

Impacts of cyclone on livelihood: study on a coastal community

H. M. Solayman

Department of Environmental Science at Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

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*Corresponding Author

HM Solayman
✉ solaymanmoni@gmail.com

ABSTRACT

Coastal region of Bangladesh is highly vulnerable to natural hazards due to local and global climate change and its geographic location. This hazard has the potentiality to causing casualties and damages with socio-economic trouble in deferent sectors like agriculture, livelihoods and livestock's. So, this study identified the probable impacts of cyclone disaster on livelihood activities and perceived economic losses by cyclone disaster. This study conducted during January to March, 2017. To collect primary information different methods had been adopted i.e. Checklist, Focus Group Discussion (FGD) and face to face questionnaires, random sampling techniques were conducted where sample size was n=100. Modified DPSIR framework applies for conceptual analysis about the impacts of cyclone on livelihood activities. In this regards agricultural (100%) and livelihood (91%) sector faced highest effects by cyclone. Most common impacts were increased sea level, less livelihood opportunity, settlement damage, land use changes/loss, loss of fisheries, economic insecurity and migration problem. Farmers group consume highest percentages of financial (45000 BDT year⁻¹) loss due to cyclone in the study area. This study suggested chicken farming duck rearing, handicrafts, tree planting, increasing religious activities, alternative livelihoods facility and two or more livelihood options, indigenous technology e.g. homestead gardening and conservation of the coastal forest most preferable adaptation and mitigation measures. So, the effective actions to cope with and reduce the impacts of cyclone hazard have now become vital requirement.

INTRODUCTION

Bangladesh is one of the most vulnerable countries in the world to climate change and natural hazards due to its geographic location. Over populations and large coast line increased hazardous situation with climate change scenario (IPCC, 2012 & 2014) e.g. cyclone, tidal flood, storm surge, coastal erosion, salinity intrusion, water logging etc (GOB, 2010). Cyclone has its devastating power in the coastal area of Bangladesh e.g. SIDR, NARGIS, AILA and ROANU. Due to hazardous event in the coastal area of Bangladesh, different sectors are more or less affected i.e. agriculture, fisheries, livelihoods and biodiversity as well as ecosystem services.

The advisory panel of the World Commission on Environmental and Development proposed "livelihood as adequate stocks and flows of food and cash to meet basic needs" (WCED, 1987). Livelihood encompasses the capabilities, the assets (natural, physical, human, financial and social capital), the activities and the accesses to these that

together decide the living gained by the individual household (Chambers and Conway, 1992). A livelihood is sustainable when it can cope with and recover from stresses, shocks, maintain its capabilities and assets both now and in future, while not undermining the natural resource base (Chambers and Conway, 1992). For sustainable development and poverty elimination, various approaches have been adopted and the "Sustainable Livelihood Approach" has been gradually expanded with its own core and principles for poverty focused development activities (DFID, 1998). The common livelihood activities in the coastal area of Bangladesh are farmer, housework, fisherman, day labor and so on. Different climatic hazards create problem and altering the livelihood activities.

Among the devastating hazards, cyclone has its most negative effects on livelihood activities in the coastal area of Bangladesh. Basically coastal peoples are migrating to the cities (Saroar et al., 2015; Rashid, 2013) due to climatic hazards for better livelihood options. Different researcher

studied about the livelihood status, coping strategies and recovery from disaster. Patharghata union situated very near of coast line and Bay of Bengal. That's why cyclone disaster heats frequently in this area. And this impact is directly hampered livelihood status as well as their economy. So I think there also need to identify the probable impacts of different disaster in the coastal Bangladesh. In this situation, this study identifies the probable impacts of cyclone disaster on livelihood activities of the coastal Patharghata union of Bangladesh and perceived economic loss due to cyclone. This study suggested some adaptation and mitigation measures against cyclone disaster.

METHODOLOGY

Study area

Patharghata Union in Barguna District is located in between 22°14' and 22°58' north latitudes and in between 89°53' and 90°05' east longitudes. There are twelve villages in Patharghata union e.g. Badurtala, Bara Tengra, Baraitala, Char Lathimara, Gaharpur, Haritana, Hatempur, Koralia, Nij Lathimara, Padma, Ptharghata and Rohita. Total population of Patharghata union was 28,451 (BBS, 2011). Main rivers are Bishkhali, Haringhata and Baleshwari. This union is very near to the coast of Bay of Bengal. That's why when Cyclone heat in the coastal area then first faced by Barguna district communities as well as Patharghata union. And this is the main cause to select this union as my study area to observe the peoples livelihood status and effects by cyclone disaster.

Data collection and analysis

Information was collected from 100 respondents in Patharghata union of Barguna district. Face to face questionnaires conducted randomly for identify the demographic status of respondents and perception about cyclone disaster. Focus group discussion (FGD) and formal dialogue were conducted for validating information. The questionnaires and FGD were conducted with in January to March, 2017. Several FGD were conducted to get deeper insight about particular concern. Interview and FGD and also causal loop diagram helps to

counting economic losses and mitigation and adaptation measures of the particular region. The economic losses due to cyclone were measured by averages from each respondent. Monetary values were counted by Bangladeshi taka (BDT).

DPSIR, Driver – Pressure – State – Impact – Response, framework (EEA, 1999) is a hypothetical model. That helps to recognize the relations among the different indicators of environmental and social systems. DPSIR framework is basic method for find cause – effect relationship, highlighting the connection among the causes of environmental problems, their impacts and the society's response to them, in an integrated way. The framework structures the indicators of environmental and human systems in five groups connected by two types of links: a direct causal chain (Driver, Pressure, State, Impact and Response); and feedback links between the Responses and their targets (Drivers, Pressure, State and Impacts) (EEA, 1999). DPSIR (Driver-Pressure-State-Impact-Response) model conducted for identifying the cause, impacts and probable solution to cope and reduce the impacts of cyclone disaster on livelihoods. DPSIR model were designed by conducting casual loop diagram with the local people. The advantage of this DPSIR is being able to clarify and analyse complex multi-sectorial inter-relationship. The coastal zone, a transitional zone between the land and the sea, is usually characterized by complex and diversified features. Such threat seems to be exacerbated due to climate change, which is reality and its impacts have been experienced in many parts of the worlds, such as increased disaster magnitude and uncertainty. However, the scope of this paper is to cover mainly the analysis of direct causal chain, but not the feedback chain. It is a very effective tool to showing the problem of any actions and finally shows the probable solution. "Drivers" described as the underlying factors influencing different pressures on livelihood activities by adverse natural events. "Pressures" defined as the variables that directly cause the changes livelihood opportunities. "States" measured physical changes. "Impacts" described the effects of changes and at last "Responses" defined the probable effort of society to cope with the problems resulting from the changes of livelihood activities.

Secondary data has been collected from different journals, reports, research papers, websites, and government and non-government organizations i.e. Disaster management bureau, Bangladesh Bureau of Statistics (BBS, Census wing) and local NGO's etc. QGIS (Version 2.4.0), SPSS (Version 21.0) and MS Excel (2007) have been used in this study for data analysis and presentation.

RESULTS AND DISCUSSION

Demographic characteristics

Among 150 respondents, 68% male and 32% were female in the study. "Adult" (36-55 years) was highest percentage (50.5%) and "Young" (19-35 years) was (36.5 %). Elder people have more experienced on impact of cyclone in the affected areas but only (11%) was "Elder" in my study. Educational level of the respondent was also observed and only 1% respondents was "Graduate" and highest (40%) were "Primary" (Table 1). According to the occupation, 36% was "Fisherman", 21% was "Farmer" and 20% was "Housework". Most of the respondents (29%) have the income level within 12001-20000 BDT Month⁻¹ and 25% was 6001-12000 BDT Month⁻¹ (Table 1).

Major cyclone in Bangladesh

From the historical statistical data (Table 2), it is clear that cyclone was severe devastating disaster in Bangladesh. The casualties, death and economic losses were very high with the time scale. Most of the cases agriculture and livelihoods sectors were affected. This may be because of geographical location and global climate change affects with seasonal variations.

Several disaster heat on the coastal region of Bangladesh, among them cyclone was most powerful and devastating. Among the devastating cyclone in Bangladesh the 1970, 1988, 1991 and 2007 were most destructive. Death, economic loss, property loss and damages were large amount over the country (Ahmed et al., 2012; Hofer and Messerli, 2006). So, it is very sorrowful news for Bangladesh that climate change consequences

heavily influenced and destroy us. We should take proper actions against these destructive events.

Table 1
Distribution of the respondents according to socio-economic status.

Characteristics		Percentage (%)
Sex	Male	68.0 %
	Female	32.0 %
Age Range	Children (0-18 years)	2.0 %
	Young (19-35 years)	36.5 %
	Adult (36-55 years)	50.5 %
	Elder (>55 years)	11.0 %
Education Level	Illiterate	24.0 %
	Only Sign	25.0 %
	Primary	40.0 %
	Secondary	5.0 %
	College	5.0 %
	Graduate	1.0 %
Occupation	Employee	4.0%
	Fisherman	36.0 %
	Farmer	21.0 %
	Petty Business	6.0 %
	Day labor	10.0 %
	Housework	20.0 %
	Others	3.0%
Monthly income (BDT Month ⁻¹)	1500-3000	19.0 %
	3001-6000	16.0 %
	6001-12000	25.0%
	12001-24000	29.0 %
	>24000	11.0 %

Among physical, social, economic, environmental and infrastructural assets of the coastal communities were more or less all of the assets increasing and decreasing with community's capacity. Aftermath of SIDR 2007, peer support were significant increasing but now a day's loan facility, homestead gardening, microcredit's, roads, market and market access were significant increase. But rice farming, soil and also roads were significant decrease aftermath of SIDR. This may be because of influences of different organization in the coastal area. Mainly significant increases were happened due to community growth and their indigenous technologies practices (Table 3).

Table 2
Major cyclone occurred in Bangladesh.

Year	Disaster	National impacts
1970	Severe cyclonic storm	Most affected were Chittagong, Barguna, Khepupara, Patuakhali, north of Char Burhanuddin, Char Tazumuddin and south of Maijdi, Haringhata. The official death toll was 500,000 but the number is likely to be higher. More than 400,000 houses and 3,500 educational institutions were destroyed. Maximum Wind:222 km/h. Maximum Surge:10.6 m.
1988	Flood, Cyclone	63% area affected, 5708 killed, \$2,137,000,000 economic loss. 160km/h
1991	Cyclone	138,000 killed \$1,780,000,000 economic loss. 235km/h
1994	Cyclone	400 people killed, economic damage data not available
1995	Cyclone	650 people killed, economic damage data not available
1997	Cyclone	126 killed economic damage. 225 km/h
2007	Flood (2 times), Water logging, Cyclone	50% area affected by flood, 1230 killed, \$114,000,000 economic damage. 200 km/h 4275 killed by cyclone, \$2,300,000,000 economic loss
2008	Cyclone, Tidal surge	55 killed, economic damage unknown
2009	Cyclone	197 killed, economic loss \$270,000

(Sources: CERD EM-DAT, 2015; Ahmed et al., 2012; Hofer and Messerli, 2006)

Table 3
Capabilities of coastal community to adapt the impacts of natural disasters.

Community Asset Dimensions	Components of Capacities	State after Cyclone SIDR in 2007	Present Scenario
1. Physical	Land use	Decreasing (-)	Decreasing (-)
2. Social	Education	Decreasing (-)	Increasing (+)
	Government supports	Increasing (+)	Increasing (+)
	Loan facility	Decreasing (-)	Increasing (+ +)
	Peer support	Increasing (++)	Increasing (+)
3. Economic	Shrimp farming	Increasing (+)	Increasing (+)
	Rice farming	Decreasing (- -)	Increasing (+)
	Home stead gardening	Decreasing (-)	Increasing (++)
	Microcredit	Increasing (+)	Increasing (++)
	General Income	Decreasing (-)	Increasing (+)
4. Environmental	Natural vegetation	Decreasing (-)	Increasing (+)
	Rivers, canals and pond	Decreasing (-)	Decreasing (-)
	Soil	Decreasing (- -)	Decreasing (-)
5. Infrastructural	Roads	Decreasing (- -)	Increasing (++)
	Market access	Decreasing (-)	Increasing (++)

(Scale: +/- small increase/decrease, ++/-- significant increase/decrease)

The destructive sector were found agriculture (Table 4), this may be because of agricultural components would not tolerate the cyclonic storm and its duration. On the other hand, the second and third positions were livelihoods and economy; these are also related with agriculture. Migration is normal phenomena in the coastal area of Bangladesh (Saroar et al., 2015). In the context of

Bangladesh, natural disasters play a significant role in forcing people to migrate to large urban centers and cope with shocks (Rayhan and Grote, 2007). The rate of migration is slow and low but it's a common practices. This is basically for secure livelihood options and economically growth opportunities.

Table 4
Community concerns on devastating impacts of cyclone in coastal area of Bangladesh.

Sectors	Percentage	Ranking
Agriculture	100%	1
Economy	90%	3
Livelihoods	91%	2
Food safety	89%	4
Education	75%	6

Infrastructure	65%	7
Health	80%	5
Water	45%	9
Ecosystem loss	41%	10
Loss of natural resources	46%	8
Migration	24%	11

*Low impact (<50%); Moderate impact (50-70%); High impact (>70%)

Impacts of cyclone on livelihoods

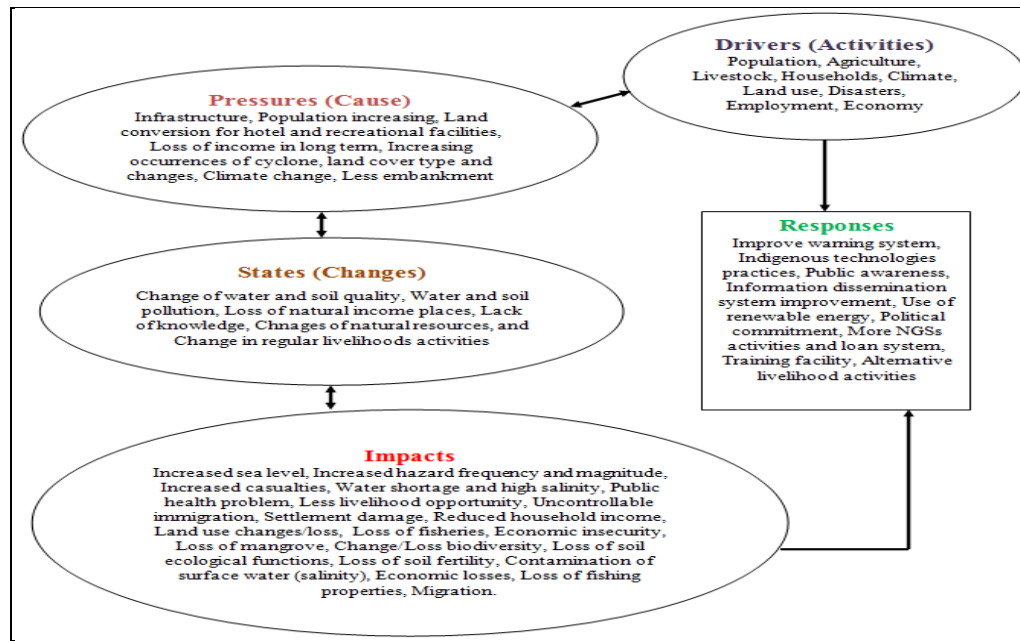


Figure 1
Application of modified DPSIR framework for cyclone impact assessment on livelihoods (EEA, 1999).

A livelihood is very important for each people well living and fulfill his/her fundamentals right. Coastal region of Bangladesh is most vulnerable for climate change as well as its destructive effects e.g. cyclone and storm surge. Cyclone can destroy people’s livelihoods and their life style.

According to DPSIR framework of cyclonic impacts on livelihoods, where the impacts were found e.g. increased sea level, less livelihood opportunity, settlement damage, land use changes/loss, loss of fisheries, economic insecurity and migration problem (Figure 1). The most common responses were found e.g. improve warning system, indigenous technologies,

emergency response, rehabilitation and reconstruction, use of increase renewable energy and political commitment etc (Figure 1). Similar results were found by the analysis of Khajuria and Ravindranath, (2012), Minar et al., (2013), Sharma, (2009), and Pouliotte et al., (2009). Where they found the common impacts were migration, less livelihoods opportunities, land use changes etc.

Livelihood capitals

The livelihoods approach is concerned first and foremost with citizens. It searches for gaining an accurate and realistic understanding of people’s

strengths and how they try to convert these into positive livelihood outcomes. The approach is founded on a belief that people require a range of assets to achieve positive livelihood outcomes. This is true for poor people whose access to any given category of assets tends to be very limited. Among five livelihoods capitals the human and physical capitals (Table 5) increasing day by day

in the coastal region of Bangladesh this may be because of development of infrastructure and took place of developmental activities by GO and NGOs. Ahmed (2001) reported that human capital is skills, knowledge, education, ability of labor and good health that together enable people to pursue their livelihood strategies.

Table 5
State of major livelihood capitals of the respondents of the coastal communities of Bangladesh.

Indicators/ Variable	Dimensions	Responses (%)			Comments
		Increase	Decrease	Constant	
1. Human capital	Health	35	40	25	Increasing human capital day by day because of awareness and public involvement with developmental activities in the coastal area.
	Literacy rate	80	10	10	
	Food	90	5	5	
	Knowledge and Skills	75	10	15	
	School attendance by children	80	15	5	
2. Natural capital	Land	10	35	55	Natural capitals mostly high and low because of decency on nature and completely unpredictable.
	Forest	17	24	59	
	Water	67	13	20	
	Pond size	35	13	52	
	Climate hazards	80	15	5	
3. Social capital	Demographic	18	12	70	Mostly social capitals were contestant because of social disorder, status of lifestyle and livelihoods.
	Network and Relationship	34	12	54	
	Social organization	39	10	51	
	Food security	23	14	63	
4. Financial capital	Assets	35	23	42	Financial capitals mainly increasing because of more NGOs response and communities organizations.
	Finance	45	10	45	
	Annual income	36	14	50	
	Cash in hand	80	5	15	
	Political involvement	35	12	53	
	Involved in social group	70	12	18	
5. Physical capital	Road and Communication	73	12	15	Physical capitals were mainly increasing because of developmental activities in the coastal region. Different organizations were helping communities as well as their needs.
	Daily needs	35	15	50	
	Household structure	34	12	54	
	Livestock	34	9	57	
	Health facilities	25	15	60	
	Drinking water	45	5	50	
	Electricity facilities	55	5	40	
	Sanitary facilities	50	10	40	

Economic losses due to cyclone

Generally, property damage, economic loss, death & injury and communication destruction by cyclone. In the coastal region of Bangladesh

economic loss was high than other loss to the communities. Farmer faced highly economic loss for cyclone in the coastal area of Bangladesh (Table 6), where their yearly loss 45000 BDT. On the other hands, fishermen lost 24500 BDT year⁻¹

and day labor lost 21600 BDT year⁻¹ (Table 6). So as soon as possible we should to mitigate the impacts of cyclone to protect our economy and our country.

Table 6
Average financial loss due to cyclone from last 20 years.

Professions	Per person fiscal value (BDT Year ⁻¹)
Farmer	45000
Fisherman	24500
Day labor	21600
Housework	14200
Others (employee, petty business, self employed in agriculture/animal husbandry and motor bike driver)	16520

Co-efficient correlation 'r' was computed to determine the relationship between socio-economic status and loss by cyclone disaster. Probability ($p < 0.001$) level of significant was used as basis to test the relationship. The relationship between the socioeconomic characteristics and losses by cyclone disaster was highly significant. Where between age and losses by cyclone was (0.778), education and losses by cyclone (0.823), occupation and losses by cyclone (0.834), monthly income and losses by cyclone (0.871) and adaptive capacity and losses by cyclone was (0.651). The socio-economic and environmental impact of the cyclone disaster affected people was multidimensional. Considering the assessment of impact of cyclone on human and environment the necessary actions should be taken by government and non government authorities to mitigate the cyclone situation and promote the livelihood in cyclone affected areas of Patharghata union of Barguna district.

Adaptation and mitigation measures

Disaster does not prevent it may be mitigate or reduce its effects by applying proper strategies. Adaptive capacity refers to the potential or ability of a community to cope with, adapt to, or recover from the effects (Yohe and Tol 2002). Proper mitigation and adaptive measure may reduce the

negative of any unwanted events. Coastal communities were familiar with different climatic events. They have their own adaptive and mitigate measures that are: chicken farming, goat rearing, duck rearing, handicrafts, tree planting, early harvesting, increasing religious activities, alternative livelihoods facility with two or more livelihood options, indigenous technology e.g. homestead gardening, construction of embankments, conservation of the coastal forest.

Generally, coastal people were familiar to traditional technologies to adopt and protect the cyclone hazards. Practicing indigenous technologies, coastal communities were reducing their half of effects on their livelihoods and lifestyle and some of the helps by the NGOs. If they will get more scientific technique then it will be possible to mitigate most of the impacts in the coastal area of Bangladesh.

CONCLUSION

Most of the respondent's educational level was primary and adult where their profession was fisherman and finally their level of income was 12001-20000 BDT month⁻¹. Major cyclone happened in the history of Bangladesh were 1970, 1988, 1991 and 2007. People's capabilities to adopt with disaster were mostly negative. Physical, social, economic capabilities were more or less increasing because of NGOs activities. Cyclonic impacts on agriculture were identified by DPSIR, based on DPSIR the most common impacts were production loss, fertility loss, water & soil quality loss and loss, crops loss and land use changes. Agriculture, economy, livelihoods, health, settlements, gender, water and infrastructure were highly affected by cyclone in the coastal area of Bangladesh. The probable mitigation and adaptation measures were, practicing indigenous technologies, plantation, early harvesting, and construction of embankments, conservation of the coastal forest, early warning systems and closure dam.

In the coastal Patharghata region of Bangladesh economic loss was higher than other loss and farmers faced most economic loss. Farmer's yearly loss was 45000 BDT due to cyclone; fishermen lost 24500 BDT year⁻¹ and day labor lost 21600

BDT year⁻¹. Proper plan and activities may reduce these economic losses due to cyclone in Bangladesh. Coastal region of Bangladesh was vulnerable for cyclone due to scattered and near the embankment settlement, lack of enough cyclone shelters and poor condition of cyclone shelters, rapid unprotected settlements around hazardous places, excessive devotion to property and animals, lack of proper warning system, lack of guidelines for cyclone resilient house and lack of training and public awareness.

Although some weakness exists in my study, this research showed the impacts of cyclone in the coastal region of Bangladesh. This study found that the economic loss occurred due to cyclone at a vast rate in the coastal Bangladesh. Though a large amount people living in coastal area so they need secure lifestyle and livelihoods. This research may act as an opportunity for policy maker to demonstrate the policy for improvement of indigenous techniques for better climate resilient future in the coastal areas. Finally, this study draws an attention to the institutional and economical opportunities to facilitate people's well being to cope with cyclone disaster in the coastal area of Bangladesh. This research suggested that the first priority of the Cyclone Preparedness Program should be the safety of people at risk, secondly property. Cyclone preparedness and crisis period activities should be the responsibility of GO and NGOs and also INGOs. Establish effective cyclone warning system and proper publicity to the community that reduce loss of life and damage to property. The mass media can play vital role to disseminate information and public awareness at different levels. Finally, construction of embankments, polder, dam and sluice gate, tree plantation along the coast of can mitigate the negative effects from cyclone.

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