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RESEARCH ARTICLE

SPATIOTEMPORAL VEGETATION ANALYSIS IN NEYYAR WILDLIFE SANCTUARY, WESTERN GHATS, INDIA USING GEOINFORMATICS

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ABSTRACT

Vegetation is a vital component of the natural environment. Terrestrial vegetation includes natural ecosystems, such as native forests and woodlands, shrub lands, grasslands and wetlands. Information on land cover is fundamental to many national/global applications including watershed management and agricultural productivity. Thus, the need to monitor land cover is derived from multiple intersecting drivers, including the physical climate, ecosystem health, and societal needs. Tropical forests have undergone rapid land cover changes especially in the last few decades. Terrestrial forest is one of the major factors in the global carbon balance, and therefore in global climate change. Change in forest cover may also have affected past climates on regional or sub-continental scales. Forest cover change accelerates the climate change and global warming. The present study analyses the vegetation change in the Neyyar wildlife sanctuary for a period of forty years using GIS and Remote sensing techniques.

INTRODUCTION

The composition, diversity, and structure of vegetation are the key determinants in assessing biological diversity of forest ecosystems. Vegetation is the source of primary production which plays a direct role in water and nutrient cycling, and interacts strongly with other biotic components. Vegetation has also been identified as a specific target for the calculation of critical loads/levels. The composition and structure of vegetation can serve as bio-indicators for environmental changes to ecosystems that echo the interactions between human activity and the natural environment (Zhang *et al*., 2008). The land cover and landscape change in semi-arid and arid environments often reflects the most significant impact on the environment due to excessive human activity (Zhou *et al*., 2008a and Zhou *et al*., 2008b). Terrestrial forest is one of the major factors in the global carbon balance, and therefore in global climate change (Francey *et al.,* 1995; Fang *et al*., 2001). Change in forest cover may also have affected past climates on regional or sub-continental scales. Forest cover change accelerates the climate change and global warming (Ruddiman, 2003). Land use/land cover is a fundamental variable that impacts the forest fragmentation and isolation of habitats, which is being linked with human and physical environments (Giriraj *et al*., 2010). 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 (Chen *et al*., 2001). Vegetation mapping is a product of the development of remote sensing, initially through aerial photography, remote sensing technology, because of the benefits it offers wide area coverage, frequent revisits, multispectral, multisource, and storage in digital format to facilitate subsequent updating and compatibility with GIS technology proved very practical and economical means for an accurate classification of land cover (Nafeesa *et al*., 2010, Lillesand and Kiefer, 1999). Forest cover change detection techniques have been developed for monitoring land cover dynamics from remotely sensed imagery (Coppin *et al.,* 2004; Lu *et al.,* 2004, Roy and Roy, 2010). The present analysis of land use and land cover change involves a quantitative estimation of land use and also reveals the periodic change that occurs in the forest vegetation in the area and its extent in detail.

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MATERIALS AND METHODS

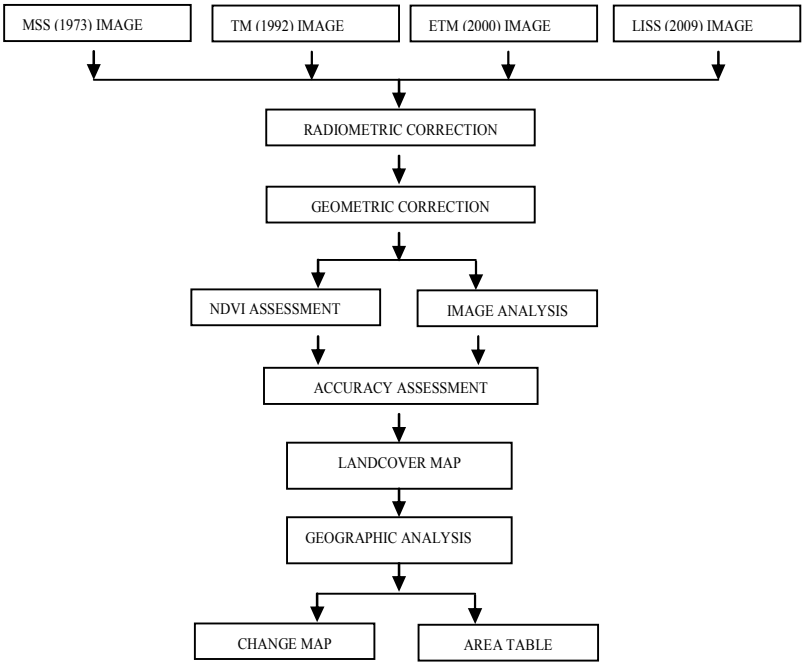
Present study adopted GIS and Remote sensing based approach for the analysis of vegetation change, the data used for the analysis including Landsat Multi Spectral Scanner (MSS) image 1973, Landsat TM (Terrain Mapper) satellite imagery 1992, Landsat ETM + (Enhanced Terrain Mapper) imagery 2000 and IRS-1C Linear Imaging Self Scanner (LISS)-III satellite data of 2009. The digital number (DN) values of the Landsat MSS, Landsat TM, Landsat ETM+ and IRS P6 LISS III data were converted into radiance values using the corresponding satellite sensor parameters for analysis. Then the images undergo Radiometric corrections, Geometric

corrections, Image analysis and Accuracy assessment. A hybrid approach combines the advantages of the automated and manual methods to produce a land cover map that is better than if just a single method was used. One hybrid approach is to use one of the automated classification methods to do an initial classification and then use manual methods to refine the classification and correct obvious errors.

RESULTS AND DISCUSSION

The vegetation map of 1973, 1992, 2000 and 2009 and area matrix of Neyyar wildlife sanctuary is revealed that dominating land cover of Neyyar wildlife sanctuary is west coast tropical evergreen forest and followed by southern moist mixed deciduous forest. The map from 1973 to 2009 shows that there is decrease in the extent of west coast tropical evergreen forest

Methodology flow chart of vegetation analysis

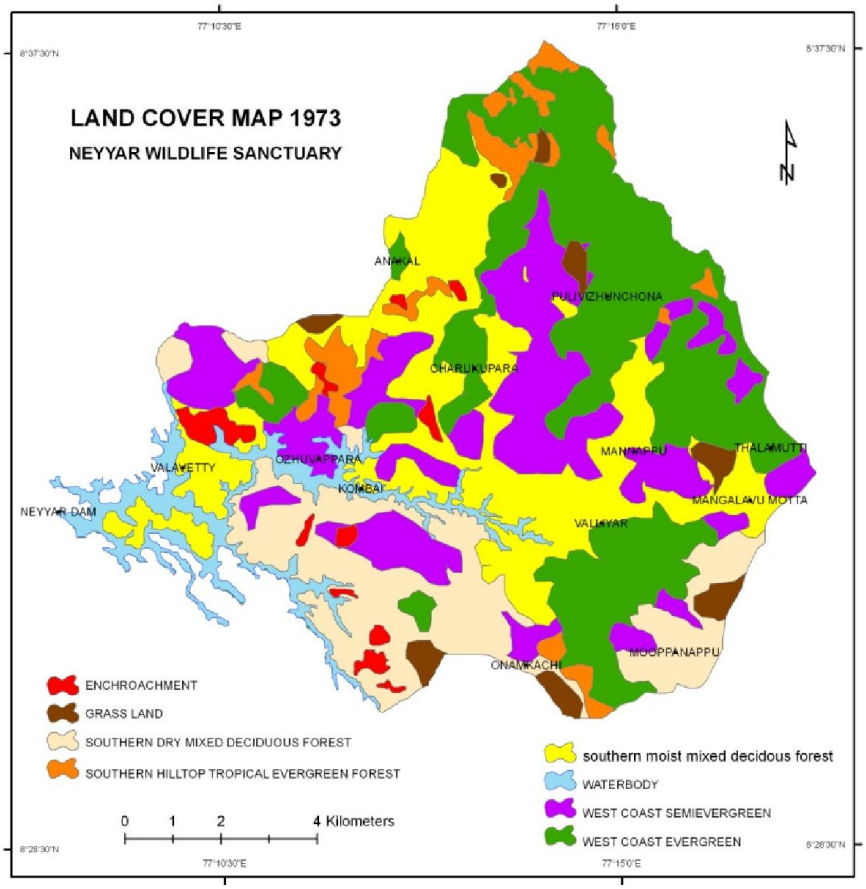


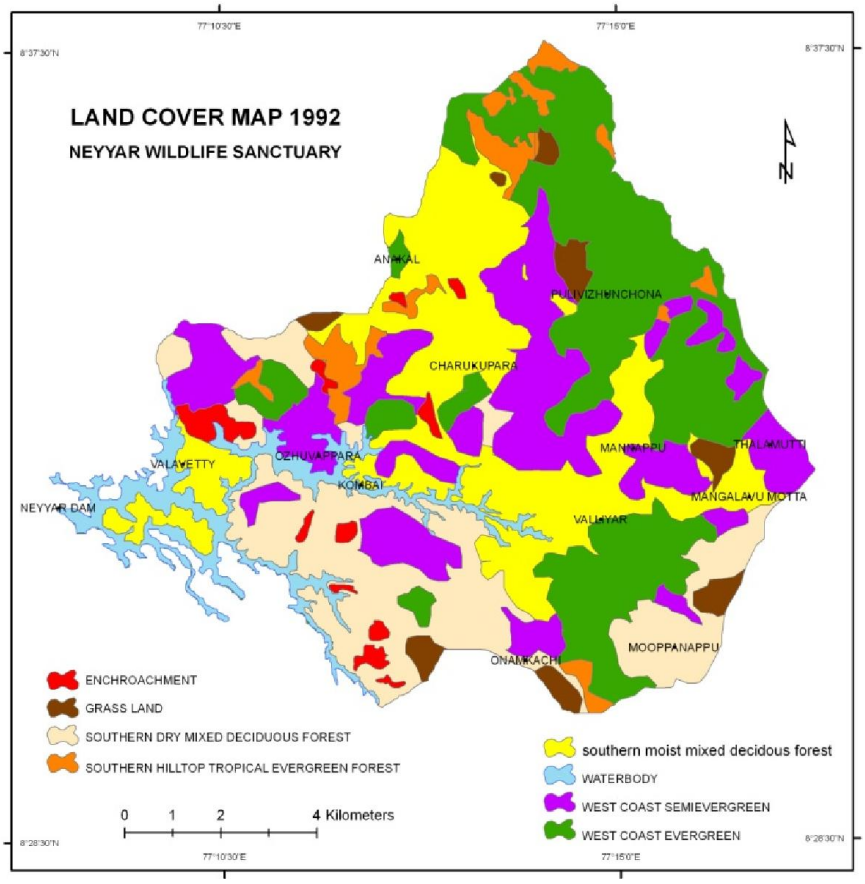
Vegetation change analysis table (area change)

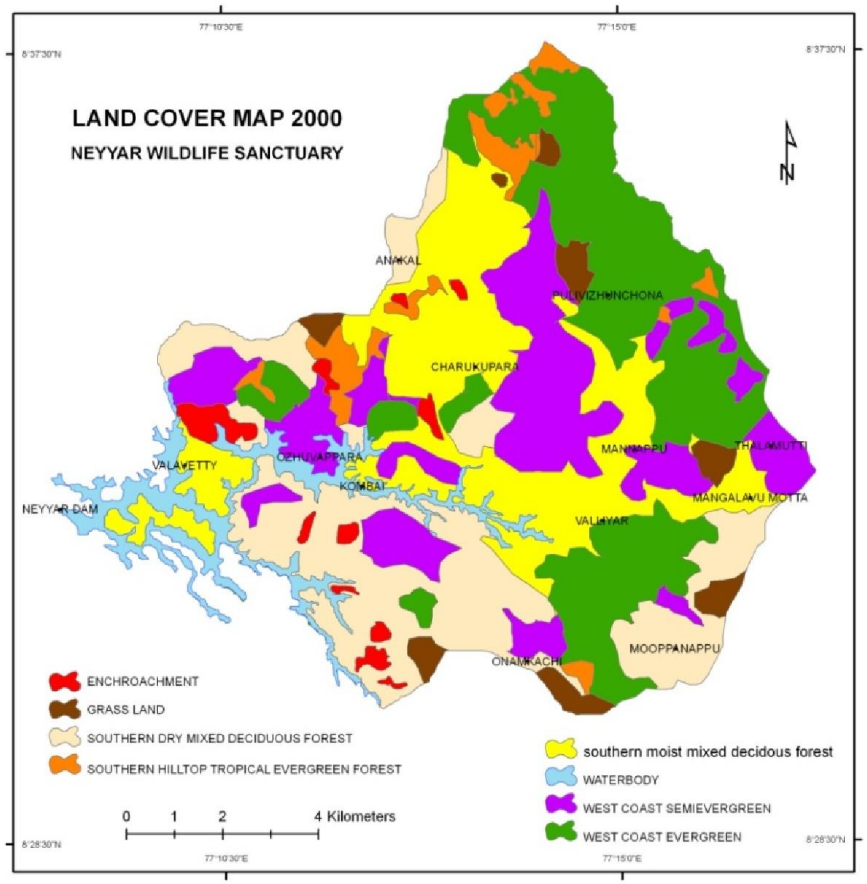
Land cover (Neyyar wildlife sanctuary)	1973(MSS) (sq.km)	Area %	1992(TM) (sq.km)	Area %	2000(ETM) (sq.km)	Area %	2009(LISS) (sq.km)	Area %
Settlement/ plantation	5.146	4.020	5.324	4.159	6.334	4.948	6.354	4.964
Grassland	5.884	4.597	6.633	5.182	7.316	5.716	7.532	5.884
Southern dry mixed deciduous forest	20.471	15.993	23.314	18.214	25.404	19.847	26.447	20.662
Southern hilltop tropical evergreen forest	7.216	5.638	7.115	5.558	6.730	5.258	5.792	4.525
Southern moist mixed deciduous forest	24.439	19.093	23.44	18.312	21.901	17.110	20.620	16.109
Waterbody	7.301	5.704	7.65	5.976	7.750	6.055	7.858	6.139
West coast semievergreen forest	23.637	18.466	22.823	17.830	21.359	16.687	19.988	15.616
West coast tropical evergreen forest	33.907	26.490	31.704	24.768	31.206	24.380	30.409	23.757

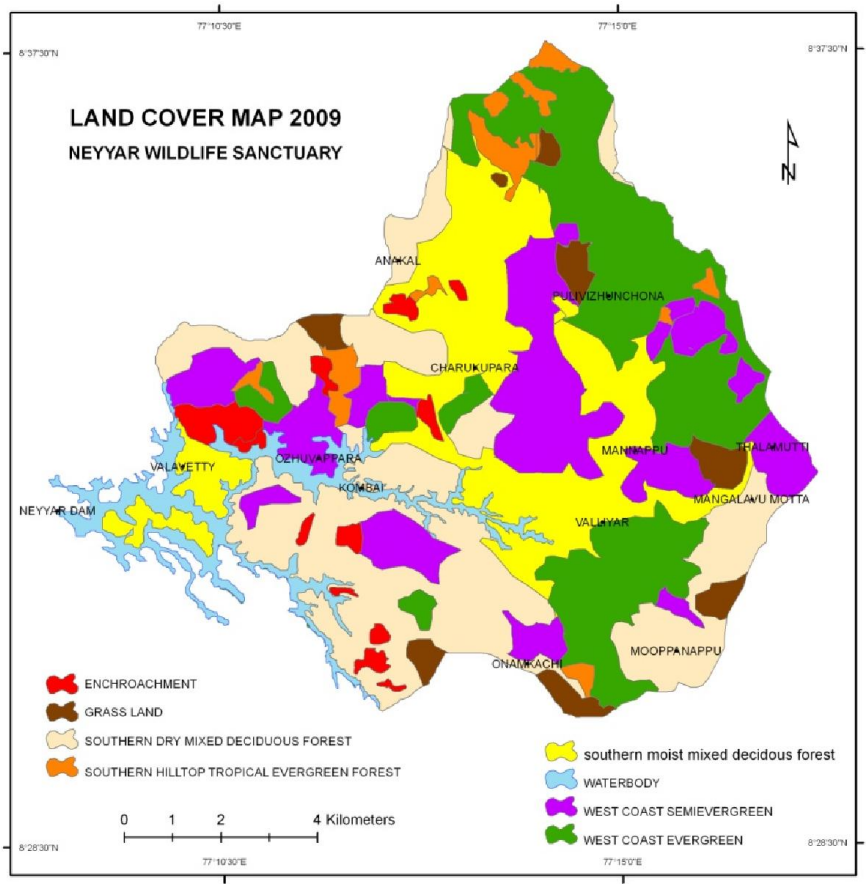
The software used for the analysis includes Arc GIS 10, and ERDAS Imagine. Classified and accuracy assessed satellite images are used for the change detection analysis. For change detection analysis the raster image is converted in to corresponding land cover polygon by using ESRI Arc GIS software. In Arc GIS, geographic analysis extension is used for change detection analysis, in this 'Union' operation is used. Based on the change detection analysis cover change of the year 1973 to 1992, 1992 to 2000, 2000 to 2009 and1973 to 2009 was generated and area statistics were calculated. In change table positive value indicates that the area of land cover is increased with previous year and negative value indicates that the land cover area of specified class is decreased compared to previous land cover image.

and there is increase in the extent of southern dry mixed deciduous forest and grassland in consecutive years. This reveal that the forest of Neyyar wildlife sanctuary is undergo degradation. During 1973 – 1992 there is a sharp increase of southern dry mixed deciduous forest is noticed. From 1973 – 2009 the most increased land cover type is southern dry mixed deciduous forest and the decreased one is southern moist mixed deciduous forest. The result indicated that the forest type during the study period was degrading that means the extent of west coast tropical evergreen forest and west coast semi evergreen forest is decreasing and the extent of southern dry mixed deciduous forest and grass land is increasing. In Neyyar wildlife sanctuary from1973 – 2009 the rate of change of west coast tropical evergreen forest is -2.73%, west coast semi evergreen forest is -2.851% , southern moist mixed deciduous


LAND COVER MAP 1973
NEYYAR WILDLIFE SANCTUARY
77°10'30"E
77°15'0"E
8°37'30"N
8°28'30"N
N
ANKAL
PULIVIZHUNCHONA
CHARUKUPARA
VALAVETTY
OZHUVAPPARA
KOMBAI
MANNAPPU
THALAMUTTI
MANGALA/U MOTTA
NEYYAR DAM
VALIYAR
MOOPPANAPPU
ONAMKACHI
ENCHROACHMENT
GRASS LAND
SOUTHERN DRY MIXED DECIDUOUS FOREST
SOUTHERN HILLTOP TROPICAL EVERGREEN FOREST
0 1 2 4 Kilometers
southern moist mixed decidous forest
WATERBODY
WEST COAST SEMIEVERGREEN
WEST COAST EVERGREEN


LAND COVER MAP 1992
NEYYAR WILDLIFE SANCTUARY
77°10'30"E
77°15'0"E
8°37'30"N
8°28'30"N
N
ANKAL
PULIVIZHUNCHONA
CHARUKUPARA
VALAVETTY
OZHUVAPPARA
KOMBAI
MANNAPPU
THALAMUTTI
MANGALA/U MOTTA
NEYYAR DAM
VALIYAR
MOOPPANAPPU
ONAMKACHI
ENCHROACHMENT
GRASS LAND
SOUTHERN DRY MIXED DECIDUOUS FOREST
SOUTHERN HILLTOP TROPICAL EVERGREEN FOREST
0 1 2 4 Kilometers
southern moist mixed decidous forest
WATERBODY
WEST COAST SEMIEVERGREEN
WEST COAST EVERGREEN


LAND COVER MAP 2000
NEYYAR WILDLIFE SANCTUARY
77°10'30"E
77°15'0"E
8°37'30"N
8°28'30"N
N
ANAKAL
PULIVIZHUNCHONA
CHARUKUPARA
MANNAPPU
THALAMUTTI
VALAVETTY
OZHUVAPPARA
KOMBAI
MANGALAVU MOTTA
NEYYAR DAM
VALIYAR
MOOPPANAPPU
ONAMKACHI
ENCHROACHMENT
GRASS LAND
SOUTHERN DRY MIXED DECIDUOUS FOREST
SOUTHERN HILLTOP TROPICAL EVERGREEN FOREST
southern moist mixed decidous forest
WATERBODY
WEST COAST SEMIEVERGREEN
WEST COAST EVERGREEN
0 1 2 4 Kilometers


LAND COVER MAP 2009
NEYYAR WILDLIFE SANCTUARY
77°10'30"E
77°15'0"E
8°37'30"N
8°28'30"N
N
ANAKAL
PULIVIZHUNCHONA
CHARUKUPARA
MANNAPPU
THALAMUTTI
VALAVETTY
OZHUVAPPARA
KOMBAI
MANGALAVU MOTTA
NEYYAR DAM
VALIYAR
MOOPPANAPPU
ONAMKACHI
ENCHROACHMENT
GRASS LAND
SOUTHERN DRY MIXED DECIDUOUS FOREST
SOUTHERN HILLTOP TROPICAL EVERGREEN FOREST
southern moist mixed decidous forest
WATERBODY
WEST COAST SEMIEVERGREEN
WEST COAST EVERGREEN
0 1 2 4 Kilometers

forest is -2.984%, southern hilltop tropical evergreen forest is -1.113%, southern dry mixed deciduous forest is 4.669%, grassland is 1.288% ,water body is 0.435% and encroachment / settlement is 0.435%. Land cover change assessment for a period of 40 years helped to identify the rates and characteristics of forest type transformations. Two major and divergent trends, positive and negative were observed in the study. These changes can be attributed to a number of causes, principally livelihood dependence, agricultural expansion and infrastructure development resulting from population growth in and around the area, tourism activities, forest fire and uncoordinated policies of the different government agencies.

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