Effectiveness of Flood Coping Strategies Practiced by the Fish Farmers: An Empirical Study in Bangladesh

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Abstract—*Flood is one of the devastating disasters that tremendously affecting the agriculture. While several Flood Coping Strategies (FCS) had been practiced by the victims to overcome the losses for the same. Thus, the study was undertaken and mainly aimed at determine to the extent of effectiveness of Flood Coping Strategies practiced by the fish farmers. The study was conducted in four villages of two unions namely Jauor and Dameha under Tarail upazila of Kishoreganj district in Bangladesh. One hundred farmers were interviewed for data collection using a pretested interview schedule. Effectiveness of flood coping strategies practiced by the fish farmers was the dependent variable and measured on the basis of opinion provided by the fish farmers according to their extent of practiced. While the extent of effectiveness of flood coping strategies was measured by using a 4-points rating scale. Appropriate scales were developed and used in order to measure the concerned variables. Both descriptive and inferential statistics were used to analyze the collected data. Results showed that 17 percent of the farmers perceived effectiveness of Flood Coping Strategies was high, followed by 56 percent of farmers perceived as "moderately effective" and 27 percent of farmers perceived as "low effective". While "raising the height of pond dike above flood level' got ranked first and denoted as highly effective flood coping strategy while Drain out dirty flood water was the least effective Flood Coping Strategiesas it got ranked 24th. Farmers' characteristics such as education, farm size, annual family income, credit received, organizational participation, social mobility, and knowledge on flood coping strategies showed significant positive relationship with the perceived effectiveness of Flood coping strategies. While other variables did not show any relationship. The influential factors that affecting the effectiveness of Flood Coping Strategies were level of education, annual family income and knowledge on Flood Coping Strategies as confirmed by the multiple regression analysis and these variables together explained 53.4 percent variation in effectiveness of Flood Coping Strategies.*

1. INTRODUCTION

Bangladesh is an agro-based riverine country enriched with fisheries resources. Its economy mainly depends on agriculture, livestock and fisheries. While fish is the second most valuable agricultural crop in Bangladesh and its production contributes to the livelihoods and employment of millions of people (DoF, 2016).The fisheries sector plays a very important role in the national economy, contributing 3.69% to the Gross Domestic Product (GDP) of the country and 22.60% to the agricultural GDP (FRSS, 2016). More than 17 million people including about 1.4 million women depend on fisheries sector for their livelihoods through fishing, farming, fish handling, and processing (BFTI, 2016). But, this sector has been struggling with different natural disasters while flood is one of them.

Bangladesh is recognized as one of the extremely vulnerable countries to climate change in the world resulted different natural calamities like flood, cyclone, drought, tornedo etc. have been found every year. These floods are primarily caused by rainfall in the monsoon season, between July and October (Hofer and Messerli, 2006). Recently, heavy rainfalls as well as onrush of water from the upstream Meghalaya hills in India have led to the inundation of vast areas of croplands of Haors (wetland ecosystem) and low-lying areas of the northeast in Bangladesh especially in six districts (Sylhet, Moulvibazar, Sunamganj, Habiganj, Netrokona and Kishoreganj). Rising water overflow and breeched embankment in many places and inundated vast areas of croplands. It destroyed nearly-ready-for-harvesting Boro rice in about 219,840 hectors areas and pond and other fish culture areas (DDM, 2017).

The northeastern part of Bangladesh is locally known as the *Haor*area and the total number of haor is 414 with sizes varies between 730 and 24292 hectares. Boro rice is the principle crop of this region in addition to fish culture. It is widely believed that the people living in different haor areas have been suffering from lack of food security due to mainly; (a) lack of single crop production (b) pre-monsoon flash flood (c) lack of communication and (d) other service providers (DDM, 2017). Flash flood damages were the maximum in 2000, 2002, 2004, 2010 and 2017 in the Haor area. To protect the crop especially the Boro crop and fisheries damage due to unexpected pre-monsoon flash floods, several coping and adaptations measures have been executing by the government and other non-government organizations (DDM, 2017). But effectiveness of flood coping strategies are still unknown.

Several research works have been conducted on flood hazards, and human and agricultural adjustments processes to flood in Bangladesh especially in *haor* areas (Younus, 2012; Younus and Harvey, 2014). Various flood issues have also been studied under the project for "Flood-control drainage and flood-control drainage and irrigation" jointly initiated by the Flood Action Plan (FAP), a French engineering consortium (FEC), and the Bangladesh Water Development Board (BWDB) (Younus, 2014). However, few studies conducted on flood coping ability issues in Haor and char areas (Khatun, 2009; Munna 2009) while flood coping strategy for rural peoplealso studied by Rafique(2016) and Kamruzzaman(2010). But, to date, no available studied found on effectiveness of flood coping strategies practiced by the fish farmers especially in haor area in Bangladesh. Thus, the study was undertaken to consider the above issue and fulfill the following specific objectives.

i. To determine the extent of effectiveness of flood coping strategies practiced by the fish farmers

ii. To identify the factors influencing the effectiveness of flood coping strategies practiced by the fish farmers.

2. METHODOLOGY

The study was conducted in four villages of two unions namely Jawar union and Damihaunder Tarailupazila (sub district) of Kishoreganj district which falls in flood prone area of the country. This area is situated near the bank of the river Narosundawhich comes under regular flood and farmers are highly vulnerable to flood damage. Almost every year flood occurs in these villages that causes human sufferings and damage to crops, livestock fisheries and other resources. The registered fish farmers who have been affected by flood and trying to cope up using different FCS were considered as population of this study. A list of 1003 farmersin four villages was collected from the UFO of which 10% percent the population was selected through simple random sampling method. Therefore, 100 farmers were selected as sample of the present study.In order to collect relevant data for the study, a structured interview schedule was carefully prepared keeping the objectives of the study in mind.

The dependent variable was "effectiveness of flood coping strategies practiced by the fish farmers" and it was measured on the basis of opinion provided by the fish farmers according to their extent of practiced. While there were 24 FCS considered tomeasure the effectiveness of those FCS. Hence, the extent of effectiveness of flood coping strategies was measured by using a4-points rating scale. The scores of 3, 2,1, and 0 were assigned to indicate extent of effectiveness as "highly effective", "moderately effective", "low effective" and "not at all effective". While the effectiveness of flood coping strategies score of a respondent could range from 0 to 72, where 0 indicates not at all and 72 indicates the highly effectiveness of flood coping strategies. Appropriate scales were developed and used in order to measure the concernedvariables.Data were collected during 8 April to 7 May, 2018 through personal interview. Both statistical and inferential analyses were used to analyze the collected data.

3. RESULT AND DISCUSSIONS

3.1 Extent of effectiveness of flood coping strategies as perceived by the fish farmers

The observed scores of the effectiveness of FCS as perceived by the fish farmers ranged from 13 to 70 against possible range from 0 to 72. The average and standard deviation of the data distribution were found 24.39 and 13.08, respectively. Based on the scores, the possible scores, farmers were classified into three categories: low (up to24), medium (25to 48), high (above 48) as shown in Table 1

Table 1: Extent of Perceived Effectiveness of flood coping strategies

Categories	Respondents		Mean	SD
	Number	Percentage		
Low effective (up to 24)	27	27	24.39	13.088
Moderate effective (25-48)	56	56		
High effective (above 48)	17	17		
Total	100	100		

Data presented in Table 4.6 indicate that the majority (56 percent) of the farmers had perceived medium effective compared to 27 percent having low effective, 17 percent having high effective. It reveals that the majority of the farmers in the study area were perceived as medium effective of flood coping strategies. Farmers` capacity in terms of knowledge, skill, financial aspects is the important issues to make the FCS effective. But results indicate that a small numbers of farmers perceived highly effective may be due to their poor capacity or others shortcomings. On the other hand, lack of regular monitoring made by the extension agents were also be the reasons for the aforementioned results. Similar results were found by Kabir (2007).

3.2 Rank order of effectiveness of flood coping strategies practiced by the fish farmers

The rank order of effectiveness of flood coping strategies was made based on the responses given by the farmers. For ranking the FCS, a total score of individual FCS have also been computed by using following formula:

Total Score=$FCS_h \times 3 + FCS_m \times 2 + FCS_l \times 1 + FCS_n \times 0$

Where,

FCS_h= Number of farmers indicating highlyeffective of FCS

FCS_m= Number of farmers indicating moderatelyeffective of FCS

FCS_l = Number of farmers indicating low effective of FCS

FCS_n = Number of farmers indicating no effective of FCS

Rank order of effectiveness of flood coping strategies was done according to farmers perception on each 24 coping strategies regarding different period have been presented in Table 2.

Data in Table 2 indicated that the of flood coping strategies in respect of 'Raising the height of pond dike above flood level' got ranked first and denoted as highly effective flood coping strategy (268) while 'Repair fishing instrument net, boat got ranked second and recognized as second best effective flood coping strategies (266). On the other hand, 'Protect the fisheries farm from the entrance of flood water by raising embankment was also the effective as it got third ranked. Drain out dirty flood water was the least effective (77) FCS as it got ranked 24th. It is predicted that being a fish farmer she or she tries to protect the pond from the flood water as it is the main place of fish production. While fishing net is a main instrument to use to catch the fish, therefore, it is necessary to repair for further utilization

Table 2: Rank order of effectiveness of flood coping strategies

Flood Coping Strategies (FCS)	Extent of effectiveness				Total Score	Rank order
	High (3)	Medium(2)	Low (1)	Not at all (0)		
Raising the height of pond dike above flood level	222	40	6	0	268	1
Repair fishing instrument net, boat.	219	42	5	0	266	2
Protect the fisheries farm from the entrance of flood water by raising embankment	165	88	1	0	254	3
Use traditional transportation boatlike, bhella for communication Locally	171	52	11	0	234	4
Using lime in the pond	138	80	8	0	226	5
Raising the platform of house above flood level	126	82	13	0	211	6
Repair small pond in house hold areas	123	78	9	0	210	7
Use of net to protect the fish in the pond	57	112	23	0	192	8
Drinking pure boiled water	45	118	20	0	183	9
Use hay (dried feed) for cattle feed	63	68	29	0	178	10
Harvested flood affected submerge crop	21	128	20	0	169	11
Store dry food like rice, fried rice and dry fish.	115	34	17	0	166	12
Harvested brood fish before flood	84	50	21	0	155	13
Repair flood affected crop land	66	52	24	0	142	14
Storing all type of seeds	42	40	46	0	128	15
To construct in beel nursery	60	44	21	0	125	16
Received credit	54	46	24	0	124	17
Take relief from different organizations	45	54	21	0	120	18
Repair flood affected Damage boat, nets	51	24	20	0	95	19
Shifting family member into Flood Center\relatives\neighbors \make A shade in high place	42	34	14	0	90	20
Repair flood affected Damage house	45	20	18	0	83	21
Avoid use of flood water for house hold purpose	30	36	16	0	82	22
Preserve essential fast aid medicine	42	20	18	0	80	23
Drain out dirty flood water	33	30	14	0	77	24

The result found above may be useful for future case while the similar situation come. Therefore, no need for adoption of all above-mentioned flood coping strategies rather we can use only those are highly effective as perceived by the farmers for a instance FCS from 1 to 5 ranked mentioned above Table 2. This way may be reduce the transaction cost and will be accepted by the all stakeholders who are involved in this case in future.

3.3 Econometric Estimation of Factors Influencing the Effectiveness of Flood Coping Strategies

To determine the factors associated with effectiveness of flood coping strategies, a linear multiple regression analysis (enter method) was conducted and results placed in Table 3. Age (X_1), level of education (X_2), family size (X_3), farm size (X_4), annual family income (X_5), training received (X_6), credit received (X_7), organizational participation (X_8), social mobility (X_9), extension contact (X_{10}) and knowledge on flood coping strategies (X_{11}) were considered as independent variables of the regression analysis.

Table 3: Summaries of the Linear Multiple Regression Analysis

Explanatory variables	Unstandardized Co-efficient		Standardized Co-efficient	t	Sig. B
	β	Std .Error	β		
(Constant)	5.432	8.106		.670	.505
Age	.072	.104	.056	.697	.488
Level of education	1.452	.292	.471	4.980	.000
Family size	.419	.441	.074	.951	.344
Farm size	-.971	.507	-.220	-1.915	.059
Annual family income	2.675E-5	.000	.304	2.638	.010
Training received	1.180	2.213	.041	.533	.595
Credit received	3.364	2.214	.117	1.520	.132
Organizational participation	.320	.359	.091	.891	.375
Extension media contact	-.261	.292	-.075	-.895	.373
Social mobility	.037	.319	.010	.115	.908
Knowledge on flood coping strategies	.458	.217	.188	2.115	.037
n=100, R^2 =.534, Adjusted R^2 =. 485, F-Value=9.173					

The value of R^2 values found in the multiple regressions was 53.4% found in the while the corresponding F-9.173value was and also significant at 0.001 level. The findings of multiple regression analysis indicated that the determinant factors of effectiveness of flood coping strategies were level of education, annual family income, and knowledge on flood coping strategies.

The findings of the multiple linear regression analysis (Table 3) indicated that level of education was significant and showed positive trend. Effectiveness of coping strategies of flood increases with increasing the level of education of the respondents. Education helps the farmers to make them knowledgeable and thus they can understand how manage the FCS properly resulted effective FCS. This assumption was in line with the results of similar work on climate change adaptation strategies done by Deressa et al., (2009). Similar results were found by Nahar (1996)andBurhan (2009).Table 3 indicates the annual family income was significant and showed positive trend with effectiveness of FCS. It implies that famers with high income levels are likely to make more effective of FCS. Family incomes help the farmers to take risk and thus, they can implement the FCS successfully and make them effective. Kim et al. (2009) found out that household income positively and significantly influenced the adoption of

adaptive climate change. Similar results also found by Khan (2016).

Multiple linear regression analysis (Table 3) indicated that knowledge of farmers was significant and showed positive trend with the farmers' effectiveness of flood coping strategies. It implies that the knowledge of farmers in different coping strategies, effects and effectiveness of the flood coping strategies enable them to make effective of FCS. Moreover, it enable them to take part in discussion and opportunity 'to exchange information about different coping strategies of flood, ideas, views, share feelings and experience with other participated members of the organization. Similar results also found by Benson and Clay (2004).The R^2 value indicated that, all variables together explained 53.4 percent variance of the extent of effectiveness of flood coping strategies practiced by the fish farmers. But to understand individual contribution of the aforesaid explanatory variables especially three significant variables, step-wise multiple regressions was conducted and results are shown in Table 4.

Data presented in Table 4 indicate that level of education of the farmers was the second variable entered the stepwise multiple regression which had a contribution of (41.6 percent) in predicting the extent of effectiveness of flood coping strategies. Education is the process to development of the mind of an individual it increases the power of the observation, understanding, decision making and adjustment of any natural disaster. Farmer's knowledge is the important factor because if farmers have good knowledge on flood coping strategies they can easily show interest to practiced coping strategies with flood hazard.

Table 4: Summary of the Step wise Multiple Regression Analysis

Model	Variables entered	Multiple R	Multiple R^2	Variation explained (percent)	Significance level
Constant +(X2)	Level of Education (X2)	.645a	.416	41.6	.000
Constant +(X2)+(X11)	Farmers' knowledge (X11)	.680b	.462	4.6	.000
Constant +(X2)+(X11)+(X5)	Annual family income (X5)	.696c	.485	2.3	.000

Data presented in Table 4 indicates that knowledge of the farmers was the variable entered the stepwise multiple regression, which solely had the contribution (4.6 percent) in predicting the effectiveness of flood coping strategies.

Farmer's knowledge is the important factor because if farmers have good knowledge on flood coping strategies they can easily show interest to practiced coping strategies with flood hazard. Moreover, knowledge help the farmers make understand about the FCS and its procedure to utilize and getting benefits from them. Knowledge also a good indicator of farmers' capacity to make the FCS effective. Data presented in Table 4 indicates that annual income of the farmers was the variable entered the stepwise multiple regression which solely had the contribution (2.3 percent) in predicting the extent of effectiveness of flood coping strategies .Annual income is the important factor because if farmers have high family income then they can easily take risk and shows interest to cope with flood hazard.

4. CONCLUSIONS

The majority (56 percent) of the respondents perceived effectiveness of FCS as moderately effective, (27 percent)of the respondents perceived as low effective and 17 percent perceived as highly effective. Therefore, it can be concluded that there is a limitations (proper guidance or poor capacity) to make the flood coping strategies effective. And proper practice of flood coping strategies by the farmers was may be challenging to make the highly effective and it is hard to achieve may be due to their poor capacity."Raising the height of pond dike above flood level" got ranked first and denoted as highly effective flood coping strategy (268) while drain out dirty flood water was the least effective (77) FCS as it got ranked 24th. The significant variables education, annual family income and knowledge on FCS were determinants of effectiveness of FCS as perceived by the farmers and confirmed by the linear multiple regression models. So, it leads to the conclusion that to increase effectiveness of FCS, the concerned stakeholders should address all of these factors as influential factors.

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