ISSN 1605-2021

লোক-প্রশাসন সাময়িকী
Lok Proshason Samoeeky
সংখ্যা: ৫১/ No. 51
জ্যৈষ্ঠ ১৪১৮/জুন ২০১১
Jaistha 1418/ June 2011

Indigenous Coping Strategies of the Cyclone-Affected Farmers in Coastal Areas of Bangladesh

Md. Ibrahim Khalil*

Abstract: *Bangladesh is a cyclone-prone country and affected by frequent devastating cyclones. Historical trend shows that a severe cyclone hits Bangladesh in every three years. Of late, this gap is reducing with the advent of human induced climate change. Cyclone causes huge loss of life, property and infrastructure of the people living in the low lying coastal areas of Bangladesh. Although all occupational groups are affected by the cyclonic devastation, but farmers are the worst sufferers as their economic loss is higher than that of any other occupational groups living in the area. They lose houses, crops, livestock, fisheries, and instruments associated with their livelihood which makes them more vulnerable that force them to accept many diversified ways for their survival. Farmers adopt indigenous strategies ahead of cyclone including house construction, response to early warning and food preservation. They undertake indigenous strategies during cyclone to save their dwelling places, crops, livestock, and fishery resources. Farmers adopt mechanisms to restore their livelihood soon after the cyclone in addition to receiving organizational and community supports. This paper is an attempt to explore the indigenous practices of the coastal farmers to cope with the ever increasing cyclonic devastation in the coastal areas of Bangladesh.*

Introduction:

Bangladesh is prone to tropical cyclones. The low-lying coastal areas are most vulnerable. For centuries, due to its location at the tip of the northern Indian Ocean, the coastal areas are frequently hit by severe cyclonic storms generating long tidal waves aggravated by the shallow Bay. It causes huge losses of lives, property and agricultural production. Historical trends of cyclonic hazard in Bangladesh coast are very alarming. Over a period of 100 years, 508 cyclones have formed in the Bay of Bengal region, of which 17 percent made landfall in Bangladesh. During the period of 1797 to 1991, Bangladesh faced sixty severe cyclones killing around one million people along with other damages and losses.[1] A severe cyclone occurs once almost in every three years,[2] and the

* Doctoral candidate, Institute of Bangladesh Studies, University of Rajshahi and OSD (Lecturer, Sociology), Directorate of Secondary and Higher Education, Dhaka; and currently. Email: ikhalilso@yahoo.com

1 GoB, "Cyclone Sidr in Bangladesh: Damage, Loss, and Needs Assessment for Disaster Recovery and Reconstruction. A report prepared by the Government of Bangladesh and assisted by the International Development Community with financial support from the European Commission, 2008", Dhaka: ERD,2008. http://reliefweb.int/rw/RWFiles2008.nsf/FilesBy RWDocUnidFilename/PANA-7K8GT8-full_report.pdf , [accessed October 12, 2010].

2 Anwar Ali, "Climate Change Impacts and Adaptation Assessment in Bangladesh," Climate Research 12 (September 1999): 121.

span of time seems to be narrowing. Super cyclone SIDR struck the coastal region in 2007, and within two years, two more cyclones–Bijli and Aila hit the region. The regular cyclonic hits and the narrowing gaps of cyclone occurrence evince to the fact that the lives and livelihoods of the coastal people are endangered. Human-induced climate change further exacerbates the problem in terms of increasing intensity and velocity of cyclone, and sea level rise.[3] The life and livelihood of the people of coastal areas are expected to be faced with monumental challenges in the years to come.[4]

All the occupational groups of the coastal areas are affected by tropical cyclones and tidal surges. The farmers are, however, one of the most vulnerable groups as they hardly get opportunity to evacuate crops from their fields and loose almost all assets and instruments associated with their livelihood. Besides geo-environmental vulnerability, low level of education and lack of media access, fragile housing condition, inadequate infrastructure, and subsistence economy of the farmers, make them more vulnerable than any other occupational group living in the coastal areas. Unveiling farmers' coping is important in the socio-economic context of Bangladesh as they are considered the heart of rural economy. If farmers' existing coping strategies are unveiled properly, appropriate planning on the basis of research findings may help reduce vulnerability of the coastal farmers. Moreover, it is widely believed that strengthening coping capacities can enhance resilience of a community to withstand the effects of hazards. Therefore, clear understanding of the coping mechanism is essential for building resilient farming community in the coastal areas of Bangladesh.

A number of studies carried out in the relevant field were thematically reviewed which include Islam (1995), Rahman (1999), Alam (2003), Hoque and Islam (2003), Hutton and Haque (2003), Hasan and Baten (2008), Parvin, Takahashi and Shaw (2009), Akhter (2010), Alam and Collins (2010), Islam (2010) and Paul and Routray (2010). These studies, in general, covered different aspects of flooding, cyclones and storm

---

[3] Inter Governmental Panel on Climate Change, "Climate Change 2001: Impacts, Adaptation and Vulnerability, Contribution to Working Group-II to the Third Assessment Report, 2001", UNEP, http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg2/619.ht, [accessed October 19, 2010].

[4] This is particularly true taking into account of the IPCC forecasts. The IPCC in its third assessment report predicted that half a metre sea level rise by 2050 will permanently inundate 11 percent of Bangladesh territory.

surges. Few studies emphasized on the coping strategies of occupational groups living in the coastal areas of Bangladesh. Moreover, systematic documentation of indigenous knowledge and practices, and identification of how different underlying factors influence coping behavior of the coastal farming community involved in agriculture is still lacking. In addition, most of these studies were conducted on geographical consideration. Sociological research on disasters, especially on the cyclone, is scant. Clearly, there exists a research gap concerning indigenous coping strategies of the coastal farmers that needs to be explored from sociological point of view.

Objectives of the Study:

The objective of the study is to explore pre, during and post-cyclone indigenous coping strategies of the farmers living in the coastal areas of Bangladesh.

Methodology:

The study has been carried out in two villages of Barguna district. Multi-stage cluster sampling has been used to find out the study locale. Previous cyclone track record reveals that among the 19 coastal districts,[5] Barguna is one of the most cyclone-prone areas of Bangladesh. The area was hit by the last three cyclones i.e. SIDR in 2007, and Aila and Bijli in 2009. All the five Upazilas of the district are almost equally vulnerable as such the study has been carried out in Barguna Sadar and Pathorghata Upazila. A village from Barguna Sadar Upazila named Garjanbunia under Naltona union and another village named Padma from Pathorghata Upazila of Sardar union has been selected considering their vulnerability. The earlier village is located at the confluence of the river Paira and the Bay of Bengal and the latter is located at shore line.

The study makes use of both the qualitative and quantitative approaches. Data for the study have been collected from both the primary and secondary sources. Along with the secondary literature review, questionnaire survey, focus group discussions (FGDs) and Key Informants Interviews provided relevant information germane to this study. Before conducting face to face interview a reconnaissance survey was carried out in both the study villages to identify the *bona fide* farmers

[5] The districts are Bagerhat, Barguna, Barisal, Bhola, Chandpur, Chittagong, Cox's Bazar, Feni, Gopalgonj, Jessore, Jhalkati, Khulna, Laksmipur, Narail, Noakhali, Patuakhali, Pirojpur, Satkhira and Sariatpur.

on the basis of some predetermined criteria which are i) Farmers who have minimum 0.5 decimal or more cultivable land; ii) Farmers who are personally involved in agricultural activities; iii) None of the family members are employed in formal sector; and iv) Farmers who have cyclonic experience at least once during their life time.

About 380 households were available in the two study villages after conducting household survey. According to sample size determination formula (n=N/1+Ne2 where n= sample size, N= population and e=deviation level/error accepted)[6], for a population size of 380, the sample size is 121 at 92.5 percent confidence level with 7.5 percent deviation. Besides, 16 participants for two FGDs have been purposively selected from among the randomly selected farmers to get in-depth knowledge on farmers' indigenous coping strategies. In addition, 6 KIs, who include farmers, local public representative and block supervisor were interviewed to get in-depth information.

Indigenous Coping Strategies:

Indigenous coping strategies entail the ways by which people use the available resources and abilities to face adverse circumstances. In general, this involves managing resources, both in normal times as well as during crises or adverse conditions. It is believed that strengthening coping capacities can enhance resilience of a community to withstand the effects of hazards.[7] Therefore, understanding community coping mechanism is essential to build a resilient community. Undertaking indigenous coping strategies by cyclone affected community depend on a number of issues viz. early warning, media access, level of awareness, availability of shelter centre and approach roads to shelter centre. In Bangladesh, an increased number of people have better access to electronic media including private radios and more recently wide coverage of cell phones to come across weather forecasting. Globally weather warning technology has improved greatly particularly with developed satellite imaging and analysis of global weather systems.

Despite technological advancement, available physical facilities, improved early warning and better access to media; survival strategies of

[6] Taro Yamane, Statistics: An Introductory Analysis (2nd edn.), (New York: Harper and Row, 1967), 886.

[7] UN, Words into Action: A guide for implementing the Hyogo Framework, UNISDR, 20 April 2007:127; www.preventionweb.net/files/594_10382.pdf [Accessed February 12, 2011].

the coastal farmers are subject to their social and economic circumstances. But the indigenous knowledge that the farmers apply to face cyclone is hardly known. So there exists a knowledge gap that needs to be explored. As such, farmers' pre, during and post-cyclone indigenous coping strategies with respect to their socio-economic condition have been discussed in this article. Farmers adopt different strategies to construct houses, take preparation to save cattle, fish, and standing crops ahead of cyclone. If available, some of them use shelter centre while others stay in their villages, and try to save themselves by adopting various means during cyclone. Soon after the cyclone, they had to meet immediate demands, ensure safe drinking water, and find alternative sources of livelihoods.

Preparedness at Pre-Cyclone Stage:

Disaster preparedness is the most important phase of disaster management. It involves forecasting and taking pre-cautionary measures prior to an imminent threat. Preparedness help minimize loss of life and property.[৪] As part of their cyclone preparedness activity, coastal farmers undertake numerous measures. They consider plinth height, house height and design, planting trees around house and facing of houses as the main strategies of house construction. In addition, they preserve food, seed and valuable items. They also try to save cattle, fish and standing crops by adopting different measures.

House Construction:

Indigenous techniques of the coastal farmers begin with the construction of houses. In this respect, house construction materials, design of the houses and other protective measures that may save the houses from the wrath of cyclone are worthy of consideration. Damage and loss could be significantly reduced if houses are constructed considering the geographical and environmental conditions of the locality. Housing site, settlement pattern, design, facing of house, materials used and plinth height are taken into account by the farmers in the coastal areas of Bangladesh.

Plinth height in coastal Chakoria is about five feet, and in Sandwip and Kutubdia Island it is around six feet above cropland. If the plinth is high

৪ M. Safiur Rahman," Disaster Management and Public Awareness in Bangladesh" in Disaster in Bangladesh: Selected Readings ed. K. Nizamuddin (Dhaka: Disaster Research Training and Management Centre, 2001), 182.

enough, house owners are more likely to save family members and belongings from severe tidal surges.[9] There was no doubt that high plinth gave the most effective protection; the Maghs, who built their houses of timber upon piles six or eight feet high, found themselves far better in 1876 than the people who inhabited the tract on the low surface which suffered the extreme fury of the wave.[10] FGD participants (conducted between February-March 2011 in Garjanbunia and Padma village) maintained that houses constructed on machan are better prepared to face cyclone. Around one tenth (10.1%) of the respondents said that building houses on high plinth gives protection from cyclone ("in table 1"). This technique is prevalent among the Rakhine community who usually build their houses on raised platforms made of wood. The plinth heights of present study respondents' house found 3-3.5 feet above the cropland. Some of the Bangalee respondents are replicating the technique applied by Rakhine people considering its cyclone resistance capacity.

Table 1: House Construction Strategy

Strategy to construct houses	Number of Responses	Percent of cases
Building house in special design	71	59.7
Building houses in special direction	24	20.2
Building houses on *machan* (high plinth)	12	10.1
Planting trees around houses	62	52.1
No strategy	19	16.0
Others	13	10.9

Note: *Multiple response* (N=121)

Source: Field survey, 2011

Plantation of trees around the homestead is another important adaptation technique for saving life, houses and properties in wind and sea surges.[11] About half of (52.1%) of the respondents said that they plant trees around their houses. The trees include Mehogini, Akashmoni, Rain tree and Gab tree that create barrier against strong wind and reduce losses during

[9] Edris Alam and Andrew E. Collins, "Cyclone Disaster Vulnerability and Response Experiences in Coastal Bangladesh," Disasters 34 (October. 2010): 946. http://onlinelibrary.wiley.com/doi/10.1111/j.1467-7717.2010.01176.x/ [accessed October 15, 2010].

[10] Md. Habibur Rashid, ed., Bangladesh District Gazetteers: Bakargonj, (Dacca: BG Press, 1981), 20.

[11] Alam and Collins, 946.

cyclone. Planting trees around homestead resembles the idea that the Sundarbans saves Bangladesh from severity of cyclone. The idea proved to be true during the cyclone SIDR that swept over the area in 2007.

Height of house and direction of houses is another issue of consideration while constructing houses said FGD participants. Constructing houses with medium height- chowchala house is another technique that save house of the coastal farmers during cyclone. The study finds that majority of the respondents (59.7%) said that they constructed chowchala houses with medium height (15-20 feet) so that flow of wind pass over the roof of the houses without damaging much. One fifth of respondents (20.2 %) told that they took direction of houses into consideration while erecting houses. FGD participants added that south facing houses are more suitable in many respect including resisting capacity of wind pressure, in most of the cases, wind flows from the south- eastern direction during cyclone. Besides, constructing houses with strong and durable wood logs like palm tree or placing cement made pillars under wooden pillars are better prepared to face cyclone.

The study finds that about one sixth of the respondents (16%) did not undertake any strategy while constructing houses. However, they were thinking of constructing houses taking into account the recent changes in the global climate and occurrence of frequent cyclone, said majority of FGD participants.

Cattle Saving Strategies:

Along with protecting houses, farmers try to save cattle. Usually they try to send their cattle to a raised place, set cattle free or keep in the cow shed to save those from the devastation of cyclone.

Table 2: Cattle Saving Measures

Strategies to save cattle	Number of responses	Percent of cases
Set cattle free	66	56.4
No measures	40	34.2
Keeping cattle in the cowshed	10	8.5
Others	5	4.3

Note: Multiple response(N=117)

Source: Field survey, 2011

Cyclone affected people try to save poultry and livestock as these are the most valuable assets for rural communities.[12] The study finds that one third of the respondents (34.2%) were not well prepared ahead of cyclone that struck the study village (Garjanbunia and Padma) in 2007. As such, they did not think of any strategy to save their cattle. Although the study area was vulnerable to frequent cyclonic devastation, there were no killas for cattle in either of the villages. Finding no alternative ways majority of the respondents (56.4%) set their cattle free so that they could save their lives by their own ways. But very few cases they survived, maintained FGD participants. However, about one tenth (8.5%) of the respondents kept their cattle in the cowshed as they were busy saving their own lives and could not take any extra measures to save their cattle. Few fortunate respondents (4.3%) could send their cattle on highland places near the houses or neighbors house.

Preserving Food, Seeds and Deed:

Storing seeds and food before cyclone help reduce sufferings of the of cyclone affected farmers immediately after the cyclone. Besides, Jewelry and deeds of land are considered most valuable household belongings. Considering the issue in mind, farmers in the study areas try to preserve those items in their own ways so that these could be retrieved when cyclone is over.

In the present study, one third of the respondents (30.8%) ill preparation is divulged in respect to saving food, seed and deeds. FGD participants said most of the respondents did not receive early warning well ahead of cyclone to prepare themselves. In addition, they could not realize the severity of cyclone that swept over the area in 2007. Another one third of the respondents kept deeds in the tranks but in most of the cases, those were washed away by surge water. However, half of the respondents (50.1%) kept seeds and food inside plastic containers said FGD participants.

Protecting Fisheries and Crops:

Protections of fisheries are almost impossible when severe cyclones

---

[12] Alam & Collins, 947; Parvin, Takashi and Shaw, 188; Shitangsu Kumar Paul and Jayant K. Routray, "Flood Proneness and Coping Strategies: The Experiences of Two Villages in Bangladesh," Disasters 34 (April 2010): 498. http://onlinelibrary.wiley.com/doi/10.1111/j.1467-7717.2009.01139.x/pdf [accessed July 21, 2010].

accompanied by a surge strikes.[13] The present study discloses the similar findings and none of the respondents could save their fish resources as well as standing crops. FGD participants maintained that they did not imagine that such devastation could happen to them. Moreover, they did not get enough time to catch fish or harvest standing crops. However, they usually try to use bamboo fence, fishing net and mosquito nets to save pond fishes at the initial stage or if the cyclone is not severe in nature. When cyclone struck the area, they remain busy with saving their own lives, they added. However, Alam's study reveals that responding to "saving seed" and "cutting crops from fields" as preparation for an imminent cyclone were only 27.8 percent and 12.6 percent respectively.[14]

Response During Cyclone:

Farmers pass a very tough time during the cyclone especially when it is severe in nature. Usually they try to protect their own house and stay there. At the extreme stage, they either evacuate themselves in a safer place or stay in their own houses. Those who stay in their own houses adopt different measures including observence of religious rituals, clinching trees and plastic container.

Protecting House:

Farmers who do not have access to shelter centre or did not evacuate in some other safe places stay in their houses. During cyclone, they try to save their houses especially if the houses are in fragile condition and feel threaten against the strong wind and storm surges. The commonly undertaken measures are attaching delicate parts of the houses with rope, fasten houses with strong trees, putting off fences and using additional supports.

For cyclones, one-third of the people apply their indigenous knowledge.[15] The present study finds that an overwhelming majority of the respondents

---

[13] Shitangsu Kumar Paul and Jayant K. Routray, "Household response to cyclone induced surge in coastal Bangladesh: Coping strategies and explanatory variables," Nat Hazards 57, no. 2 (October 2010): 498. http://www.springerlink.com/content/a1857633p96427ut/fulltext.pdf [accessed March 13, 2011].

[14] Edris Alam, "Coping with Cyclone: An Occupational Group Perspective," Journal of the Asiatic Society of Bangladesh Humanities 48, no.2 (2003): 64.

[15] Gulsan Ara Parvin, Fumito Takahashi and Rajib Shaw, "Coastal Hazards and Community-coping Methods in Bangladesh," Journal of Coastal Conservation 12 (2008): 187. http://www.springerlink.com/content/78400583630p27g1/fulltext.pdf [accessed July 22, 2010].

tried to save houses by applying local knowledge. In their effort to save houses, more than one third of the respondents (37.5%) attached fragile parts of their house with rope. About one fourth of the respondents (23.3%) put off fence so that strong wind could pass through the houses. They think that the measures will save their houses. Binding houses with adjacent large trees i.e coconut tree, rain tree and gab tree is another way the respondents try to save their houses. About one tenth said they save their houses using additional support with strong bamboo and wood logs.

Use of Shelter Centre:

As mentioned earlier, using shelter centre by the farmers in cyclone-prone areas to a great extent depended on availability and suitability of shelter centres, issuance of early warning, level of awareness about early warning and destructive power of cyclone, distance of shelter centre from the dwelling places of the farmers etc. Almost half of the people (46%) take shelter at cyclone centers.[16] The present study finds that about two third of the respondents (77%) did not use shelter centre. There are many reasons behind their refraining from using shelter centre. The main causes are distance of shelter centre, low level of awareness, fear of theft in the house, early warning incredible, fear of space shortage in the shelter centre and non-availability of killas for the livestock etc.

Table 3: Causes behind refraining from visiting shelter centre

Causes of not visiting shelter centre	Number of response	Percent of cases
Non-availability of shelter centre	60	65.2
Could not realized severity of cyclone	47	51.1
Non-availability of *killas*	40	43.5
Fear of heft	30	32.6
Fear of washed away by surge water	31	33.7
Early warning was not credible	23	25.1
Shortage of space in the shelter centre	9	9.8

Note: Multiple response(N=92)

Source: Field survey, 2011

[16] Ibid.

Distance of Shelter Centre:

Shelters centres established in the cyclone-prone coastal districts are located at a distance of more than 3.5 miles (5.6 km) apart.[17] Haque's study finds that locations of the nearest centres lie between 1 to 3 km.[18] Studies have shown that unless a cyclone shelter lie within 1 mile (1.6 km) of human settlements, it may be too far for coastal residents to travel during an emergency.[19] Distance of shelter centre from the respondents' homes was the main reason for their non-evacuation.[20] The present study finds that majority of the respondents (65.2%) did not use shelter centre due to distance of shelter centre from their houses ("in table: 3").

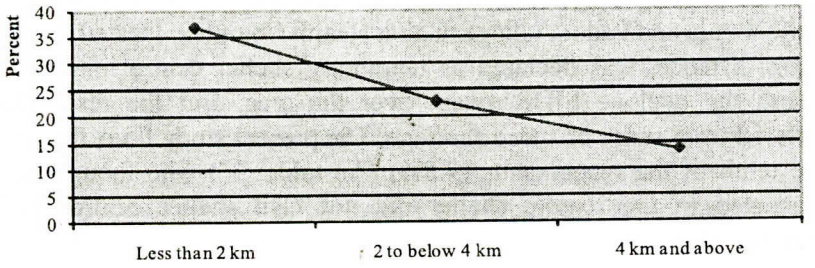

Figure 1 Percenatge distribution of shelter distance and its use

The present study further finds that with the increase of distance of shelter centre from the dwelling places of the respondents, the tendency of using shelter centre decrease ("in figure 1"). However, distance is not the only factor that influences use of shelter centre by the farmers. The other reasons that influence farmers' use of shelter centres are as follows:

Fear of Space Shortage:

Soon after the independence of Bangladesh, a program was initiated to construct shelters centre with a view to protect coastal residents from the affect associated with cyclones and storm surges. There are more than 2,000 cyclone shelters along the coast of Bangladesh, but these can

[17] Bimal Kanti Paul, "Why relatively fewer people died? The case of Bangladesh's Cyclone SIDR" Natural Hazards 50 (2009):292. http://www.springerlink.com/content/76500g0581u03782/fulltext.pdf [accesses September 29, 2010].

[18] Abdul Hoque and M. Shahidul Islam, "Local Wisdom in Disaster Management: Case Studies of Chakaria and Moheshkhali," Journal of Bangladesh National Geographical Association 31, no.1 & 2 (2003): 40.

[19] Paul, 292.

[20] Ibid.

accommodate only one-fourth of the population in high-risk area.[21] Another study reveals that the number of shelter centres established in the cyclone-prone coastal districts is not enough to accommodate all people in these areas.[22]

The scenario is quite similar in Garjanbunia and Padma village. There are around 2,890 people in the two villages but there were no shelter centres in the villages before 2007 so that the people could take shelter before the cyclone strikes. The villagers were supposed to visit shelter centre located at more than 2 km distance. When early warning is issued, respondents think that cyclone shelter centres located at remote area are overloaded with the people of adjoining areas, said participant of FGD conducted in Garjanbunia and Padma village. Union Health Complex, located at within 2 km distance, was declared as temporary shelter centre immediately before the cyclone SIDR swept over the area. But the respondents suffered from sense of space shortage. The present study finds that about one tenth of the respondents (9.8%) ("in table: 3") who thought to be evacuated in the remote shelter did not visit shelter centre fearing shortage of space.

Besides, there are some others reasons which discouraged the respondents to visit shelter centre. About one third of the respondents (33.7 %) did not move lest they are washed away by tidal bore on their way to shelter centre. About half (51.1%) of the respondents did not realize the strictness of cyclone and they did not go shelter centre. Another one third of the respondents did not use shelter centre due to fear of theft (32.6%) in their houses. Yet another one third did not use shelter centre because there were no killa for the cattle. About one fourth did not visit as early warning was not credible to them ("in table 3").

Alternative Shelter Places:

As there is no formal cyclone shelter centre in the study village, during cyclone of 2007, majority of the respondents had to stay places like own house, neighbours house and union health complex. In disaster-prone localities, coping measures immediately before hazard event start with the saving of human lives.[23] Paul and Routry finds that a majority of the

[21] Parvin, Takashi & Shaw, 187.

[22] Paul, 292.

[23] Paul, 292.

accommodate only one-fourth of the population in high-risk area.[21] Another study reveals that the number of shelter centres established in the cyclone-prone coastal districts is not enough to accommodate all people in these areas.[22]

The scenario is quite similar in Garjanbunia and Padma village. There are around 2,890 people in the two villages but there were no shelter centres in the villages before 2007 so that the people could take shelter before the cyclone strikes. The villagers were supposed to visit shelter centre located at more than 2 km distance. When early warning is issued, respondents think that cyclone shelter centres located at remote area are overloaded with the people of adjoining areas, said participant of FGD conducted in Garjanbunia and Padma village. Union Health Complex, located at within 2 km distance, was declared as temporary shelter centre immediately before the cyclone SIDR swept over the area. But the respondents suffered from sense of space shortage. The present study finds that about one tenth of the respondents (9.8%) ("in table: 3") who thought to be evacuated in the remote shelter did not visit shelter centre fearing shortage of space.

Besides, there are some others reasons which discouraged the respondents to visit shelter centre. About one third of the respondents (33.7 %) did not move lest they are washed away by tidal bore on their way to shelter centre. About half (51.1%) of the respondents did not realize the strictness of cyclone and they did not go shelter centre. Another one third of the respondents did not use shelter centre due to fear of theft (32.6%) in their houses. Yet another one third did not use shelter centre because there were no killa for the cattle. About one fourth did not visit as early warning was not credible to them ("in table 3").

Alternative Shelter Places:

As there is no formal cyclone shelter centre in the study village, during cyclone of 2007, majority of the respondents had to stay places like own house, neighbours house and union health complex. In disaster-prone localities, coping measures immediately before hazard event start with the saving of human lives.[23] Paul and Routry finds that a majority of the

[21] Parvin, Takashi & Shaw, 187.

[22] Paul, 292.

[23] Paul, 292.

household members do not take shelter in traditional cyclone shelters.[24] The present study finds that more than one third (42.4%) of the respondents stayed in their own houses and about one third (29.3%) of them stayed at neighbours house. Union Health Complex was declared as temporary shelter centre apprehending severity of cyclone immediately before the cyclone but it did not get much attention of the respondents and attracted only one fourth of the respondents (26.1%) to take shelter during cyclone.

Strategies Adopted at House:

Respondents who did not go shelter centre or other safer places and stayed at their own house, adopted some mechanism which include staying at machan, clinching trees and staying with plastic container. They also observed religious rituals during cyclone.

It is evident that majority of the respondents (56.41%) stayed on machan of their own houses. About half of them (51.8%) climbed or attached strong trees like gab tree, rain tree, akashmoni and mehogini until the severity of cyclone was reduced. FGD participants said that when their house was collapsed they, along with their family members, float on surge water with some plastic container which was tied together beforehand.

In the event of any disaster, the immediate response is to prying God and offering Ajan.[25] In the present study about half (48.71%) of the respondents, who stayed in their houses, offered religious rituals like offering Ajan and Towba (seeking divine blessing) so that Allah could save them from the wrath of cyclone. People of Muslim community strongly belief that Allah(God) has given the cyclone which could be reduced if He is satisfied with offering religious rituals. In reality, offering religious rituals has no practical implication but it has psychological affects on them during crisis moment.

Recovery at Post-Cyclone Period:

As soon as cyclone is over, affected farmers become helpless loosing crops, cattle, and agricultural equipments. Their houses are torn and tossed and they suffer from dearth of food, shelter and drinking water. Community or organizational assistance from outside contributes to some

[24] H. Rasid and Bimal Kanti Paul "Flood problems in Bangladesh: is there an indigenous solution? Environmental Management 11, no. 2 (1987):166; P Thompson & I Tod, "Mitigating flood losses in the active floodplains of Bangladesh, Disaster Prevention Management 7, no. 2 (1987):118.

[25] Paul and Routray, "Household response to cyclone induced surge in coastal Bangladesh, 485.

extent to meet emergency needs. But outside help does not last long and those are not adequate as well compared to the need of farmer families. They strive to restore their livelihood but face difficulties due to of acute crisis of seed, salinity, cattle and agricultural equipments.

Restoring Livelihood:

Agriculture is the main source of livelihood of the study area especially of food grain production. All the respondents were from farming community. Agriculture suffers most whenever cyclone affects any part of coastal areas in Bangladesh. During the cyclone of 2007, farmers of Garjanbunia and Padma lost almost entire standing crops which were the main source of food supply for rest of time of the year. Most of the agricultural farmers lives on subsistence economy. Cyclonic devastation further increases their vulnerability. Although relief and rehabilitation program are initiated by NGOs and GO soon after the cyclone, but the farmers fall in distressed situation as the relief materials are very often inadequate compared to their needs, said FGD participants. That is why it is very urgent to start the agricultural activity. Every year, two crops are grown in the area i.e Robi and Amon. After the cyclone of 2007, majority (61%) of the respondents could not cultivate robi crop as farmlands are covered with high level saline sediments. As they fail to get any harvest during robi crop, farmers had to wait for the cultivation of amon crop to resume their living. Meanwhile farmers overcome primary shock and losses and they start again amon cultivation. Almost all the respondents cultivated amon crops, but they had to face difficulties with respect to cattle for tilling land, agricultural equipments, seed and cost of agricultural activities. In spite of that they cultivated land by borrowing tractor, cattle and taking loans.

Table 4

Ways cultivated land	Number of responses	Percent
Borrowing tractor	103	88.0
Borrowing cattle from relatives	18	15.3
By the surviving cattle	12	10.2
Note: *Multiple responses (N=117)*		

Source: Field survey, 2011

It is estimated that livestock will face fodder crisis in the coastal areas. Production of livestock will decrease considerably with increasing

intensity and frequency of shocks such as cyclone and storm surges.[26] The present study reveals that almost all the respondents lost their cattle during the cyclone of 2007 and an overwhelming majority (88.0%) of them had to borrow tractor to cultivate their lands ("in table 4"). However, one tenth of them (10.2%) cultivated land with surviving cattle.

Collecting Seed:

Supply of seed is very crucial for restoring agricultural activities. Few respondents can save seeds unless those are preserved taking special measures since surge water swept away everything. Present study reveals that majority of the respondents lost seeds during the cyclone of 2007. As such, collecting seeds was a major challenge for them. They collected seeds from various sources viz. market, NGOs, Government organization and relatives.

The study reveals that majority of the respondents (87.9%) collected seeds from market followed by NGOs (38.8 %) and Government offices (26.7%). Relatives and kin had also made some contribution (19.8%) in supplying seeds. Both GO and NGOs contribution in reinvigorating agricultural activities in respect of supply of seed was lower than the market. As a result, farmers had a hard time to keep their agricultural activities continued, maintained FGD participants.

Coping with Salinity:

High level salinity intrusion has been considered potential source of human sufferings due to its adverse effect on agricultural practices.[27] It is estimated that about 8.5 percent of the nation's agricultural output originate from the area with elevation up to 1 meter from the sea level. Estimated agricultural output originating seaward of the 3 m scenario line amounts to 21 percent of the nations agricultural output. A major consideration for agricultural productivity is the intrusion of saline water into the fresh ground water resources. Current estimates suggest that saline water intrusion now extends as far as about 240 km inland. Assuming an extreme scenario, the wedge of saline water could be driven another 240 km northward. If the rivers are effectively dammed, the whole country would be affected by the intrusion of saline water.[28] Impact of saline water on cropland is also evident from the citation enunciated in

[26] Haque & Islam, 40.

[27] GoB, Ministry of Environment and Forest, National Adaptation Programme of Action (NAPA), Dhaka, August 2009, 33.

[28] Ibid., 38.

the Bakerganj district Gazetteer which portrays that, "Bakarganj was hit by a devastating cyclone in 1965. Saline water got into agricultural land which did not allow any crop to grow for some time to come."[29]

The present study finds that majority (61%) of the respondents could not cultivate robi crop due to salinity intrusion in the cultivable lands. Those who cultivated (39%) did not get any crop due to high level of sanity ingress which continued until rain water washed away salty level of soil during monsoon said FGD participants. Rice production in saline areas is very low due to lack of suitable saline tolerant varieties, limited seed availability, and unavailability of appropriate technology. The indigenous rice varieties like Bouari, Dignamoni, Dudhkalom, Girmi, Haitta, Rajashail etc are gradually disappearing due to sea level rise and salinity ingress in the cropland. However, farmers are increasingly cultivating Bangladesh Rice Research Institute (BRRI) innovated BR-47 of rice variety, which can tolerate up to 7- 8 ppt of salinity. FGD participants said that they are getting good harvest if they cultivate B-47 variety of rice in the croplands where saline water enters frequently.

Coping with Diseases:

The post-cyclone effects on the survivors can be as severe as the immediate impacts of the cyclone itself. Spread of diseases among the human being and livestock in Garjanbunia and Padma village after the cyclone of 2007 was major concern for the respondents. Human beings are attacked by typhoid, fever, dysentery, diarrhea and cold related disease while Anthrax, diarrhea and homorganic septicemia spread among cattle population.

Human Diseases:

Coastal hazards like cyclones and tidal surges are often followed by skin diseases, fever, and diarrhea.[30] Low level of awareness, economic constraint, and lack of medical facilities make their life very difficult. Cyclone increases the sufferings of the affected people manifold during and after the emergency period. Although medical team works after the cyclone, but its coverage remain small with respect to their need. Relief distributing agencies lays emphasis on rescue, emergency food supply and shelter related activities. As a result, spread of diseases among human

[29] Jyotirmoy Talukder, "Living with Cyclone," (Dhaka: Community Development Library, 1992), 25.

[30] Md. Habibur Rashid, 21.

being and livestock become major concern; and typhoid, fever, dysentery, diarrhea, cold related diseases and malaria spread out among the respondents. Diarrohea broke out in large-scale immediately after cyclone in the island (Sandwip).[31] The study finds that about half of the respondents (47%) were attacked by diseases like typhoid, fever, diarrohea and cold related diseases. Among them about one third (35%) of the respondents were attacked by typhoid followed by fever (26%), dysentery (26%), diarrohea (23%) and cold related diseases. But diseases did not spread in epidemic form due to intervention of GO and NGOs especially due to ensuring supply of potable water and activities of health team, said FGD participants.

Human sufferings, after the occurrence of any natural disaster draw attention of all concerned. The outbreak of various disease and sufferings during cyclone, need medical support.[32] Being rural poor, people usually do not seek treatment until the illness becomes severe. If needed, most of them take herbal treatment using indigenous knowledge and those who cannot afford it seek treatment from Local Medical Assistant and Family Planning (LMAF) workers. Seeking religious treatment is not so common.[33] The respondents in this study took medical treatment from different sources like Union health complex, mobile team of both GO and NGOs, private doctors and Upazila health complex.

Most of the respondents got medical services from the government facilities which include union health complex (75%) and Upazila health complex (11%). Soon after the cyclone both the government and NGOs run more than one mobile team to provide door to door medical service to the affected people. NGOs health team and government mobile health team served about one third (35%) and one sixth of the respondents (14%) respectively. A few of them depended on LMAF (9%) and indigenous healing system (2%) for treating diseases.

Cattle Diseases:

Spread of disease among the surviving cattle population is another concern of farmer community. Soon after the disaster, the surviving cattle

[31] Parvin, Takashi & Shaw, 188.

[32] Md. Soyeb Uddin Haider, "Surviving the Apocalypse: A Case Study of Cyclone Disaster Management in Sandwip, 1991," Bangladesh Sociological Studies 3, no. 1 (March 2007):83.

[33] Haque & Islam, 42.

had a hard time due to scarcity of fodder and drinking water.[34] Decomposed corpses and carcasses polluted grazing fields and sources water. The study come across that majority of the respondents lost their cattle during cyclone of 2007. The surviving cattle were attacked by numerous diseases after drinking polluted and high saline water and new grasses that grown after receding the surge water. All these made the life of the surviving cattle very difficult aggravated by spread of diseases. The study finds that about one third of the surviving cattle were attacked by diseases like anthrax, diarrohea and Homorganic Septicemia (HS). Most of the cattle population were attacked by anthrax (48%) followed by diarrohea(41%). About one tenth of them were attacked by Homorganic Septicemia(HS). However, almost all the respondents treated their cattle from government veterinary hospital, ayurvedic doctor and LMAF.

The study finds that majority of the respondents (70.3%) got their cattle treated from government run veterinary hospitals. However, they had to pay extra money for this, said FGD participants. A few of them went to Ayurvedic Doctor (7.4%) and LMAF (11%). Low level of awareness was observed among the respondents regarding cattle disease. They make delay to take their cattle to veterinary hospital if cattle are attacked with diseases. Initially they try to treat by themselves or with the assistance of local quacks. The farmers feed mixture of biskathali for cattle disease especially FMD. Besides, they also practice religious medicine like Tabiz, Pani para, and Jharfuk etc which indicate that farmers still lack awareness to accept modern veterinary facilities due to low level of awareness and education. As result, unfortunately some of the cattle died before taking them to veterinary hospital for treatment, said FGD respondents.

Safe Drinking Water:

Ensuring safe drinking water is very important soon after the cyclone. Tube wells become inoperative, and pond and river water remain contaminated with carcasses and debris. Under such circumstances, safe drinking water source is very crucial to deal with post cyclone situation. The respondents had to collect safe water from a number of sources viz. NGO supplied water, using water purification tablet, water from unaffected tube well and boiling pond/rivers water.

Storing pure drinking water before hazards or disasters and the use of

[34] Parvin, Takashi & Shaw, 188.

water purification tablets are common practices among the people in the cyclone and tidal-surge-prone areas.[35] The present study finds that NGOs had a major contribution in supplying drinking water in the cyclone affected areas and majority of the respondents (97.5%) received pure drinking water supplied by NGOs for a period 3-4 months after the cyclone. In addition to NGO supplied water, they also used water purifying tablets (83.3%). After the cyclone that hit the study area in 2007, all the tube wells of the locality became inoperative which made availability of drinking water very acute. Respondents had to collect drinking water from unaffected tube wells (57.5%) or community based water purification plants located at 4-5 km distance.

Ponds were the major source of sweet water, but most of the sweet water sources including ponds were contaminated by saline water soon after the cyclone SIDR. Farmers in the study area tried in many ways to clean up pond water. Some of them used lime to get the pond water cleaned while others dried up their ponds, re-excavated, and raised embankments of the ponds to avoid further intrusion of saline water during tidal surge which yield better results and about one third of the respondents (37.5%) used to drink pond water after boiling.

Harvesting rain water was another source of drinking water. Indigenous technology of harvesting rainwater is easy to use and maintain. Rainwater runs down the slope of the CI sheet made roof which is harvested by fixing a plastic half-pipe to the edge of the roof. The pipe flows down to the pots/tanks which could be stored for couple of weeks. In such a ways, farmers harvest rain water to meet their demand of drinking water, said FGD participants.

Historical evidence enunciated in the East Pakistan District Gazetteer portrays that, 'the country was covered with the corpses of men and animals, and the water supply was polluted. Cholera broke out with appalling intensity. In Kutubdia alone, it was estimated that 11 per cent of the population perished during the epidemic. The total mortality of Cholera was 18,000.'[37] FGD participants said that, in the past, cholera broke out due to intake of unsafe water. But during the cyclone of 2007, none of the respondents and their family members were attacked by

---

35 Alam, 67.

36 Parvin, Takashi and Shaw,188.

37 S. N. H. Rizvi, ed., East Pakistan District Gazetteers: Chittagong, (Dacca: East Pakistan Govt. Press, 1970),

cholera as safe drinking water was ensured from different sources especially NGOs as such no casualty was observed due to outbreak of cholera.

Alternative Livelihood Strategies:

Although cyclone affected farmers got assistance from different sources to meet their immediate needs, they had to find sustainable ways of livelihood for their survival. They took different profession, took loan from relatives, NGOs and Banks, sold household items, used savings and migrated to cities for living.

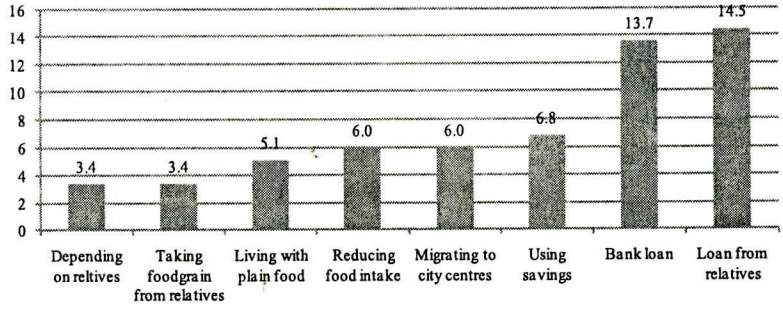

Figure 2. Percentage distribution of alternative livelihood strategies

Alternative Occupation:

There is a process of occupational mobility of the cyclone affected farmers. Most occupational changes took place from agriculture turning peasants into day labourers.[38] The present study finds that majority of the respondents (83.8%) were engaged in different profession which include day labour. They worked in road repair, removing debrises from roads and ponds, earth and sand filing, cleaning houses and working as helper of mason. They also worked as carpenter and rickshaw/rickshaw van puller to eke out their living. In the study villages, farmers are used to rear poultry birds including ducks and swans. Although they have lost almost all the poultry birds during the cyclone of 2007, they collected swan and poultry birds from kin, relatives, and local market. The female family members reared those, and subsequently get more poultry and eggs which are sold in the local market. The farmers now days are g ng more emphasis on swan rearing than ever before as swans can survive in moderate saline water. They clean weeds of the crop lands and have good market price as well. Considering the issues, the farmers are rearing swan said FGD participants.

[38] Alam, 69.

Taking Loan:

Borrowing money is a common coping measure.[39] The present study finds that about two third (70.9%) of respondents took loan from different sources and NGOs (42.7%) are the highest loan providers followed by relatives (14.5%) and government banks (13.7%). Most of the respondents borrowed money to meet food consumption and restart agricultural activities. It was observed that most of the borrowers took loan from more than one credit providers.

Disposal of Assets:

Disposal of assets is also a common coping strategy for rural households exposed to shocks in order to meet consumption requirements or acquire the means to purchase food.[40] The study reveals that during post-disaster period about one fourth (25.6%) of the respondents sold assets that comprise trees and jewelry. FGD participants said that some of the respondents also leased out or pledged farmland, etc. Very few respondents had cattle and poultry birds to sell out in the market. However, Paul and Routry find that selling of cattle and chickens are most common in the study villages.[41]

Using Savings:

Among the different coping methods related to livelihood or income sources, people primarily try to use whatever savings they have.[42] The study reveals that 6.8 percent of the respondents used savings to cope with the post-cyclone financial crisis especially to meet immediate food demand and restart agricultural activities. Actually farmers in the coastal areas live on subsistence economy and has least scope to save money to meet future crisis.

Migration:

Migration after a cyclone is not so common in the study villages.[43] On the other hand leaving one's village for a job is also very common. After any

39 Paul and Routry, Household response to cyclone induced surge in coastal Bangladesh, 487.

40 C Del Ninno & P A Dorosh, "Public policy, markets and household coping strategies in Bangladesh: avoiding a food security crisis following the 1998 floods." World Dev 31, no. 7 (2003):1228.

41 Paul and Routry, Household response to cyclone induced surge in coastal Bangladesh, 487.

42 Parvin, Takashi and Shaw, 188.

43 Paul & Routry, Household response and coping strategies, 487.

coastal hazards or disasters, many people go to cities for job opportunities.[44] The present study reveals that very few respondents migrated from Garganbunia and Padma village to city centres for job opportunities. Migration trend depend on the land ownership pattern of the people, contiguity of the city with the settlement of prospective displacees and job opportunity for those in the cities. Migration to city centres is common among those who are either landless or have some educational skill. As most of the respondents had land of their own, the tendency of migration among the farmers is less, said FGD participants. And few of the respondents (6%) went to city centres for alternative source of income ("in figure 2").

Relatives/Kin's Help:

Disaster affected people's coping strategy includes assistance from relatives.[45] The study also reveals that about 6.8 percent of the respondents received help from their relatives in the form of food grain aid, and food and lodging assistance. Neighbours also played a crucial role. They helped each other during and after the cyclone especially evacuation, reconstruction of houses, lending cattle and cash money, food, and agricultural equipments.

Conclusion:

The techniques that coastal farmers employ to cope with pre, during and post cyclone crisis are diversified in nature. Before cyclone the farmers undertake various protective measures; during cyclone they try to save lives using shelter centre or staying at their own houses. They also strive to save moveable properties and livestock. After the cyclone, they struggle for immediate needs and drinking water. They cope with human and cattle diseases. In addition, they try to regain livelihood along with searching alternative ways to face the aftereffects of cyclone. As part of long term preparedness, the farmers construct house with indigenous knowledge to make it durable and strong to face cyclone. They try to save house, cattle, food, seeds and valuable household items. But none of the respondents could save fish and standing crop.

---

[44] Parvin, Takashi and Shaw, 188.

[45] Mahbuba Nasreen, "Coping with Floods: Contribution of Women in Bangladesh," The Dhaka University Studies 55, no. 2 (December 1993):155.

Timely early warning and availability of shelter centre influences indigenous coping strategies of the farmers. Although early warning has improved, and a considerable number of shelter centres have been constructed in the cyclone-prone areas, these are still insufficient with respect to number of vulnerable people. The present study finds that there is no shelter centre within the 2 km distance of human settlement of the study area. Some of the respondents went to temporary shelter centre but majority of them stayed in their respective houses. When their houses were washed away they took shelter on strong trees or float on the tidal surge attaching with a plastic container.

Visiting shelter centre they can save their lives, but there is no provision to take cattle, valuable household item and agricultural equipment with them. It deters the respondents to visit shelter centre. Moreover, in many cases, shelter centres are not suitable for the affected people in respect of space and gender segregated separate sanitary facilities. In addition, confusion and credibility over early warning prevails among the rural farmers due to low level of education, awareness and lack of farmer friendly early warning. Furthermore, prejudice and ignorance of the farmers is also worthy to mention.

Restoring livelihood is a major challenge for the cyclone affected farmers. Most of the farmers could not cultivate robi crops due to salinity ingress. However, all the respondents cultivated amon crop borrowing tractor as most of the respondents (90%) lost their cattle. Majority of them (87.9%) had to collect seeds from the market. Other sources of seed include NGOs(36.8%), government office(26.7%) and relatives(19.8%).

Spread of diseases among human being and cattle is another issue of consideration while thinking of indigenous coping strategies of the farmers. Although some diseases spread both among the human being and cattle but these were not in epidemic form. In the past, cholera broke out due to lack of safe drinking water. But effective measures of both GO and NGOs helped ensure safe drinking water in the area after the cyclone of 2007. The respondents undertake various measures including taking alternative profession, selling out trees, jewelry and valuable item and taking loan from NGOs, Nationalized Commercialized Banks(NCBs) and relatives to meet immediate demands.

The present study finds that indigenous knowledge and techniques varies from ethnic group and location of the area. While some people still use them, many see these as "old fashioned' knowledge. Elderly people are more knowledgeable on indigenous knowledge than younger ones. Uncovering the indigenous methods to cope with the post-cyclone situation and disseminating among the new generation is important to build a cyclone disaster resilient community. Besides, community knowledge is crucial in formulating cyclone preparedness and post-cyclone management policies in Bangladesh.

Reference:

Alam, Edris. "Coping with Cyclone: An Occupational Group Perspective." Journal of the Asiatic Society of Bangladesh Humanities 48, no.2 (Dec. 2003): 59-74.

Alam, Edris and Andrew E. Collins. "Cyclone Disaster Vulnerability and Response Experiences in Coastal Bangladesh." Disasters 34 (Oct. 2010): 932-954. http://onlinelibrary.wiley.com/doi/10.1111/j.1467-7717.2010.01176.x/pdf, [accessed September 12, 2010]

Alam, Khurshid. Why should community coping mechanism be the centre of disaster reduction policy and practices? http://www.khurshidalam.org/articles_pdf . [accessed October 10, 2010]

Ali, Anwar. "Climate Change Impacts and Adaptation Assessment in Bangladesh." Climate Research 12 (1999):121-135.

Chowdhury, M. I. "Shape of Bangladesh through Ages". Journal of Bangladesh National Geographical Association 2, no.1 & 2 (1974): 1-12.

Hasan, Mohammad Tareq and Mohammad Abdul Baten. Indigenous Perception and Prediction, and Survival Strategies at pre, during and post disaster Phases: A Case Study of Cyclone SIDR. http://www.conftool.com/idrc2010/index.php/.[accessed October 12, 2010].

Howell, P. Indigenous Early Warning Indicators of cyclones: Potential Application in Coastal Bangladesh. London: Benfield Hazard Research Centre, 2003.

Hassan, S. "Indigenous Disaster Management Culture: A Comparative Study between Cyclone Affected People of Bangladesh." Journal of Human Sciences 26, no.3 (2000): 251-263.

Hoque, Abdul and M. Shahidul Islam. "Local Wisdom in Disaster Management: Case Studies of Chakaria and Moheshkhali." Journal of Bangladesh National Geographical Association 31, no.1 & 2 (2003): 34-43.

Islam, M. Rafiqul and Mohiuddin Ahmed, Living in the Coast: Problems Opportunities and Challenges. Dhaka: Program Development Office, Integrated Coastal Zones Management Plan, Ministry of Water Resources,

GoB, 2004: http://www.dotsilicon.com/webhost/host3500/coastalmediabd.com/related-documents/problems,%20opportunities%20 and%20challenges.pdf [accessed October 13, 2010].

Islam, Md. Kamrul and Mahbuba Nasreen. " Vulnerabilities and Capabilities of Rural Women During Flood: A Sociological Study." Khulna University Studies 6, no. 1 & 2 (2005):107-114

Karim, A., S.G. Hussain and M Ahmed. Salinity Problems and Crop Intensification in the Coastal Region of Bangladesh. Dhaka: BRAC, 1990.

Mustafa, M. M. "Towards an Understanding of Indigenous Knowledge." In Indigenous Knowledge Development in Bangladesh: Present and Future, ed. P. Sillitoe. Dhaka: UPL, 2000.

Nasreen, M. "Coping with Floods: Contribution of Women in Bangladesh." The Dhaka University Studies 55 (1998): 130-157.

Ninno, C Del & P A Dorosh, "Public policy, markets and household coping strategies in Bangladesh: avoiding a food security crisis following the 1998 floods." World Dev 31, no. 7 (2003):1228-1242.

Parvin, G. A. "Coastal Hazard and Community Coping Mechanism in Hatia Island of Bangladesh" International Environment and Disaster Management, no. 2 (2008), 15-18.

Parvin, Gulsan Ara, Fumito Takahashi and Rajib Shaw. "Coastal Hazards and Community-coping Methods in Bangladesh." Journal of Coastal Conservation 12 (2008): 1881-193. http://www.springerlink.com/content/78400583630p27g1/fulltext.pdf , [accessed September 12, 2010].

Paul, Bimal Kanti, "Why relatively fewer people died? The case of Bangladesh's Cyclone SIDR" Natural Hazards 50 (2009): 289-304. http://www.springerlink.com/content/76500g0581u03782/fulltext.pdf [accessed September 29, 2010].

Paul, Shitangsu Kumar and Jayant K. Routray, "Household response to cyclone induced surge in coastal Bangladesh: Coping strategies and explanatory variables," Nat Hazards 57 no. 2 (October 2010): 477-499.http://www.springerlink.com/content/a1857633p96427ut/fulltext.pdf [accessed March 13, 2011].

Paul, Shitangsu Kumar and Jayant K. Routray." Flood Proneness and Coping Strategies: The Experiences of two Villages in Bangladesh." Disasters 34 (April 2010): 489-508. http://onlinelibrary.wiley.com/doi/10.1111/j.1467-7717.2009. 01139.x/pdf [accessed October 7, 2010].

Rahman, M. Safiur," Disaster Management and Public Awareness in Bangladesh" in Disaster in Bangladesh: Selected Readings ed K. Nizamuddin. Dhaka: Disaster Research Training and Management Centre, 2001: 179-97.

Rasid, H. and Bimal Kanti Paul BK, "Flood Problems in Bangladesh: is there an indigenous solution? Environmental Management 11, no. 2 (1987):166.; P Thompson & I Tod, "Mitigating flood losses in the active floodplains of Bangladesh, Disaster Prevention Management 7, no. 2(1987):118-132.

Rashid, Md. Habibur ed., Bangladesh District Gazetteers: Bakargonj, Dacca: BG Press, 1981.

Rizvi, S. N. H. ed., East Pakistan District Gazetteers: Chittagong, Dacca: East Pakistan Govt. Press, 1970.

Samshuddoha, M. and M Sahadat Hossain. "Improving Coastal Resource Management for Socio-economic Development of Rural Communities in Cox's Bazar." The Chittagong University Journal of Social Sciences vol. xxiv, part 2 (May 2008): 175-92.

Shaw, Rajib and RR Krishnamurthy, Disaster Management, Hydrabad: Universities Press (India) Private limited, 2009.

Talukder, Joyotimoy, Gauranga Deb Roy & Mohiuddin Ahmad, Living with Cyclone: Study on Storm Surge Prediction and Disaster Preparedness, Dhaka: Community Development Library, 1993.

UN, Words into Action: A guide for implementing the Hyogo Framework, UNISDR, 20 April 2007, www.preventionweb.net/files/594_10382.pdf [Accessed February 12, 2011].

Yamane, Taro, Statistics: An Introductory Analysis (2nd edn.). Harper and Row, New York, 1967.