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Land Use Change Analysis of Neyyar Wildlife Sanctuary, Kerala Using GIS and Remote Sensing Methods

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Abstract

The Western Ghats is one of the world's 18 hotspots of biodiversity and forest communities that have a vital role in maintaining a balanced eco-system of the world. The Neyyar Wildlife Sanctuary located on the Western slopes of the Western Ghats along the South East corner of Kerala in India was selected as the study area owing to its diversified wealth of floral characteristics specifically at the landscape level. The present study was carried out using an integrated approach employing Remote Sensing and GIS techniques for land cover change analysis. The aim of the study was to quantify and map forest cover change in term of land use change during 2001-2015. Land sat 8 images (8 bands), Survey of India toposheets and Google earth images were used for visual interpretation of the land cover classes. The most notable land use categories obtained were evergreen forest, water body, mixed jungle, scrub land and barren land/rocky areas. The study revealed that there is a net decrease in the forest cover during 2001 to 2015.

Keywords change detection technique, GIS, India, land use change, remote sensing, unsupervised classification

Introduction

Forest is a biological unit having a vast social organization of living communities. These forest communities have a vital role in maintaining the balanced eco-system of the world. Studies have shown that there are only few forest areas on the earth that remains in their natural state. Anthropogenic activities have altered the forest resources significantly. Forest cover change accelerates the climate change and global warming [1]. Forest cover changes may have been important consequences for natural and forest landscapes through their impacts on soil and water quality, biodiversity and global climatic systems [2]. Rapid population growth and subsequent demand of agricultural land and forest products had accelerated the deforestation process in many developed countries. The land use/land cover classification and mapping issue have a main role in monitoring and effective utilization of our natural resources to stabilize future generation and for environmental stability. GIS, GPS and Remote Sensing tools are effective and efficient decision making techniques for making Land use/land cover classification mapping of one specific area of interest. Satellite remote sensing provides a synoptic view of forests and their condition on real-time basis [3]. Satellite remote sensing has played a pivotal role in generating information about forest cover, vegetation type and land use changes [4-6].

Study area

The Neyyar Wildlife Sanctuary located on (Figure 1) the Western slopes of the Western Ghats along the South East corner of Kerala is selected as the study area owing to its diversified wealth of floral characteristics specifically at the landscape level. The sanctuary lies between 80 29'30" to 80 37' 30" North latitude and between 770 8' 20" to 770 17’05" East longitude. The entire area lies within the catchment area of Neyyar River, which originates from the slopes of Agasthyarkoodam, the highest peak of the sanctuary. Forest Types include West coast tropical evergreen, Southern hilltop tropical evergreen, Southern moist mixed deciduous forest, Southern tropical hill forests, southern sub-

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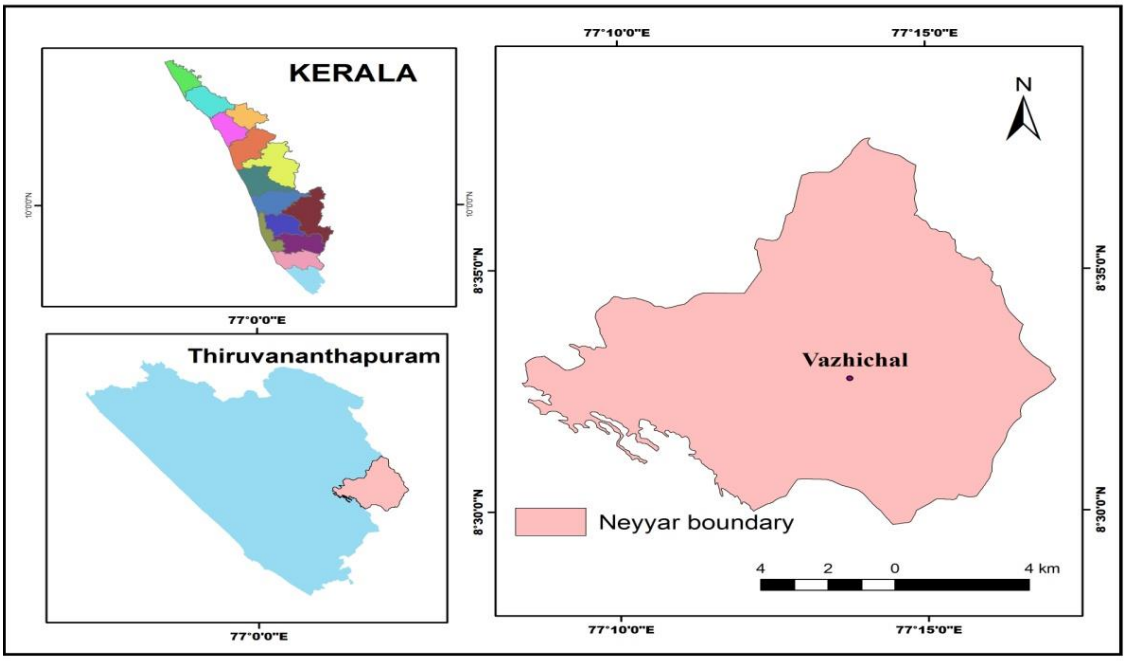

Figure 1. Location map of Neyyar Wildlife Sanctuary Study

tropical savannahs and Reed brakes. Map showing the study area is shown in Figure 1.

Methodology

The materials used for the study includes Survey of India Toposheets of scale 1:25000 – 58H/6/SW, 58H/3NE, and 58H/21 and Satellite imageries obtained from LANDSAT 8 (7 January 2000 and 23 February 2015). GIS and Image processing softwares used in the study were ArcGIS 9.3 and Erdas Imagine 10.1. Unsupervised classification method was employed to develop a land use map of the area. A modified version of the Anderson scheme of land use/cover classification was adopted [7]. The categories included: (1) Water (2) Evergreen forest (3) Mixed Jungle (4) Scrub forest/land (5) Barren land/rocky areas. Quantitative areal data of the overall land use and land cover changes as well as gains and losses in each category between 2001 and 2015 can be compiled by calculating the area extent. The change matrix gives the knowledge of the main types of changes in the study area. In order to analyze the nature, rate, and location of land use and land cover changes, land cover maps of year 2001 and 2015 were created in ArcGIS. Ancillary data such as Google Earth image and topographic maps were used for visual interpretation of the land cover categories.

Results and Discussion

For the land use classification, unsupervised classification method was resorted. The total areal coverage of Neyyar wildlife sanctuary as per the Toposheet is 118 sq.km. The land use categories of Neyyar WLS were divided into five which includes water body, evergreen forest, mixed jungle, Scrub forest and barren land/rocky area. The land use and land cover maps for 2001 and 2015 were produced from Landsat ETM+ and Landsat 8 images and displayed in Figure 2. The result showed that the major land use of the area was

Table 1. Land use class and area calculation- 2001 and 2015

Land Use Class	2001 (area in sq.km)	2015 (area insq.km)
Water body	7.64 sq.km	5.02 sq.km
Evergreen	34.28 sq.km	20.78 sq.km
Mixed jungle	45.35 sq.km	48.93 sq.km
Scrub land	20.13 sq.km	31.84 sq.km
Barren land/Hilltop	10.56 sq.km	11.42 sq.km
Total area	**118 sq.km**	**118 sq.km**

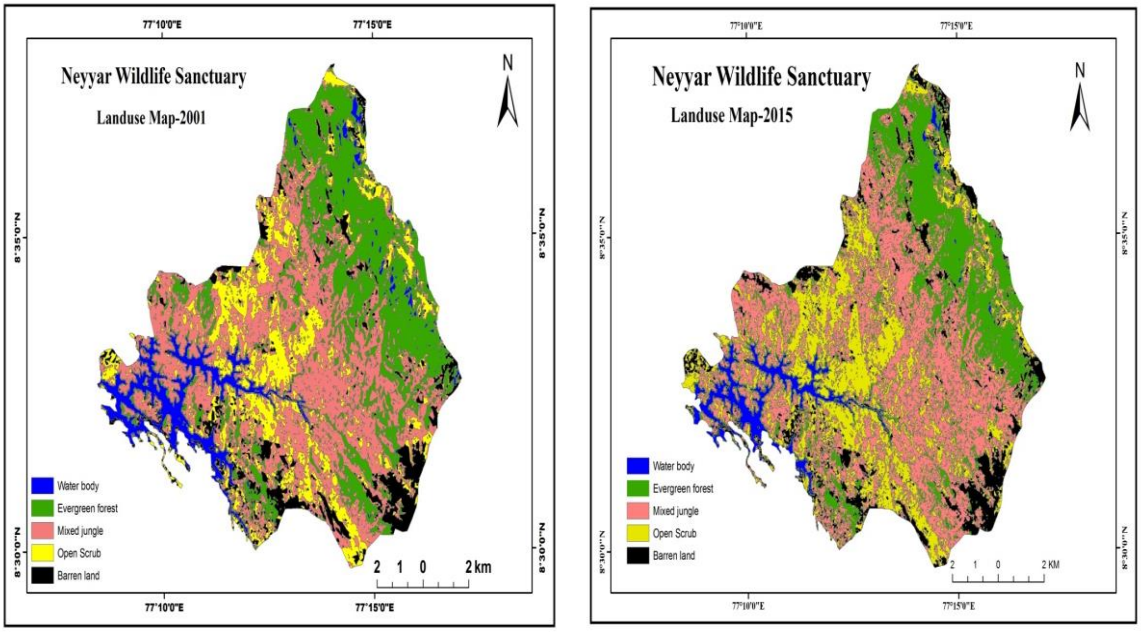

Figure 2. Land use map of the year 2001 and 2015.

mixed jungle with an area of 45.3 sq.km in 2001 and 48.93 sq.km in 2015 (Table 1).

The evergreen forest which had about 34.28 sq.km areal extent was decreased by about 10%. The open scrub area showed tremendous increase of approx. 11 sq.km. This showed the shifting of vegetation pattern from dense forest to scrub. The barren land also showed a net increase of about 2% in 2015. However, a net decrease was exhibited by water body in the area. Data registered in Table 1 along with Figure 2 revealed that negative changes occurred in the land use/cover pattern of the Neyyar WLS. The result indicated that the forest type during the study period was degrading. This degradation trend has already been reported by earlier workers in specific areas of Western Ghats. Menon and Bawa [8] estimated an annual decline rate of 0.57% in the whole Western Ghats during 1920 – 1990, while Jha et al. [9] estimated a decline of 1.16% per year during the period of 1973-1999.

Conclusion

The present study was an integrated approach of GIS and Remote Sensing for land cover change analysis. This study has demonstrated the utility of Landsat images and GIS to monitor changes in the forest. The results of the study suggested that the forest cover has been under human pressure degrading its originality over the years. Such rates have defeated the whole essence of calling the study area a forest reserve. The complex forces of changing economic opportunities have the most significant impacts on deforestation of the forest reserves. Therefore, we need to prudently manage these delicate resources with proper planning and sustainable forest resource management.

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