

Analysis of Land Cover Change in Shendurney Wildlife Sanctuary, Western Ghats, India using Remote Sensing and GIS

Aditya S. K., Smitha Asok V., Rajesh Reghunath

Received: 30 June 2016, Accepted: 17 August 2016

Abstract

Land cover and land use change is an important component in understanding the reciprocal action of human activities with the environment. Tropical forests of Western Ghats have undergone swift land cover changes in the last few decades due to several anthropogenic factors. The present study assessed the land cover change in the Shendurney wildlife sanctuary, a mega biodiversity hot spot of Western Ghats, Kerala over a period of fifteen years using GIS and Remote sensing techniques. The study intended to develop a land use map of the experimental area based on the unsupervised classification method and to assess the rate of land degradation. The results revealed that there was a great spatial variability in the pattern of forest loss and land use change throughout the region which in turn affected the species diversity.

Keywords deforestation, land use/land cover, GIS, remote sensing

Introduction

Forest resources are fundamental for human existence. It is estimated that around 1.6 billion people depend on forests for their livelihood worldwide [1]. Several anthropogenic activities such as cultivation, mining, construction and deforestation have serious influence on the changing land use patterns. Changes in land use and land cover (LULC) are pervasive, increasingly rapid, and can have adverse impacts and implications at local, regional and global scales. The change in land use is a significant factor which impacts fragmentation of forest and isolation of

habitats for species, which are linked with human and physical environments of that particular area. The major cause of forest fragmentation and habitat isolation is the change in land use pattern which can be linked with mankind and the surrounding environment [2]. The extrinsic factors in an ecosystem may sometimes trigger the existing land cover to undergo changes leading to drastic land use change [3]. The change in land use cover can be best analyzed by using Remote Sensing and GIS tools because of the ability to identify spatially and temporally referenced objects [4]. However, the GIS overlaying the forest change detection technique has been found to be superior [5-6]. Technically, land use and land cover change means the quantitative changes in the area (increase or decrease) of a given type of land use and land cover. The forests of Kerala are in various stages of degradation under the influence of biotic pressure [7]. Presently, the forests of Kerala especially the Shendurney wildlife sanctuary undergo forest degradation due to various natural causes and human based activities. The present analysis of land use and land cover change involved a quantitative estimation of land use, as well as the change in vegetation structure over a temporal scale of 15 years.

Study Area

The present study was performed in Shendurney wildlife sanctuary in Pathanapuram Taluk of Kollam district which is a part of Agasthyamalai biosphere reserve, Western Ghats, Kerala. Agasthyamalai Biosphere Reserve (ABR) was notified under the UNESCO's Man and Biosphere

Aditya S.K. ✉, S. Asok. V.

Post Graduate Department of Environmental Sciences, All Saints College, Thiruvananthapuram-695007, India

R. Reghunath

International and Inter University Centre for Natural Resources Management, University of Kerala, Kariavattom-695581, India

✉ aditya.palazhy@gmail.com

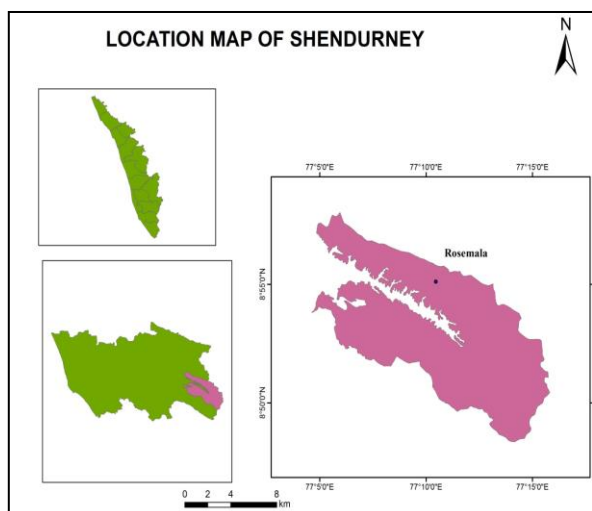


Figure 1. Location map of the study area

Programme on 12th November, 2001. Shendurney Wildlife Sanctuary has a total areal extend of 171.32 sq. km. The study area lies between 77° 4' and 77° 17' east longitude and 8° 48' and 8° 58' north latitude (Figure 1). Shendurney WLS lies 100-1785m above the mean sea level. The main drainage basin is the Kallada River which is formed by 3 major rivers Shendurney, Kazhuthuruthy and Kulathupuzha. In the middle of the sanctuary lies an artificial lake of 18 sq. km formed by the Thenmala (Parappara) Dam built across the Shendurney and Kulathupuzha rivers. The sanctuary got its name from *Gluta travancorica* locally known as "Chenkurinji", a rare timber species. The vegetation types of this sanctuary include evergreen forest, semi evergreen forest, moist deciduous forest, Myristica swamp, etc. For the last few decades, the disturbance in this sanctuary is high due to various factors. The studied area is a native locality for several endemic and threatened species of Western Ghats. Location map of the studied area is given in Figure 1.

Methodology

In the present study, an attempt was made to assess and evaluate the land use and land cover change in Shendurney wildlife sanctuary by using Remote Sensing and GIS. Multi-temporal satellite data set observed by Landsat 7 (ETM+SLC on) and Landsat 8 (OLI/TIRS) and Survey of India toposheets of 1:50,000 scales were used for the analysis (Table 1). The reflectance of 2015 image was corrected

Table 1 Spatial Data Sources

Data	Month of observation
Landsat 7	7th January 2001
Landsat 8	23rd February 2015
Survey of India toposheet	58H1 and 58H5

and land use/land cover classification was done through unsupervised classification method, based on Google Earth images and Toposheets. Arc GIS 9.1 and Erdas Imagine 9.1 were used as tools for assessing the land use/land cover analysis. The vegetation analysis of the study area was done by Normalized Difference Vegetation Index (NDVI) and the vegetation analysis was done with the help of the ERDAS Imagine and Google Earth Images. The LULC classes included water body, evergreen, semi evergreen, deciduous forest, mixed jungle, grassland and barren land/ hilltop.

Results and Discussion

The dominating land cover of Shendurney wildlife sanctuary is tropical evergreen forest followed by west coast semi evergreen forest. The map from 2001 to 2015 showed that there was a decrease in the extent of mixed jungle and deciduous forest and a drastic increase in the extent of barren land. The change or increase of water body from 2001 to 2015 was due to the construction of Kallada dam in Shendurney wildlife sanctuary. This revealed that the forest of Shendurney wildlife sanctuary has undergone considerable degradation in the past. The results indicated that the forest type during the study period was degrading. The increase in evergreen forests might be because of its distance from settlements and other activities. These forests are located at the core zone, where human interference is almost absent. The forest cover type change analysis indicated that the forest area of this sanctuary was under degradation.

The spatial analysis of land use change in Shendurney WLS indicated that most of the forest cover changes have occurred on the tourist areas of the sanctuary and close to the settlements inside the sanctuary. These changes could be classified into different clusters of causes like livelihood dependence of local people for timber, agricultural expansion (plantation), forestry operations, forest fire and various other infrastructure developments. Figure 2 depict the land use map of Shendurney

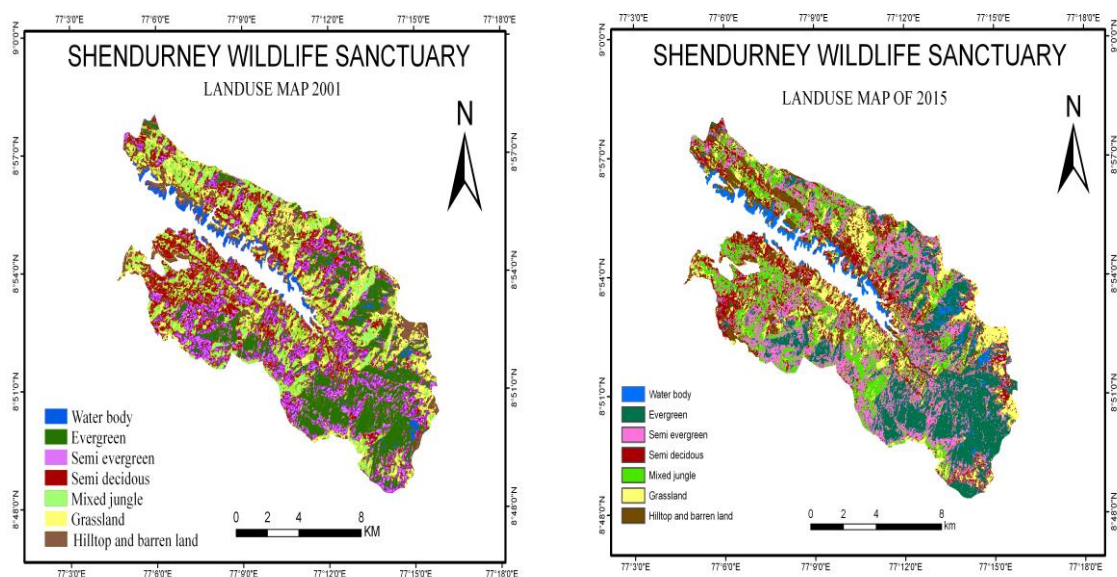


Figure 2. Land Use Map of Shendurney WLS for 2001 and 2015

WLS for 2001 and 2015 years and Figure 3 represent the difference in area of different land use classes in the study area in hectares. The major demands of the population residing on the forest of the sanctuary are timber and woods for building huts and roofing for houses, for making agricultural implements and fencing purposes. Fire woods are used for household consumption, grasses for rearing cattle etc. In addition, infrastructure developmental activities like construction and maintenance of roads and dams, buildings for people residing inside the sanctuary and associated movement of machines and vehicles contributes to the degradation of ecosystem.

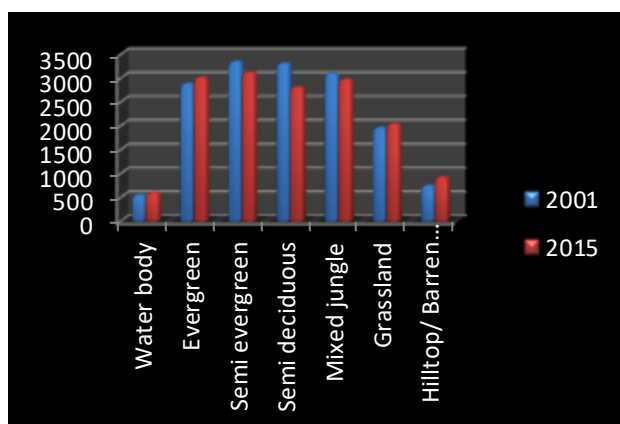


Figure 3. Areal extent of land use classes in the study area in ha.

Another major threat is the over grazing which is probably playing an important role in the degradation of undisturbed or intact core area of the forest [8]. Soil erosion and forest fire also accelerate the process of forest degradation. It has been identified that increase in population and associated pressure developed inside the sanctuary was a significant driving agent which can often be a primary underlying cause of deforestation [9]. Importantly, there have been uncoordinated development policies of the various government agencies which have conflicted with conservation efforts.

Conclusion

The present investigation using remote sensing revealed that the area of forest under study was affected by the surrounding areas of varying magnitude. It was supported by clear evidences that forest cover decrease occurred due to illegal anthropogenic activities and cultivation of agriculture crops. It can be concluded that agriculture expansions, tourism and over grazing has a crucial role in this degradation. The present study also suggested that preventive measures should be taken to reduce forest disturbances and for implementing sustainable management of Shendurney wildlife sanctuary [10].

References

- [1] World bank (2004). Threats protected areas. <http://inweb18.worldbank.org/SSD/envex.nsf/80bydoc>.
- [2] A. Giriraj, M. S. Murthy and C. Beierkuhnlein (2010). Evaluating forest fragmentation and its tree community composition in the tropical rain forest of Southern Western Ghats (India) from 1973 to 2004. *Environ. Monit. Assess.*, **161**: 29-44.
- [3] B. S. Bisht and B. P. Kothari (2001). Land cover changes analysis of Garur Ganga Watershed Using GIS/Remote Sensing Technique. *J. Indian Soc. Remote Sensing*, **29**: 137-141.
- [4] C. P. Lo and R. L. Shipman (1990). A GIS approach to landuse change dynamics detection. *Photogramm. Eng. Remote Sens.*, **56**: 1483-1491.
- [5] W. A. Malila (1980). Change vector analysis—an approach for detecting forest changes with Landsat. *Proceedings of the 6th Annual Symposium on Machine Processing of Remotely Sensed Data*, LARS, Purdue University, Indiana (West Lafayette, IN: Purdue University Press), 326-331.
- [6] P. S. Roy and S. Tomar (2001). Landscape cover dynamics pattern in Meghalaya. *Int. J. Remote Sensing*, **22**: 3813- 382.
- [7] K. S. Nair and P. Naghesh (2000). 'Forest in Kerala: Yesterday, today, and tomorrow', *Indian Forester*, **124**: 425-432.
- [8] M. A. Kumar, M. Singh, S. K. Srivastava, A. Udhayan, H. N. Kumara and A. K. Sharma (2002). Distribution Patterns, Relative Abundance and Management of mammals in Indira Gandhi Wildlife Sanctuary, Tamil Nadu, India. *Journal of Bombay Natural History Society*, **99**: 184-210.
- [9] D. H. Wibowo and R. N. Byron (1999). Deforestation Mechanisms-A Survey. *Int. J. Soc. Econ.*, **26**: 455-474.
- [10] S. K. Jose, C. J. Alex, S. Kumar, A. Varghese and G. Madhu (2011). Landscape Metric Modeling-a Technique for Forest Disturbance Assessment in Shendurney Wildlife Sanctuary. *Environmental Research, Engineering and Management*, **58**: 34-41.