



People's Participation in Flood Coping Mechanism in Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. Author MYU designed the study, conducted field survey, performed the statistical analysis and wrote the first draft of the manuscript.

Author MNI wrote the protocol, designed conceptual framework and edited the first draft of the manuscript to finalize it. Author MAK supervised the research work, instructed the statistical analysis and reviewed the manuscript. Authors MJA and MMH managed the literature searches, conducted field survey, collected data and helps in writing research report. All authors read and approved the final manuscript.

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ABSTRACT

The purpose of this study was to determine peoples' participation in flood coping mechanism, to explore the relationships between selected characteristics of the respondents and their flood coping mechanism and to assess the contribution of selected personal and socio-economic characteristics to their participation in flood coping mechanism. Data were collected from a sample of 298 flood affected peoples selected by multistage random sampling procedure from Sirajganj district of Bangladesh during the period from 20 August, 2014 to 20 November, 2014. The flood coping mechanism was determined initially on five aspects namely food collection and management, agricultural products protection, household assets protection, health and sanitation and some social context. Ten statements were identified under each aspect making a total of 50 statements

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considered as dependent variable of the study. Finally a flood coping mechanism index (CMI) was computed. Among the 50 statements of flood coping mechanism the highest coping mechanism in each aspects was observed where 'dry food preparation and preservation', 'rapid growth short duration crop cultivation', 'cooperate with abled relatives', 'transportation of all houses to the safe place due to over flood' and 'use small boat or vella for defecation purpose etc. More than two-thirds (68.1 percent) of the respondents had medium, whereas nearly one-fifth (19.1 percent) had low and 12.8 percent had high concentration on flood coping mechanism. Among 15 individual characteristics of the respondents, nine of them had positive and significant relationship with flood coping mechanism while six of them had no significant relationship with flood coping mechanism.

Keywords: Participation; flood; coping mechanism.

1. INTRODUCTION

1.1 General Background

Disaster is a recurrent phenomenon in Bangladesh and the growing climate change is expected to enhance such occurrence in future. Climate change effects take the form of calamities such as cyclones, floods and droughts. The Intergovernmental Panel on Climate Change (IPCC) has underscored that developing countries are disproportionately vulnerable to climate change [1]. The Climate Change Vulnerability Index (2011) put Bangladesh at top of the list in 170 vulnerable countries to the impacts of climate change [2]. Bangladesh is one of the most vulnerable countries due to climate change and ill prepared to death with its impact [3]. According to CCVI, considering vulnerability, Bangladesh is an extreme risk country out of 194 country (1. Haiti, 2. Bangladesh). The common natural disasters are high rainfall, drought, riverbank erosion, flood, cyclone, earthquake, landslides, tornado, hailstorm, north-western wind, snowfall, insect pest diseases, etc. and again 50 or more disasters are created by man [4].

Bangladesh is situated in one of the most dynamic hydrological system of the world. In fact, the country is a tender landmass framed by the three major rivers and a fluid landscape. Due to the odd geographic conditions Bangladesh always subject to some degree of natural hazards. From 1904 to 2007 about 63,923,520 people were affected by natural disasters (CRFI, 2007). It is reported that after liberation Bangladesh has lost 18 billion US\$ by 295 natural disasters. It is also reported that natural disasters in 2007 killed 9718 people in South Asia; 58 percent of them belonged to Bangladesh, followed by India (26 percent), Pakistan (9 percent), Afghanistan and Nepal (3 percent) and Sri Lanka (1 percent) (*source*). In

terms of number of people affected due to the natural disasters, Bangladesh and India occupied first two positions. It is reported that by 21st century Bangladesh will face 29 percent more flood [5]. Displacement due to flood and drought and erosion along with inadequate facilities/supports during and after major disasters creates hardship and life-threatening problems to the population, specially the poor, women and children. Dealing with this multitude of hazards is a major challenge for the national government. The Government of Bangladesh has also a vision to reduce the risk of people from such natural hazards. Considering the above circumstances, the research topic highlights the following objectives to guide the study.

1.2 Objectives of the Study

The present study was therefore undertaken with the following research objectives:

1. To determine the people's participation in flood coping mechanism in the following aspects:
 - a. Food collection and management
 - b. Agricultural products protection
 - c. Household assets protection
 - d. Health and sanitation
 - e. Some social context
2. To explore the relationships between selected characteristics of the respondents and their flood coping mechanism. The selected characteristics of the people were: age, education, family size, farm size, annual income, extension media contact, training received, aspiration, household belongings, calorie intake, body mass index, environmental awareness, self-confidence, participation in

- community activities and disaster management knowledge.
- To determine the contribution of selected personal and socio-economic characteristics of the farmers to their participation in flood coping mechanism.

2. METHODOLOGY

2.1 Locale, Population and Sampling of the Study

Sirajganj district of Bangladesh is situated in the bank of the river Jamuna which is considered as most vulnerable districts and Kazipur upazila under the same district was selected purposively because this upazila is badly affected by flood frequently throughout the year. Out of 12 unions of Kazipur upazila, three unions namely Maizbari, Khasrajbari and Natuarpara were selected purposively. From these three union 6 villages namely Boduarpara, NatunMaizbari, Khasrajbari, Shanbandha, Fulzora and Ghoragacha were selected purposively for conducting the research following the multistage random sampling procedure. This selection was made on the basis of flood occurrence in previous years (1974, 1987, 1988, 1998, 2004, 2007, 2008,2009 and 2010). Total population from these six villages were 2981, out of which 298 (about 10 percent of the population) were selected as sample of the study by using a Table of random numbers. A reserve list of 31 people was also prepared for data collection. Out of 298 respondents, a total of 232 (78%) of them were male and rest 66 (22%) being female. They were selected from a mixture of professional group e.g. landless farmers, fishermen, boatman, carpenters, rickshaw pullers, school teacher, day laborers and tenant farmers. The female respondents belong to housewife, day laborer, katha sewer and also tenant farmers.

In order to collect relevant data for the study, a structured interview schedule was carefully prepared on the basis of the objectives. The dependent variable was "flood coping mechanism" was dependent variable and the selected personal attributes of the respondents viz. age, education, family size, farm size, annual income, extension media contact, training experience, aspiration, household belongings, calorie intake, body mass index, environmental awareness, self-confidence, participation in community activities and disaster management knowledge were the independent variables of the study.

2.2 Measurement of the Dependent Variable

Farmers' participation in flood coping mechanism was the dependent variable of the study. To measure the variable, first selected items were recorded against each of the following five components of flood coping mechanism.

- Food collection and management
- Agricultural products protection
- Household assets protection
- Health and sanitation
- Some social contexts

Firstly, 15 items were collected against each of the above components of flood coping mechanism. At the second stage, the list of items was validated through judge rating in order to test the internal consistency and suitability of the items against the context. In the third stage, a list of 10 (ten) items against each of the components was kept for final data gathering instruments. Therefore, a total of 50 items were kept against all five components of flood coping mechanism. Each of the items regarding farmers' participation was put against a three point rating scale as 'always', 'sometimes' and 'never' where a score of 2, 1 and 0 was assigned. Therefore, the range of participation score could vary from 0 to 100, where, 100 indicating the highest level of participation and 0 for lowest level of participation in flood coping mechanism by a respondent.

2.3 Development of Indices

For comparative analysis of flood coping mechanism in individual activities a "Coping Mechanism Index" was calculated by considering the concept and formula used by Huda [6] as follows:

$$\text{Coping Mechanism Index, CMI} = P_a \times 2 + P_s \times 1 + P_n \times 0$$

Where,

P_a = Percentage of respondents indicate coping mechanism as always

P_s = Percentage of respondents indicate coping mechanism as sometimes

P_n = Percentage of respondents indicate coping mechanism as never

In respect of any activities in coping mechanism the "Coping Mechanism Index" could range from 200 to 0, where 200 indicating highcoping mechanism and 0 indicating nocoping mechanism adopted by a respondents.

Various descriptive statistical measures such as range, frequency, number, percentage, mean, standard deviation and rank order were used for describing the variables. Pearson's correlation coefficient (r) was used for testing the relationships between the concerned variables. Stepwise multiple regression analysis and path analysis were conducted to determine the explanation of total variation of a given variable based on one or more variables. Throughout the study, 0.05 level of significance was used to reject or accept any null hypothesis. Some graphs and charts were also used for clarity of understanding.

3. FINDINGS AND DISCUSSION

3.1 Selected Characteristics of the Respondents

3.1.1 Education

Education score of the flood affected people ranged from 0.5 to 12 with the mean education score of 3.09 and standard deviation of 2.84. Based on their education score the respondents were classified into four categories, namely ability to sign (0.5), primary education (1 to 5), secondary education (6 to 10) and above secondary education (above 10) as shown in Table 1. This distribution was supported by Pal [7] and Islam [8].

The findings indicate that the majority (59.7 percent) of the respondents had primary education, 26.2 percent could sign only and 13.1 percent had secondary education and 1 percent had above secondary education.

3.1.2 Farm size

Farm size determines economic, social status of the farmer. Farm size of respondents ranged from 0.008 to 3.450 ha with the mean of 0.266 ha and standard deviation of 0.32 hectares. Based on their farm size score the respondents were classified into five categories namely, landless farmer (less than 0.02 ha), marginal farmer (0.02 to 0.2 ha), small farmer (0.201 to 1.0 ha), medium farmer (1 to 3 ha) and large farmer (above 3 ha).

The findings indicate that the highest portion (46.0 percent) had marginal farm size compared to 7 percent were landless, 44.3 percent had small farm size, 2.3 percent had medium farm size and 3 percent had large farm size.

3.1.3 Extension media contact

Extension media contact refers to an individual's contact with different extension communication media for receiving modern agricultural information. The extension media contact scores of the respondents ranged from 0 to 21, against the possible score 0 to 24. The mean and standard deviation were 5.63 and 3.80 respectively. The respondents were classified into four categories based on their extension media contact as 'No contact' (0), 'low contact' (1 to 3), 'medium contact' (4 to 9) and 'high contact' (above 9) as shown in Table 1.

Data presented in Table 1 show that majority (46.0 percent) of the respondents had low extension media contact, 4.7 percent had no extension media contact, 37.9 percent had medium extension media contact and 11.4 percent had high extension media contact. The findings indicate that an overwhelming majority (83.9 percent) of the respondents had low to medium extension media contact. This may be due to the reason that the respondents had moderate contact with different extension media.

3.1.4 Training experience

Training experience by the respondents ranged from 0 to 29 with the mean and standard deviation of 2.10 and 2.83 respectively. The respondents were classified into four categories based on their training experience score as 'no training' (0), 'short training' (1 to 5), medium training (6 to 10) and 'long training' (above 10) as shown in Table 1.

Data contained in Table 1 show that majority of the respondents (71.8 percent) had short training, 23.8 percent had no training, 2.7 percent had medium training and only 1.7 percent had long training. The low training experience might be due to lack of well communication facilities and lack of presence of development intervention in the charland. Similar findings were found in the study of Beauty (2010), Forhad [9] and Rahman [10].

3.1.5 Household asset

The household asset or belongings scores of the respondents ranged from 7 to 60 with the average being 28.01 and standard deviation of 10.20. Based on their household asset or belongings scores, the respondents were classified as 'low asset belongings' (up to 20),

'medium asset belongings' (21-40) and 'high asset belongings' (above 40) which is presented in the Table 1. The highest proportion (62.8 percent) of the respondents had medium belongings, while a quarter (25.8 percent) of them had low belongings and only 11.4 percent had high belongings as shown in Table 1. The distribution was supported by Islam [8]. It is well known that higher the belongings higher will be the economic status of the respondents. In the present study, majority (88.6 percent) of the respondents had low to medium belongings.

3.1.6 Calorie intake

Calorie intake is one of the important factors in the flood affected area that ensure the physical and mental efficiency of the respondents in flood coping mechanism. The calorie intake scores of the respondents ranged from 1863 to 2895 kcal and the mean was 2469.64 kcal with a standard deviation of 235.08 kcal. Based on the calorie intake, the respondents were classified into three categories such as 'below optimum' (up to 2150 kcal), optimum (2151 to 2500 kcal) and above

Table 1. Distribution of the respondents according to their personal characteristics

Variables	Categories	Respondents		Mean	SD
		Number	Percent		
Education	Ability to sign (0.5)	78	26.2	3.09	2.84
	Primary education (1-5)	178	59.7		
	Secondary education (6-10)	39	13.1		
	Above secondary education (>10)	3	1.0		
	Total	298	100.0		
Farm size	Landless (<0.02 ha)	21	7.0	0.266	0.32
	Marginal farmer (0.02-0.2 ha)	137	46.0		
	Small farmer (0.21-1.0 ha)	132	44.3		
	Medium farmer (1.1-3.0 ha)	7	2.3		
	Large farmer (>3.0 ha)	1	0.3		
	Total	298	100.0		
Extension Media Contact	No contact (0)	14	4.7	5.63	3.80
	Low (1 to 3)	137	46.0		
	Medium (4-9)	113	37.9		
	High (above 9)	34	11.4		
	Total	298	100		
Training Experience	No training (0)	71	23.8	2.10	2.83
	Short training (1-5 days)	214	71.8		
	Medium training (6-10 days)	8	2.7		
	Long training (above 10 days)	5	1.7		
	Total	298	100.0		
Household belongings	Low belongings (upto20)	77	25.8	28.01	10.20
	Medium belongings (21-40)	187	62.8		
	High Belonging (Above 40)	34	11.4		
	Total	298	100.0		
Calorie Intake	Below optimum (up to 2150)	15	5.0	2469.64	235.08
	Optimum (2151-2500)	73	24.5		
	Above optimum (above 2500)	210	70.5		
	Total	298	100.0		
Participation in Community activities	Low participation (up to 20)	29	9.7	25.52	4.26
	Moderate participation (21-30)	235	78.9		
	High participation (above 30)	34	11.4		
	Total	298	100.0		
Disaster Management Knowledge	Low knowledge (up to 25)	53	17.8	30.00	4.70
	Medium knowledge (26-35)	212	71.1		
	High knowledge (above 35)	33	11.1		
	Total	298	100.0		

optimum (>2500 kcal). Calorie intake was measured following a chart of CTA/ECSA (1987).

Data presented in Table 1 indicate that majority (70.5 percent) of the respondents had calorie intake above optimum level, while 24.5 percent had optimum calorie intake and only 5 percent had below optimum calorie intake.

3.1.7 Participation in community activities

The respondents' participation in community activities scores ranged from 14 to 39 against the possible range of 10 to 40. Average score being 25.52 with a standard deviation of 4.26. On the basis of actual scores of the respondents, they were classified into three categories such as 'low participation' (up to 20), 'moderate participation' (21-30) and 'high participation' (>30) as shown in Table 1.

Data presented in Table 1 revealed that slightly more than three fourths (78.9 percent) of the respondents had moderate, 9.7 percent had low and 11.4 percent had high participation in community activities. This finding indicates that a highest proportion (90.3 percent) of the respondents had medium to high participation in community activities. It may be due to that the extension agents as well as mass media might have played a vital role in creating awareness among the large number of respondents to participate in different community activities.

3.1.8 Disaster management knowledge

It refers to the prevention, mitigation, preparedness, response and recovery that save lives, property, operations or the environment from any disaster like flood. The knowledge on disaster management of the respondents ranged from 12 to 39 against the possible range of 0-40 with the mean of 30.0 and standard deviation being 4.70. According to the knowledge on disaster management, respondents were classified into three categories viz. 'low knowledge' (up to 25); 'medium knowledge' (26-35) and high knowledge' (>35) as presented in Table 1.

Data furnished in Table 1 revealed that near about three-fourths (71.1 percent) of the respondents had medium knowledge followed by 11.1 percent of the respondents had high knowledge and 17.8 percent had low knowledge on disaster management. If knowledge and

awareness on disaster management is increased among the respondents then they will be more able to cope with flood.

3.2 Flood Coping Mechanism

Bangladesh is a flood prone delta. In some areas regular inundation is very common during peak monsoon. People live with this natural phenomenon and build up their coping mechanism mainly based on indigenous and ancestral knowledge. Floodwaters bring great difficulty when it appears as disaster. Coping mechanism is an important factor related to reduce loss from flood which was the main focus of the study. In the present study flood coping mechanism was measured in five dimensions namely food collection and management, agricultural product protection, some social aspects, household assets protection and health and sanitation. Findings in connection with these five dimensions are furnished below:

3.2.1 Food collection and management

The respondents had taken different methods of food collection and management in varying degrees. Respondents were classified into three categories on the basis of their extent of coping mechanism such as 'never', 'sometimes' and 'always'. The number of respondent's extent of coping mechanism of each of the categories was converted to percentage. The Coping Mechanism Index (CMI) of food collection and management ranged from 11.3 to 151.3 against the possible range 0 to 200. The rank order of each of the information was made on the basis of RI value (Table 2).

Data obtained in Table 2 revealed that the highest proportion of farmers take coping mechanism on food collection and management on 'dry food preparation and preservation' (CMI=151.3) followed by 'sweet gourd, potato and sweet potato preservation and selling' (CMI=140.7), 'eat two times by cooking one times' (CMI=114.0) and so on. The lowest coping mechanism taken was found on 'food collection from relief and rehabilitation center' (CMI=11.3).

3.2.2 Overall food collection and management

Scores of the overall food collection and management of the respondents varied from 13 to 24 against possible range of 0 to 30. The mean and standard deviation were 18.97 and 3.04 respectively. On the basis of the overall

food collection and management scores, the respondents were classified in to three categories viz. 'Low' (≤ 16), 'medium' (17-22) and 'high' (>22) as shown in Table 3.

Table 2. Extent of coping mechanism on food collection and management

Sl. No.	Statements	Extent of coping mechanism (%)			CMI	Rank Order
		Never	Sometimes	Always		
1	Buying foods by reserved cash	2.3	96.0	1.7	99.4	4
2	Buying foods by borrowing taka from neighbour or relatives	16.3	83.0	0.7	84.4	7
3	Engage in due labour only for food	74.3	24.3	1.3	26.9	9
4	Food collection from relief and rehabilitation center	87.7	11.3	0.0	11.3	10
5	Buying foods on due or borrow	5.3	94.0	0.7	95.4	5
6	Buying foods buy selling fish, livestock or poultry	16.3	82.7	1.0	84.7	6
7	Dry food preparation and preservation	4.7	39.3	56.0	151.3	1
8	Sweet gourd, potato and sweet potato preservation and selling	4.0	51.3	44.7	140.7	2
9	Fuel and grass selling	38.7	52.0	9.3	70.6	8
10	Eat two times by cooking one times	3.0	80.0	17.0	114.0	3

Table 3. Distribution of the respondents according to their overall food collection and management

Categories	Respondents (298)		Range		Mean	SD
	Number	Percent	Possible	Observed		
Low (≤ 16)	66	22.1	0-30	13-24	18.97	3.04
Medium (17-22)	227	76.2				
High (>22)	5	1.7				
Total	298	100				

Table 4. Extent of coping mechanism on agricultural product protection

Sl. No.	Statements	Extent of coping mechanism (%)			CMI	Rank Order
		Never	Sometimes	Always		
1	Seed collection and storing for emergency use after flood	4.7	78	17.3	112.6	4
2	Rapid growth short duration crop cultivation	11.3	5.4	83.3	172.0	1
3	Seedbed preparation in flood free area	13.0	2.7	84.3	171.3	2
4	Vaccination to livestock and poultry before and during flood	12.7	54.7	32.6	119.9	3
5	Transfer of livestock and poultry to comparatively high place of house	16.3	79.7	4.0	87.7	7
6	Take suggestion from VS about diseases of livestock and poultry	3.3	89.0	7.7	104.4	5
7	Prevent outgoing of fish by netting around the pond	16.0	80.7	3.3	87.3	8
8	Transportation of agril. product to high place or house of others	86.0	12.0	2.0	16.0	10
9	Fencing by net for duck rearing	8.3	88.3	3.4	95.1	6
10	Selling livestock and poultry	82.3	16.7	1.0	18.7	9

Table 5. Distribution of the respondents according to their overall agricultural product protection

Categories	Respondents (298)		Range		Mean	SD
	Number	Percent	Possible	Observed		
Low (≤ 17)	55	18.5	0-30	12-25	19.65	2.28
Medium (18-22)	225	75.5				
High (>22)	18	6.0				
Total	298	100				

Table 6. Extent of coping mechanism on some social aspects

Sl. No.	Statements	Extent of coping mechanism (%)			CMI	Rank Order
		Never	Sometimes	Always		
1	Cooperate with abled relatives	1.7	10.3	88.0	186.3	1
2	Cooperate with the NGOs working in char lands	1.0	14.7	84.3	183.3	2
3	Create awareness about cleaning of floating waste due to flood	5.3	16.0	78.7	173.4	3
4	Arrange group guard to prevent stealing and robbery	6.0	85.0	9.0	103.0	4
5	Involve himself in relief and rehabilitation after flood	13.7	75.3	11.0	97.3	5
6	Organize social group to prevent stealing and robbery	18.3	69.0	12.7	94.4	6
7	Cooperate with UP chairman or members	6.7	92.3	1.0	94.3	7
8	Use microphone and mobile to prevent stealing and robbery	15.3	80.0	4.7	89.4	8
9	Create awareness about transformation of house	24.0	70.3	5.7	81.7	9
10	Inform the society about natural disaster, precaution and information	65.3	26.7	8.0	42.7	10

Table 7. Distribution of the respondents according to their overall social aspects

Categories	Respondents (298)		Range		Mean	SD
	Number	Percent	Possible	Observed		
Low (≤ 19)	85	28.5	0-30	16-30	21.36	1.96
Medium (20-23)	184	61.8				
High (>23)	29	9.7				
Total	298	100				

Data presented in the Table 3 indicate that slightly more than three-fourths (76.2 percent) of the respondents had medium, whereas 22.1 percent had low and only 1.7 percent had high concentration on food collection and management as adopting it as a flood coping mechanism strategy (Table 3).

3.2.3 Agricultural product protection

Agricultural product protection was the second dimension of flood coping mechanism by the respondents. The respondents had taken

different methods of agricultural product protection in varying degrees. Respondents were classified into three categories on the basis of their extent of coping mechanism such as 'never', 'sometimes' and 'always'. The number of respondent's extent of coping mechanism of each of the categories was converted to percentage. The Coping Mechanism Index (CMI) of agricultural product protection ranged from 16.0 to 172.0 against the possible range 0 to 200. The rank order of each of the coping mechanism was made on the basis of CMI value (Table 4). Data presented in Table 4.18 revealed

that the highest proportion of farmers take coping mechanism of agricultural product protection on 'rapid growth short duration crop cultivation' (CMI=172.0) followed by 'seedbed preparation in flood free area' (CMI=171.3), 'vaccination to livestock and poultry before and during flood' (CMI=119.9) and so on. The lowest coping mechanism taken was found on 'transportation of agricultural Product to high place or house of others' (CMI=16.0).

3.2.4 Overall agricultural product protection

Agricultural product protection scores of the respondents varied from 12 to 25 against possible range of 0 to 30. The mean and standard deviation were 19.65 and 2.28 respectively. On the basis of the agricultural product protection scores, the respondents were classified in to three categories viz. 'Low' (≤ 17), 'medium' (18-22) and 'high' (>22) as shown in Table 5.

The findings revealed that slightly more than three-fourths (75.5 percent) of the respondents had medium, whereas 18.5 percent had low and 6.0 percent had high concentration on agricultural product protection as being adopted it as a flood coping mechanism strategy (Table 5).

3.2.5 Some social aspects

Members of a society have some common language and understanding in case of any disaster including flood coping mechanism. As such, some social aspects were investigated to address their coping mechanism. The respondents had taken these aspects of coping mechanism in varying degrees. Respondents were classified into three categories on the basis of their extent of coping mechanism such as 'never', 'sometimes' and 'always'. The number of respondent's extent of coping mechanism of each of the categories was converted to percentage. The Coping Mechanism Index (CMI) of some social aspects ranged from 42.7 to 186.3 against the possible range 0 to 200. The rank order of each of the coping mechanism was made on the basis of CMI value (Table 6).

Data contained in Table 6 revealed that the highest proportion of farmers took coping mechanism in regard to some social aspects on 'cooperate with abled relatives' (CMI=186.3) followed by 'cooperate with the NGOs working in char lands' (CMI=183.3), 'create awareness about cleaning of floating waste due to flood' (CMI=173.4) and so on. The lowest coping mechanism taken was found on 'inform the society about natural disaster, precaution and

Table 8. Extent of coping mechanism on household assets protection

Sl. No.	Statements	Extent of coping mechanism (%)			CMI	Rank Order
		Never	Sometimes	Always		
1	Transportation of all household belongings to the safe place	2.0	9.7	88.3	186.3	1
2	Transfer of family members to flood center or relatives or neighbor	0.7	63.6	35.7	135.0	2
3	Selling some assets for cash	1.0	78.0	21.0	120.0	3
4	Transportation of valuable resource and goods to the flood free area	2.3	85.7	12.0	109.7	4
5	Keep in safe the valuable papers and stamps by covering polythene	0.7	92.6	6.7	106.0	5
6	Use small boat and vella (made of banana tree) to move	3.3	93	3.7	100.4	6
7	Keep in safe the valuable ornaments and cash in reliable person or bank	3.7	93.0	3.3	99.6	7
8	Keep watch to the left goods (of his own flooded house)	21.7	72.0	6.3	84.6	8
9	Keep valuable resource and goods in high place	15.7	82.3	2.0	86.3	9
10	Make a temporary in-house stage (MACHA) above flood level for dwelling	39.7	53.3	7.0	67.3	10

Table 9. Distribution of the respondents according to their overall household asset protection

Categories	Respondents (298)		Range		Mean	SD
	Number	Percent	Possible	Observed		
Low (≤ 21)	204	68.5	0-30	19-28	22.15	1.42
Medium (22-24)	70	23.4				
High (>24)	24	8.1				
Total	298	100				

Table 10. Extent of coping mechanism on health and sanitation

Sl. no.	Statements	Extent of coping mechanism (%)			CMI	Rank Order
		Never	Sometimes	Always		
1	Use small boat or vella for toilet purpose	1.0	16.0	83.0	182.0	1
2	Collection of water purifying tablet or fitkiri from nearest health center or bazar	7.0	43.0	50.0	143.0	2
3	Spray bleaching powder in house	1.3	68.0	30.7	129.4	3
4	No bath in flood water	3.0	65.7	31.3	128.3	4
5	Eat saline in case of diarrhoea and other diseases of stomach disorder	1.4	69.3	29.3	127.9	5
6	Be aware of getting wet for long time	5.7	80.3	14.0	108.3	6
7	Use purified or tube well water for drinking purpose	2.7	91.0	6.3	103.6	7
8	Make a person and family members were about water borne diseases	20.7	76.0	3.3	82.6	8
9	Making non-permanent or floating toilet by bamboo at the high place of house	31.7	59.0	9.3	77.6	9
10	Take suggestion from doctor or health worker of nearest health center	90.4	6.3	3.3	12.9	10

Table 11. Distribution of the respondents according to their overall health and sanitation

Categories	Respondents (298)		Range		Mean	SD
	Number	Percent	Possible	Observed		
Low (≤ 19)	129	43.3	0-30	17-21	20.98	2.03
Medium (20-23)	157	52.7				
High (>23)	12	4.0				
Total	298	100				

Table 12. Distribution of the respondents according to their total flood coping mechanism

Categories	Respondents (298)		Range		Mean	SD
	Number	Percent	Possible	Observed		
Low (≤ 97)	57	19.1	0-150	89-143	103.12	6.06
Medium (98-109)	203	68.1				
High (>109)	38	12.8				
Total	298	100				

information' (CMI=42.7). The findings indicate that the victims give more value to their abled relatives who could provide them some provisions to tackle the emergency situations.

3.2.6 Overall social aspects

Scores of the overall social aspects of the respondents varied from 16 to 30 against possible range of 0 to 30. The mean and

standard deviation were 21.36 and 1.96 respectively. On the basis of the overall social aspects scores, the respondents were classified in to three categories viz. 'Low' (≤ 19), 'medium' (20-23) and 'high' (>23) as shown in Table 7.

The findings revealed that majority (61.8 percent) of the respondents had medium, whereas 28.5 percent had low and 9.7 percent had high concentration on some social aspects as adopting it as a flood coping mechanism strategy (Table 7). These indicate that majority of the respondents think that they cannot avoid flood, but when they appear they should be prepared to adopt flood coping mechanism.

3.2.7 Household assets protection

Household assets protection was another important dimension of coping mechanism. The respondents had taken different methods of household assets protection of coping mechanism in varying degrees. Respondents were classified into three categories on the basis of their extent of coping mechanism such as 'never', 'sometimes' and 'always'. The number of respondent's extent of coping mechanism of each of the categories was converted into percentage. The Coping Mechanism Index (CMI) of household assets protection ranged from 67.3 to 186.3 against the possible range 0 to 200. The rank order of each of the coping mechanism was made on the basis of CMI value (Table 8). Data contained in Table 8 revealed that the highest proportion of farmers take coping mechanism of household assets protection on 'transportation of all household belongings to the safe place (CMI=186.3) followed by 'transfer of family members to flood center or relatives or neighbor' (CMI=135.0), 'selling some assets for cash' (CMI=120.0) and so on. The lowest coping mechanism taken was found on 'make a temporary in-house stage (MACHA) above flood level for dwelling' (CMI=67.3).

3.2.8 Overall household assets protection

Scores of the overall household assets protection varied from 19 to 28 against possible range of 0 to 30. The mean and standard deviation were 22.15 and 1.42 respectively. On the basis of the household assets protection scores, the respondents were classified in to three categories viz. 'low' (≤ 21), 'medium' (22-24) and 'high' (>24) as shown in Table 9.

Data in Table 9 revealed that majority (68.5 percent) of the respondents had low, whereas 23.4 percent had medium and 8.1 percent had high concentration on household asset protection as adopting it as a flood coping mechanism strategy.

3.2.9 Health and sanitation

The last dimension of coping mechanism was selected on health and sanitation. The respondents had taken different methods of coping mechanism on health and sanitation in varying degrees. The respondents were classified into three categories on the basis of their extent of coping mechanism such as 'never', 'sometimes' and 'always'.

The number of respondent's extent of coping mechanism of each of the categories was converted into percentage. The Coping Mechanism Index (CMI) of health and sanitation ranged from 12.9 to 182.0 against the possible range 0 to 200. The rank order of each of the coping mechanism was made on the basis of CMI value (Table 10). Data contained in Table 10 revealed that the highest proportion of farmers take coping mechanism of health and sanitation was 'use small boat or vella for toilet purpose (CMI=182.0) followed by 'collection of water purifying tablet or fitkiri from nearest health center or bazar (CMI=143.0), 'spraying bleaching powder in house' (CMI=129.4) and so on. The lowest coping mechanism taken was found on 'take suggestion from doctor or health worker of nearest health center' (CMI=12.9).

3.2.10 Overall health and sanitation

Overall health and sanitation scores of the respondents varied from 17 to 21 against the possible range of 0 to 30. The mean and standard deviation were 20.98 and 2.03 respectively. On the basis of the overall health and sanitation scores, the respondents were classified in to three categories viz. 'low' (≤ 19), 'medium' (20-23) and 'high' (>23) as shown in Table 11.

Data in Table 11 revealed that slightly more than half (52.7 percent) of the respondents had medium, whereas 43.3 percent had low and 4.0 percent had high concentration on health and sanitation as adopting it as a flood coping mechanism strategy.

3.2.11 Total flood coping mechanism in five aspects

Scores of the overall flood coping mechanism varied from 89 to 143 against possible range of 0 to 150. The mean and standard deviation were 103.02 and 6.06 respectively. On the basis of the overall flood coping mechanism scores, the respondents were classified in to three categories viz. 'low' (≤ 97), 'medium' (98-109) and 'high' (>109) as shown in Table 12.

Data in Table 12 revealed that more than half (68.1 percent) of the respondents had medium, whereas 19.1 percent had low and 12.8 percent had high extent of flood coping mechanism.

3.3 Relationships between Selected Characteristics of the Respondent and Their Participation in Flood Coping Mechanism

Relationships of 15 independent variables with the extent of coping mechanism were computed by correlation test and are described in this section. The computed coefficient of correlation (r) among the

variable concerned were put in the following Table.13 Those variables showing significant relationship were considered for discussion.

According to the computed correlation coefficient (r) among the selected characteristics of the respondents education, farm size, extension media contact, training experience, aspiration, household belongings, calorie intake, participation in community activities and disaster management knowledge had positive and significant relationship with flood coping mechanism. On the other hand, age, family size, annual income, body mass index, environmental awareness and self-confidence had no significant relationship with flood coping mechanism.

3.4 Contribution of the Selected Variables to Flood Coping Mechanism

The coefficient of correlation (r) only indicates the linear relationship between two variables. It does not express the contribution of a particular independent variable to the dependent variable. Hence, linear multiple regression analysis was done to determine the contribution of the selected characteristics of the respondents i.e.

Table 13. Relationship between selected characteristics of the respondents and their practices of flood coping mechanism

Dependent Variable	Independent Variables	Co-efficient of Correlation with 296 d.f.	Tabulated value of 'r'	
			0.05 level	0.01 level
Flood coping mechanism	Age	0.092	± 0.123	± 0.161
	Education	0.546**		
	Family size	0.100		
	Farm size	0.213**		
	Annual income	-0.026		
	Extension media contact	0.300**		
	Training experience	0.314**		
	Aspiration	0.123*		
	Household belongings	0.139*		
	Calorie intake	0.156**		
	Body mass index	-0.023		
	Environmental awareness	0.076		
	Self confidence	-0.047		
	Participation in community activities	0.452**		
	Disaster management knowledge	0.411**		

* $P < 0.05$ level of probability, ** $P < 0.01$ level of probability, $r = \pm 0.114$ with 296 df at 0.05 level of probability and $r = \pm 0.150$ with 296 df at 0.01 level of probability

Table 14. Multiple regression co-efficient of the respondents' flood coping mechanism with their selected characteristics (independent variables)

Independent variables/(Characteristics of the respondents)	Dependent variable: Flood coping mechanism				
	Regression Coefficients Unstandardized Beta	Regression Coefficients Standardized Beta	t-value	Significance level	Adjusted R ²
(Constant)	82.491		27.004	0.000	0.351
Education	0.154	0,087	2.166	0.372	
Farm Size	-0.380	-0.200	-0.405	0.686	
Extension Media Contact	0.363	0.240	4.348	0.000	
Training experience	0.435	0.202	3.965	0.000	
Aspiration	-0.078	-0.063	-1.271	0.205	
Household Belongings	0.013	0.022	0.443	0.658	
Calorie Intake	0.001	0.034	0.699	0.485	
Participation in Community Activities	0.311	0.219	3.826	0.000	
Disaster Management Knowledge	0.307	0.237	4.497	0.000	

R²=0.368, F-value=21.19, p<0.000

Table 15. Multiple regression co-efficient of the respondents' flood coping mechanism with their selected characteristics

Independent variables	Dependent variable: Flood coping mechanism				
	Regression coefficients unstandardized Beta	Regression coefficients standardized beta	t-value	Significance level	Adjusted R ²
Extension Media Contact	0.361 (B ₁)	0.238	4.365	0.000	0.355
Training experience	0.411 (B ₂)	0.191	3.898	0.000	
Participation in Community Activities	0.300 (B ₃)	0.211	3.771	0.000	
Disaster Management Knowledge	0.310 (B ₄)	0.239	4.607	0.000	

R²=0.363, F-value=42.09, p<0.000

Table 16. Stepwise regression analysis showing contribution of the selected characteristics to flood coping mechanism of the respondents

Selected characteristics	R-squared	R-squared change	Variance explained (%)
Extension Media Contact	0.213	0.213	21.3
Training experience	0.298	0.085	8.5
Participation in Community Activities	0.333	0.035	3.5
Disaster Management Knowledge	0.363	0.031	3.1

education, farm size, extension media contact, training experience, aspiration, household belongings, calorie intake, participation in community activities and disaster management knowledge which had significant relationship with flood coping mechanism (the dependent variable). These variables were included in the regression analysis model and findings of the regression analysis are presented in the Table 13.

Out of nine significant independent variables entered for linear multiple regression analysis, four variables namely extension media contact, training experience, participation in community activities and disaster management knowledge were statistically significant. The R-square value was 0.368 with corresponding F-value of 21.19, $p < 0.000$. (Table 14). This R-square value indicated that nine independent variables all together explained 36.8 percent variation in flood coping mechanism. In other words, contribution of all the nine variables was 36.8 percent out of which four significant variables contributed 35.1 percent variation (adjusted $R^2 = 0.351$) and five insignificant variables contributed only 0.017 percent variation to flood coping mechanism. However, it was possible that the proper contribution of the variables could not be properly expressed because of multicollinearity (inter-correlations) among the variables.

Therefore, it was decided to run a stepwise multiple regression analysis. It was observed that out of nine variables only four variables namely, extension media contact, training experience, participation in community activities and disaster management knowledge entered into the regression model. So, whatever variation was found in the flood coping mechanism, it was mainly due to the contribution of these four variables. Finally, another linear multiple regression analysis was done involving only the four variables having contributed significantly in the stepwise regression and results are presented in Table 15. The R-square value obtained was 0.363 with an F-value of 42.09,

$p < 0.000$. This final analysis indicated that 36.30 percent of the total variation in the flood coping mechanism was explained by the following four variables: extension media contact, training experience, participation in community activities and disaster management knowledge.

Regression analysis revealed that extension media contact had significant positive ($B_1 = 0.361$) effect on flood coping mechanism (Table 15). Increase in extension media contact of a respondent indicated the increase of flood coping mechanism. With the increase of extension media contact, the respondents were more conscious about the flood coping mechanism due to their continuous involvement with government officials for extension activities as well as disaster coping mechanism.

The regression coefficient for training experience showed significant positive ($B_2 = 0.411$) effect on flood coping mechanism (Table 15). The respondents who received training had more knowledge about flood coping mechanism. This is true because in training activities, people come in contact with different nature and types of people and interaction takes place among them which ultimately they gain knowledge and skill on different topics on farm production as well as disaster coping strategies.

The regression result in Table 15 showed that the respondents participation in community activities had significant positive ($B_3 = 0.300$) effect on their flood coping mechanism. Participation in community activities is considered as one of the important social factors that facilitates respondents to have better social network and opportunity to communicate outside home that have a positive impact on their flood coping mechanism.

Disaster management knowledge also had significant positive ($B_4 = 0.310$) effect on flood coping mechanism (Table 15). Since, person having knowledge on disaster management will be able to manage the coping strategies in the

better way than who doesn't have it. During training of such a program on disaster management, he is supposed to have gained skill on the subject which could enable him to strengthen his capacity of doing so.

In view of the significant contribution of the above mentioned characteristics of the respondents with flood coping mechanism, the researcher rejected the concerned null hypothesis and concluded that each of these characteristics had a significant positive effect on the flood coping mechanism. These facts led the researcher to conclude that *'The flood coping mechanism of the respondents increased when they had more extension contact, had received more training, having adequate participation in community activities, and acquired more disaster management knowledge'*.

The unique contribution of each of the four variables was also determined by taking the changes in R-square value occurred for entry of a particular variable in the stepwise regression model. The findings of the stepwise regression presented in Table 16 indicate that 'extension media contact' had the largest possible contribution (21.3 percent) to the variation in the flood coping mechanism, followed in descending order, by training experience (8.5 percent), participation in community activities (3.5 percent) and disaster management knowledge (3.1 percent).

4. CONCLUSION

On the basis of the findings and their logical interpretations in the light of relevant facts, the following conclusions are presented below:

- More than half (68.1 percent) of the respondents had medium, whereas 19.1 percent had low and 12.8 percent had high flood coping mechanism. So it was concluded that the respondents moderately responded to cope with different flood coping mechanism in the study area.
- Slightly more than three-fourths (76.2 percent) of the respondents had medium, whereas 22.1 percent had low and only 1.7 percent had high concentration on food collection and management adopting it as a flood coping mechanism strategy. Slightly more than three-fourths (75.5 percent) of the respondents had medium, 18.5 percent had low and 6.0 percent had high responses on agricultural product protection adopting it as

a flood coping mechanism strategy. This situation leads to conclude that the respondents were also aware about different dimensions of flood coping mechanism.

- Among the selected characteristics, the respondents' extension media contact, training experience and participation in community activities had positive and significant relationship with flood coping mechanism. The finding leads to conclude that social networking like contact with extension personnel, participation in different training activities and also participation in community activities certainly strengthen the social networking which enable a person to know various items of life saving mechanisms and might have played a significant role in flood coping mechanism.
- Extension media contact enriches the knowledge and attitude with new information ideas, techniques and technologies, makes confidence among the flood affected people resulting surviving with the flood condition during and after flood. Contact with extension people helps increase the social mobility and networking which enable a person to undertake various actions against natural catastrophe. Extension media contact showed statistically significant contribution in the flood coping mechanism meaning that more of a person with extension media contact more will be his/her ability to have better performance in disaster coping strategy. From the findings it may however, be concluded that, people need to build up their capacity to increase extension media contact for better disaster coping ability.
- Training experience was positively related and had positive effect on flood coping mechanism which indicate that a person having more training experience s/he used to have better performance in flood coping mechanism. Through training a person become acquainted with different extension officials at upazila level and be able to know different items of disaster coping strategy which might play a significant role in disaster coping capability. From the findings it may conclude that, in the study area people need adequate training experience in order to upgrade their capability towards disaster coping strategy.
- Participation in community activities encourages the flood affected people to solve the problems being encountered during and after disaster. Participation in community activities showed statistically significant

contribution in flood coping mechanism. This indicates that participation in community activities may also help the affected people properly and effectively in flood coping mechanism. Participation in community activities helps an individual increase his/her social networking which enable him/her to take necessary action against natural disaster. The findings leads to conclude that there is an ample scope in the study area to encourage people in participating different volunteers community work which eventually strengthen their coping capability towards disasters.

- Decision making ability helps in preparedness, response and recovery that save lives and properties from any disaster specially flood. It makes the affected people to cope with flood effectively. Decision making ability showed statistically significant contribution in flood coping mechanism. So, it is found that respondents who had Decision making ability are more competent and effective in flood coping mechanism.

5. RECOMMENDATION

The following recommendations were made on the basis of the findings and their logical interpretations:

- A greater number of the respondents (87.2 percent) had low to medium flood coping mechanism. Hence, it is recommended that the concerned government authorities (MoDMR, MoAg, MoFL, MoFW, MoHFP, CDMP, DDMR, NDMC and DDMB) and NGOs (Local, National and International) should come forward with special flood coping mechanism for the respondents in the study area.
- Out of nine, four influencing characteristics, namely, extension media contact, training experience, participation in community activities and disaster management knowledge were positively related and had positive effect on the flood coping mechanism. Therefore, it was recommended that these characteristics might be considered while planning and executing flood coping mechanism for them in future.
- Concerned authorities (FFWC, SPARRSO, EFC, CDMP, MoDMR, UDMC and UPDMC) and others (NGOs- Local, National and International) should take special care so that to combat flood disasters in future, provision of more modern warning system,

emergency measures, individual and family preparedness should be developed.

- There should be special project to be launched in the flood affected areas of the country in order to raise plinth of the houses of people in the flood affected areas so that during flood they need not to move away from their houses. Hence, it is recommended that the concerned government authorities (MoDMR, CDMP, DDMR, LGED and UP) and NGOs (Local, National and International) should come forward with special program about this.
- To combat flood and increase the efficacy of disaster coping ability adequate flood center should be constructed or reconstructed in the study area. Hence, it is recommended that the concerned government authorities (MoDMR, CDMP, DDMR, LGED and UP) and NGOs (Local, National and International) should come forward with special program to combat flood.
- During and after disaster people become helpless and they need money to purchase foods and other emergency belongings for saving lives. In order to meet those emergency matters the concerned authorities (MoFDM, MoSW, LGED, CDMP, DDMR and UP) and NGOs (local, national and international) should come forward for enhancing income generating activities (IGA) in study areas.
- As the people are highly vulnerable to flood, it would be highly effective to make an Early and timely warning system so as to enable them to take necessary precautionary measure against flood. Hence, it is recommended that the concerned authorities (FFWC, SPARRSO, EFC, CDMP, MoDMR, UDMC and UPDMC) and others (NGOs- local, national and international) should enable the flood affected people to take necessary precautionary measures against flood.
- Flood affected people should get sufficient disaster management related training in order to enable them to take precautionary measure against flood as well as strengthen their building capacity towards flood coping strategies. Hence, it is recommended that the concerned government authorities (MoFS, MoAg, MoEF, BRDB, DAE, CDMP and DMB) and NGOs (local, national and international) should come forward with special program about this.
- It may be highly recommended to plant more trees along the coastline and flood affected

areas of the country for enabling the affected people to earn some extra money after disaster is over through selling those trees. So, the concerned government authorities (MoEF, DMB and CDMP) and NGOs (local, national and international) should take necessary steps about this.

- River erosion was found another disaster for the flood prone areas. Bangladesh Water Development Board should take necessary measure to prevent the river erosion and save the people from being homeless and asset less.
- Our rivers are being dead by depositing siltation because of 'Farrakka dam' constructed by India – which is a root cause of 'Flood'. There is no water holding capacity of the river and consequently during each monsoon flood occurs. This problem could be minimized to some extent by increasing water holding capacity through dredging rivers, canals, bills, haors, baors and other water bodies.
- Construction of embankments in the flood prone areas could be a major solution of the problem. It makes manifold uses like road communication of the affected areas will be increased at the same time millions of people will be saved during flood disasters.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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