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The Impacts of Climate Change on the Coastal Belt of Bangladesh: An Investigation of Risks & Adaptations on Agricultural Sector

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Abstract— Bangladesh is one of the worst affected among countries that are facing the early impacts of climate change particularly in agricultural sector. The coastal area of Bangladesh is naturally susceptible to disaster whereas climate change asserts a new depressing effect to the lives and agronomy. The aim of this work is to assess the impact of climate change on agriculture in the coastal area of Bangladesh. The study is based on long-term climatic and crop productivity data, regional climatic scenarios and impact analysis of different aspects of climate change on agriculture. The study reveals that the crop yield would be negatively impacted by rise in temperature, erratic rainfall, flooding, droughts, salinity, etc. and among which water logging and drainage congestion are the major problems. The ecological conditions are more vulnerable which is very likely to be alerted though slowly but surely due to climate change and sea level rise. Dependency on fertilizer and irrigation is increasing which leads to permanent fertility loss of the land, loss of biodiversity, extinction of local varieties, ground water scarcity, loss the sustainability of production. However, adaptations to climate change like agronomic manipulations, sustainable climate-resilient agriculture, shifting the planting dates, using short duration crop cultivars can reduce vulnerabilities, delay the process and increase food security.

INTRODUCTION

The climate in Bangladesh is changing and it is becoming more unpredictable every year. The impacts of higher temperatures, more variable precipitation, more extreme weather events, and sea level rise are already felt in Bangladesh and will continue to intensify. Climate change poses now-a-days severe threat mostly in agricultural sector and food security among all other affected sectors. Crop yields are predicted to fall by up to 30 per cent, creating a very high risk of hunger and only sustainable climate-resilient agriculture is the key to enabling farmers to adapt and increase food security [3]. The principal objective of the current study is to understand the impact of climate change and climate variability at the local community of the coastal area with special emphasis on agriculture. To assess the vulnerability and the adaptations practices due to climate change is another major purpose of this study.

METHODOLOGY

For this study, the coastal area particularly Noakhali, Barisal, Bagerhat, Potuakhali and Satkhira district was selected. The whole study was conducted by collection of secondary information on various aspects related to agriculture and livelihood particularly in the coastal region was done through literature review, Upazila Land Resource Utilization Guide of Soil Resource Development Institute, socio-economic and statistical data from Bangladesh Bureau of Statistics. Climate data were

collected from Bangladesh Meteorological Department. Crop considered under this study are rice (Aus, Aman and Boro), wheat, maize, potato, sugarcane, soybean, chickpea and peanut.

RESULTS & DISCUSSION

It is predicted that climate change could have devastating impacts on agriculture. The predicted sea-level rise will threaten valuable coastal agricultural land, particularly in low-lying areas. Biodiversity would be reduced in some of the most fragile environments, such as Sunderbans and tropical forests. Climate change imposes higher level of vulnerability mostly in crop agriculture sector and then fisheries, livestock and health respectively. Yield of most of the crops would be negatively impacted by rise in temperature and erratic rainfall, flooding, droughts, salinity, etc.

As a consequence of climate change the trend shows that drier regions would be drier in the winter season. Therefore, possibility of growing rain fed crops would be diminished. During the dry months of March and April, salinity problems, resulting from seawater intrusion, are more acute and lands are commonly let fallow as crop productions restricted by the presence of salt. Yields of crops are drastically reduced when the threshold value for tolerance is crossed. More than 50% of the potential yields of most crops are reduced when the salinity is above 5 dS m⁻¹ (EC). Among the crops, cotton is the most resistant crop followed by Burmuda grass (EC 6.75 dS⁻¹) and wheat (EC 6.0dS⁻¹). Normally, rice can tolerate EC value up to 3.0 dS m⁻¹. However, the Bangladesh Rice Research Institute has developed varieties that can tolerate salinity level up to 8.0 dS m⁻¹. These varieties are: BRRI Dhan40 and BRRI Dhan41, which can be grown during the Transplanted Aman, seasons in the coastal saline belt of the country [5].

Karim et al. (1996) conducted a simulation study to assess the vulnerability of food grain production (rice and wheat) at six locations of Bangladesh to potential climate change but to enhanced CO₂ and temperature. Increased levels of CO₂ increased yields of rice in all locations. The maximum yield increase of 44% was noted for a CO₂ level of 660 ppmv [4]. The percent average increases of HYV Aus, Aman and Boro rice at 660 ppmv CO₂ level were 40, 33 and 30%, respectively. The average increase of wheat was 40%. Under elevated CO₂ (330, 580 and 660 ppmv) and temperature (0.2 and 4^oC) levels the yield increases at 660 ppmv CO₂ +2^oC and 660 ppmv CO₂ +4^oC treatments were respectively 32 and 20% for rice and 9 and -31% for wheat. Some of the rice bases cropping patterns and modern rice varieties grown in the coastal region of Bangladesh are presented in Table 1. In the water logged area Fallow-Fallow-Boro is the dominant cropping pattern.

If there were no water-logging, then two crops could have been grown. In that case some crops are grown in the periphery of the water bodies [2].

class suitable means that the crop in view can produce 60 to 80 percent of maximum attainable yield (MAY), and Moderately Suitable can produce 40 to 60 percent of MAY. Adaptations to climate change are the only way to reduce vulnerabilities and delay the process (Table 3).

Table 2, shows the list of crops / cropping patterns can be grown based on the local agro climatic conditions. The

Table 1: Major Rice-Based Cropping Patterns and Modern Rice Varieties Grown in the Coastal Region of Bangladesh.

Cropping Patterns	Rice Cultivars
Boro-Fallow-Fallow	BR1, BR3, BR10, BR11, BR22
Fallow-Fallow-T.Aus-T.Aman	BR23, BR25, BRRI Dhan30, BRRI Dhan40, BRRI Dhan41
Fallow-B.Aus-T.Aman	BRRI Dhan31, BRRI Dhan32, BR14, BRRI Dhan40, BRRI Dhan41
Fallow-Fallow-T.Aman	BR16, BR26, BRRI Dhan28, BRRI Dhan40, BRRI Dhan41
Rabi Crops-Aus-T.Aman	BRRI Dhan 29, BRRI Dhan40, BRRI Dhan41

Source: BRRI, 2004.

Table 2: Potential Cropping Patterns for the Coastal Region of Bangladesh.

Suitability	Cropping Patterns		Annual or Perennial crops	
	Rabi	Kharif-1	Khari-11	
Suitable Crops	Maize, Cotton, Potato, nut, Mustard, flower, Cabbage	Broadcast Aus, Deepwater Aman, T. Aus (local/HYV), Jute.	T. Aman (local/HYV)	Sugarcane, Coconut, Betel nut.
Moderately Suitable Crops	Wheat, Fox tail millet, Sorghum, Soybean, Tomato, Onion, Garlic, Chili, Lentil	Watermelon, Groundnut, Sesame, Cowpea, Mungbean, Blackgram		Mango, Jackfruit.

Table 3: Adaptation options for agriculture due to different vulnerability of climate change.

Problem	Sectors	Existing Coping
Water level high, riverbank erosion or breaching the embankment.	Cultivable land	Plant timber trees.
	Agriculture (Crops are damaged)	Fast growing and early growing crop varieties. Kitchen gardening.
	Homestead trees and vegetation	Tree plantation need both side of the embankment.
Salinity	Agriculture (damage agricultural land & crops)	In rainy season they cultivate paddy in shrimp gher/farm. Cultivate saline tolerant rice and fish varieties. Growing vegetables in raised beds Cultivate paddy and shrimp alternatively. Shrimp cultivate at distance from homestead. Cultivate the land by re-excavation of canal and pond.
	Homestead trees and vegetation.	Cultivate saline tolerant rice and fish varieties.
Cyclone and tidal surge	Plant and vegetation	Plant timber trees.
	Agricultural crops damage	Fast growing and early growing crop varieties.
Floods and water logging	Agriculture (damage among paddy and vegetables)	Try to water drained out and re-excavation of canal.
	Food scarcity	Go outside the locality for employment. Sometimes they pass their time without taking any food.
Lack of drinking water		
Drought	Agriculture (Unable to cultivate vegetables and crops (Paddy, Jute)	Excavate and re-excavate pond. Establish electric supply system. Sink tubewell.

Source: [1] & [4]

CONCLUSION

Vulnerability within the coast is again spatially and temporally different. People at those vulnerable areas require adaptations to these consequences of climate change so that they do not have to move away from their homes. Necessarily adaptation tools are urgently needed for these vulnerable communities. One aspect of climate change is that though unstoppable, it is still likely to be slow in its manifestations. Improvement in the crop-based weather and flood forecasting systems, early warning system, improving drainage, cultivating adaptive crops, developing technology for floating bed agriculture, rice and fish culture and organized fisheries, etc. are some of the options for water logged areas. The impact of climate change on agriculture is undeniable and will most certainly worsen if governments and donors fail to take suitable steps right now. Bangladesh urgently needs support to develop climate-resilient agriculture for its people to survive and prosper in the long term.

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