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Vegetal cover change detection based on remote sensing and GIS study of Salem revenue division, Salem district, Tamilnadu, India

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ABSTRACT

The present study focuses on the role of remote sensing and geographic information system (GIS) in assessment of changes in vegetation cover, between 1973 and 2010, in the Salem revenue division, Salem district of Tamilnadu, India. The trend of vegetal cover changes over the time span of 37 years, was precisely analysed using Satellite images. The study revealed that the vegetal cover was 1325.99 and 1199.04 sqkm in 1973 and 2010 respectively. It was noticed that vegetal cover has decreased in 2010, because of the urban expansion led deforestation. It also revealed that the vegetal cover loss is due to expansion of cultivation and human interference. It is envisaged that the study would prove the usefulness of Remote Sensing and GIS in forest restoration planning.

Introduction

The recent researches show that the overwhelming population pressure, practicing of unscientific agricultural methods and the lack of awareness about the importance of forests among the people and causes for deforestation/ degradation of forests. The essential factors to assess the forest cover in any terrain are to know the rate of depletion, reasons for the deterioration and remedial measures to restore it. The vegetal resources and forest cover assessment in the rugged topography or hill sector is not an easy task and it is a time-consuming process. This can be made easier only through the high spectral, spatial and temporal resolution qualities of remote sensing techniques.

Overview of detect changes in forest cover

It has been widely investigated and documented (Brandt and Thornes, 1996) that over the last several decades the Mediterranean region has been subjected to major changes in land use/cover as a result of forest fires, the abandonment of farms and grazing land, the relocation of people to the coastal border, the rapid expansion of tourism-related activities, and the intensification of agriculture, among others. Specifically, forest fires are seen as one of the most important driving factors of the observed land degradation in the region.

Remote Sensing (RS) can provide information on habitat types, vegetation structures, landscape geometry and habitat fragmentation. It also provides digital models, net primary production area, actual evaporation, and amount of biomass and leaf area indices %. Vegetation cover can be estimated by using Normalised Difference Vegetation Index (NDVI) and Transformed Soil Adjusted Vegetation Index (TSAVI) (Puredorj, 1998).

The Bartin forests are always affected by people of local and towns or cities located in close proximity to the forests. Villagers mostly depend on agriculture and animal husbandry, however, region's fields and pastures are insufficient to meet their requirements. Therefore, it is common for farmers and herders to transform forest land into agricultural fields, pastures, nut groves, settlements, and other human uses (Tunay and Atesoglu, 2002). Moreover, construction of buildings in response to growth in population and the increased extent of settlements have also put pressure on the forest resource. On the other hand, the efforts of local forest directorates have created limited areas of new forest in the region. As a result of this mixture of activities, serious problems have arisen in relation to land use in the region (Hizal et al.,1996).

The change maps can be used to support ecological research and socio-economic studies of the driving forces and environmental consequences of land-cover and land-use change in the region (Kristensen *et al.*1997)have claimed that the forest change detection mapping from satellite imagery is the 'most powerful monitoring tool' for conservation agencies, local administration and the non government organizations (NGO). The change is usually detected by comparison between two or multiple-dates satellite images, or sometimes between old maps and a recent remote sensing images. Most of the change detection techniques are based on a pixel-to-pixel analysis and essentially comprise quantification of temporal phenomena through multispectral sensors. The effective use of remote sensing as a tool for generating land cover information is highly dependent on the measurable quality of this information (Congalton, et.al,1999).

Hayes and Sader (2001) compared image differencing, principal component analysis, and RGB-NDVI methods for a tropical forest study site. The goal of the study was to determine which technique was most accurate and efficient for multidate forest change detection. Hayes and Sader (2001) found the RGB-NDVI change-detection method to be the most accurate and efficient of the three methods for several reasons.

Forests are cleared to acquire constructional materials, provide source of energy, make space for grazing, farming, building and layout infrastructures networks and to supplement

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raw materials such as an input for agricultural production and livestock grazing (Ezra, 1997; MoARDSLM Secretariat, 2008). Sakthivel .R et.al(2010) study focuses on the role of remote sensing and geographic information system (GIS) in assessment of changes in forest cover, between 1931 and 2001, in the Kalrayan hills, Tamil Nadu. The trend of forest cover changes over the time span of 70 years, was precisely analysed using high resolution Satellite data. The study analyses the forest cover change in the tropical deciduous forest region of the Eastern Ghats of India. It is envisaged that the study would prove the usefulness of Remote Sensing and GIS in forest restoration planning.

Study area

Salem is an interior district of Tamil Nadu in India with an area of 8634.23 Km2 (Fig.1) and is bounded by Dharmapuri district on the North, Coimbatore on the West, South Arcot on the northeast and Tiruchirapalli on the South and South-West. The district lying between latitudes N 11°00' and 12°00 and longitudes E 77°40' and 78°50'. Study area is extracted from the distric map with area covering 1737 sqkms. It is The lying between latitudes N 11°25' and 11°55 and longitudes E 77°48' and 78°32'.

The soils of Salem District can be assorted into the main types viz., Red Calcareous, Red non-calcareous, brown soil calcareous, Red collurial careareous, Red collurial non calcreous, Black soils, Alluvial calcareous, Brown soil non calcareous.

Salem district is underlain entirely by Archaean Crystalline formations with Recent alluvial and Colluvial deposits of limited areal extents along the courses of major rivers and foothills respectively. Weathered and fractured crystalline rocks and the Recent Colluvial deposits constitute the important aquifer systems in the district. Ground water occurs under phreatic conditions and is developed by means of dug wells. They are important from ground water development point of view in the hilly terrain.

The District has a hot tropical climate with temperature ranging from 18.9° C (Minimum) to 37.9° C (Maximum) and the relative humidity is high at 79% with an average ranging from 80% to 90%.

The major source for groundwater in the study area is rainfall during monsoonal season. The average 10 years annual rainfall is about 759.03 mm.

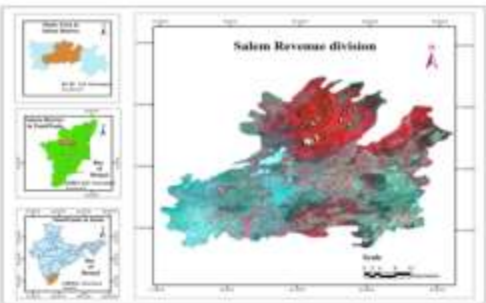

Fig.1.Study area- Salem district

Materials and Methods

In the present study, for assessing the temporal changes in the forest cover Landsat 1

Panchromatic RBV,MSS- 154/52, 57X57, 1973 from GLCF and IRS LISS III (P6)- 101/65, 23.5 x 23.5, 2010 from NRSC were used and the Survey of India (SOI) toposheet of 1972 was also used. Moreover, the forest working plan reports and administrative maps were also taken into account.

The study area (Salem district) map was prepared from SOI topographical sheets on 1:50,000 scale. The forest cover, in the study area, during 1973 and 2010 were derived from the Satellite images. As the data sources used are varied in nature, these pose problems while directly comparing the forest details with each other. The images were used for carrying out the change detection studies for the period 1973 and 2010(Fig2).

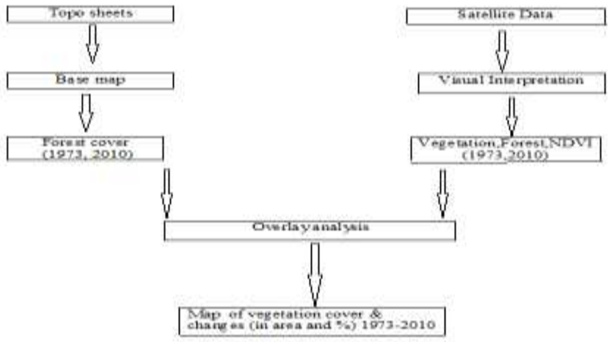

Fig. 2: Methodology flow chart

Image analysis

Clustering

The unsupervised clustering procedure generated 6 clusters as shown in figure 3 with settlement, Mining activities, forest, open land, grass and rock expose were identified.

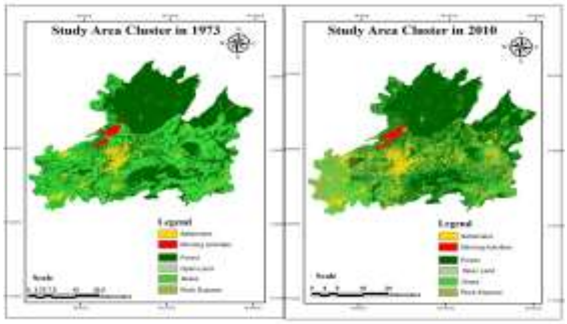

Fig. 3 Cluster of image 1973 and 2010

Vegetation

The image analysis part of vegetation is further classified in to forest, grass and others as shown in below (Fig.4).

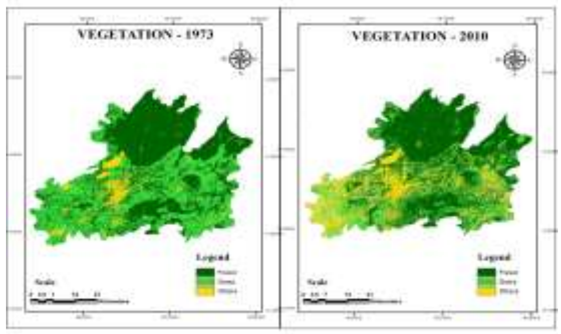

Fig. 4. Vegetation 1973 and 2010

In the year 1973, Forest 611.95 km2 with 35.23% and Grass and others is 714.04 km2 with 41.1% In the year 2010, Forest 594.92 km2 with 34.24% and Grass and others is 604.12 km2 with 34.77% .

Forest

The image analysis part of vegetation is further classified in to forest, grass in which forest is visualized for better understanding is shown in below (Fig.5). There not much change in visual effect but in the area wise it is decreased 17.95sqkm with 2.93% of forest area compare with 1973.

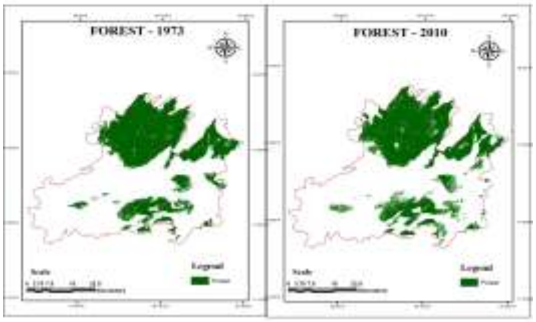

Fig. 5. Forest cover 1973 and 2010

NDVI

NDVI is calculated from the visible and near-infrared light reflected by vegetation. Calculations of NDVI for a given pixel always result in a number that ranges from minus one (-1) to plus one (+1);0 means no vegetation NIR=Red +1 (0.8 -0.9) indicates the highest possible density of green leaves. 0 to -1 Indicated higher red reflectance than NIR. The NDVI analysis reveals that 1)Decrease in NDVI between two scenes will be the result of new development 2)Increase in NDVI between two scenes will be the result of forest re-growth 3)Urban changes in red signal may be unrelated to vegetation (Source: NSAS Earth Observatory)

The two NDVI results shows there is a increase in vegetation due to government policy on afforestation and encourage of social forest besides permanent pasture and tree type of crop commercial cultivation. The settlement area is also increased in the same side by side vegetal cover too along with their residential area (Fig.6).

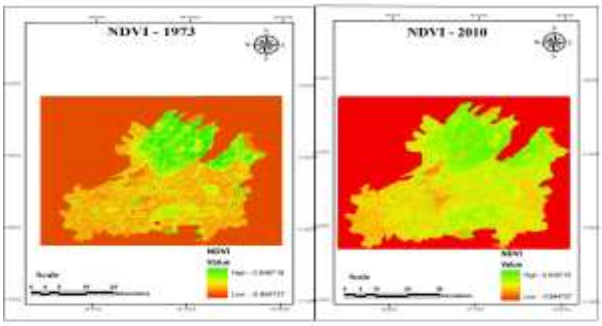

Fig.6. Normalized Difference Vegetation Index

Results and Conclusion

The study analysis reveals the following information and changes in the part of vegetation also shown clearly in the table. (Fig.7 &Table 1.)

Fig.7.Vegetal cover changes

The thirty seven years (1973-2010) of urban and settlement/human interference variations has been precisely analyzed. The study result shows that the Forest area degreased 17.95 km2 with 2.93%. Grass land and others has decreased 109.92km2 with 15.39% .The present study also has opened so many avenues for a detailed study such as micro level / watershed wise vegetation analysis and forest cover changes assessment.

Table 1. Showing vegetation changes

Sl. No	Components	1973	2010	Changes in area(Sqkm)*	Changes in %
1	Forest	611.95	594.92	-17.95	-2.93
2	Grass land and others	714.04	604.12	-109.92	-15.39
	Vegetation	1325.99	1199.04	-126.95	-9.57

(*+ is Increase, - is Degrease of area)

The same classes were then visually interpreted from the 1973 satellite data by using the common image interpretation elements. The forest areas were delineated from their green tone and contiguous pattern. The grass were identified from their light green tone and human occupied and interference with yellow colour Then, the softwares such as Arc GIS9.3 and Erdas imagine9.2 were used to prepare the classified (final) forest cover and vegetation maps. Finally, the status of changes during 1973-2010 The final maps which represent the Forest cover, forest cover changes during 1973 and 2010 (both area and percentage) were also generated.

Acknowledgments

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