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ABSTRACT

Alam M, Amin MS, Nandi P (2012) Climate resilient disaster vulnerable livelihood adaptations in coastal Bangladesh. *J. Innov. Dev. Strategy*. 6(2), 87-93.

Studies were conducted on climate resilient disaster vulnerable livelihood adaptations in coastal Bangladesh. With the objectives of identifying the ways to reduce vulnerability of coastal communities to the impacts of climate change-induced risks; and to know the technological factors of Community Based Adaptation to Climate Change through Coastal Afforestation (CBACC-CF); assessing the present interventions as to its livelihood improvement. The study was conducted using Participatory Rural (PRA) and Focus Group Discussion using pre-tested guidelines. Venn diagram Analysis of Hazards were done. The study covered 4 coastal Barguna, Bhola, Noakhali, and Chittagong districts. The results indicated that daily labour on animal and crop cultivation were the main sector of livelihood being 28.14 per cent as highest, followed by about 22 per cent for fishing sector. It was previously reported that small business and local services were more dominant in the area due to migration of free lancer labour, but the present finding reveal that now the employment scopes are increasing due to transfer of agro-technologies in the areas. Unprecedented hazard events such as heavy rainfall cause damage of harvestable crops and remains increasing risk to any further cropping. Soil salinity does not favor for rice cropping as it grew up from November till the onset monsoon. The highest numbers of agriculture day labors are engaged to Aman rice cultivation and harvesting time Two paddy crops (Aman rice and Boro rice) are currently cultivated for local rice demand throughout a year. Fishing activities is considerably found from the mid of July till December. Day labour and fishing significantly varied which may be due to the availability of disaster adapting crop technologies and characteristics of the water bodies. The adaptation status of study areas were found to be highly sensitive to tropical cyclone, storm surge, rainfall and high tide. Natural resource endowment in the area comprises mangroves, agricultural lands, and river, canal and fish ponds. There are additional income generated by homestead gardening, poultry rearing, mat preparation, weaving of fishing net and small grocery business.

***Key words**: coastal bangladesh, hazard vulnerability, livelihood adaptations*

INTRODUCTION

Bangladesh is highly vulnerable to climate change. Livelihoods of coastal people are highly dependent on climate sensitive sectors. Coastal areas possess an array of ecosystems including mangroves, water bodies and char lands. Sustainable benefits of the coastal resources were highly fragmented by the impacts of natural disasters and social-institutional interplay on use and access to the resources. Climate change has increased unprecedented threats to life and livelihoods of people living in coastal areas of Bangladesh. According to the research reports, coastal population has confronted a number of tropical cyclones and storm surges, and voluminous salinity ingress (Amin *et al.* 1990a,b; Coxhead and Jayasuriya, 1994; Grether and de Melo, 2004). They added that the geographical location of coastal areas along the Bay of Bengal has itself been manifested with such firsthand vulnerability of people to natural disasters followed by negative impacts on their life. Following any disaster, people always remain less able to cope and continue their regular life supporting livelihood function due to few alternative resource endowments in coastal area. Disproportionate resource distribution and access to natural resources and institutional services, particularly landless poor and marginal farmers face extremely vulnerability to disaster shocks. With climate changes and of its increasing degree of impacts, the vulnerability of coastal people goes beyond any of their least coping capacities and remains far off long-term adaptation. The risk of climate change-induced damage to human and economic development in coastal areas of Bangladesh is mounting. The combined effects of sea-level rise and subsidence, changes in upstream river discharge, increased frequency and intensity of tropical cyclones, and erosion of coastal embankments pose a serious threat to the natural resource base and livelihood opportunities of coastal communities.

The existing disaster management framework in Bangladesh was largely organized to deal with recurrent extreme events, whereas coastal zones in Bangladesh were also confronted with a range of creeping climate risks, such as increasing salinity trends in coastal freshwater, drainage congestions, As a part of Community Based Adaptation to Climate Change through Coastal Afforestation(CBACC-CF) project, a study was conducted in four unions of Chittagong, Noakhali, Bhola and Barguna districts. The aim of the study was to assess the need and capacity of the people for adaptation through looking into the existing Agro-livelihood context of the area and vulnerability to climate changes. The main objective of the research concept was to develop climate resilient livelihood strategic framework with emphasis on marginalized groups.

MATERIALS AND METHODS

The study was conducted through following community based demand for solution approach. Community participants were engaged in PRA exercises to pull out own perception on existing social, natural and economic context of the locality followed by specific discussion on climate change issues in nexus of need and capacity assessment. Participants were allowed to interact and respond on common problem they face for their livelihood, weather variability and need for solution in the context of climate change. In group exercises, participants discussed on specific issue such as livelihood or hazard related vulnerability and provide in depth explanation for defining target root for adaptation interventions in the long-run. The whole PRA study was undertaken through following 4 steps: i. Selection of participants, ii. Organizing PRA exercises, iii. Facilitation in exercises, and iv. Data collection and sorting. The main analysis included social mapping, hazard trend analysis, hazard identification and ranking, preparing hazard and livelihood calendar, and cropping pattern analysis. The study covered 4 coastal districts (Barguna, Bhola, Noakhali and Chittagong). PRA and Focus group discussions were held to know climate variability induced problems and their coping mechanism, how they fight with natural calamities and how they cope with frequent natural disaster.

Data Analysis Process: The data collected through the PRA process was consolidated as per parameter integrations. For instance data collected under social mapping falls within map drawing exercises that represented different types of resources in an easily understandable format. Under each tool different sub-categories were analyzed through simple quantitative works, such as: sum of respondent percentage for agriculture as their main livelihood and vice versa. The methods and materials used in the studies were formulated considering the recommendations of Amin (1989) and Amin (1992).

RESULTS AND DISCUSSION

The results obtained from the studies are sequentially mentioned and described and presented in tabular and graphical forms.

Tropical cyclone hazards: In 1970, tropical cyclone with storm surges hit the coastal area of Bangladesh and incurred huge loss of life and property. The respondent participants identified storm surges of 1970 as one of the severe disasters they experienced over their life in the area. After 1970s, tropical cyclone and storm surges hit the area in several times. The frequency of tropical cyclone event has increased which often falls more than one in a single year. Between 1991 and 1995, tropical cyclone hit the area three times which caused loss of people's life, natural resources of agriculture, fisheries and livestock. Participants recognized the cyclone of 1991 to be severe for those people who were living outside the embankment and exposed to first hit. The number of cyclone event increased between 1996 and 2000 and was observed for four times. In succeeding years from 2001 to 2005, tropical cyclone occurred for five times. Between 2006 and 2010, the highest numbers of tropical cyclone with severe intensity occurred for six times in the area.

Storm surges: In early time, storm surges were an extreme hazard event in the area that occurred in rainy season of the year. Between 1991 and 2000 only two storm surges hit the area, which by contrary increased in subsequent years. The participants perceived the water surge event has changed its probable occurrence time beyond any prediction.

High tide induced salinity ingress: In the past years, salinity ingress with high tidal effects was severe problems for the area. Between 1991 and 1995, with tidal surge salinity ingress was observed for six times. In the following years, however, salinity ingress has reduced in nos. of time and intensity.

Epidemic of animal/bird: Poultry Ranikhet diseases followed by mortality have been identified to be increasing. Between 1991 and 1995 the spread of the disease has been observed for six times. From 2001 to 2005, the number of disease attack increased in two folds with severe loss of poultry.

Heavy rainfall: In 10 years interval, from 1991 to 2000, heavy rainfall was recorded for five times. Between 2001 and 2005, heavy rainfall occurred for 2 times in the area. The number of heavy rainfall did not largely increase in the area, but the intensity and consequent impacts grew up than before.

Hazard calendar: Upon experiences, the participants identified different types of hazards such as tropical cyclone, high tide, storm surges, heavy rainfall and seasonal drought that observed in a year (Fig. 1). Considering frequency and intensity of each hazard, maximum types occur from April to September. The salient features of each hazard with respect to its occurrence, frequency and intensity is given here.

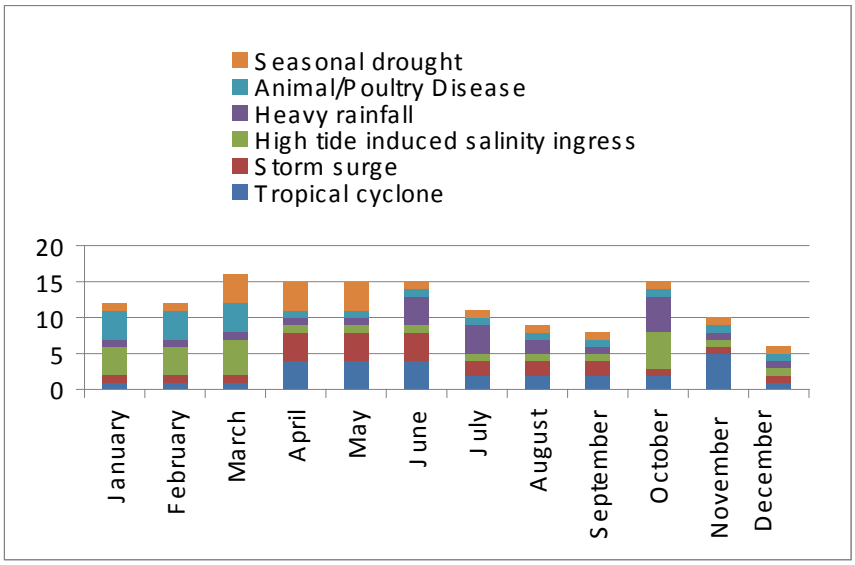

Fig. 1. Hazard observed in different months of a year (based on frequency and intensity, each hazard has been presented by horizontal number line. Higher frequency and intensity = 4, normal occurrence = 2, nil = 1 and *Abrupt occurrence =5)

Tropical cyclone and storm surges remain frequent and severe from April to June in the area. The usual time of high tide occurrence is from January to March of a year. According to respondents' view, high tide induced salinity ingress has reduced over the last years, but they noted an abrupt occurrence of the hazard on March, 2011 and October, 2010 that caused severe damage of standing crops and ponds. From January till March, the disease of domestic animals and poultry birds increases severely in the area. Notably, the water scarcity becomes severe at the end of June when the first agricultural crop namely Aman rice cultivation starts for the year.

Hazard ranking: In the study area, a number of hazards have been observed as given here in Fig. 2 of which tropical cyclone, storm surges, high tide, heavy rainfall, epidemic of animals and seasonal droughts are predominantly affecting life-supporting components of people. Based upon participants' counting, storm surges have been recognized to be the second most hazard which often occurs with tropical cyclone and cause swift and enormous loss of life and livelihoods.

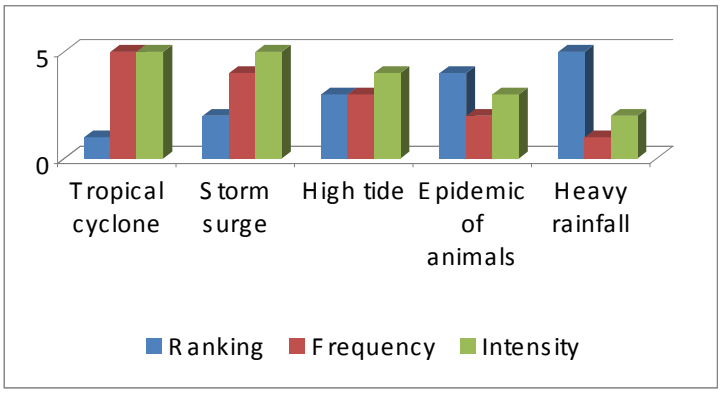

Fig. 2. Hazard identification and ranking based on frequency and intensity arranged on higher to lower (Priority ranking 1-5, Frequency 5-1, Intensity 5-1)

Livelihood agriculture calendar: Agricultural farming related works were highly concentrated from July to September and January- (Fig. 3). Maximum workloads are observed during Aman rice cultivation from July - August and its harvesting time around February. The highest numbers of agriculture day labors are engaged to Aman cultivation and harvesting. Following Aman rice harvesting, large scale winter crop cultivation and harvesting work continues from February–April. People work on winter Boro rice cultivation and harvesting from February to May.

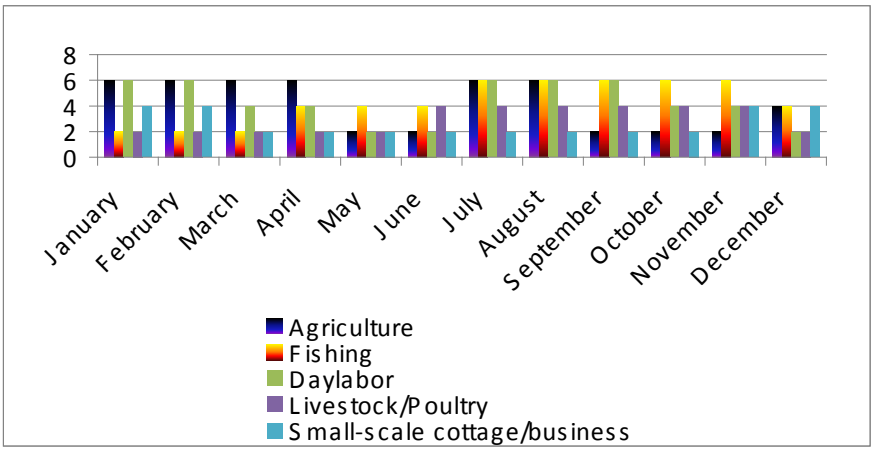

Fig. 3. Seasonal livelihood calendar (work intensity ranking, highest = 6, medium = 4, low = 2)

Fishing: Fishing activities is considerably found from the mid of July till December in the area as mentioned in the figure 3. During these months, size of fish catch is the highest in river and sea that people remain engaged in the work for the season. For the six months, few fishermen works in large fish trawler to catch fish in the seas and others also drive for 15-20 days in near distance of river. Due to storm surge and heavy rainfall, coupled with lack of improved fish varieties, fish pond activities are currently limited in the area.

Day labor: People usually substitute agriculture and fishing activities taking into account of their rice and vegetable cultivation/harvesting time and size of fish catch, as well weather conditions. After crop cultivation and when fish catch decline after December, landless people often migrate to the nearest market and Upazila centre for daily works.

Poultry and livestock: Household level poultry and livestock rearing are found to be a profitable and supplementary livelihood activity throughout a year.

Livelihood pattern: Looking into the livelihood activities in a year as given in Fig. 4, the primary livelihood was found to be related agriculture and fishing. Beside, poultry and livestock rearing, daily labor were identified as secondary livelihood. About 60 percent of people are directly involved with agricultural activities. Among those, 10 per cent people who have own and adequate lands for farming. Many people (30%) have no own lands and lease out others land for farming or work as day labors.

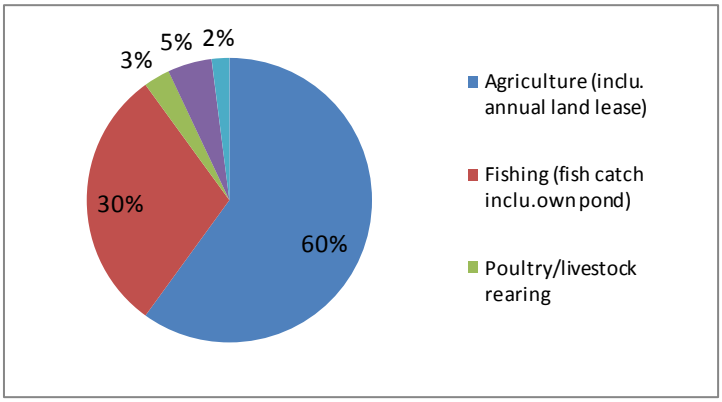

Fig. 4. Livelihood pattern

About 30 percent people are directly involved with fish catch in adjacent river and nearest distance of the sea, as well as shrimp fry collection for a year. Poultry, cow and goat rearing have been observed to be significant income generating source. About 4 percent of households have significantly contributed to their food and income through poultry and livestock rearing. Only 2 percent people have showed their other additional livelihood activities such as weaving fishing net, shrimp fry collection, Hogla mat preparation, grocery business and Govt/NGO services. Similar results were also reported by Plantinga (1996) and James Boyce (2003).

Cropping trend: The usual cropping pattern in the area was paddy and vegetables observed in different seasons. Aman and Boro rice were cultivated for local rice demand throughout a year. Winter vegetables and pulse crops were cultivated after Aman harvesting. For last three years, farmers are no longer cultivating Aus paddy due to lack of irrigation. Women usually begin vegetable cultivation around homestead as rain recedes. Most importantly found that over the last 10 years, vegetable types as may be seen in the Table 1 and Table 2

have been replaced by other varieties as well as people's preference also changed. This is due to growth rate and market demand to some extent, and also seasonal behavior changes".

Table 1. Leafy vegetable cropping trend of the study area

Previous (10-15 yrs. ago)	Preference	Present
Lal Shak	1	Puisak
Puisak	2	Lal Shak
Kalmi Sak	3	Data Sak
Data Sak	4	Kalmi Sak

Table 2. Fruit vegetable cropping trend of the study area

Previous (10-15 yrs. ago)	Preference	Present
Papaya	1	Cucumber
Lau	2	Brinjal
Brinjal	3	Lau
Cucumber	4	Sasa

Crop calendar: The results on the vegetable preference and production trend are given in the Table 3. The data show that a good deal of changes in crop species and varieties has occurred. A crop calendar was developed that indicated the type and time pattern of On-Farm, and Off-Farm activities. The calendar showed that the area is dominated by single or one season farming of rice crops. Unprecedented hazard events such as heavy rainfall cause damage of harvestable crops and remains increasing risk to any further cropping. Soil salinity does not favor for rice cropping as it grew up from November till the onset monsoon. The studied area has shown to be pre-dominant of single rice crops followed by a minimal size of winter crops in winter season. However, the study also found that size of crop production is related with land distribution and ownership pattern in the area:

Table 3. Crop species preference trend

Previous crops (10-15 yrs. ago)	Present Preference
Red amaranth	Indian Spinach
Aroids local	Aroids HYV
Ipomea Sak	Green amaranth
Snake gourd	Sweet gourd hybrid
Papaya	Cucumber
Bottle gourd	Brinjal
Mustard	Sunflower BARI
Cucumber	Watermelon hybrid
Local rice	Maize
Grass pea	Mungbean
Fallow	Chili capsicum

Dynamics of climate change vulnerability: After application of participatory climate vulnerability assessment it was found following dynamics- where shocks, seasonality, agricultural and fisheries problem being under increasing trend resulted, hampered community peoples' livelihood (Fig. 5). The dynamics of the climate change vulnerability are illustrated in the figure 5 which shows the focal points of the developmental agents. Combined effects of less income and affected livelihood increase poverty and make community vulnerable. On the other hand, due to changing climate variability's like embankment breech and frequent natural disaster community become more vulnerable day by day. Results of river bank erosion shifting their settlement frequently lost their permanent asset and felt into ultra poor condition and increase vulnerability. Different types of crops were grown. Due to salinity intrusion soil productivity declined resulting reduced food security. Unavailability of quality agricultural inputs were another problem. Department of Agricultural Extension (DAE) tries to provide support to farmers but, very less considering requirements. Some NGOs now work on this. The triple cropped area was very low being only 16% due to lack of irrigation water. In the dry season, salinity increase in the crop field and no fresh water found in the pond. On the other hand, double cropped area was much higher 46%. Mainly T. Aman rice cultivation area, by using short duration HYV or early variety farmers match with Aus season or early winter, results area become double cropped.

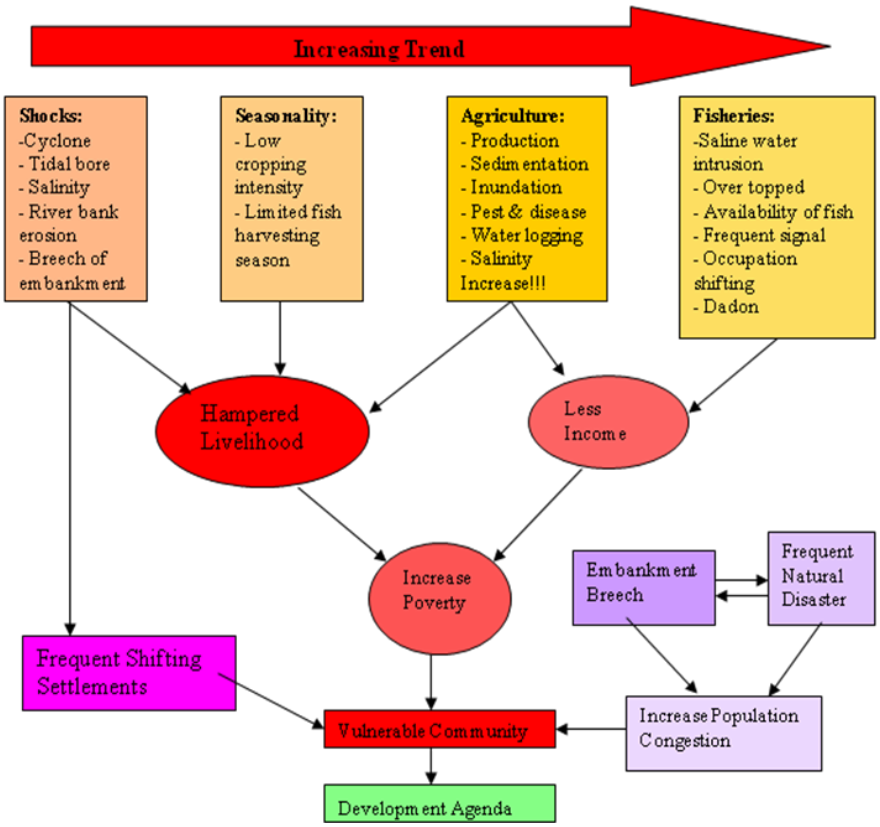

Fig. 5. Dynamics of Climate Change Vulnerability

It was found that the climate of Bangladesh has been changing over a period. Climate change adaptation may be spontaneous or artificial, it may be technology, shifting time or adjust livelihood with adverse climatic condition. Research organization should take lead to identify suitable adaptation options but it time bounding. As a result autonomous adaptation measure was searched to mitigate present needs identified by local community. They suggested following activities as their alternative livelihood options. Fishing net preparation, Fish drying and manufacture, Small cottage industry (using hogla and others plant materials), Handicrafts by using plant materials, Handicrafts by using cloth and tread, Fish landing station, Fish cold storage, etc. Specific options were: a. Goat, sheep duck rearing, b. Beef, crab and pig Fattening, c. Saline tolerant rice HH veg. cultivation, d. Grass pea and sugar beet cultivation as relay crops, e. Zero tillage potato and maize, f. Re-excavation of ponds and integrated rice-fish cultivation, g. Turmeric + betel nut cultivation, h. Aroids, gourds and sweet potato cultivation, i. Chili and mixed jujube gardening, j. Compost preparation and use. The existing disaster administration framework in Bangladesh was largely organized to deal with rapid onset extreme events, whereas coastal zones were also confronted with a range of creeping climate risks, such as increasing salinity trends, drainage congestions. External agency could inform them about some new ideas and effectiveness of those should be justified critically by the community.

CONCLUSION

The physical setting of areas was highly sensitive to tropical cyclone, storm surge, rainfall and high tide. Natural resource endowment in the area comprises mangroves, agricultural lands, and river, canal and fish ponds. The large size of agriculture lands for farming paddy and vegetables is located inside the coastal embankment. Only a small amount of land is also cultivated outside the embankment due to higher risk of storm surges and high tide. Almost all agriculture lands are currently cultivated with two seasonal rice crops and vegetable and pulse varieties. Apart from agriculture, given close distance to river and canals, fishing activities are a broad source of fishing activities throughout a year. Agriculture and fishing based livelihood activities generates the most of the households' income for significant months of a year. Fishing is a yearly activity either in river, canal or pond based on seasons and size of productivity. There are additional income generated by day labor, homestead gardening, domestic animal and poultry rearing, mat preparation, weaving of fishing net and small grocery business. Few of the women respondents emphasized on animal and poultry rearing and mat preparation which would be viable income option and complementary source for their household income. Community people indeed have different sorts of experience and perception regarding their vulnerability to climate changes and subsequently certain limit of adaptation capacity.

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