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Natural and traditional defense mechanisms to reduce climate risks in coastal zones of Bangladesh



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ABSTRACT

Substantially resourceful and densely populated coastal zones of Bangladesh experience numerous extreme events linked to hydro-meteorological processes viz. cyclones, tidal surges, floods, salinity intrusion and erosion etc. These hazards give rise to extensive damage to property and loss of lives every year. Further, anthropogenic activities in the coastal zones are accentuating environmental degradation causing widespread suffering. Cyclones and tornadoes in particular damage infrastructures and crops every year affecting the economy of the country negatively. Some naturally adapted plants as well as landscapes usually reduce the speed of cyclones and tornadoes and thus, protect the coastal zones. However, human activities have destroyed many of the forests and landscapes. Sundarbans and Chokoria Sundarbans mangrove forests of Bangladesh are under a great threat of extinction due to illicit logging and agricultural expansion. At least 34 plant species of tropical forest are on the verge of extinction. Many animals e.g., cats, bears, porcupines, wild boars, pythons and anteaters are in the process of being wiped out from the coastal areas. Among the marine and coastal species, Red crabs, jelly-fish, sharks, and dolphins are also rare but these were the major species prior to 1980s. This study revealed that during the recent decades there has been massive plantations and construction of embankment and polderization but these and other measures have been found to be impractical and ineffective in reducing disasters in coastal areas. There is a need for integration of traditional coping practices and wisdoms with modern approaches. Available knowledge on some of these traditional practices has been documented for establishing a sustainable policy for management of coastal zones of Bangladesh. By combining traditional and scientific management of coastal ecosystem with mangroves and other plants following triple-tier mechanism and habitat, it is possible to reduce the effects of natural and climate change-induced disasters. Under such a management system, the entire coastal zone can be made more productive and sustainable.

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1. Introduction

In South Asia, Bangladesh is the most densely populated delta of the Ganges–Brahmaputra–Meghna (GBM) basin. Most of the country is the flood-plain of the GBM river systems with their tributaries and distributaries. The fertile alluvial flood-plain is characterized by gently undulated landscape with hills and hillocks in the north, east; a central undulated red soil terrace, the Madhupur Tract; and a huge coastal zone with highly fertile land, rivers, estuaries, mangroves, seashore and islands adjacent to the

land-water interface of the southern part of the country. The coastal zone comprises 19 administrative districts that have a great diversity of natural resources including coastal fisheries, forests, salt, and minerals, as well as high potential for exploration of both onshore and offshore natural gas. It harbors ports, tourism facilities, and other development opportunities (Michel and Pandya, 2010). Although Bangladesh is most vulnerable to frequent hydro-meteorological hazards such as floods, cyclones and droughts, historically people had developed coping mechanisms including the use of traditional practices for making their homes and homesteads resilient to floods, tornadoes and erosion etc.; climatic-season-based cropping, fish-farming and developed major transportation by boat. They applied traditional knowledge for agriculture, floodplain management and used natural and traditional defense mechanism etc. However, over the last few decades,

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along with the increased frequencies of climate change disasters, increased urbanization, unplanned road construction, industrialization and population growth, many aspects of traditional life have been changing very fast (Nagaraju, 2012; Raygorodetsky, 2013).

Coastal zone communities in different parts of the world, have long before conventional western practices were introduced, relied on their traditional knowledge to reduce disaster risks. Recent human history contains examples of entire islands rendered uninhabitable through environmental destruction owing to external causes; small island developing states (SIDs) are fully aware about the environmental consequences of ill-conceived development with catastrophic effects. Unsustainable development threatens the livelihood and the cultures they nurture; deforestation, coral reef deterioration, habitat degradation and loss, and the introduction of certain non-indigenous species are the most significant causes of the loss of biodiversity and endemism in SIDs which cause fragility of island ecosystems. However, an improved capacity to tap local knowledge and to develop environmentally sound endogenous technologies is also an important step towards sustainable development in a number of areas, including agriculture, agricultural processing, construction, communications and the marine sciences (UNEP, 1994; GDRC, 2014; FAO, 2014).

Traditional customs and management structures are still strong in many coastal communities throughout Timor-Leste. Traditional natural resource management schemes have been weakened by centuries of suppression by Portuguese colonization and Indonesian occupation. Development, modernization, and education have been influencing coastal communities and further weakened traditional coastal resource management; the younger generation is losing such valuable local and traditional knowledge. There is an urgent need to collect and record information on traditions and customs to avoid loss of indigenous culture and heritage that can also serve as model for sustainable use of natural resources (Wever, 2008).

However, Bangladesh is recognized globally as most vulnerable to climate change extremes (Climate Change Cell, 2007). About 80% of the country is deltaic floodplain of the GBM with many rivers flowing from the central India, Himalayas, China, Assam, Lusat and Arakan-Burmese ranges and the catchments of the GBM Rivers flowing to the Bay of Bengal through the estuaries (Fig. 1). Bangladesh is the most vulnerable country in the world to tropical cyclones and the sixth most vulnerable to floods (Government of Bangladesh, 2008). More than 68 million people have been directly affected over the last eight years (Vos et al., 2010), and millions of lives and livelihoods are threatened by frequent weather-related disasters. Low-lying lands, coastline areas and floodplains of most part of the country are highly exposed to both disasters and sea level rise, especially in the coastal zones (Global Humanitarian Forum, 2009).

Above the coastal zone, one-third of the country is partially elevated plain-land, which gets flooded temporarily but with the increased population this floodplain has gradually been occupied with expanded homes and townships. Another 44,000 km² area consists of wet-bodies which remain wet for most of the time. However, after the 1960s Green Revolution, these wetlands were also destroyed by earth-filling for agricultural expansion especially for High Yielding Variety (HYV) rice developed by International Rice Research Institute (IRRI). Thus the natural systems including forests, wet-bodies and traditionally managed floodplains and coastal ecosystem have been destroyed and the country is facing serious climate change disasters affecting millions every year (Flood Archive, 2004).

Considering the increasing frequencies of climate change disasters, this study was conducted to compile the natural and

traditional adaptation practices and the defense mechanisms used by the people of the coastal zone of Bangladesh to reduce vulnerability to hydro-meteorological hazards and to find out sustainable coping methods which can be integrated in the national or regional policy.

During the study, hazards and degradation in coastal zone, traditional disaster risk reduction measures, mal-adaptation practices and disasters and purview of policy challenges have been assessed.

2. Methodology

During the study, relevant information was collected from grey and published literatures of different scientific research work. Information was also gathered through organizing local workshops and seminars; attending different regional workshops and conferences; visiting research institutions and meteorological stations. Random interviews of different stakeholders, rural and urban administrative bodies, Non-Government Organizations (NGOs), men and women and youth communities of the coastal region, were conducted. Media sources, folklore and local cultures were another source of information.

The effects of climate variability and change, and vulnerability of natural and human systems in the coastal area were studied. For a cross-scale synthesis and policy recommendation, the traditional practices and coping behaviors were investigated; their efficacies were highlighted and compared with present practices to find out the misfits as well as to integrate the scientific basis of the traditional knowledge regarding natural and artificial defense mechanism followed by the people in this most vulnerable region of the earth for thousands of years.

3. Hazards and degradation in coastal zone

The coastal zone has many resources like fertile land, fishing, mangrove forests, marine and terrestrial biodiversity, scenic beauty, marine resources, meeting point of flora and fauna of fresh and saline water; salt fields, and minerals: Quartzes and Zircon, Uranium etc.; and easy transportation and sailing facilities (Rahman, 2010; DoE, 2013). These have facilitated developments of ports, industries and tourism.

The GBM estuaries in the south; the Karnaphuli, Halda and Sangu rivers and the shoreline of the Arakan ranges in the southeast form a distinct feature of the whole coastal zone of Bangladesh (Fig. 1). It has a difficult coastline with many rivers and distributaries and complex ecology which is affected by natural hazards like cyclone, coastal flooding, tidal surges, erosion, salinity and human related activities. About 50 million people, nearly one-third of the total population of Bangladesh live in the coastal zone (Miyan, 2009; Rahman, 2010). However, some phenomena often create disasters; endanger and disrupt lives and the whole coastal ecosystem. Among these, tropical cyclones and tornadoes, tidal surges and floods, erosion, heavy siltation, and pollution especially from the mega-cities and ports, shrimp hatchery and shrimp farms are the most prominent. Deforestation, over-fishing and cutting of hills for unplanned construction, ship-breaking industries and tourism have accelerated destruction of the ecosystem. Unregulated removal of sand, gravel and pebble deposits from beaches and underwater coastal slopes add to the ongoing threats to the coasts (Banica et al., 2003; Bird, 1979; Rahman, 2011a). More than 34 species of tropical rainforest plants, including *Podocarpus nerifolia* and *Enteda phaseoloids* are facing extinction from the coastal hill forests of Chittagong ranges (Rahman, 2011a,b; Khan et al. 2001; Hossain and Ahmed, 2008; Miyan, 2012). Many

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