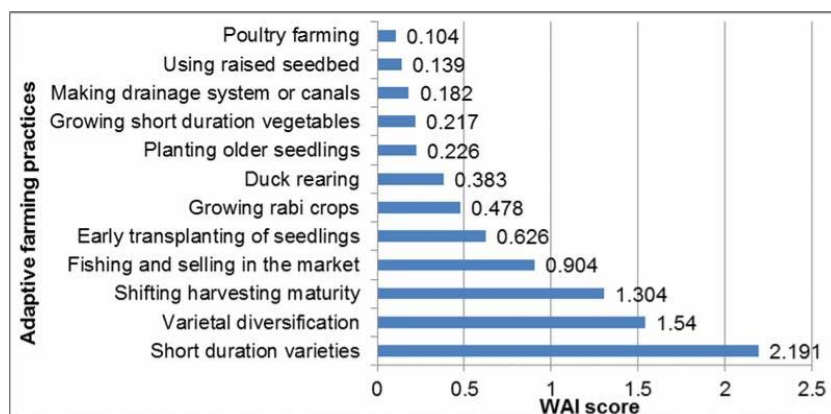


Fig. 1. Rank order of different adaptive farming practices

It was revealed that, the observed WAI score ranged from 0.104 to 2.191 against the possible score from 0 to 3. Here, farmers gave 1st rank to the cultivation of short duration high yielding *boro* rice varieties with a highest WAI score of 2.191. They gave next rank to practice of varietal diversification with a WAI score of 1.54 and 3rd rank to harvesting rice at 80% maturity with WAI score of 1.304. In this similar way all the twelve practices were ranked in order on the basis of their individual Weighted Average Index (WAI) score, as the 4th one was fishing and selling them in the market with WAI score of 0.904, 5th was change in planting time of rice seedling (WAI =0.626), 6th one was growing rabi crops (WAI =0.478), 7th one was duck rearing (WAI =0.383), 8th was transplanting older seedlings (WAI =0.226), 9th one was growing short duration vegetables (WAI =0.217), the 10th one was making necessary drainage system (WAI =0.182), the 11th one was use of raised seedbed during water logged condition (WAI =0.139) and the last one with lowest WAI score of 0.104 was poultry farming.

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, mean age of the farmers were 46.29 years when standard deviation was 13.974. Here, the highest portion of the respondents (68.7%) was medium to old aged compared to only 31.3% were young. On the other hand, farmers' mean of level of education was 3.761 with 3.76 standard deviation value. Here, highest (29.6%) portion of the framers had primary education and only 1.7% had higher secondary level education. Again, highest (75.7%) portion of them had medium sized family while 8.7% had large family with mean 6.52 and standard deviation was 2535. In case of farm size, highest portion (45.2%) was marginal to small farmers where only 15.7% was large farmers with a mean 1.75 and 1.98 standard deviation value. Again, majority (75.6%) of the farmers had very low to low income while only 3.5% had high annual income with mean 56571.30 and 54655.15 standard deviation. Here, highest (88.7%) portion of the framers had very low to low extension media contact while only 3.5% had high contact with 13.17 mean and 3.52 standard deviation value. In addition to that, highest (80.9%) portion of the framers had no agricultural training experience and only 19.1% had low training experience with 0.19 mean and standard deviation was 0.39. Here, majority (86.1%) of the farmers had a low to moderate perception on climate change adaptation while only 13.9% had high perception with mean 15.80 and standard deviation value of 3.75. Finally, in case of farmers extent of adaptation of farming practices, majority (80.0%) of the farmers had low to moderate adaptation while only 20% had high adaptation with mean 8.3 and 4.009 standard deviation.

Table 1. Characteristics profile of the haor farmers

Age					Mean	SD
Young	Middle	Old				
31.3%	33.9%	34.8%			46.29	31.974
Level of education					Mean	SD
Illiterate	Can sign only	Primary	Secondary	Higher secondary		
23.5%	22.6%	29.6%	22.6%	1.7%	3.761	3.76

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Family size					
Small 15.7%	Medium 75.7%	Large 8.7%	Mean 6.52	SD 2.535	
Farm size					
Marginal 0.9%	Small 44.3%	Medium 39.1%	Large 15.7%	Mean 1.75	SD 1.98
Annual income					
Very low 44.3%	Low 31.3%	Medium 20.9%	High 3.5%	Mean 54571.30	SD 54655.15
Extension media contact					
Very low 20.9%	Low 67.8%	Moderate 7.8%	High 3.5%	Mean 13.17	SD 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. Socio-economic traits influencing farmers' adaptive behavior in boro rice cultivation

Data were analyzed with a view to test the association or correlation between farmers' socio-economic traits as independent variable with their adaptive behavior as dependent variables. 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 (χ^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

Pearson's correlation co-efficient test analysis 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 significant relationship with the adaptation of selected farming practices. On the other hand, family size had a non-significant relationship with their adaptation. These findings explain a meaningful correlation between farmers' socio-economic traits with their adaptive behavior. Findings from Billah [18], Karim [19] and Mahmood [20] also support the evidence. The correlation matrix model suggests that, any desirable change in farmers age, level of education, farm size, annual family income, communication exposure, agricultural experience and their perception on climate change will results in significant variation in their adaptation of the farming practices that in turns develops their adaptive behavior against flash flood hazard.

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Again, the selected socio-economic 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. Results revealed that, among the eight socio-economic 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. On the other hand, 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 behavior towards the farming practices to face the flash flood damage in case of rice production.

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

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The observed count and expected count under each category of personality traits along with the calculated API score were discussed below:

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, df = 4; Insignificant relationship

In Table 3 the association between farmers' age and their adaptive behavior was explained. Here, the calculated value of χ^2 (5.876) was observed as insignificant at 0.05 level with 4 df. Hence, the null hypothesis 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 are more likely to adapt different farming practices with the change of climate.

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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, df = 4; insignificant relationship

In Table 4, the association between farmers' level of education and their adaptive behavior was shown. Here, the calculated value of χ^2 (12.377) was observed insignificant at 0.05 level with 4 df. Hence, the null hypothesis 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 are 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, df = 4; Insignificant relationship

The association between farmers' family size and their adaptive behavior was explained in Table 5. Here, the calculated value of X^2 (7.557) was observed insignificant at 0.05 level with 4 df. Hence, the null hypothesis cannot be rejected 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=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 are 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^{**}, df = 4; Significant relationship

Table 6 showed the association between farmers' farm size and their adaptive behavior. Here, the calculated value of X^2 (21.222^{**}) was observed significant at 0.01 level with 4 df. Hence, the null hypothesis 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 be adapted these farming practices 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^{**}, df = 4; Significant relationship

The association between farmers' annual family income and their adaptive behavior was explained in Table 7. Here, the calculated value of X^2 (102.691^{**}) was observed significant at 0.01 level with 4 df. Hence, the null hypothesis 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 even if they face some difficulties to adapt 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**, df = 4; Significant relationship

Table 8 explained the association between farmers' communication exposure and their adaptive behavior. Here, the calculated value of X^2 (32.306**) was observed significant at 0.01 level with 4 df. Hence, the null hypothesis 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 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) Low	33 (29.1)	45 (45.3)	15 (18.6)	93 (115)	168
2.	training (1-3) Medium	3 (6.9)	11 (10.7)	8 (4.4)	22 (115)	49
3.	training (4-8) High	0	0	0	0 (115)	0
4.	training(>8)	0	0	0	0 (115)	0
Total		36	56	23	115	

Pearson Chi-Square value = 6.364*, df = 4; Significant relationship

The association between farmers' training experience and their adaptive behavior was explained in Table 9. Here, the calculated value of X^2 (6.364*) was observed significant at 0.05 level with 4 df. Hence, the null hypothesis 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^{***}, df = 4; Significant relationship

The association between farmers' perception on climate change and their adaptive behavior was showed in Table 10. Here, the calculated value of X^2 (65.491^{***}) was observed significant at 0.01 level with 4 df. Hence, the null hypothesis was 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=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 clear perception are more prone to adapt these farming practices which can contest the loss due to climate change.

4. CONCLUSION

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 by growing short duration varieties in the low lands and allocation of *Kanda* land for long duration modern variety and shifting harvesting maturity. Though adaptation in 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 about climate change while their age showed negative significant relationship and family size showed non-significant relationship; by emphasizing these aspects, adaptive behavior 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-behavior-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.

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Comment [OO15]: This may be written as conclusion and recommendations.

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