

# Chapter 1

## Impact of Land Use Change on Ecosystem Services in a Coastal Town of Bangladesh

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### ABSTRACT

*There is an interplay between land use change and ecosystem services. The relationship between land use change and ecosystem services was explored in Barisal Sadar Upazila, a small coastal town in Bangladesh. Land use changes in this municipality were analyzed using Landsat satellite images from 1980 to 2010 at 10 years intervals. It was found that the town experienced a rapid change in its ecosystem services in proportion to land use change, especially the conversion of agricultural land to urban settlement. In the town, the agricultural land, wetlands, and water bodies decreased by 30%, 47%, and 6% respectively from 1980 to 2010. On the contrary, urban land and rural land area increased by 201% and 23% respectively during the same period. Even though the land use change had brought economic development to the people of the town, there had been a negative impact on ecosystem services which calls for a balancing trade-off between economic development and conservation of ecosystem services for the greater benefit of the society, especially for the sustenance of the ecosystem.*

### INTRODUCTION

Land use has experienced massive changes worldwide over the past half-century i.e. from forest, grassland & wetland to arable & developed land; due to the increase in population, commercial advancement, urban stretch, hasty expansion of industrial and agricultural activities, etc (Chen et al. 2014). Sometimes these changes seemed advantageous but disrupt the various ecosystem services so gravely which is past repairable. Appreciating the necessity of balanced ecosystem services; this study quantifies the land use

DOI: 10.4018/978-1-6684-5619-4.ch001

changes of Barisal Sadar Upazila, a small coastal municipality in Bangladesh using Landsat satellite images from 1980 to 2010 at 10 years intervals. The impact of those changes on ecosystem services has also been explored here.

Ecosystem services are the features of ecosystems that are enthusiastically or submissively consumed to yield mankind's well-being (Fisher et al. 2009). As per the 2006 Millennium Ecosystem Assessment (MA), ecosystem services are "the benefits people obtain from ecosystems" (MA, 2005). These services include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational and cultural benefits which affect the people directly and finally supporting services such as nutrient cycling, that sustain the surroundings for life on earth (Mooney et al. 1996). The poor and marginalized people of society depend on ecosystem services especially the provisioning type of ecosystem services. The demolition of ecosystem services may cause societal collapse. Since the early 1990s, people become more concerned about rapid land use change and understand that the provision of ecosystem services is directly affected by land use changes (DeGroot et al. 2002). Many studies were accomplished in the last couple of decades worldwide to quantify these land use changes and figured out the effect of those changes on ecosystem services. Some of them only computed the area to find the change while others linked the land use changes with ecosystem services.

The world's net cultivated area has grown by 12 percent over the last 50 years, mostly at the cost of the forest, wetland and grassland habitats (Dubois, 2011). From 1975 to 2000, Africa had expanded 57% of its agricultural land at the expense of 16% of its forest and 5% of its woodlands and grasslands; where almost 50000 sq. km of natural vegetation was lost per year (Eva et al. 2006). In China urbanization increased from 17% in 1978 to 41% in 2006 (Kabba et al. 2011) and from 1990 to 2000 China's cropland increased by 27900 sq. km (Liu et al. 2005). Vihervaara et al. (2012) studied the land use changes in Uruguay from 1987 to 2007 and found a significant loss of grassland area to plantations, which affects the provision of ecosystem services seriously. The land use changes in the Small Sanjiang Plain in China experienced 17300 sq. km of cropland increases at the expense of wetland, forest, grassland, and wasteland from 1980 to 2010 (Chen et al. 2014). Kodaikanal Taluk, a hilly area in India had lost 395 sq. km (almost 50%) of its forest area for the expansion of agricultural, harvested and built-up areas (Prakasam, 2010). Bangladesh lost more than 10000 sq. km of cropland in the period from 1976 to 2010 (Hasan et al. 2013).

Kumar and Yashiro (2014) studied the linkage between ecosystem services and aspects of extreme poverty. Their findings suggest that the poor are often more vulnerable to the loss of ecosystem function that restricts the supply of natural goods and services. From 1995 to 2006, the loss of ecosystem services value along the coast of the Gulf of Mexico was found approximately \$0.20 million/sq. km/year (Mendoza-González et al. 2012). Due to coastal erosion in Europe ecosystem services value decreased approximately from \$23.10 billion in 1975 to \$22.30 billion in 2006 and for the year 2050, the predicted loss stuck between \$20.80 billion to \$20.1 billion per year (Roebeling et al. 2013). In the Small Sanjiang Plain, China excluding food production all other ecosystem services were reduced and the estimated loss of ecosystem services was \$2.37 billion from 1980 to 2000 and \$1.67 billion from 2000 to 2010 (Chen et al. 2014). Islam et al. (2015) identified the agricultural land use changes in the Ganges delta and their implications on ecosystem services. They found an almost 50% reduction of agricultural land and over 500% expansion of wetlands from 1980 to 2008 because of a significantly increasing trend of saltwater shrimp farming. The reduction of agricultural lands and the rise of wetlands are endorsed by the fact that the agricultural lands have been transformed into shrimp farms in the study area. During this period settlement & other land use types also increased to nearly 5% but the area of Sundarbans remains steady.

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