Chapter 48
Geospatial Analysis of Land Loss, Land Cover Change, and Landuse Patterns of Kutubdia Island, Bangladesh

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ABSTRACT

This study utilizes geospatial tools of remote sensing, geographical information systems (GIS), and global positioning system (GPS) to examine the land loss, land cover (LC) change, landuse of Kutubdia Island, Bangladesh. Multi-spectral Scanner (MSS), Thematic Mapper (TM), and Landsat8 OLI imageries were used for land cover change. For assessing the landuse patterns of 2012, spatial video data were collected by using contour GPS camera. Using remote sensing analysis three different land cover classes (water, trees and forest, and agriculture) were identified and land cover changes were detected from 1972 to 2013. The results show from 1972 to 2013, an estimated 9 km^2 of land has been lost and significant changes have taken place from 1972 to 2013. Only an estimated .35 km^2 area of accretion has taken place during the study period. Using GIS eight different landuse patterns were identified based on spatial video data.

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INTRODUCTION

Bangladesh occupies the Bengal delta in South Asia with over 710 km of coastline on the Bay of Bengal. The population is 160 million with 45 million (28%) residing in the coastal zone at 3 meters or less above sea level (World Bank, 2013). This coastal zone constitutes 32% of Bangladesh (Islam, 2004). These coastal zones are geographically complex and dominated by dozens of inlets and low-lying islands that are vulnerable to erosion and flooding, especially when struck by storm surges during cyclones (World Bank, 2010). Beyond the direct impacts of cyclones and other natural hazards, a major concern is landuse and land cover (LC) change that often occurs after a disastrous storm (Khan et al., 2015). Landuse and land cover change modifies the capability of ecosystems to provide services including biodiversity, natural resources, and water for human society in both the present and future (Khan et al., 2015). The combined effects of natural and human activities may accelerate the damage to the ecosystem and ultimately impact the economy, livelihood, and migration of residents (Penning-Rowsell, Sultana, & Thompson, 2013). Coastal zones are recognized as functional regions that need sustainable planning and management (Kumar & Ghosh, 2012). The coastal zones, including deltaic lands, offer multiple natural resources and economic benefits to the local people and society (Renaud et al., 2013).

Coastal zones are often densely populated (Ericson et al., 2006) leaving populations in these regions vulnerable to changes in their environment. Natural hazards, such as floods, cyclones, storm surges, climate change, and sea level rise, affect the coastal zones and livelihoods of the residents (Renaud et al., 2013). These hazards along with anthropogenic interventions, such as exploitation of natural resources and alterations along the coast, may inundate coastal wetlands and accelerate coastal erosion (Hassan & Das, 2015). Ericson et al., (2006) showed that by the year 2025, over 1 million people will be directly affected by the sea level rise in the Ganges-Brahmaputra Meghan deltas in Bangladesh. Sea level rise and erosion of coastal lands are two major concerns for the coastal zone of Bangladesh (Hassan & Das, 2015).

Natural hazards and anthropogenic interventions may cause unsustainable landuse and land cover change that degrades biodiversity (Chase et al., 2000). In Bangladesh unplanned landuse changes and intrusion of saline water are causing degradation of soils in the coastal zone (Rahman and Wahid, 2013). Soil salinity in the coastal area of Bangladesh has increased in recent years and it was estimated that about 1.2 million hectares of arable land are affected by soil salinity (Abedin & Shaw, 2015). A recent study conducted by Mohammad (2015), reported that heavier rainfall in the Ganges-Brahmaputra and Meghan system of Bangladesh could increase the rate of erosion and may result in a mass displacement of population.

Several studies have looked at the societal risks from natural disasters and landuse and land cover changes globally (Wisner et al., 2004; Jianchu et al., 2005; Metzger et al., 2006) and examine the relationships between humans and their natural environments (Fichera, Modica, & Pollino, 2012). Studies of land cover change are important in understanding the interactions between humans and the environment and can be used to identify the direct and indirect processes of land degradation (Dewan, Yamaguchi, & Rahman, 2012; Ikiel et al., 2013).

According to the Intergovernmental Panel on Climate Change (IPCC), sea level rise induced by global warming would cause an estimated 20 million environmental refugees in Bangladesh by 2050 and Bangladesh will lose about 30% of its food production and 17% of its land (IPCC, 2007). Coastal erosion causes communities to experience loss of cultivable land and settlements and causes other property damage. Agriculture is a key element in the Bangladeshi economy so any loss of cultivable land is a concern (Dewan, Yamaguchi, & Rahman, 2012). Coastal residents are very dependent on the natural