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RESEARCH ARTICLE

CHANGING LAND USE PATTERN IN NILGIRIS HILL ENVIRONMENT USING GEOSPATIAL TECHNOLOGY

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ABSTRACT

The Nilgiri mountain range in south India is considered unique by anthropologists, geologists, climatologists, botanists as well as tourists. It has remained a subject of constant study and research over the last two centuries. Man-nature balance had continued undisturbed in the Nilgiris for thousands of years until the early 19th century when it became a British colony attracting, in due course, various developmental activities. Subsequently, the Nilgiris and its popular hill stations emerged as favourite places for rest and recuperation, game and for raising commercial plantations. In the process, the traditional indigenous crops were replaced by "English" vegetables and then natural forests gave way to commercial plantations of coffee, tea and other exoticspecies of trees. Land use is the term that is used to describe human uses of the land, or immediate actions modifying or converting land cover. It includes such broad categories as human settlements, protected areas and agriculture. Within those broad categories are more refined categories, such as urban and rural settlements, irrigated and rainfed fields, national parks and forest reserves, and transportation and other infrastructure. Land cover refers to the natural vegetative cover types that characterize a particular area.

INTRODUCTION

"Land" is the most significant resource of mankind. It is a 'finite area. However, population growth is very rapid. Since man is a terrestrial animal, this increase is exerting a greater pressure on land. Land surface characteristics differ from one region to the other. This results in varied environments. The land must be utilized on a rational basis so that the available resource of land, water and livestock are developed to the maximum potential and the population is assured a decent living. Nilgiris entered an anxious era of landslides, which have become more frequent and disastrous in recent decades. The "Report on the study of Landslides of November 1993 in Nilgiris district" observed that "occurrence of land-slides in Nilgiris, particularly at the onset and during the north-east monsoons, is a ubiquitous, recurring, annual phenomenon". The colonists simultaneously developed the Nilgiris as a tourist resort for the English population. When independence came, the English were replaced by the Indian princely classes, politicians, capitalists and bureaucrats. After the 1970s, tourism became a mass industry for various reasons. Tourist arrivals increased exponentially to cross a million a year since 2000. However, without a proper plan to promote iton desired lines, the lop-sided and haphazard growth of tourism brought more harm than good to the hills. Alongside, unrelenting commercialization and immigration explosion with no corresponding improvements in infrastructures and amenities have begun to strain the carrying capacity of the hills, leading to water famine, pollution, urban congestion and marginalisation of the indigenous people. The Nilgiris is at the cross roads in the 21st century. Its development appears to have reached its limits with the predominant plantation economy collapsing and its tourism industry stagnating. Any further shifts in land use or cropping pattern appear economically unsound and ecologically catastrophic. Promotion of tourism again may prove counterproductive unless there is a radical change in the focus and objectives of the industry in consonance with the overall priorities of the district. The Nilgiris is desperately looking for the best international practices to balance the needs of development and conservation. The Nilgiri hills have a history going back a good many centuries. It is not known why they were called the Blue Mountains. Several sources cite the reason as the smoky haze enveloping the area, while other sources say it is because of the kurunji flower, which blooms every twelve years giving the slopes a bluish tinge. In Nilgiris district the topography is rolling and steep. About 60 per cent of the cultivable land falls under the slopes ranging from 16 to 35 per cent. The altitude of the Nilgiris results in a much cooler and wetter climate than the surrounding plains, so the area is popular as a retreat from the summer heat. During summer the temperature remains to the maximum of 25°C and reaches a minimum of 10°C. During winter the temperature reaches a maximum of 20°C and a minimum of 0°C. The holding size is small in the district, averaging 1.94 hectares. Roughly 78 per cent of the holdings are less than 1 hectare each in size. Total Individual Holdings in respect of Marginal/Small farmers are given below: Below 0.2 Hectare to 0.4 hectares; Marginal: 0.4 to 0.81hectares;

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Small:0.81 to 1.21. As per the latest survey conducted, forests accounted for about 56 per cent of the total area as against the State average of 16.6 per cent there is an increase of 13.6 per cent in the composition of forests in the last 10 years. The Nilgiris District occupies the first position among the 31 Districts in the forest share of the State. The increase constitutes only the barren and uncultivable land. The gross cropped area is maintained almost at the same level of about 31 per cent. In Nilgiris District there has been appreciable change in the cropping pattern after the Hill Area Development Programme was introduced. The main emphasis under Hill Area Development Programme is to increase the perennial crops to reduce soil erosion problem and to increase the vegetative cover for eco-development. Nilgiris district is endowed with rich natural resources, which pose an imperative need to check the uncontrolled urban growth and denudation of forests to maintain the fragile ecosystem.

To regulate the urban development in consonance with desirable ecological parameters and as well as to guide and monitor the spatial growth of the towns in the district Accurate information of land use/land cover is required to central all scientific studies that aims to understand the terrestrial dynamics and is required to local to global scale to aid planning while safe guarding the environmental concerns. It is well known that land use/land cover have great impact on the economic and social development of the region. Remote sensing is an effective and economic means to collect the data and to monitor the changes occurring in land use categories. LANDSAT imageries provide up to date land use land cover information at small scale at reasonably low cost and with better accuracy.

The importance of land use /land cover analysis is numerous some of them are

- For proper planning and developing the land Use and land cover.
- For regular monitoring of the resources.
- Interpret land use from remotely sensed imagery.
- Establish hierarchical categories by grouping similar or related uses.
- Use a uniform point sampling technique for tabulating for large areas

LITERATURE REVIEW

Land cover, defined as the assemblage of biotic and abiotic components on the Earth's surface, is one of the most crucial properties of the Earth system. There are three fundamental ways in which it is important (Turner *et al*.1994). The first lies in the interaction of land cover with the atmosphere, which leads to regulation of the hydrologic cycle and energy budget, and as such is needed both for weather and climate prediction (DeFries *et al*., 2002). For example, most climate models are now coupled with Land Surface Parameterizations (LSPs) which use digital land cover data to produce databases of albedo, surface roughness, evapo transpiration and respiration. Second, land cover plays a major role in the carbon cycle acting as both sources and sinks of carbon. In particular, the rates of deforestation, afforestation and re growth play a significant role in the release and sequestering of carbon and consequently affect atmospheric CO2 concentration and the strength of the greenhouse effect (IPCC, 2000; Janetos and Justice, 2000; Houghton, 1999). Finally, land cover also reflects the availability of food, fuel, timber, fiber, and shelter resources for human populations, and serves as a critical indicator of other ecosystem services such as biodiversity. 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.

Problem statement

Land use is generally refers to the human activity associated with a specific piece of land. The land use types are agriculture land, settlements, plantation etc., and the term land use is used to indicate the particular purpose for which piece of land is utilized. The problem in analyzing the land use/Land cover is to Procedures for identifying land use from various types of remote sensor imagery, Classification and categorization and Mapping land use traits.

Land degradation is a central challenge to sustainable development. The latter has been defined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs"This was accepted as a common goal at the UN Conference on Environment and Development (UNCED) in 1991.

The holding size is small in the district, averaging 1.94 hectares. Roughly 78 per cent of the holdings are less than 1 hectare each in size. Total Individual Holdings in respect of Marginal/Small farmers are given below: Below 0.2 Hectare to 0.4 hectares; Marginal: 0.4 to 0.81hectares; Small: 0.81 to 1.21. As per the latest survey conducted, forests accounted for about 56 per cent of the total area as against the State average of 16.6 per cent there is an increase of 13.6 per cent in the composition of forests in the last 10 years. The Nilgiris District occupies the first position among the 31 Districts in the forest share of the State. The increase constitutes only the barren and uncultivable land. The gross cropped area is maintained almost at the same level of about 31 per cent. At the global scale, key problems threatening natural resources and the sustainability of life support systems are (1) soil degradation, (2) the availability of water and (3) the loss of biodiversity. These occur in virtually all socio – cultural and economic context Worldwide. However, there are great differences in the abilities of countries to cope with the problem of land degradation.

Objective

- To Assess the land use pattern in Nilgiris District Using SOI Topographical maps.
- To evaluate the land use/land cover utilization of resources on in Nilgiris District using optical remote sensing.
- To compare and study between topographical sheet and IRS-P6 Digital data using ENVI to determine the changes in land use and land cover.

METHODOLOGY

To study the human influence on the hill environment, the Indian topographical maps (ITM) of (1970) the entire Nilgiris district (13 topo sheets) have been converted into digital map formats. To find the changing hill environment in Nilgiris district, Indian Remote Sensing Digital Data for IRS-P6 for the time period 27th February 2010 has been obtained for the Digital Image analysis technique using ENVI 4.0. The image processed with the sample points collected by the GPS and the results were converted into raster to vector transformations and different shape files were derived. The results were downloaded to Arc View software and estimate the landuse in squre metres and square kilometers and find the different land use between the two time periods.

N latitude and 76° 14'E to 77° 2' E longitude and its climate has aptly been described as "the cold tropical island rising above the warm tropical sea of South India". It is bounded on the north by Karnataka State, North West by Kerala State, on the South East by Coimbatore District and the North East by Erode District of Tamilnadu. The entire district is hilly and is divided into two natural zones namely the Nilgiris plateau and the Wynad tableland. Figure – 1 is the IRS P6 digital data for study of District.

The district usually receives rains both during South West Monsoon and North East Monsoon. The entire Gudalur and Pandalaur, Kundah Taluks and portion of Udhagamandalam Taluk receives rain by the South West Monsoon and some

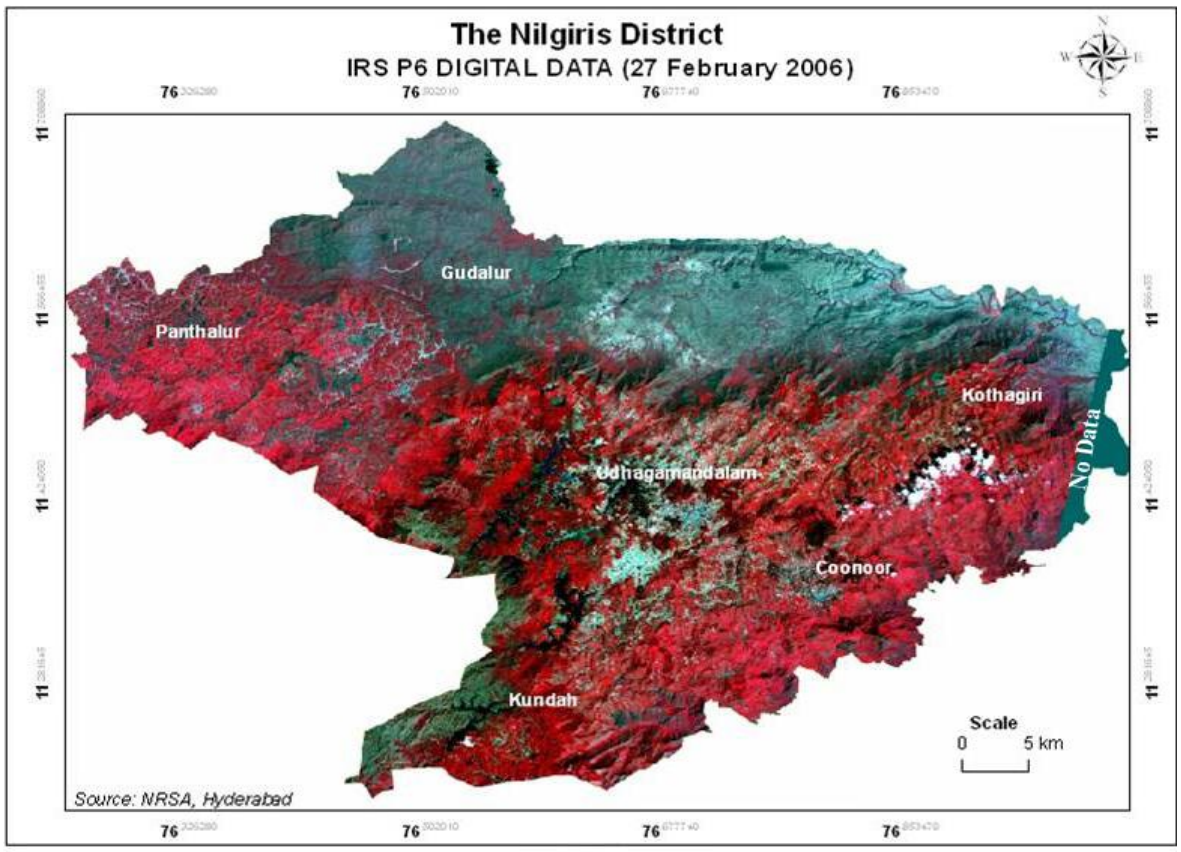

Figure - 1

Table 4.2 Land use Changes from 1970 to 2010

S. No	Category	Topo sheet m^2	Km^2	2010 Pixel m^2	Km^2	Difference Km^2
1	Dense Forest	70630.26	70.63	39143627.58	39.14	-31.49
2	Open Forest	28451.37	28.45	26073497.91	26.07	-02.38
3	Scrub	11668	11.66	10428817.80	10.42	-01.24
4	Rocky area	14572.17	14.57	31188488.63	31.18	+16.61
5	Grass land	32055.77	32.05	20518571.63	20.51	-11.54
6	Dense tree cover	16400.55	16.40	11472539.30	11.47	-04.93
7	Plantation cover	27791.36	27.79	24063975.2	24.06	-05.73
8	Urban	5072	05.72	20190534.36	20.19	+14.47
9	Water bodies	6855.17	06.85	6.746553.97	06.74	-0.11
10	Estates	54509.18	54.50	80372356.8	80.37	+25.87

Source: Digital image analysis and data generated from Indian Topographical maps

Study area

The Nilgiris, popularly known as the "Blue Mountains" is a tiny district, with an area of 2545 sq.km, forms an integral part of the Western Ghats. It is located between 11° 10'N to 11° 45' portion of Udhagamandalam Taluk and the entire Coonoor and Kotagiri Taluks are benefited by the rains of North East Monsoon. The prominent geomorphic units were identified in the district through interpretation of satellite imagery are Crust

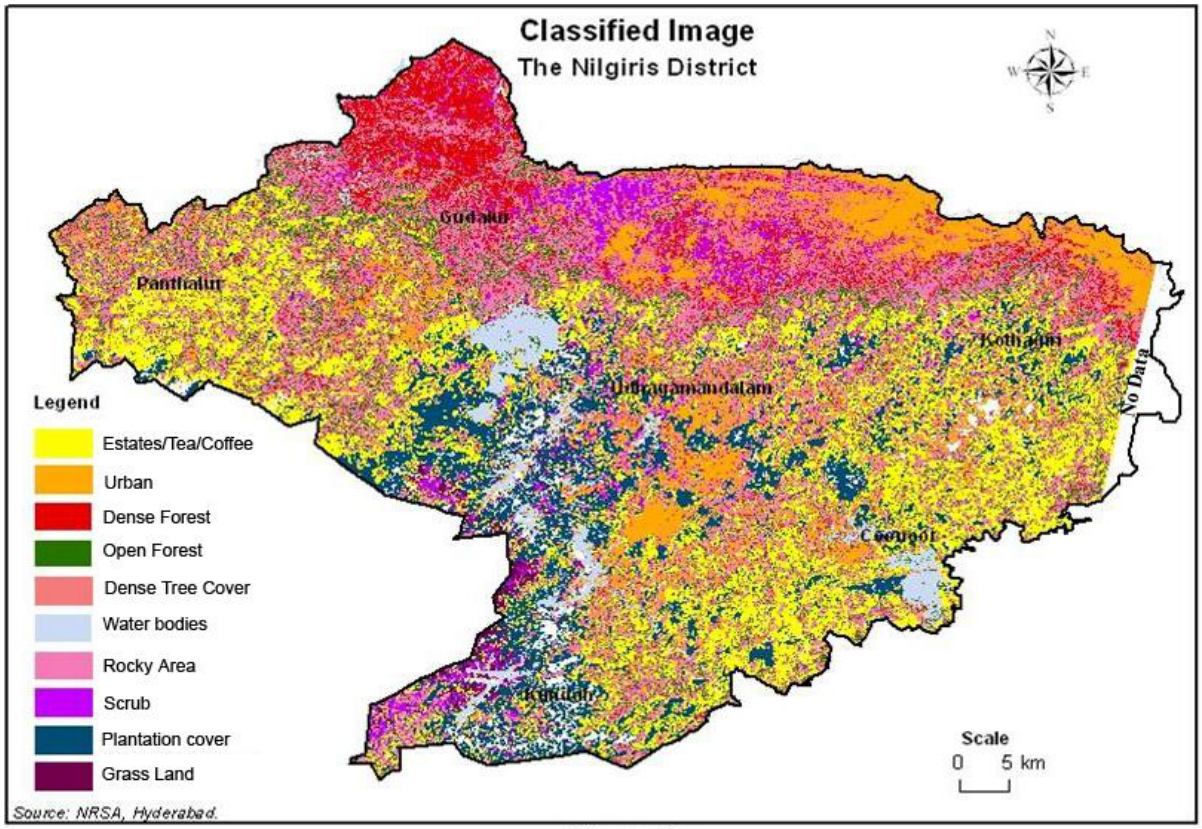

Figure - 2

line, debris slope, alluvial fills, colluvial fills, gullied valley, vegetation filled valley, fractured filled valley, intermountain valley, bazada zone, escarpments, pediments, deep pediments, shallow pediments, undissected plateau, dissected plateau, erosional plateau, flood plain, pediplain, moderate pediplain, residual hill. The Nilgiris hills rise abruptly from the plains (300 m above MSL) to an average elevation of 1370 m above MSL. Some of the prominent peaks are the Doddabetta (2634 m), the highest peak in Tamilnadu, Kolari (2625 m), Mukurthi (2554 m), Kudikadu (2590 m), Devabetta (2552 m), the conical grass covered Bear hill (2531 m) and Nilgiris peak.

RESULTS AND DISCUSSION

Table 4.2 shows the Land use changes from 1970 (using the base data generated from ITM) and optical remote sensing digital data for the year 2010. Figure -2 shows the classified image in to ten categories of land use data have been grouped to find the changes between two time periods. They are dense forest cover, open forest cover, scrub, rocky area, grass land, dense tree cover, and plantation cover, urban and built up areas, water bodies and estates. The pixel by pixel change from 1970 to 2010 clearly shows that there had been a decrease of 32 in dense forest cover, 2.38 in open forest, 1-24 in scrub class, 11.54 in grass land, 4.93 in dense tree cover, 5.73 in plantation crops and very meager level of water bodies, all in km^2. There has been increased or exposed rocky surface of 16.6 km^2 and expansion of urban areas in 14.47 km^2 and increase in estates 26 km^2. The results indicate there has been a radical change among the built up areas and estate building in the district. Nilgiris has experienced a much sharper growth in population both prior to and after independence. According to the latest census the population of the hills is 764,826 with the livelihood opportunities being limited in hill areas, the growth in population immigration only aggravated the poverty situation and marginalized the indigenous people. the continuous surge in population, Loss of biodiversity: Over 2700 species of flowering plants, 160 species of fern and fern allies, countless types of flowerless plants, mosses, fungi, algae, land lichens are found in the sholas of the Nilgiris. No other Hill station has so many exotic species Much of the Nilgiris natural Montane grasslands and scrublands interspersed with sholas has been much disturbed or destroyed by extensive tea plantations, easy motor vehicle access and extensive commercial planting and harvesting of non-native eucalyptus and wattle plantations The unrestrained spread of monoculture (tea, coffee, eucalyptus etc) destroyed priceless tropical rain forests, mountain forests and grasslands which have evolved over millions of years.

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