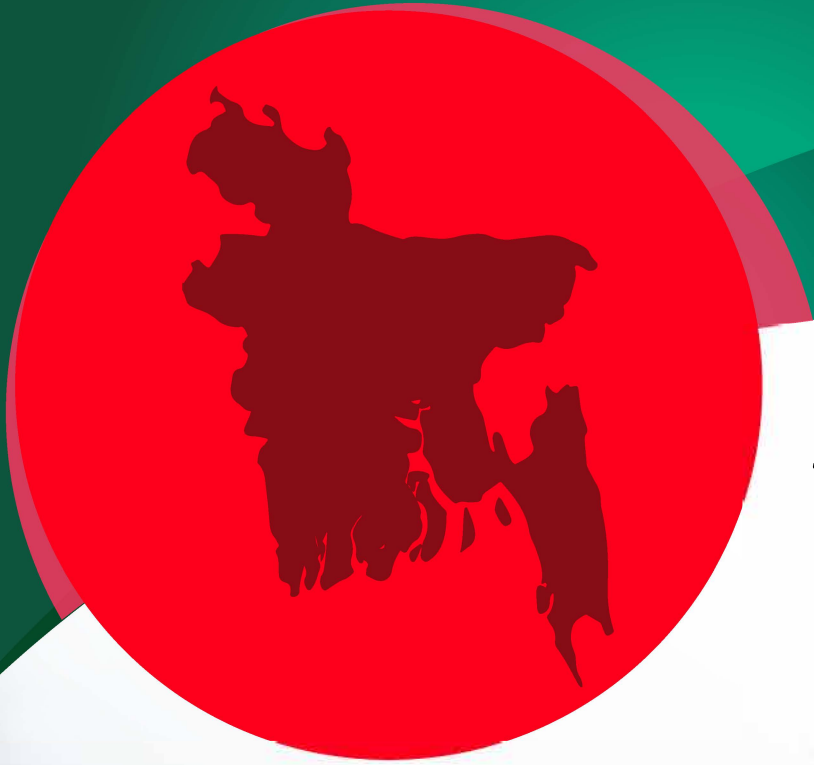


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Indigenous Coping Strategies of the Cyclone-Affected Farmers in Coastal Areas of Bangladesh

M. Ibrahim Khalil

Abstract

Bangladesh is a country affected by frequent and devastating cyclones. Historical trends show that a severe cyclone hits Bangladesh every three years. Of late, this gap has reduced with the advent of human induced climate change. Cyclones cause 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 cyclones, 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 highly vulnerable and forces them to adopt various strategies for survival. 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.

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's coasts are very alarming. Over a period of 100 years, 508 cyclones have formed in the Bay of Bengal, 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 and causing other damages and losses (GoB, 2008). A severe cyclone occurs once almost every three years (Ali, 1998); the 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. Such regular cyclonic patterns and the narrowing gap of their occurrence suggest that the lives and livelihoods of the coastal people are endangered. Human-induced climate change further exacerbates the intensity and velocity of cyclones and a rise in sea levels (IPCC, 2010). The life and livelihood of the people of coastal areas are expected to be faced with monumental challenges in the years to come.¹

While all the occupational groups of the coastal areas are affected by tropical cyclones and tidal surges, farmers are one of the most vulnerable groups as they hardly get any opportunity to evacuate crops from their fields and lose almost all assets and equipment associated with their livelihood. Besides, geo-environmental vulnerability, low level of education and lack of media access, fragile housing conditions, inadequate infrastructure, and the subsistence

economy makes the farmers more vulnerable than any other occupational group living in the coastal areas. Unveiling farmers' coping strategies is important in the socio-economic context of Bangladesh as they are considered the heart of the rural economy. If farmers' existing coping strategies are understood properly, appropriate planning may help reduce the 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, a clear understanding of the coping mechanisms is essential for building resilient farming communities in the coastal areas of Bangladesh.

A number of studies 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 surges. Few studies, however, emphasized 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 concerning cyclones, 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 this study is to explore the indigenous coping strategies of the farmers living in the coastal areas of Bangladesh prior to, during, and the post-cyclone phases.

Methodology

The study was conducted in two villages of Barguna district. Multistage cluster sampling was used to determine the study locale. Previous cyclone track record reveals that among the 19 coastal districts,² 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 five Upazilas of the district are almost equally vulnerable; as such the study was 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 Sardar union of Pathorghata Upazila were selected considering their vulnerability. The first village is located at the confluence of the river *Paira* and the Bay of Bengal and the latter is located at the shore line.

The study makes use of both the qualitative and quantitative approaches. Data for the study were collected from both the primary and secondary sources. Along with the literature review, surveys, focus group discussions (FGDs), and key informants interviews provided relevant information germane to this study. Before conducting face to face interviews a reconnaissance survey was carried out in both the study villages to identify the *bona fide* farmers on the basis of several predetermined criteria including 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 the formal sector; and iv) Farmers who have had a 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 ($n=N/1+Ne^2$ where n = sample size, N = population and e =deviation level/error accepted) (Yamane, 1967, p. 886), 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 were

purposively selected for two FGDs from among the randomly selected farmers to obtain in-depth knowledge of farmers' indigenous coping strategies. In addition, six key informants including farmers, local public representatives and block supervisors were interviewed to obtain in-depth information.

Indigenous Coping Strategies

Indigenous coping strategies involve ways in which people use 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 (UN, 2007). Therefore, understanding community coping mechanism is essential to build a resilient community. Undertaking indigenous coping strategies by a cyclone affected community depends on a number of issues such as early warning systems, media access, level of awareness, availability of shelters, and approach roads to these shelters. In Bangladesh, increasing numbers of people have better access to electronic media including private radios and, more recently, wide coverage of cell phones to track weather forecasts. Globally, weather warning technology has improved greatly particularly with developed satellite imaging and analysis of global weather systems.

Despite technological advancements, available physical facilities, improved early warning systems, and better access to media, survival strategies of the coastal farmers are subject to their social and economic circumstances. But the indigenous knowledge that farmers apply when facing a cyclone is little known or understood.

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 helps minimize loss of life and property (Rahman, 2001). As part of their cyclone preparedness activity, coastal farmers consider plinth height, house height and design, planting trees around the house, and facing of their 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

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 <i>machan</i> (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*

different measures. These strategies are further examined next.

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 a 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 enough, house owners are more likely to save family members and belongings from severe tidal surges (Alam & Collins, 2010). The Maghs, who built their houses of timber upon piles six or eight feet high, found themselves far better off in 1876 than the people whose houses were at the surface level which bore the extreme fury of the waves (Rashid, 1981). 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 plinths offer protection from cyclones (see 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.

Plantation of trees around the homestead is another important adaptation technique for saving lives, houses and property during wind storms and sea surges (Alam & Collins, 2010). 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* that create barriers against strong wind and reduce losses during cyclone. Planting trees around homesteads resembles the idea that the Sundarbans saves Bangladesh from the severity of cyclone. The idea proved to be true during cyclone SIDR that swept over the area in 2007.

The heights of the houses and their facing are also of consideration while constructing houses according to the FGD participants. Constructing houses of medium height -- *chowchala* house³ -- is another technique that saves house of the coastal farmers during a cyclone. The study found that majority of the respondents (59.7%) said they constructed *chowchala* houses of medium height (15-20 feet) so that strong winds pass over the roof of the houses without causing much damage. One-fifth of the respondents (20.2 %) said that they considered facing of the houses while erecting them: south facing houses are better able to resist wind pressure because, in most of the cases, wind flows from the south-easterly direction during a cyclone. Besides, constructing houses with strong and durable logs using palm trees or placing cement pillars under wooden pillars are better for staving off the effects of cyclones.

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=121)

Source: Field survey, 2011

The study found that about one-sixth of the respondents (16%) did not undertake any strategy while constructing houses.

Strategies for saving cattle

Along with protecting their houses, farmers also try to save their cattle. Usually they try to send their cattle to high ground, set them free, or keep them in the cow sheds to save them from the devastation of a cyclone.

Strategies for saving cattle

Along with protecting their houses, farmers also try to save their cattle. Usually they try to send their cattle to high ground, set them free, or keep them in the cow sheds to save them from the devastation of a cyclone. Cyclone affected people try to save poultry and livestock as these are the most valuable assets for rural communities (Alam & Collins, 2010; Parvin, Takashi, & Shaw 2008; Paul & Routry 2010). The study found that one-third of the respondents (34.2%) were not well prepared ahead of a cyclone that struck the study villages in 2007. Although the study area was vulnerable to frequent cyclonic devastation, there were no *killas* (high ground) for cattle in either of the villages. Finding no alternative ways, a majority of the respondents (56.4%) set their cattle free to find refuge on their own. Under the circumstances, very few survived, as maintained by the FGD participants. A few fortunate respondents (4.3%) could send their cattle to higher ground or to their neighbors' house to save them.

Preserving food, seeds and land deeds

Storing seeds and food before a cyclone can help reduce the suffering of the of cyclone- affected

farmers immediately after the cyclone. Besides, jewelry and land deeds are also considered as valuable household belongings. Farmers in the study areas try to preserve these items in their own ways to retrieve them when the cyclone is over.

In the present study, one-third of the respondents (30.8%) were found ill-prepared about saving food, seed and land deeds. Most of the FGD participants did not receive any early warning well ahead of cyclone to prepare themselves. In addition, they could not assess the severity of the cyclone that swept over the area in 2007. Half of the respondents (50.1%) kept seeds and food inside plastic containers.

Protecting fish and crops

Protecting fish is almost impossible when severe cyclones are accompanied by a surge (Paul & Routry, 2010). The present study obtained similar findings that none of the respondents could save their fish resources as well as standing crops. FGD participants stated that they could not imagine that such devastation could strike them. Moreover, they did not get enough time to catch fish or harvest standing crops. However, they usually try to use bamboo fences, fishing nets and mosquito nets to save fish in the pond at the initial stage or if the cyclone is not severe in nature.

Response During a Cyclone

Farmers face 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. For extreme situations, they either evacuate themselves to a safer place or stay in their own houses. Those who stay in their own houses adopt different measures including observance of religious rituals, clinging to trees and using plastic containers as flotation devices.

Table 3. Causes behind refraining from visiting shelter center

Causes of not visiting shelter center	Number of response	Percent of cases
Non-availability of shelter center	60	65.2
Could not realize severity of cyclone	47	51.1
Non-availability of <i>killas</i>	40	43.5
Fear of theft	30	32.6
Fear of being washed away by surge water	31	33.7
Early warning was not credible	23	25.1
Shortage of space in the shelter center	9	9.8

Note: Multiple response(N=92)

Source: Field survey, 2011

Protecting homes

Farmers without access to shelters or who do not evacuate to a safe place stay in their homes. During a cyclone, they try to save their houses. The common measures include attaching delicate parts of the houses with rope, fastening houses to strong trees, putting up fences, and using additional support.

For cyclones, one-third of the people apply their indigenous knowledge (Parvin et al, 2008). In their effort to save houses, more than one-third of the respondents (37.5%) tied together fragile parts of their house with rope. About one-fourth of the respondents (23.3%) put up fences. Binding houses to adjacent large trees, i.e. coconut trees, rain trees and *gaab* trees is another way in which the respondents try to save their houses. About one-tenth said they tethered their houses using additional support with strong bamboo and logs.

Use of shelter center

As mentioned earlier, use of shelters by the farmers in cyclone-prone areas depend on availability and suitability of shelter, issuance of early warning, level of awareness about early warning and destructive power of cyclone, distance of shelter center from the dwelling places of the farmers, etc. Almost half of the people (46%) take shelter at the cyclone centers (Parvin et al, 2008). The present study found that about two-thirds of the respondents (77%) did not use any shelter centers. The main reasons are distance of the shelter centers, low levels of awareness, fear of theft in the house, lack of early warning incredible, fear of space shortage in the shelter center and non-

availability of *killas* for the livestock.

Distance of shelter centers

Shelters centers established in the cyclone-prone coastal districts are located at a distance of more than 3.5 miles (5.6 km) apart (Paul, 2009). Haque and Islam's (2003) study found that locations of the nearest centers lie between 1 to 3 km. Studies have shown that unless a cyclone shelter is within 1 mile (1.6 km) of human settlements it may be too far for coastal residents to travel during an emergency (Paul, 2009). Distance of shelters from the respondents' homes was the main reason for their non-evacuation (Paul, 2009). The present study found that a majority of the respondents (65.2%) did not use shelter centers due to their distance from their houses. The present study further found that with the increase of distance of shelter center from the dwelling places of the respondents, the tendency of using shelter center decreases.

Fear of space shortage

Soon after the independence of Bangladesh, a program was initiated to construct shelters with a view to protect coastal residents from cyclones and storm surges. There are more than 2,000 cyclone shelters along the coast of Bangladesh, but these can accommodate only one-fourth of the population in high-risk areas (Parvin et al, 2008). Another study reveals that the number of shelters established in the cyclone-prone coastal districts is not enough to accommodate all people in these areas (Paul, 2009).

The scenario is quite similar in Garjanbunia and

Padma village. There are around 2,890 people in the two villages but there were no shelters in the villages before 2007. The villagers were expected to go to a shelter located at more than 2 km distance. When early warning is issued, respondents feel that the cyclone shelters located at a distance would overflow with the people of adjoining areas, said FGD participants. The Union Health Complex, located within two kilometers distance, was declared as a temporary shelter immediately before the cyclone SIDR swept over the area. But the respondents suffered from perceived space shortage. The present study found that about one-tenth of the respondents (9.8%) who considered a remote shelter did not visit it fearing for shortage of space.

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

Alternative shelters

As there was no formal cyclone shelter in the study village, during the cyclone of 2007, a majority of the respondents had to stay in places like their own homes, neighbors' house and the union health complex. In disaster-prone localities, coping measures start with saving human lives (Rashid & Paul, 1987; Thompson & Tod, 1987). Paul and Routry (2010) found that a majority of the household members do not take shelter in traditional cyclone shelters. The present study found 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 their neighbor's house. The Union Health Complex did not get much attention of the respondents and attracted only one fourth of the respondents (26.1%) to take shelter.

Strategies adopted at home

Respondents who did not go to a shelter or other safer place climbed on a *machan* (high platform), clung to strong trees, or tied together plastic containers as flotation devices. They also observed

religious rituals.

A majority of the respondents (56.41%) stayed on a *machan* in their own houses. About half of them (51.8%) climbed or attached themselves to strong trees until the severity of cyclone was diminished. FGD participants said that when their house collapsed they, along with their family members, floated on surge waters with plastic containers which were tied together beforehand.

In the event of any disaster, the immediate response is praying to God and offering *Ajan* (Hoque & Islam, 2003). 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 would save them from the wrath of the cyclone. People of Muslim communities strongly believe that Allah (God) brings the cyclone, the intensity of which would be reduced if He is satisfied with their religious rituals. The offering religious rituals, thus, has deep psychological effects during the moment of crisis.

Post-Cyclone Period

As soon as the cyclone has passed, affected farmers become helpless losing crops, cattle, and agricultural equipment. Their houses are devastated and they suffer from dearth of food, shelter and drinking water. Community or organizational assistance from outside contributes to some extent to meet emergency needs. But such outside help does not last long and are not adequate compared to the needs of the farmer families who strive to restore their livelihoods but face difficulties due to of acute crisis of seeds, salinity intrusion, and loss of cattle and agricultural equipment.

Restoring livelihood

Agriculture is the main source of livelihood in the study area, especially food grain production. All of the respondents were from the farming community. Agriculture suffers most whenever cyclone affects any part of the coastal areas of Bangladesh. During the cyclone of 2007, farmers of Garjanbunia and Padma lost almost all of their standing crops which were the main source of food supply for the rest of the year. Most of the agricultural farmers live on subsistence. Cyclonic devastations further increase their vulnerability. Although relief and rehabilitation programs are initiated by government organizations

Table 4. Ways of *amon* cultivation

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
NGO/MFI loan	5	4.2
Bank loan	3	2.5

Note: Multiple responses (N=117)

Source: Field survey, 2011

(GOs) and non-government organizations (NGOs) soon after the cyclone, the farmers remain distressed as the relief materials are very often inadequate compared to their needs, said FGD participants. That is why it is very urgent to start agricultural activities. 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 the farmlands were affected by high levels of saline sediments. As they failed to harvest the *robi* crop, farmers had to wait to cultivate *amon* crop. Meanwhile they began to overcome the primary shock and losses. Almost all the respondents cultivated *amon* crops, but they had to face difficulties with respect to cattle for tilling land, agricultural equipments, seeds, and cost of agricultural activities. In spite of such adversities they cultivated land by borrowing tractors and cattle, and taking loans.

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 from cyclones and storm surges (GoB, MoEF, 2009). 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 tractors to cultivate their lands. However, one-tenth of them (10.2%) cultivated land with surviving cattle. Few of the respondents got loans from MFIs/NGOs (4.2%) and banks (2.5%) for meeting agricultural expenses.

Collecting Seed

Supply of seed is very crucial for restoring agricultural activities. Few respondents can save seeds since surge waters sweep away everything. The present study reveals that a majority of the

respondents lost their supply of seeds during the cyclone of 2007. As such, collecting seeds was a major challenge for them, obtaining them from various sources such as the market, NGOs, government organization and relatives.

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

Coping with salinity

High level salinity intrusion has been considered a potential source of human suffering due to its adverse effect on agricultural practices (GoB, MoEF, 2009). It is estimated that about 8.5 percent of the nation's agricultural output originate from areas with elevation up to one meter from the sea level. Estimated agricultural output above three meters amounts to 21 percent of the nation's agricultural output. Current estimates suggest that saline water intrusion now extends as far as about 240 kilometers inland. Assuming an extreme scenario, saline water could be driven another 240 kilometers northward. If the rivers are affected, the whole country would be affected by the intrusion of saline water (Talukder, Roy & Ahmad, 1992). Impact of saline water on cropland is also evident from the Bakerganj district Gazetteer which indicates that, "Bakerganj 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 (Rashid 1981)."

The present study found that a 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 salinity ingress which continued until rain water washed it away during the monsoons, 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 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 intrudes frequently.

Human diseases

Coastal hazards like cyclones and tidal surges are often followed by skin diseases, fever, and diarrhea (Parvin et al, 2008). Low level of awareness, economic constraints, 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 teams work after the cyclone, their coverage remains limited with respect to actual needs. Relief distributing agencies emphasize rescue, emergency food supply, and shelter related activities. As a result, spread of diseases among human being and livestock become of major concern. Diarrhea broke out on a large-scale immediately after a cyclone in Sandwip (Haider, 2007). The study found that about half of the respondents (47%) were attacked by diseases like typhoid, fever, diarrhea and cold-related diseases. Among them about one-third (35%) of the respondents were attacked by typhoid, followed by fever (26%), dysentery (26%), diarrhea (23%) and cold-related diseases. But diseases did not spread in epidemic form due to intervention of the GOs and NGOs, especially due to ensuring supply of potable water and activities of health teams, said FGD participants.

Human suffering, after the occurrence of any natural disaster, draws the attention of all concerned. The outbreak of various diseases and suffering during cyclone needs medical support (Hoque & Islam, 2003). 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 divine intervention is not so common (Parvin et al, 2008). 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 a cyclone both the government and NGOs run more than one mobile team to provide door to door medical service to the affected people. NGOs and government mobile health teams 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 among the farmer community. Soon after the disaster, the surviving cattle had a hard time due to scarcity of fodder and drinking water. Decomposed corpses and carcasses polluted grazing fields and sources of water (Alam, 2003). A majority of the respondents lost their cattle during the cyclone of 2007. The surviving cattle were attacked by numerous diseases after drinking polluted and saline water and the new grass that grew after the surge water receded. The study found that most of the cattle population were attacked by anthrax (48%), followed by diarrhea(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 found that a 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* doctors (7.4%) and LMAF (11%). Low level of awareness was observed among the respondents regarding cattle diseases. They delay taking their cattle to veterinary hospitals when attacked with diseases. Initially they try to treat the cattle by themselves or with the assistance of local

quacks. The farmers feed the cattle a mixture of *biskathali* for cattle disease especially FMD. Besides, they also indulge in religious practices like *Tabiz*, *Pani para*, and *Jharfuk* which indicate that farmers still lack awareness of modern veterinary facilities. As result, unfortunately, some of the cattle died before they could be taken to veterinary facilities 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 waters 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 obtain safe water from a number of sources viz. NGO supplied water, using water purification tablet, water from unaffected tube wells, and by boiling pond/river water.

Storing pure drinking water before hazards or disasters and the use of water purification tablets are common practices among the people in the cyclone and tidal-surge-prone areas (Parvin et al, 2008). The present study found 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 from 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 from cholera was 18,000 (Rizvi, 1970, p. 49).” 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 cholera as safe drinking water was ensured from different sources especially NGOs.

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.

Alternative occupation

Most occupational changes took place with agricultural farmers turning into day laborers (Alam, 2003). The present study found that a majority of the respondents (83.8%) were engaged in different professions. They worked in road repair, removing debris from roads and ponds, earth and sand filling, cleaning houses and working as helpers of masons. They also worked as carpenters and rickshaw/rickshaw van pullers to eke out a living. In the study villages, farmers are used to rearing poultry including ducks and swans. Although they lost almost all their poultry during the cyclone of 2007, they collected swan and poultry birds from kin, relatives, and the local market. The female family members reared them, and subsequently sold poultry and eggs in the local market. The farmers now-a-days are giving more emphasis to swan rearing than ever before as swans survive better in moderate saline water. They also clean weeds and have good market price.

Taking loans

Borrowing money is a common coping measure (Paul & Routry, 2010). The present study found that about two-thirds (70.9%) of respondents took loan from different sources. 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. Most of the borrowers took loan from more than one source.

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 (Ninno & Dorosh, 2003). The study reveals that during the post-disaster period, about one-fourth (25.6%) of the respondents sold assets such as 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 to sell. However, Paul and Routry (2010) found that selling of cattle and chicken are most common in the study villages.

Using Savings

Among the different coping methods related to livelihood or income sources, people primarily try to use whatever savings they have (Parvin et al, 2008). 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.

Migration

Migration after a cyclone is not so common in the study villages (Paul & Routry, 2010). On the other hand, leaving one's village for work is also very common. After any coastal hazards or disasters, many people go to cities to seek work (Parvin et al, 2008). The present study reveals that very few respondents migrated from Garganbunia and Padma village to city centers for work opportunities. Migration trends depend on the land ownership pattern of the people, contiguity of a city with the affected area, and work opportunities. Migration to city centers is common among those who are either landless or have some education. As most of the respondents had land of their own, the tendency of migration among the farmers is less, said FGD

participants. And very few of the respondents (6%) went to city centers for alternative source of income.

Relatives'/Kin's help

Disaster affected people's coping strategy includes assistance from relatives (Nasreen, 1998). The study also reveals that about 6.8 percent of the respondents received help from their relatives in the form of food grain and lodging. Neighbors also played a crucial role. They helped each other during and after the cyclone especially with evacuation, reconstruction of houses, and lending cattle, cash money, food, and agricultural equipment.

Conclusion

The techniques that coastal farmers employ at different times -- pre-, during and post cyclone crises -- are quite diversified. Before a cyclone the farmers undertake various protective measures; during cyclone they try to save lives using shelter center 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 their livelihood along with searching for alternative ways to face the after-effects of a cyclone. As part of long term preparedness, the farmers construct house with indigenous knowledge to make it durable and strong. They try to save their homes, cattle, food, seeds and valuable household items. But none of the respondents could save fish and standing crop.

Timely early warning and availability of shelters influences indigenous coping strategies of the farmers. Although early warning has improved, and a considerable number of shelters have been constructed in the cyclone-prone areas, these are still insufficient with respect to the number of vulnerable people. The present study found that there is no shelter center within two kilometers of the study area. Some of the respondents went to temporary shelters but a majority of them stayed in their respective homes. When their houses were washed away they took shelter among strong trees or floated using plastic containers.

By visiting shelter centers farmers can save their lives, but there is no provision to take cattle, valuable household items, and agricultural equipment with them. This deters the farmers from visiting shelter

centers. Moreover, in many cases, the shelters are not suitable for the affected people in respect of space and gender segregated 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 mechanisms. Furthermore, prejudice and ignorance of the farmers is also worth mentioning.

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 by borrowing tractors 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 offices (26.7%), and relatives (19.8%).

Spread of diseases among human beings and cattle is another issue to consider when thinking of indigenous coping strategies of the farmers. Although some diseases spread both among the human and cattle populations, these were not in epidemic form. In the past, cholera broke out due to lack of safe drinking water. But effective measures of both GOs and NGOs helped ensure safe drinking water in the area after the cyclone of 2007. The respondents undertook various measures including alternative profession or selling trees, jewelry and other valuable items, and taking loans from NGOs, Nationalized Commercialized Banks (NCBs) and relatives, to meet immediate demands.

The present study found that indigenous knowledge and techniques vary from between ethnic groups and locations. While some people still use them, many see these as “old fashioned” knowledge. Elderly people are more aware of indigenous knowledge than younger people. Uncovering indigenous methods of coping with the post-cyclone situation and disseminating this information among the new generation is important to build cyclone disaster resilient communities. Besides, community knowledge and awareness building is crucial in formulating cyclone preparedness and post-cyclone management policies in Bangladesh.

Endnotes

1. This is particularly true taking into account of the IPCC forecasts. The IPCC in its third assessment report predicted that half a meter sea level rise by

2050 will permanently inundate 11 percent of Bangladesh territory.

2. The districts are Bagerhat, Barguna, Barisal, Bhola, Chandpur, Chittagong, Cox’s Bazar, Feni, Gopalganj, Jessore, Jhalkati, Khulna, Laksmipur, Narail, Noakhali, Patuakhali, Pirojpur, Satkhira and Sariatpur.
3. Chowchala House has a pyramid-shaped roof containing four adjoining parts (Chala) usually made of iron sheet/straw/Golpata which stands on a wooden structure with a height of 20-24 feet from the ground.

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