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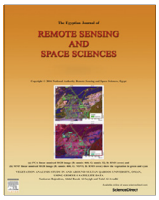

Research Paper

Land use classification and change detection by using multi-temporal remotely sensed imagery: The case of Chunati wildlife sanctuary, Bangladesh ☆

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ABSTRACT

The degraded Chunati wildlife sanctuary (CWS) has undergone various land use changes since 1980s. In this study, land use changes of CWS were assessed from 2005 to 2015 by using Landsat TM and Landsat 8 OLI/TIRS images. The ArcGIS v10.1 and ERDAS Imagine v14 were used to process satellite imageries and assessed quantitative data for land use change assessment of this study area. Maximum likelihood classification algorithm was used in order to derive supervised land use classification. It was found that about 256 ha of degraded forest area had been increased within 10 years (2005–2015) and the annual rate of change was 25.56%. Another 159 ha of naturally forested land had been changed to other land uses having an (−) annual rate of change of 15.88%. The overall supervised classification accuracy was found 92.16% for 2015, 86.15% for 2010, and 83.96% for 2005 with Kappa values of 0.89, 0.82, and 0.81 for 2015, 2010, and 2005, respectively and these were fairly satisfactory. The results of this study would be helpful to plan and implement important management decisions in order to conserve the rich biodiversity of Chunati wildlife sanctuary.

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1. Introduction

Land use and land cover change (LULCC) is considered as an important tool to assess global change in different spatio-temporal scales (Lambin, 1997). It is a widespread, accelerating, and significant process which is driven by human actions, and, in many cases, it also drives changes that affect humans (Agarwal et al., 2001). The impacts of LULCC on the sustainability of the ecosystems are becoming increasingly important issues in global changes research. Human actions seem to lead to the greatest changes in the current state of the earth's surface. Alterations in the surface cover result in changes to the balance of energy, water, and the geochemical fluxes at the local, regional and global level and these changes will inevitably influence the sustainability of natural resources and socio-economic activities (Vescovi et al., 2002). With the increase in growth of population, pressure is exerted on limited natural resources of a country and contributes to the changes in land cover.

The causes of LULCC are many (Agarwal et al., 2001; Geist, 2005; Lambin, 1997; Lambin et al., 2001; Veldkamp and Lambin, 2001; Zeng et al., 2008). Lambin et al. (2001) described tropical deforestation, rangeland modification, agricultural intensification, urbanization and globalization as the prime causes and factors for global and regional land use/land cover changes. Beside these, socio-economic and biophysical attributes are also contributing to this significant change in land cover (Aspinall, 2004; Zeng et al., 2008).

As land use change is a locally pervasive and globally significant ecological trend, these changes have important implications for future changes in Earth's environment and have for subsequent land use change (Agarwal et al., 2001). The LULCC is a dynamic and continuous process (Mondal et al., 2016) and therefore, extensive research on LULCC pattern is important along with their social and environmental implications at different spatial and temporal scales (López et al., 2001). Studies on the changes in different land uses are important for forest monitoring and in overall environmental monitoring (Lal and Margret Anouncia, 2015). In recent

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years, LULCC study has been emerged as an important research question as it can cause environmental modification on a greater scale. Information relating to LULCC can play a vital role in natural resources management (Iqbal and Khan, 2014; Kantakumar and Neelamsetti, 2015; Lin et al., 2015). The Chunati wildlife sanctuary (CWS) is strategically important for the protection of wildlife, mainly of the Asian elephant. It acts as a wildlife corridor that facilitates elephant movement in three countries including Bangladesh, India, and Myanmar. Previously it was Chunati reserve forest which was declared as the CWS in 1986 in order to prevent forest degradation and to protect the wildlife habitat. It represents a fragile forest landscape near the Bay of Bengal and, which if not conserved soon, may be lost for the future generation (GIZ, 2015; Nath et al., 2016a). Anthropogenic pressures including increased commercial extraction of forest produces, brought by manifold increase in human population, led to widespread shrinkage and deforestation of hill forests which in turn ultimately converts the natural land cover into different land uses (GIZ, 2015). Conversion of land cover into human induced land uses have a tremendous effect on the natural habitats of plant and animal species of this area which is a threat for the sustaining of this fragile ecosystem (Islam et al., 2016).

In the CWS, a few studies have so far been carried out to explore the impact of co-management (Miah, 2007; Hoque, 2008), status of flora and fauna (Khan and Huq, 2001; Rahman and Hossain, 2003; Hossain and Hossain, 2014), perception on resource conservation (Uddin and Foisal, 2007), fuel wood and alternative energy use (Roy, 2008), non-timber forest product (Miah, 2007), protected area management system (Chowdhury and Koike, 2010). However, little is known about LULCC in the CWS and their impact on surrounding ecosystems.

This study considered 2005 as the base year and examined the LULCC from 2005 to 2015 so that recent changes could be identified. Another reason to choose this time period was that the major forest destruction and conversion in land use change activities had occurred within this period at a greater scale compared to the previous time (Nath et al., 2016b).

A number of techniques are available for detecting and assessing LULCC. Among them, remote sensing and GIS technique were widely used by researchers in the field of LULCC study (Dewan and Yamaguchi, 2009a,b; Mallick et al., 2008; Mamun et al., 2013; Nemani and Running, 1997; Wang et al., 2009; Zhan et al., 2002). Remote sensing and GIS technique are also applied in this study to detect LULCC in CWS with the aim of answering the question of how the land use has been changed in CWS in the year 2005, 2010, and 2015.

2. Study area

The CWS is a tropical semi-evergreen forest in south-eastern Bangladesh lies between 21° 40′N 92° 07′E (Fig. 1). It was formally established as a wildlife sanctuary through a gazette notification in 1986 under the provision of Bangladesh Wildlife (Preservation) (Amendment) Act, 1974 (Act No. XVII of 1974). It consists of 7 beats (beat is the smallest administrative unit of a large forest area) namely Chunati, Aziznagar, Harbang, Jaldi, Chambal, Napura, and Puichari. It is one of the most important protected areas of Bangladesh because it is an important habitat of globally threatened Asian Elephant. This sanctuary is also rich with diversified flora and fauna but due to over-exploitation of natural resources it is now in a fragile condition (GIZ, 2015; Islam et al., 2016; Nath et al., 2016b). The physiography of CWS is hilly to mountainous

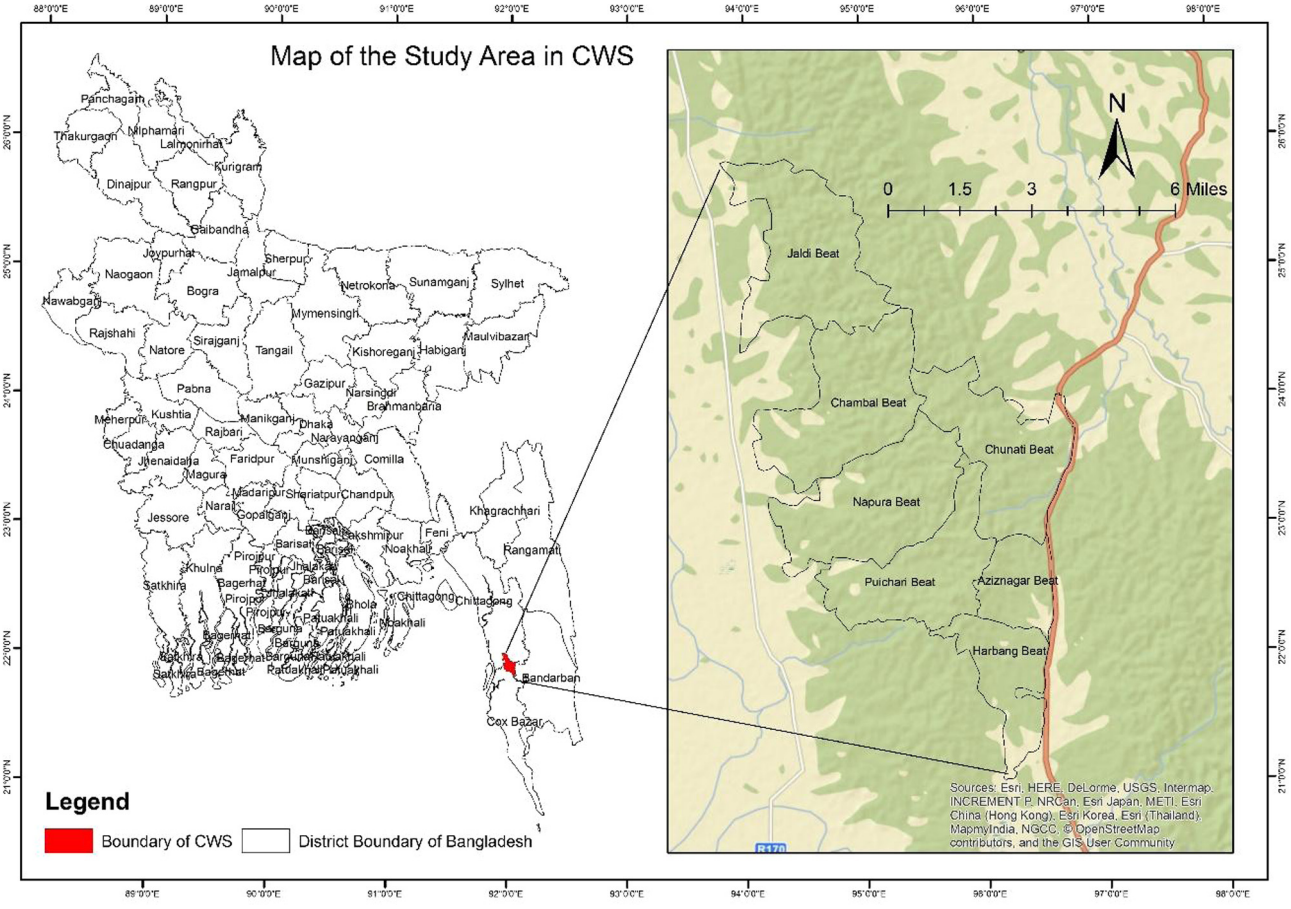

Fig. 1. Study area.

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