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Assessment on Climate Change Adaptation: A Study on Coastal Area of Khulna District in Bangladesh

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ABSTRACT

Bangladesh is likely to be one of the most vulnerable countries in the world to climate change due to geographical location and geo-morphological conditions. Bangladesh experiences extremely disastrous situation like cyclone, flood, saline water intrusion, water logging, heavy rainfall, river erosion, storm surge etc. that occur frequently in the coastal part of Bangladesh. This results huge loss of lives, damages properties and degrade the integrity of the environmental components. This study was conducted on 2 villages (Chotta Chalna and Shivnagar) of Dacope Upazila of Khulna district with the purpose of assessing existing climate change adaptation scenario and techniques for mitigating climatic change related risks. Necessary data were collected from various sources namely direct household survey, focus group discussion, and key informants interview and from various journals, related thesis papers. About 46% of the respondents cited cyclone is the most terrific type hazard and 17.33% respondent cited salinity intrusion is the second devastating type hazard that they faced. The results show that the study area climate change risks are very high and existing climate change adaptation techniques are not effective enough to mitigate the risks. Sustainable climate change adaptation strategies are much needed to mitigate the climate change risks of the study area.

Keywords: Climate change, Adaptation, Coastal area, Khulna district, Assessment, and Vulnerable countries.

INTRODUCTION

Bangladesh is extremely vulnerable to climate change because of its geophysical settings. This low level of development combined with other factors such as its geography and climate, makes the country quite vulnerable to climate change (World Bank, 2002). The country has faced devastating Sidr in November 2007, Aila in April 2009, series of flood of 2004, 2007 and 2009, Nargis in 2010 and Mahasen in May 2013 (Ahmed, 2010). According to Intergovernmental Panel

on Climate Change (IPCC, 2001), coastal area of Bangladesh may go under saline water by 2050. Due to the rise in temperature, crop production will be reduced by about 30%. Climate change would decrease the yield of “boro” rice by 55-62% and wheat by 61% by 2050 in Bangladesh (Adger, 2003). Agricultural land use in low land areas is very poor, which is roughly 50% of the country’s average (Petersen and Shireen, 2001). Climate change now occupies the top of the environmental concerns that

impede progress in socioeconomic development and threaten human security. According to 4th IPCC Report, Bangladesh is recognized worldwide as one of the country’s most vulnerable to the impacts of global warming and climate change (IPCC, 2007). One critical variable that determines the vulnerability of Bangladesh to climate change impacts is the magnitude of sea level rise. Scientists of Bangladesh believe that because of sea level rise coastal Bangladesh has already experienced the worst impacts especially in terms of coastal inundation and erosion, saline intrusion, deforestation, loss of bio-diversity and agriculture, and large-scale migration (DOE, 2007).

With this background, this study discussed the assessment on climate change adaptation practices in a coastal part of Bangladesh. The biophysical and socio-economic condition of Dacope upazila in Khulna District is extremely vulnerable and almost every year this region is being affected by natural disasters and climatic stress like cyclone, flood, water logging, salinity intrusion, storm surge, river bank erosion etc. Community peoples of this area loss their lives and livelihoods due to cyclone within a regular interval of time (Author Field Survey, 2018).

Salinity intrusion causes fresh water scarcity in the study area, so the community people largely depended on rain water, GOs and NGOs supply water scheme for drinking purpose. Maximum people of the study area are poor and they do not have adequate knowledge about climate change issues and its impact on their livelihood. They don’t know how they can adapt with climate change issues to mitigate climatic risks and how to make their livelihood more secure and resistant to disaster. There is lack of sufficient

disaster preparedness at family and community level (Hossain *et al.*, 2019). Considering the above circumstances this study goes with the aim of exploring present climate change adaptation scenario in the study area.

Conceptual framework for process of adaptation to climate change:

Since climate change was recognized as a problem in the late 1980s, the major focus has been on mitigation (i.e., reducing atmospheric greenhouse-gas emissions) rather than adaptation. However, interest in adaptation to climate change is growing as it is increasingly recognized that some climate change has become inevitable even with significant mitigation. Further, there can be important synergies between adaptation and management of existing problems (Parry *et al.*, 1998).

In an integrated coastal policy that aims to address climate and non-climate issues, the potential for conflict between development objectives and adaptation needs should be minimized. In order to do so, it is important that all stakeholders-governments, universities and government-sponsored laboratories, the private sector, non-governmental organizations and local communities- are aware of the need to reduce coastal vulnerability to climate. In addition, successful coastal management requires that the planning, design and implementation of adaptation technologies be based on the best available information as well as on the regular monitoring and evaluation of their performance. According to Klein *et al.* (1999) coastal adaptation to climate change can be considered as a multi-stage and iterative process.

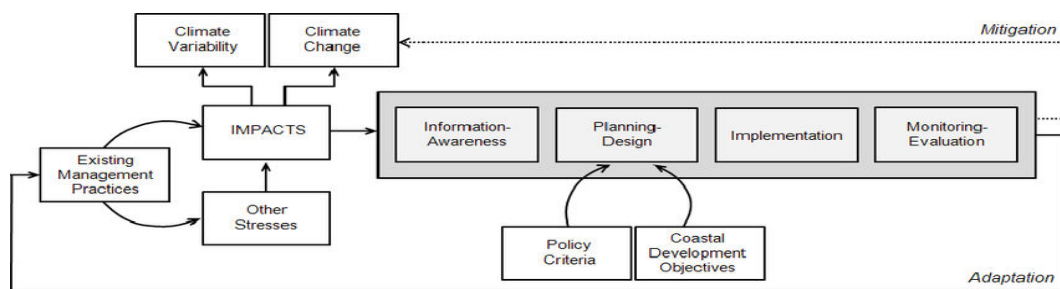


Fig 1: Conceptual framework for coastal adaptation to climate change (Klein *et al.*, 1999).

METHODOLOGY

Selection of the study area - Dacope Upazila of Khulna district was selected as the study area to map out the assessment on climate change adaptation practices in order to mitigating climatic risks. The study was performed in Chalna and Kamarkhola Union. Dacope upazila is adjacent with the Sundarban mangrove forest of Khulna district (Bagchi et al., 2019). It is bounded by Pasur River on the south, Batiaghata upazila on the north, Mongla and Rampal Upazila of Bagerhat district on the east, Koyra and Paikgachha Upazila of Satkhira district on the west.

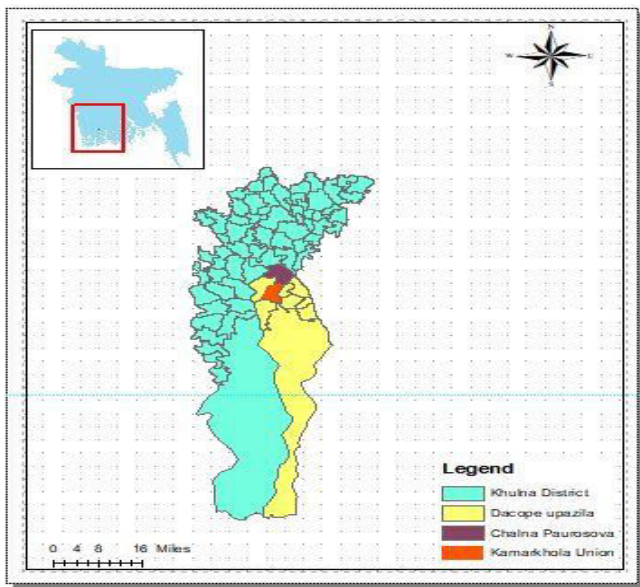


Fig 2: Location of the selected study area map of Khulna district.

Data Collection - In this study, data was collected from both primary and secondary sources. The primary data was collected from direct household survey, focus group discussion and key informant interview and secondary data was collected from various related thesis papers and published journals.

Sample Collection- Sample size calculation (household survey): Yamane’s formula:

$$n = \frac{N}{1+N*(e)^2} \dots \dots \dots (1)$$

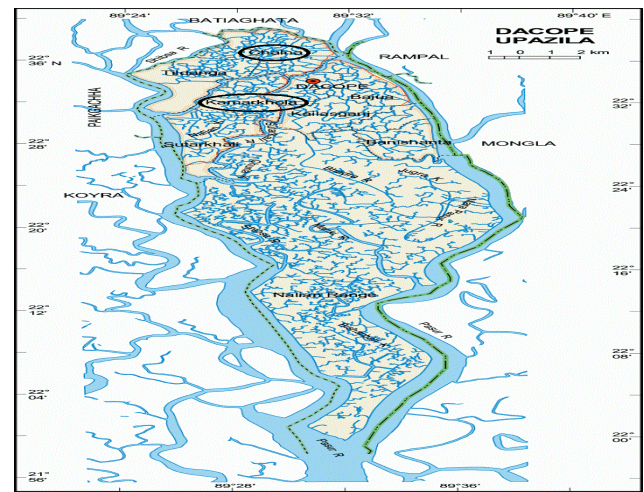
Where,
 n = Sample size, N = Population size, and e = Level of precision or sampling of error.

Table 1: Selected Study Areas

District	Upazila	Union	Village
Khulna	Dacope	Chalna	Chotta Chalna
		Kamarkhola	Shivnagar

Factors considered for study area selection - Following factors were considered for the selection of the study area:

- Higher degree of risk due to climate change related hazard like cyclone, salinity intrusion, river erosion, tidal surge and coastal inundation, etc.
- Availability of adaptation program or project to combat against climate change both by GOs and NGOs.



For the study area (Chotta Chalna)

According to the formula (1), sampling size:

$$n = \frac{89}{1+89*(.05)^2} = 72 \sim 70$$

For the study area (Shivnagar)

According to the formula (1), sampling size:

$$n = \frac{104}{1+104*(.05)^2} = 82 \sim 80$$

The study was conducted through total 150 (70+80) a household survey in the study area. Here, **Table 2** shows the sample selection status.

Table 2: Sample Selection Status of the study area.

Village	Respondents Number	Respondents Percentage	Total Responders
Chotta Chalna	70	81%	150
Shivnagar	80	76%	

(Author Field Survey, 2018)

Data entry, data processing and map preparation -

After data collection, data entry and data processing

operation were took place. Microsoft Excel software was used for data processing. Study area map was prepared through ArcGIS software.

Results and Discussion - This section describes the output and findings of the study and reveals elaborately the problems regarding successful implementation of adaptation measures to reduce climate change impacts in Dacope Upazila has been investigated and determined.

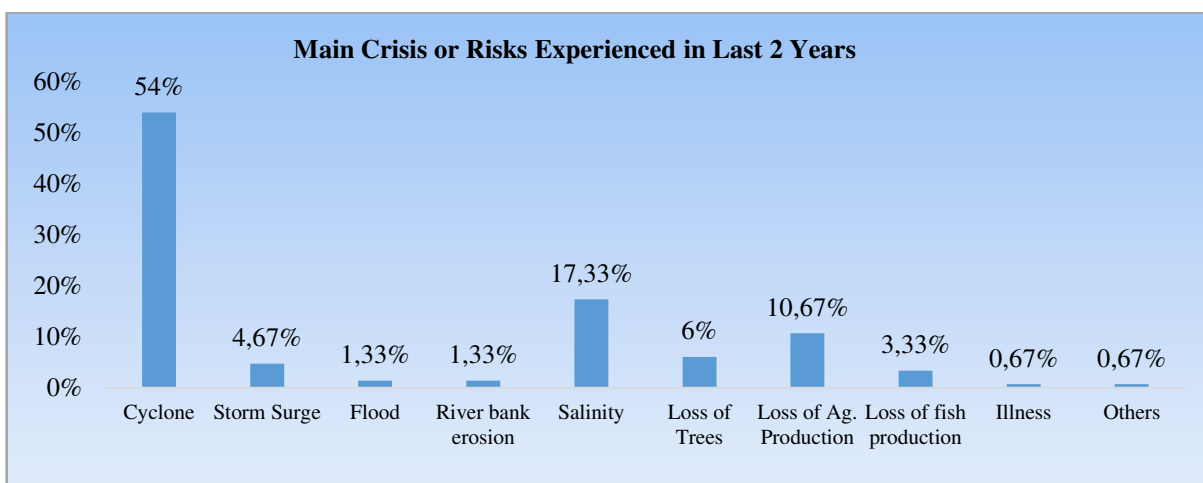


Fig 3: Main crisis experienced by the respondent in 2015-2017 (Author Field Survey, 2018).

Main crisis or risks occurred at present time - The study area is highly vulnerable for Climate change impacts and climatic stress. Different type of hazards occurred in the study area such as cyclone, storm surge, flood, river bank erosion, salinity intrusion and erratic rainfall, unavailability of irrigation water, excess temperature and water logging. Highest 54% of the respondent cited that cyclone is the most terrific type hazard that the respondent experienced and 17.33% respondent opined that salinity intrusion is the second devastating type hazard that they faced. Here **Fig 3** presented the risk experienced by the respondent in the last 2 year (2015-2017) due to climatic hazards.

MAJOR FINDINGS

Climate change induced risks and vulnerability were assessed of the study area based on exposure and climate change impacts on socio economic sectors of the respondents. After analysis of physical exposure and socio-economic implications, it was found that

housing, production activity, food security, availability of drinking water and change of occupation are major social vulnerable sector of the study area. The study area is economically vulnerable due to the poor production in agriculture, fisheries and livestock sector. The study revealed that the respondent have good indigenous knowledgeable about local environmental conditions.

Respondents generally talk about climate change as changes in the local environment and it causes subsequent problems with their living standards. The respondents are so excruciatingly poor and they don't think about the future. The study found that agricultural adjustments and measures which have already been taken are not adequate. No adaptation measures on climate-sensitive diseases are found in the study areas. Safe drinking water from tube well is not available in Chotta Chalna and Shivnagar. Safe water supply in the study area is not adequate.

Table 3: Adaptation scenario of the study area.

Problem area	Adaptation measures practiced in study areas	Practicing/ Implementing authority	Comment		
Drinking water	Use of water purification tablet and Fitkiri	Indigenous practice, GO, NGO	NGO's are doing well. GO initiatives are negligible to meet the local demand.		
	Pond excavation and boundary raising for sweet water preservation	Indigenous practice, NGO, CBO			
	Rain water harvesting	NGO			
	Fetch water from long distance and boil water	Indigenous practice			
	Distribution of tube well free of cost	GO, NGO			
	Distribution of safe drinking water by water filtering plant	GO, NGO			
Agriculture	Boro cultivation	GO, NGO	GO initiative is negligible but NGO initiatives are well		
	Late varieties of Aman are sown	GO, NGO			
	Training, seed collection and technical Support	GO, NGO, CBO			
	Early crop harvesting	Indigenous practice			
	Crop land is used to cultivate winter crops (Rabi crop)	Indigenous practice, GO, NGO			
Fisheries and Livestock	Promote fisheries aquaculture	Indigenous practice, NGO, CBO	Local people and NGO and CBO initiative is good but GO initiative is negligible		
	Promotion of salt tolerant species	GO, NGO			
	Rehabilitation of degraded habitat and maintenance of fish migratory routes	GO, NGO			
	Skill enhancement of fisherman community and create market linkages for marketing of fish and fisheries product	GO, NGO, CBO			
	Raising the boundary of pond	Indigenous practice			
Physical exposure	Embankment Dredging of river and canals Mangrove and non-mangrove forest	GO, NGO, CBO, Indigenous practice	All these GO, NGO, CBO and local measures taken to reduce physical exposure		
	Housing	Flood resistant housing using new material and technology		GO, NGO and CBO	People, GO, NGO are involved
		Housing project for landless people		GO, NGO	
Change of occupation	Preparation of "Shutki (dry fish)"	Indigenous practice	GO and different NGO's roles in "Shutki" production and marketing		
	Engage as day labor in crop field, house building and road construction, mud cutting, etc.	GO, NGO			

The study found some currently practiced adaptation measures to climate change that related to practices of indigenous knowledge and GOs, NGOs, CBOs adaptation measures but it is not sufficient for the locality if compared to local people's needs and IPCC proposed list of adaptation measures due to climate change. Adaptation measures is much essentially for the solutions of climatic problems and therefore means addressing basic and immediate needs of water, food security and livelihood strategies. At the same time, it is important to reduce the risk of natural disasters that disrupt the respondent's livelihoods, mobility and damage their homes and assets.

Adaptation techniques for mitigating climate change risks - The study reveal that the awareness and preparedness of local community towards climate change and its response are increasing by the change of time. At the present time the community people of this study area are involving with different government and non-government organizations climate change adaptation activities. Here, **Table 3** presented the adaptation scenario of the study area.

CONCLUSION AND RECOMMENDATION:

From a country-coverage perspective, the study area (2 villages) might not be a good representative sample. However, issues discussed in the study climate change adaptation and related measure such as the importance of local knowledge, reasons of weakness of different adaptation measures, GO-NGO and local people's co-ordination scenarios are more or less similar to other districts and villages in Coastal zones of Bangladesh and may also resemble issues in other developing countries. The experiences and lessons learned will have relevance to practitioners and researchers interested in climate change adaptation programs. As the communities are experiencing the success or failure of the aforementioned programs, perception of climate affected communities shall be very helpful in reassessment of existing adaptation measures.

From the above-mentioned discussed of the study area demonstrates following recommendations that make the communities' resilient and less vulnerable to climate change problem:

- (i) Strengthening GOs (both national and local), NGOs with local and scientific knowledge, skills and resources, facilitate community-based adaptation, empower people to demand their rights and build their capacity for collective action. International donors should step up and support the program;
- (ii) Local adjustment of agricultural system with changing climate through change of planting time of crops, introduction of saline resilient varieties of crops, introduction of floating bed cropping in flood monsoon, rain water harvesting and encouraging the fish farmers to fresh water shrimp culture to control salinity intrusion.

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CONFLICTS OF INTEREST:

The authors declare that they have no potential conflicts with respect to the research work.

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