Good adaptation practices on flood and its risk reduction in Patuakhali district of Bangladesh

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Abstract: This study was undertaken to investigate the strategies for flood disaster risk reduction and local adaptation practices in Patuakhali district of Bangladesh. Six characteristics of the respondents were taken as independent variables such as education level and environmental awareness, family size, farm size, adaptation tools, loss due to flood disaster. Pre- and post-flood disaster activities were considered as dependent variable of the study. Pre flood activities such as miking around the flood disaster areas reduced flood risk 44.2 %, radio and TV bulletin reduced flood risk 25.0 %, enclosure tube-well by polythene bag reduced flood risk 16.7 %, shifting the people to cyclone center reduced flood risk 14.2 %. On the other side food and water supply contributed to adapt to flood disaster 48.3%, activities of medical rescue team (i.e. supply medicine, vaccines, saline) 25.8%, agricultural inputs supply (i.e. seed, fertilizer, livestock, fisheries) 25.8 % were taken as post flood activities. These variables were tested to explore the relationship between the dependent and independent variables. Education level and environmental awareness, family size, farm size, adaptation tools, loss due to flood disaster of the respondent were significantly correlated with the pre- and post-flood activities for flood disaster risk reduction in the Patuakhali district of Bangladesh. The findings indicated that lower the education level and environmental awareness, the lower the activities (pre and post) were followed for flood disaster risk reduction and adaptation. The findings also indicated that the pre flood preparation activities were not enough for flood disaster risk reduction and adaptation tools were not sufficient for flood disaster risk reduction in Patuakhali district of Bangladesh.

Key words: Adaptation, practices, flood, risk, reduction, coastal area, Patuakhali, Bangladesh.

Introduction

Bangladesh is situated on a low-lying flood plain made up of the lower reaches of the Ganges (known in Bangladesh as the Padma), the Brahmaputra (known in Bangladesh as the Jamuna) and the Megna rivers. As about 60% of the country is lower than 6 metres above sea level with an average river gradient of only 6cm/km in the delta, Bangladesh is very vulnerable to large volumes of water flowing down these rivers and other types of flooding. Annually around 20% of the country is temporarily flooded but in extreme cases this may rise to as high as 70% of the country (Mirza, 2002). In the past the seasonal floods were seen as a blessing bringing fertility in the form of deposited silt onto farmland, but due to population pressure the poorest-of-the poor have been pushed onto flood prone land and environmental damage is making floods more severe. There are four main types of floods in Bangladesh: flash floods, river floods, rain floods and coastal storm-surge floods. Among these disasters, storm-surge floods are considered as the major and most devastating disaster to the human habitation of this study area. Storm surge floods occur in the coastal area of Bangladesh, which consists of large estuaries, extensive tidal flats, and low-lying islands. Storm surges generated by tropical cyclones cause widespread damage to property and the loss of life in coastal area (Mirza, 2002).They are not the result of rainfall but of sea water being pushed inland by the strong winds of a cyclone. Food supply will be another problem caused by river floods; for the 1998 flood reduced agricultural production by 45% (Ahmed, 2006). It will also affect on rural incomes, where agriculture still employs 70% of the population. High-yielding aman rice varieties are very easily destroyed by floods as they are unable to grow fast enough to keep up with the increasing depth of flood water and if the flood water rises faster than 4-5cm deep per day other rice varieties will also be lost. Monsoon vegetables also die when under water (Karim *et al*., 1999). Boro rice on the other hand, cultivated in the winter usually gives a very good harvest after a high flood in the previous year, due to a good supply of moisture and the growth of blue–green algae. However, other climatic changes due to global warming such as temperature rise and carbon dioxide levels may reduce boro rice harvests by 4% by 2050 (Karim *et al*., 1999) and arsenic contaminated irrigation water increasingly necessary in the expected dryer winters will also significantly reduce boro harvests (Jahiruddin *et al*., 2005). The quality of floodwater may also be reducing; threatening rice production, including the bumper harvests of boro rice after flooding. Flooding increases the risk of diseases by extending the range of vectors such as mosquitoes, bacteria and other pathogens as well as by washing agricultural pesticides into drinking water. Leading to water-borne diseases including cholera and the diarrhoeal diseases caused by organisms such as Giardia, Salmonella and Cryptosporidium (Cruz *et al*., 2007), as well as chemical poisoning. However, floods also affect everyone from rich to poor with over 30 million in 52 of the 62 districts (Mirza, 2002), including a third of the population of the capital Dhaka affected in 1998 (Tanner *et al*., 2007). For the floods have a huge impact on industry such as in 1998 when 111,000 industrial units and 110 textile mills were closed down with losses of roughly 160,000 million Taka. Therefore, this study aims to find out the good adaptation practices on flood and its risk reduction strategies in Patuakhali district of Bangladesh.

Materials and Methods

The study was conducted during 7 May to 25 July 2013 at Nizampur, Eusufpur, Charipara, Dhanjupara, Banatipara, Poshurbunia, Chowdhurypara, Munshipara, Nayakata, Nawapara, Majher Howla Boropachnon and Puratan Mohipur villages under the Lalua and Mithagonj union in Kalapara upazila of Patuakhali district in Bangladesh. Kalapara Upazila is one of the most flood prone Upazila in South-western Bangladesh. It lies between 21°48′ and 22°05′ North latitude and between 90°05′ and 90°20′ East latitude (BBS, 2006). Kalapara Upazila is bounded by Amtali Upazila of Barguna district on the north, the Bay of Bengal on the south, Rabnabad channel and Galachipa

Upazila on the east, Amtali Upazila on the west (Banglapedia, 2011). The Upazila is blessed with the sea resort, the Kuakata sea-beach. The total area of Kalapara Upazila is 483.08 square kilometers and population is 202078 where 104399 is male and 97679 is female. Kalapara Upazila consists of 9 union parishads, 58 mauzas, 217 villages, 1 paurashava, 9 paura wards and 24 mahallas (BBS, 2006). Micro-data from a farm-level survey conducted by the first author was the main source of data. A sample of 120 respondents was drawn using proportionate random sampling technique. A structured survey questionnaire with a face-face interview was employed to collect data from the heads of farm households during the period 7 August to 25 October 2015. The researcher selected six characteristics as independent variables such as age, education level and environmental awareness, family size, farm size, loss due to flood disaster, adaptation tools. Activities (pre and post) were taken as dependent variable of the study. A variety of factors might be related to the dependent variables which were selected to conduct the survey in Patuakhali district of Bangladesh.

Measurement of Characteristics profile of the respondents:

Factors	Assigned score	Sources
Age of the household head	Actual years from his birth to the time of interview	Kurukulasuriya & Ajwad 2007
Education	Years of schooling of the household head	Kurukulasuriya & Ajwad 2007; KabuboMariara & Karanja 2007
Environmental awareness		
Family size	Number of people in his/her family.	Kurukulasuriya & Ajwad 2007;
Farm size	In hectares	Benhin 2008; Charles 2009
Loss due to flood	The loss calculated in taka	-
Adaptation tools	One is given for each of the adaptation tools used by the people.	Mirza, 2002

Measurement of dependent variables: Pre- and post-flood activities were considered as dependent variable of the study. It was measured on the basis of activities were taken by the local people to flood disaster risk reduction and adaptation. The pre-flood activities were miking around the coastal area, warning through radio and TV bulletin, enclosure of tube-well by polythene bag, shifting the people to cyclone center. For scoring one (1) mark was given if respondent adopt any of these pre flood activities and the post-flood activities were food and water supply to the affected area, activities of medical rescue team, agricultural inputs supply to the flood affected people. For scoring one (1) mark was given if respondent adopt any of these post- flood activities. The SPSS (Statistical Package for Social Science) computer package was used to perform the data analysis. Descriptive statistics such as frequency, range, mean, standard deviation and rank order were used in describing the variables of the study. Correlation co-efficient was computed in order to observe the significant relationships between the concerned variables.

Results and Discussion

Selected Characteristics of the Respondents

Age of the respondents: The findings related to the selected characteristics of the respondents namely age, education level and environmental awareness, family size, farm size, loss due to flood disaster, adaptation tools, and area of the rivers and canals of the localities are given in Table 1. Data presented in the Table 1 indicate that the highest proportion (39.2 percent) of the respondent fall in the middle aged category, while 38.3and 22.5percent belonged to young aged and old aged categories, respectively. However, data also revealed that 77.5 percent of the respondent people in the study area belonged to young to middle aged category.

Table 1. Age of the respondents

Categories	Frequency	Percent	Mean	SD
Young (>30Yers)	46	38.3	35.08	7.91
Middle(30-40 Years)	47	39.2		
Old (<40 Years)	27	22.5		
Total	120	100		

According to development psychologists, young and middle aged groups of' people have more physical and mental abilities and also are more innovative than old aged people. Generally younger people tend to have broader outlook and have more social media contact than the old aged women. They are more aware about the recent disaster and its risk reduction and adaptation. Thus people belonging to this age group might take more initiatives to flood disaster risk reduction and adaption (Bhattacharyya, 2008).

Education level and environmental awareness: Data presented in Fig. 1 indicate that 4% of the respondent were illiterate, 26% respondents could sign only, while 58% percent had primary level, 9% had primary pass and 3% had higher level of education. Education is an important factor for acquiring knowledge by an individual on different aspects of his/her life. Educated people may get useful information through reading leaflets, books, newspaper and other printed material.

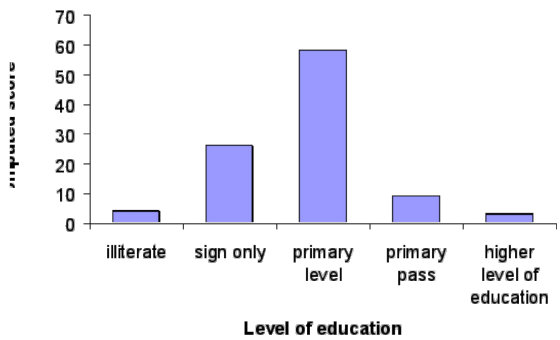

Fig. 1. Education level and environmental awareness percentage of the respondents

Education broad the power of understanding and develop the abilities of analyzing facts and situation in order to take correct decision. The low level of education among the coastal people in this study indicates traditional backwardness on the other hand and the lack of infrastructural facilities, for education on the other, making the inaccessible to the newspaper and other print media and restricting them to exposure to limited channels of communication (Bhattacharyya, 2008).

Family size of the respondents: Data in Table 2 indicate that 30.8, 64.2and 5.0 percent respondents fell in the small, medium and large family categories, respectively. The average family size (4.82) was greater than that of national average of 4.80 (BBS, 2002). It is a sign of ignorance of the respondents regarding family planning procedure in the study area. However, the large families were mostly characterized as joint family always busy for earning life expense, keep away from awareness program.

Table 2. Family size of the respondents

Categories	Frequency	Percent	Mean	SD
Large	37	30.8	4.82	1.23
Medium	77	64.2		
Small	6	5.0		
Total	120	100		

Farm size of the respondents: The study explored that 30.0 percent of the respondents belonged to the high farm category, 30.0 percent belonged to small farm category and the rest 58.3 percent to medium farm category. There were no landless and large farmers. Land is an important factor for taking early initiatives against flood as it considered as the source of money (Table 3).

Losses due to flood disaster: Highest percentage occurred 85.0 in respect to bellow 50000Tk, 11.7 percentage occurred between 50000-100000Tk. 3.3 Percentage occur in respect to above1, 00,000 Tk. because coastal people were low to medium income people. It indicates initiatives were not taken appropriately to reduce loss due to flood (Table 4).

Table 3. Farm size of the respondents

Categories in Farm size (acre)	Frequency	Percent	Mean	SD
Small (0.02-0.2)	14	11.7	0.85	0.80
Medium (0.2 -1.)	70	58.3		
Large (1.0-3.0)	36	30.0		
Total	120	100		

Table 4. Table total losses due to flood

Categories in Total losses	Frequency	Percent	Mean	SD
Bellow 50000 Tk	102	85.0	6707.500	4503.15
50000 -100000 Tk	14	11.7		
Above 100000Tk	4	3.3		
Total	120	100		

Adaptation tools: Highest percentages occupied by shallow tube-wall were 50.0, 25.8 percentage by shelter belt, 16.7 percentages by cyclone center and 7.5 percentages by embankment. Shallow tube-wall played pivotal role during flood. The availability shelter belt and embankment were not sufficient. This adaptation tools should be increased (Table 5).

Table 5. Adaptation tools

Adaptation tools	Frequency	Percent	Mean	SD
Shallow tube-wel	60	50.0	1.82	0.97
Shelter Belt	31	25.8		
Cyclone Shelter	20	16.7		
Embankment	9	7.5		
Total	120	100		

Measurement of Pre flood activities: Pre flood activities contributed significantly to reduce flood disaster such as miking around the flood disaster areas contributed 44.2%, radio & TV bulletin 25.0%, enclosure of tube- well by polythene bag 16.7%, shift the people to cyclone center 14.2% shown on Table 6.

Table 6. Pre-flood activities

Pre-flood activities	Frequency	Percent	Mean	SD
Miking around disaster areas	53	44.2	2.01	1.09
Warning through Radio & TV bulletin	30	25.0		
Keep tube-well by polythene bag	20	16.7		
Shift the people to cyclone shelter	17	14.2		
Total	120	100		

Adaptation in weather bulleting due to flood: Miking or announcing around the coastal area was played crucial role adaptation with flood and weather bulleting through radio and television also keep pivotal role in flood disaster risk reduction around the coastal area. These were not sufficient to reduce loss due to flood. Activities should be strengthening.

Measurement of Post flood activities: Post flood activities like food and water supply contributed to adapt to flood 48.3%, activities of medical rescue team 25.8%, seed and fertilizer supply 25.8% shown on table 8. Highest percentage was occupied by food and water supply to affected areas it was pivotal for risk reduction of flood in coastal area. Same percentage occupied by possible medical rescue team seed and fertilizer supply this was also pivotal flood disaster risk reduction. But the activities were not sufficient (Fig. 2).

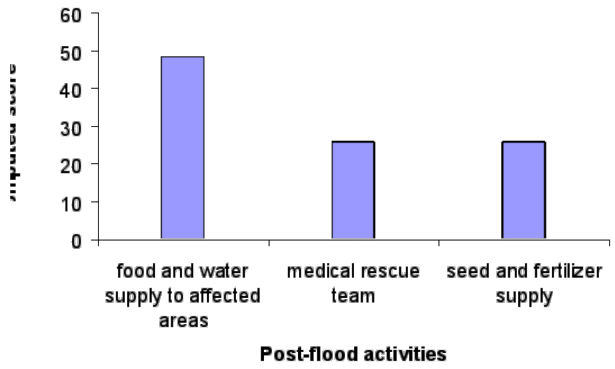

Fig. 2. Showing post-flood activities

Relationship between the selected characteristics of the respondents and pre- and post-flood activities: To explore the relationship of selected characteristics of coastal area people with pre and post flood activities in flood disaster risk reduction and adaptation around the coastal area of Bangladesh. Pearson's product moment correlation coefficient (r) was used to test the concerned null hypothesis in exploring relationship between any two variables. One percent (0.01) level of probability was used as the basis for rejection of a null hypothesis. The results of the correlation test have been presented in Table 7.

Table 7. Correlations table

Factors	Age	Education	Family size	Farm size	Loss assessment livestock	Rice	Fish Production	Human population	Total loss Tk	Rescue	Tools	Activity before	Activity after
Age	1	.127	.061	.089	.055	.130	.005	-.028	.102	-.209*	.084	-.011	.045
Education	.127	1	.257**	-.119	-,281**	-.133	-.357**	-.283**	-.242**	.327**	.503**	.389**	.663**
Family Size	.061	.257**	1	-.025	-.312**	-,187*	-.250**	-.032	-.257**	.169	.397**	.308**	.398**
Farm size	.089	-.119	-.025	1	-.034	.030	-.076	.119	.011	.061	.093	.115	.023
Loss assessment livestock	.055	-.281**	-.312**	-.034	1	.686**	.597**	.370**	.884**	-.153	-.429**	-.388**	-.430**
Rice	.130	-.133	-.187*	.030	.686**	1	.208*	.291**	.936**	-.069	-.263**	-.202*	-.236**
Fish Production	.005	-.357**	-.250**	-.076	.597**	.208*	1	.316**	.464**	-.166	-.303**	-.303**	-.414**
Human population	-.28	-.283**	-.032	.119	.370**	.291**	.316**	1	.433**	-.107	-.274**	-.173	-.338**
Total loss Tk	.102	-.242**	-.257**	.011	.884**	.936**	.464**	.433**	1	-.123	-.376**	-.310**	-.371**
rescue	-.209*	.327**	.169	.061	-.153	-.069	-.166	-.107	-.123	1	.300**	.392**	.468**
tools	.084	.503**	.397**	.093	-.429**	-.263**	-.330**	-.274**	-.376**	.300**	1	.829**	.820**
activity before	-.011	.389**	.308**	.115	-.388**	-.202*	-.303**	-.173	-310**	.392**	.829**	1	.686**
activity after	.045	.663**	.398**	.023	-.430**	-.236**	-.414**	-.338**	-.371**	.468**	.820**	.686**	1

* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed), A List wise N=120

Relationship between age and activities (pre and post) during flood disaster: The calculated value of the correlation coefficient between the concerned variables was found to be 0.101and 0.045 as shown in Table 7. Based on the above findings, the researcher concluded that age of the coastal area people had no significant relationship with activities (pre and post) during flood disaster in flood disaster risk reduction and adaptation around the coastal area of Bangladesh. This meant that age of the coastal area people was not an important factor for flood disaster risk reduction and adaptation around the coastal area of Bangladesh.

Relationship between education level and environmental awareness with the activities (pre and post) during flood disaster: The computed value of "r"(.389**) pre, (.663**) post flood was found significant with 120 degrees of freedom at 0.01% level of significance. Based on the above findings, the researcher concluded that education level of the coastal area people had a significant relationship with activities (pre and post) during flood disaster in flood disaster risk reduction and adaptation around the coastal area of Bangladesh. The findings indicated that the lower the education level and environmental awareness of the coastal area people, the lower the activities (pre and post) during flood disaster in flood disaster risk reduction and adaptation. Education is the key for development in any respect and hence, for participating pre and post flood activities. But the coastal area people of the study area have very low level of education and most of them cannot read or write. Concerned agencies should include literacy program for the coastal area people.

Relationship between Family size and activities (pre and post) during flood disaster: The computed value of "r" (.308**) pre flood and (.398**) post flood was found significant with 120 degrees of freedom at 0.01% level of significance. Based on the above findings, the researcher concluded that family size of the people had a significant relationship with activities (pre and post) during flood disaster in flood disaster risk reduction and adaptation around the coastal area of Bangladesh. The findings indicated that the higher the family sizes of the coastal area people, the lower the activities in flood disaster risk reduction and adaptation. Because the joint family had low rate of literacy. For this they were unconscious about flood control. Concerned agencies should include family planning program for coastal area people.

Relationship between farm size and activities (pre and post) during flood disaster: The calculated value of the correlation coefficient between the concerned variables was found to be 0.115 pre, 0.023 post flood as shown in table 9. Based on the above findings, the researcher concluded that farm size of the coastal area people had no significant relationship with flood disaster risk reduction and adaptation around the coastal area of Bangladesh. This meant that farm size of the coastal area people was not an important factor for activities (pre and post) during flood disaster in flood disaster risk reduction and adaptation around the coastal area of Bangladesh.

Relationship between total loss (Tk) and activities (pre and post) during flood disaster: The computed value of "r" (0.388**) pre, (0.430**) post flood for livestock (0.202**) pre,(0.236**) post for rice (0.303**) pre, (0.414**) post for fish production, (0.338**) post for human (0.310**) pre,(0.371**) post flood. Total loss was found significant at 0.01% level of significant. Based on the above findings, the researcher concluded that total loss of the coastal area people had a significant relationship with activities (pre and post) during flood disaster in flood disaster risk reduction and adaptation around the coastal area of Bangladesh. The findings indicated that the pre flood preparation is not enough for flood disaster risk reduction and adaptation around the coastal area of Bangladesh.

Relationship between adaptation tools and activities (pre and post) during flood disaster: The computed value of "r"(0.829**) pre, (0.820**) post flood was found significant with 120 degrees of freedom at 0.01% level of significant. Based on the above findings, the researcher concluded that adaptation tools for the coastal area people had a significant relationship with activities. The findings indicated that adaptation tools (STW, Boat, Shelter belt, Cyclone center, Embankment) were not sufficient for

flood disaster risk reduction and adaptation around the coastal area of Bangladesh.

Relationship between independent and dependent variables: Null hypotheses were tested to explore the relationship between the dependent and independent variables. Education, family size, farm size, tools, loss, rescue team, of the respondent were significantly correlated with the activities. The pre-flood activities were miking around the coastal area, warning through radio and TV bulletin, enclosure of tube-well by polythene bag, shifting the people to cyclone center. The post-flood activities were food and water supply to the affected area, activities of medical rescue team, agricultural inputs supply to the flood affected people.

In the study area the respondents mainly followed for reducing flood risk four pre-flood activities were taken such as: (i) Miking around the coastal area (reduced flood risk 44.2%), (ii) Radio and TV bulletin (reduced flood risk 25.0%), (iii) Enclosure of the tube-well by polythene (reduced flood 16.7%) and (iv) Shifting the people to cyclone center (reduced flood risk 14.2%).

In addition for adapting flood risk three Post flood activities followed which were, (i) Food and water supply (reduced flood disaster vulnerability 48.3%), (ii) Agricultural inputs (i.e. seed, fertilizer, livestock's, fisheries) supply (reduced flood disaster 25.8%), (iii) Services provided by medical rescue team (such as supply of medicine, vaccination, saline) (reduced flood vulnerability 25.8%), (iv) The findings indicated that the lower the education level and environmental awareness of the coastal area people, the lower the activities (pre and post) during flood disaster in flood disaster risk reduction and adaptation, (v) The pre flood preparation activities were not enough for flood disaster risk reduction and adaptation strategies around the coastal area of Bangladesh and tools were not sufficient for flood disaster risk reduction.

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