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LAND USE AND LAND COVER DETECTION FOR THREE DECADES USING GIS AND RS -A CASE STUDY OF ERODE DISTRICT

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ABSTRACT

This paper evaluates the changes in land use and land cover in a specific area in Erode District, TamilNadu by comparing aerial photographs from 1990 and 2010. An attempt is also made to discuss possible implications of these land cover changes for land degradation. By applying Geographic Information Systems (GIS), two maps of the study area for the years 1990 and 2010 were produced. The maps show a decrease in coverage by shrub lands, vegetation and forests, and an increase in remaining open areas, settlements, and a water body. The aerial extension of categories of land cover was calculated by overlaying the two maps, the percentage of each type of land cover that was converted into other categories was computed. Land cover changes were most noticeable for shrub lands, with a crops has increased 19.57% and plantation crops has decreased -51.81% and settlements has increased 43.32% Areas under cultivation remained more or less unchanged. By and large, land cover changes observed in this study were the result of clearing of vegetation for grazing lands, new cultivation areas, etc., thus contributing to the current problem of land degradation in the country.

KEYWORDS

land use, land cover, GIS and RS.

1. INTRODUCTION

Land use and land cover change means quantitative changes in aerial extent (increase or decrease) of a given type of land use or land cover respectively. The detection and measurement of change depends on the spatial scale; higher the spatial level of detail, larger the changes in aerial extent of land use and land cover which can be detected and recorded. In case of land cover as well as land use, the meaning and conceptualization of change is much broader. Change could be because of conversion or modification. In case of land cover change, conversion involves. Conversion from one type of use to another i.e. changes in the mix and pattern of land uses in an area.

Knowledge of land use and land cover is important of many planning and management activities and is considered an essential element for modeling and understanding the earth as a system. Land cover maps are presently being developed from local to national to global scales. The use of panchromatic, medium-scale aerial photographs to map land use has been an accepted practice since the 1940s. More recently, small-scale aerial photographs and satellite images have been utilized for land use/land cover mapping.

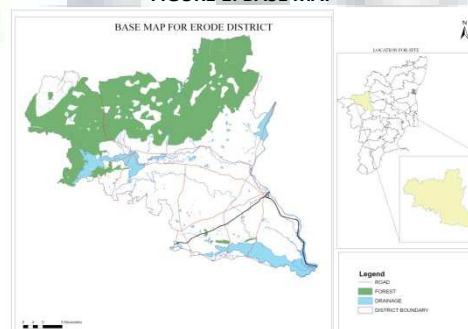
Remote sensing and GIS-based change detection studies have predominantly focused on providing the knowledge of how much, where, and what type of land use and land cover change has occurred. Only a few models have been developed to address how and why the changes occurred, and even fewer studies have attempted to link satellite remote sensing and GIS to stochastic modeling in landscape change studies.

GIS is emerging as an integrated technology that can tackle many problems in nature and society, especially at the global scale. Land cover classification is an important application of remote sensing data. A number of image classification algorithms have been developed to extract information from a variety of remote sensing datasets [5]. In general, these algorithms are able to produce classifications with high accuracy. However, the performance of these degrades rapidly when one or multiple types of imperfections occur in raw images due to a number of human, environmental, and instrumental factors. This study aims at analyzing land use changes using satellite imagery and GIS in Erode District in order to achieve this objective, topographic sheets and Land sat Satellite data were used. Geo-processing techniques and change detection comparison strategy was employed to identify land use changes.

2. STUDY AREA

Erode District is one of the industrialized districts located in the western part (Kongu Nadu) of the state of TamilNadu, India. The district comprises a long undulating plain, sloping gently towards the Kaveri River in the south-east. Erode District is landlocked and is situated at between 10 36" and 11 58" North latitude and between 76 49" and 77 58" East longitude. Western Ghats traverses across the district giving rise to small hill locks. Erode district had a population of 22,59,608 as of 2011. It is 46.25% urbanized as per Census 2010.

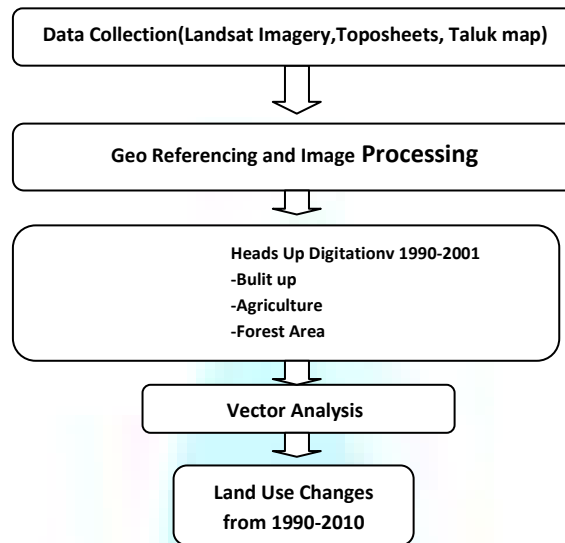
FIGURE 1: BASE MAP



3. SOFTWARE USED

In this study, satellite images are converted into vector analysis using GIS Arc. In ERDAS 9.1, images are classified on the basis of visual interpretation and the statistical attributes are analyzed using supervised Algorithm.

4. METHODOLOGY



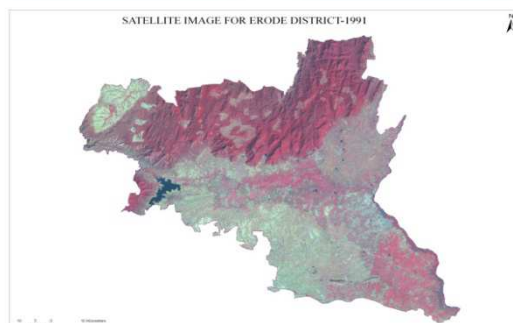
4.1 Data Collection

Landsat TM 21-11-1990 , Landsat TM 17-10-2000 and LISS III 09-10-2010 satellite images have been downloaded from USGS website .Study areas are covered by 11 Toposheets (58E/09,58A/14, 58E/03,58E/02, 58E/06, 58E/07, 58E/08,58E/10, 58E/11, 58E/12 and 58E/16) have been bought from Survey of India, Chennai.

TABLE 1: NAME OF THE DATA AND SOURCES

S.No	Type of Map	Resolution/ Scale	Date/Year of Acquisition
1	Toposheet	1:50,000	58E/09,58A/14, 58E/03,58E/02, 58E/06, 58E/07, 58E/08,58E/10, 58E/11, 58E/12 & 58E/16 1975
2	Landsat TM	1:50,000	21-11-1990 17-10-2000 9-10 2010
3	NR census Atlas	1:50,000	2008
4	District and village maps	1:75,000	-

FIGURE 2: LANDSAT TM SATELLITE IMAGE FOR ERODE DISTRICT



4.2 Geo-Referencing

Geo-referencing means to define the position of earth surface or establishing its location in terms of map projection or coordinate systems. It is essential to make various data sources (Table1) into common referencing or projection system i.e. World Geodetic System (WGS 84), Universal Traverse Mercator (UTM).

4.3 Image Processing

Digital Image Processing is largely concerned with four basic operations: image restoration, image enhancement, image classification, image transformation. Most of the image processing operations were completed by using ERDAS environment. Geometric Correction is essential that any form of remotely sensed imagery be accurately georeferenced to the proposed base map. Image enhancement is concerned with the modification of images to make them more suited to the capabilities of human vision. Regardless of the extent of digital intervention, visual analysis invariably plays a very strong role in all aspects of remote sensing. Digital Filtering is one of the most intriguing capabilities of digital analysis is the ability to apply digital filters. Filters can be used to provide edge enhancement.

4.4 Heads-up digitization

Heads-up digitizing is manual digitization by tracing a mouse over features displayed on a computer monitor, used as a method of vectorizing georeferenced raster data. Table 2 depicted the various layers was created based on heads-up digitization. This study assessed the land use changes between year 1990 and 2010. Land use vector layers (1990) were created by using Survey of India topographic sheets. Land use vector layers (2011) were created by using GIS satellite imagery..

4.5 Topology building and Error fixing

Creation of topology is necessary to make the spatial data usable. Errors were edited which included arc, label, move and intersect. The topology was constructed by using GRASS GIS commands. The topology was reconstructed when errors were found.

TABLE 2: VARIOUS LAYERS AND TYPES

Layer name	Layer type	1990	2010
Roads	Polyline	✓	✓
Water Body	Polygon	✓	✓
Settlements	Polygon	✓	✓
Forest Area	Polygon	✓	✓
Agriculture	Polygon	✓	✓
Administrative Boundary	Polygon	✓	✓

FIGURE 3: LAND USE AND LAND COVER MAP-1990

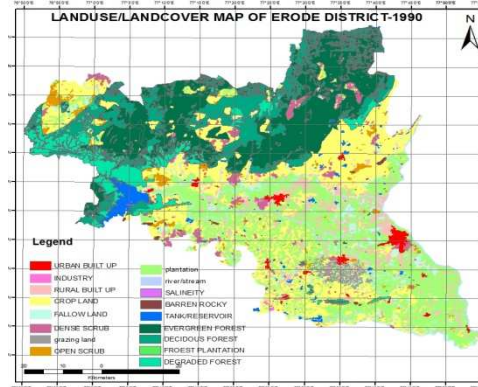
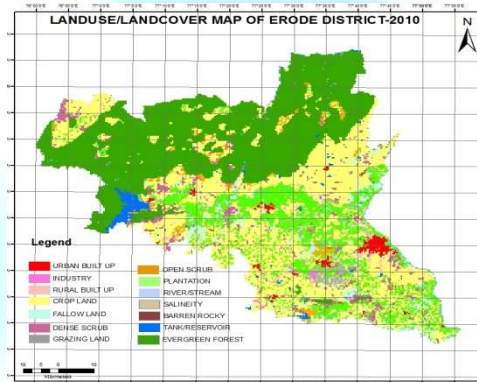


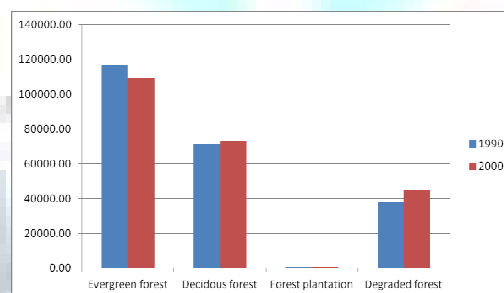
FIGURE 4: LAND USE AND LAND COVER MAP-2010



4.5 Vector analysis

Area of each category was calculated in QGIS software environment. The flow diagram indicating the methodology for land use mapping is given in Fig 2. The procedure adopted in this research work forms the basis for deriving statistics of land use dynamics and subsequently in the overall, the findings. The difference between land use 1990 and 2010 were predicted by using geo-processing tools present in GIS software environment. The difference has been shown in Table 3.

HISTOGRAM OF FOREST COVER BETWEEN 1990-2010



AGGREGATED DIFFERENCES BETWEEN FEATURE CLASSES IN THE CLASSIFIED IMAGE OF 1990-2010

S.No	LEVEL I	LEVEL11	LULC 1990	LULC 2010	Difference	Area in Percentage
1.	Built up	Urban Built Up	4438.83	6887.72	1923.30	35.55
		Rural Built Up	14966.70	15966.70	1000.00	6.26
		Industry	404.89	2055.16	800.78	80.30
2.	Agriculture	Crop Land	169801.00	190751.88	33235.00	10.98
		Fallow Land	24734.00	16576.01	0.00	-49.22
		Plantation	111119.00	91621.96	-57576.80	-21.28
3.	Forest	Evergreen forest	116506.79	70613.66	-43393.13	-64.99
		Deciduous forest	71896.99	102753.07	37075.98	30.03
		Forest Plantation	116.45	114.26	0.00	-1.92
		Degraded Forest	38245.46	53282.50	6317.14	28.22
4.	Grazing land	Grazing land	5849.36	3509.23	954.07	-66.68
5.	Waste land	Dense scrub	12561.80	9673.72	0.00	-29.85
		Open scrub	15589.50	24498.95	-4929.60	36.37
		Barren rocky	1103.28	1103.28	0.00	0.00
		Salinity	199.11	260.08	60.97	23.44
6.	water body	Tank/Reservoir	8708.61	8805.63	0.00	1.10
		River/ Stream	5909.67	5109.67	-800.00	-15.66

CONCLUSION

Overall changes in the landscape has shown an increased trend for urban development (43.32%) and growth of industry to 198% and forest to 52% . Such development is guided or often times constricted by various environmentally sensitive or protected areas (e.g. Reserve Forests.) and existing high-density development. The study has revealed that satellite data has the unique capability to detect the changes in land use quickly. From the analysis it is found that the satellite data is very useful and effective for getting the results of temporal changes. With this effective data it is found that the agriculture land is decreasing at the rate of increasing the settlements

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