Chapter 68
Coastline Change and Erosion-Accretion Evolution of the Sandwip Island, Bangladesh

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ABSTRACT

The study tries to analyze the morphological and hydrological changes and to establish their relationship in the Sandwip Island through the integration of Remote Sensing (RS) and Geographic Information Systems (GIS). The study concludes from the recent 30 years' data that the different parts of the island response different cycle of coastline change associated with hydrological dynamics. The resulted net loss of the coastline is about 6.98 km (0.23 km/y) and the net loss of the coastal area is about 23.99 km2 (0.8 km2/y). The erosion processes (increase in the water depth near shore) were active along the western and the south-western shores. This erosion of the island is facilitated by the steep slope of the bank, high tidal water pressure and loose bank materials. In contrast, the accretions (decrease in the water depth near shore) were taken place in the larger parts of the northern and the north-eastern shores of the island. This is due to the backwash sediment deposition with the favor of gentle topographic slope along shores.

INTRODUCTION

Coasts can be defined as the interface between land and water (Vinayaraj, *et. al* 2011; Amin, 2008) where a large number of the world's population lives (Wang, *et al.* 2013). Coastal off-shore islands, located near the coast, are experienced with massive environmental change resulting from a complex interaction of natural and anthropogenic processes (Yanli, 2011). The natural process comprises of increased

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sea level, geo-tectonic change, natural calamities, coastal inundation, erosion-accretion of shore, and channel shifting along with many human-induced environmental impacts (Yanli, 2011). Therefore, coastal environmental modification by natural and human activities has emerged as matter of concern in worldwide and its management demands information about coastline and its changes. In Bangladesh, the majority of the coastal islands is located in the central coastal zone, more specifically in the Meghna estuary (Sarwar, 2005), where rapid geomorphologic changes are taking place (Brammer, 2014). The hydrodynamic factors resulting from complex interactions between large discharge of major rivers, enormous sediment load (nearly 2.4 billion tons/year), strong tidal forces, wind & wave actions, cyclonic storm surge and estuarine circulation shape morphology of the Meghna Estuary and islands located in the estuary, results in morphological changes through a constant process of land formation and erosion (Alam, *et al*. 2014; Hussain, 2009). The sediments which are deposited in the bed of the channel and the river of estuary results in a changes in the hydrology by decreasing the water depth in different parts of the estuary whereas the natural process of accretion is giving rise to new *chars*[1] along a major portion of the 710 km of coast. The bed of the Meghna Estuary consists of silt and fine sand with a median bed material grain (Sokolewicz and Louters, 2007) in which, approximately, one-fifth to one-third of the original supply of 1100 million tons are retained which play an important role providing the material for land formation in the central part of the coast (de Wilde, 2011) and ultimately influence the hydrology of surroundings. The Sandwip is an off-shore island along the south eastern coast of Bangladesh in the Chittagong District, located in Meghna estuary, which is very dynamic and unique in nature due to its geographical position and hydro-geomorphic settings. The island has been experiencing severe morphological and hydrological changes over the time due to combine the effects of estuary and tidal effects of the Bay of Bengal. The island has been declining in size for the past 200 years. The historical data reveals that in 1780, the island had a total area of about 480 km^2, but until 1880, it had increased to 502 km^2 due to land reclamation. However, the area was 290 km^2 in 1979 due to the massive bank erosion (Rob, 1997). The available data from 1978 to 1989 indicates that about 19 km^2 was lost and only 4.1 km^2 lands accreted. About 40% of the island in the east was eroded during the period between 1984 and 2007 (Brammer, 2014). Different parts of Sandwip Island exhibit cyclic accretion and erosion. The erosion accretion of the island resulted from the physical and anthropogenic causes. Physical causes are; river discharge in the Meghna estuary from upstream Ganges- Brahmaputra- Meghna Rivers, sediment load, tide, wave, water current, and bank configuration. In addition, human activities play a role on shoreline change and hydrology of the channel. The water depth around the island exhibits the similar dynamics in response from/to the erosion-accretion of the shoreline. Generally, thus, there is a relationship between the coastal morphology change and erosion-accretion evolution in this off-shore island. Recently, the integration of latest techniques of remote sensing with geographical information system (GIS) has been proven to be an extremely useful approach for the shoreline change studies due to its reliability, covering a large area, and cost effectiveness in comparison to traditional methods (Chand, 2010). The present study aims to detect and analyze the coastline and hydrological changes and to establish their relationship in the Sandwip. Multi-temporal and multi-resolution satellite images and nautical charts were the main data sources to focus the objectives through the integration of Remote Sensing and GIS techniques.