Monitoring Land Cover Changes in the Parts of East Cost of Tamilnadu and Pondicherry Union Territory using Geospatial Technology

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***Abstract:** Monitoring decade changes of land use / land cover using multi-temporal remotely sensed data provides an effective and accurate evaluation of human impact on the environment. Agriculture, tourism and industrial activities are the key elements of study area social structure and economy. The main objective of this study was to monitor land-cover changes in this area using multi-temporal Indian Remote Sensing Satellite data acquired in the year 2000 and 2011. Temporal changes were determined using supervised classification with limited field validation. The results showed that this area involves twelve land cover classes were built-up land, crop land, fallow land, plantation, land with/without scrub, sandy area, waste land and water bodies of canal, river; tank and water logged areas. During the study period, around 67% of land cover features were not changed. However, overlay analysis shows that land cover features of built-up land and crop land were increased their areal extent. Moreover, land use classes of fallow land and land without scrub was reduced their area of 11 from 14.61 and 2 from 2.86km2 respectively.*

***Key words:** Land use /land cover, Change detection, Satellite remote sensing, GIS, supervised classification,*

I. INTRODUCTION

Land use / land cover is an important tool for the various planning authorities with responsibilities for the management of territory at a regional level (Marcal et al., 2005). Using the Land use/land cover tools allows for the identification of major processes of change and, by inference, the characterization of land use dynamics (Ademiluyi et al., 2008). Same time, the knowledge of the land use/land cover map is very important to understand the coastal environment, utilization, conservation and management. Globally, land cover nowadays is altered predominantly by direct human use. Therefore, land degradation is mainly due to population pressure, which leads to intense land use without proper management practices (Raju et al., 2006)). These land use/ land-cover changes perturb the existing ecosystem (Chauhan and Nayak, 2005).

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Remote Sensing data was effectively used in identifying and mapping land degradation risks Lu et al., (2007). Using multi-temporal satellite images to detect land use/cover change and its spatio-temporal pattern has been proven an efficient approach (Masek et al., 2000; Herold et al., 2003; Dietzel et al., 2005; Maktav and Erbek, 2005). Nobi et al., (2009) also suggested that the remote-sensing couple with GIS tool is being extensively used for real time and long-term monitoring of the environment.

The determination of the long-term trend of land degradation requires spatial comparison of multiple land cover maps derived from remotely sensed data at different times that must be co registered with one another to determine spatial changes (Geymen and Baz, 2008). This is commonly known as digital change detection. Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (Singh, 1989). Lu, Mausel, Brondizio, & Moran (2004) stated that, timely and accurate change detection of Earth's surface features provides understanding of the interactions between human and natural phenomena for better manage and usage of resources. Change detection can be performed by supervised or unsupervised approaches (Singh, 1989). A supervised technique requires ground truth points to derive training sets containing information about the spectral signatures of the changes that occur in the considered area between two dates. An unsupervised technique performs change detection without any additional information besides the raw images considered; however, it is also fraught with some critical limitations (Bruzzone & Prieto, 2002).

Accurate per pixel registration of multi-temporal remote sensing data is essential for change detection since the potential exists for registration errors to be interpreted as land cover and land-use change, leading to an over estimation of actual change (Stow, 1999). The process of visually interpreting digitally enhanced imagery attempts to optimize the complementary abilities of the human mind and computer. The mind is excellent at interpreting spatial attributes of an image and is capable of identifying obscure of subtle features (Lillesand & Kiefer, 1994). Land cover classes are typically mapped from digital remotely sensed data through the process of a supervised digital image classification (Campell 1987; Thomas, Benning, & Ching, 1987). The overall objective of the image classification procedure is automatically categorizing all pixels in an image into land cover classes or themes (Lillesand & Kiefer, 1994). In this study area supervised classification was done using ground control points and digital topographic map.

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A. Study Area

The Fig. 1 shows the study area is located on the East coast between 77° 45' and 77° 50' E longitudes and 11° 45' and 12° 03' N latitudes. It is limited on the east by the Bay of Bengal and on the other three sides by the Villupuram and Cuddalore districts of Tamil Nadu State and Pondicherry Union Territory. The physiography is more or less a flat land and there is no hill in the study area. The main soil types are red ferrallitic black clayey and coastal alluvial soil. Geologically, the study area has three types of formations namely, Charnockite, Cuddalore sandstone and alluvium. The ten year average annual rainfall was noticed in the study area is 1205mm. Gingee River is the important river flowing crosses diagonally from northwest to the southeast and distributed in the study area is Ariankuppam river and Chunnambu river. The northern part of the study area is radial pattern and the southern part is more or less parallel drainage pattern.

B. Methodology

In this study analyze the land use and land-cover changes by using IRS 1D and Cartosat1 satellite data. Initially, digital topographic maps are digitized from hardcopy with scale of 1:50,000 were used mainly for geometric correction of the satellite images with ground truth information. Second, the Cartosat1 (IRS P5) satellite data recorded in 2011 and IRS 1D 2000 used in the study area and the image has been geometrically referenced. Finally ground information was collected for supervised classification and classification accuracy assessment, and the Methodology flow chart is shown in Fig 2.

II. RESULTS AND DISCUSSIONS

Classification is the process of sorting dataset pixels into a number of classes based on their spectral values (Singh, 1989). The common pixel-based classification methods are unsupervised and supervised classifications (Jensen, 2005). Supervised classification was used in this study area of both IRS 1D LISS III and Cortosate-1 data. Fig. 3 and 4 are the classification results of the land use/land cover map of Level II categories of the NRSA (1996) classification scheme.

In the year 2000, crop land, fallow land and plantations (Agricultural land) were the leading land use features covering 11.02%, 10.31% and 32.52% followed by villages (Rural) and towns/cities (Urban) at 17.21% and 20.6874% while wasteland covered merely 4.21% of the entire study area (Table 1). Moreover, in the year 2011 also crop land, fallow land and plantations were the most dominant class covering 13.10%, 7.96% and 31.08% followed by villages (Rural) and towns/cities (Urban) at 12.66% and 28.68% respectively. However, wasteland and water body covered 3.76% and 21.29% of the total area (Table 1). Settlement was the most increased with all other classes for the period from 2000 to 2011.

In order to get all land use / land cover information's from 2000 to 2011 are unified, and it is essential to integrate these data with appropriate factor. Therefore, numerically this information is integrated through the application of GIS. A simple arithmetical model has been adopted to integrate two thematic maps and final change detection map (Fig. 5) and their areal coverage is shown in Table 1. The percentage of land cover change is shown in Graph 1. This explains the importance of integrating remote sensing and GIS in the study of land cover change detection since it provides essential information about the nature and spatial distribution of land-cover changes. Land degradation processes in the study area are conversion of agriculture land into the built-up land due to promotion of increasing population, shortage of the labor force in agriculture, real estate, tourism, etc. Reducing the areal extents of water bodies are due to mismanagement.

III. CONCLUSION

The objectives of this study were to provide a recent perspective for land cover types and their changes that have taken place in the last decades. Integrate the visual interpretation with supervised classification in image processing and to integrate remote sensing and GIS in studying the different land-cover changes with their areal extent. It was found that the study area has undergone very severe land-cover changes as a result of development of real estates, industry or tourist, etc. A considerable increase in built-up land has taken place as well as a huge decrease in agricultural land during the study period. This problem needs to be seriously studied, through multi-dimensional fields, including socioeconomic, in order to preserve the newly reclaimed land and increase food production.

IV. ACKNOWLEDGMENT

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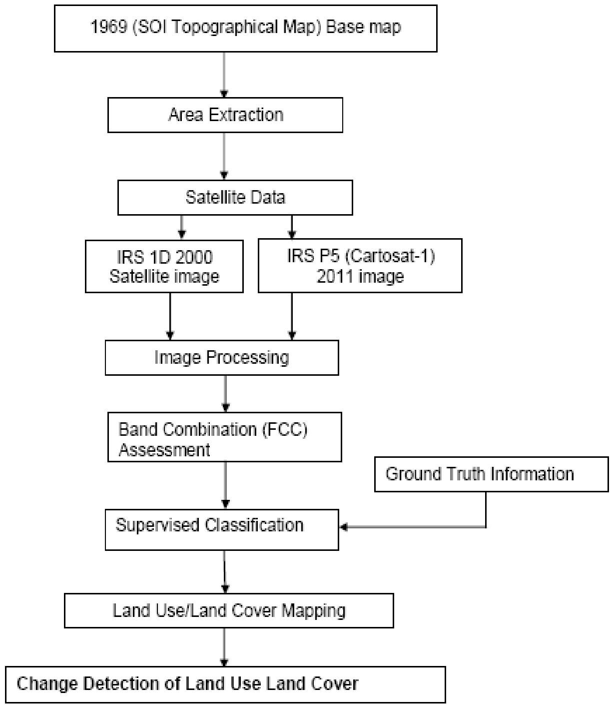

Fig.2 Methodology flow chart

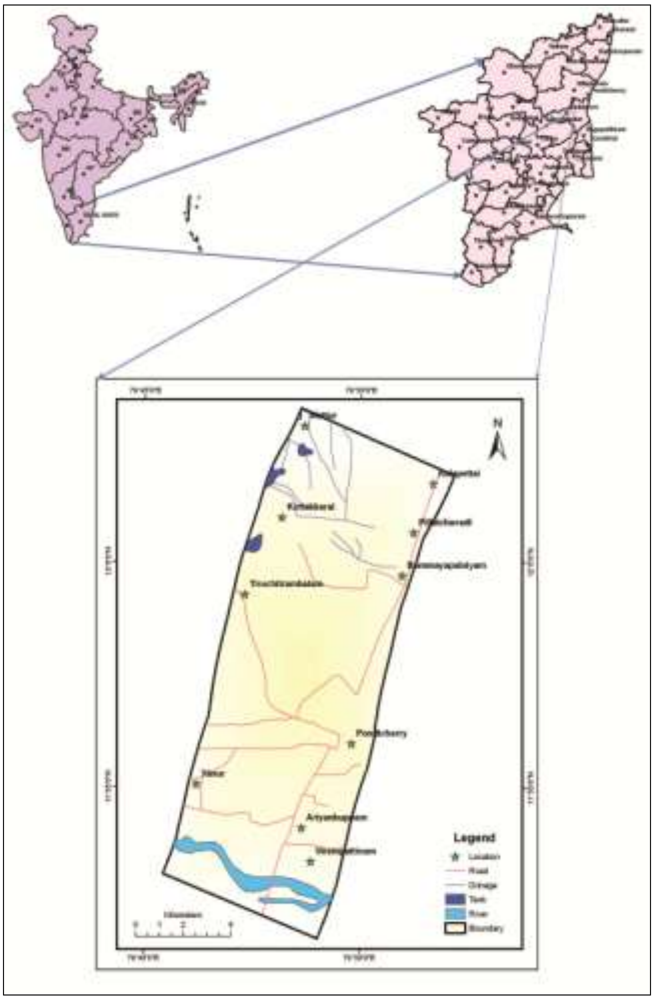

Fig.1 Study Area Map

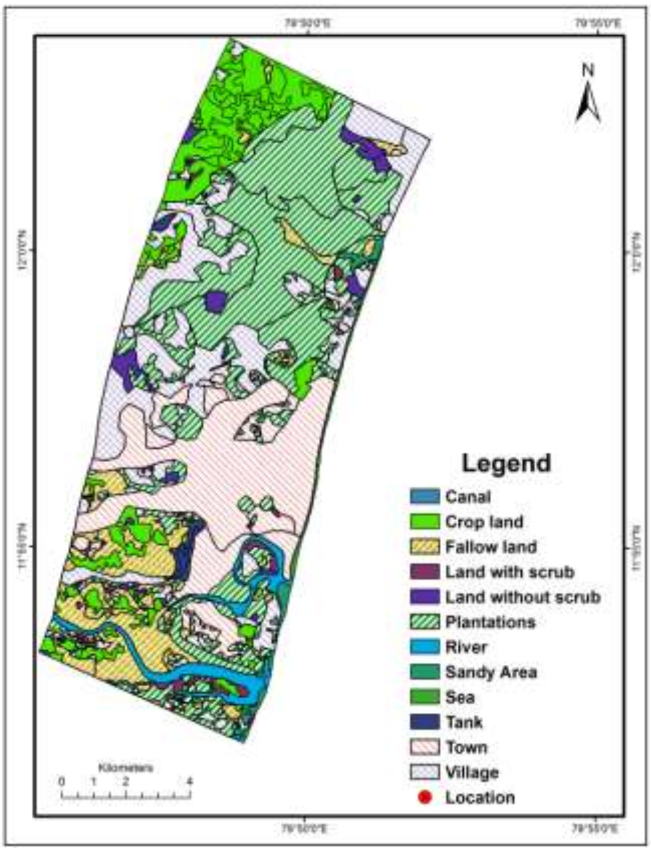

Fig.3 Land use / land cover map (2000)

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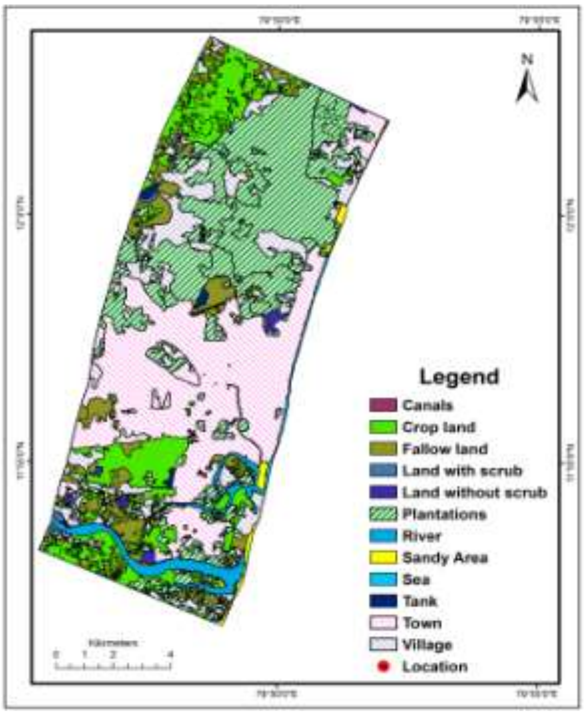


Fig. Fig. 4 Land use / land cover map (2011)

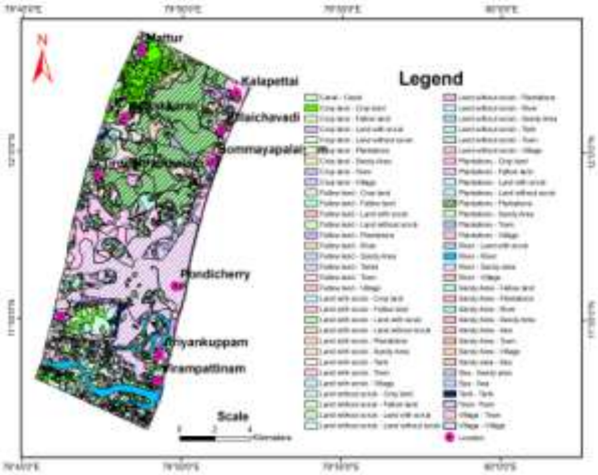
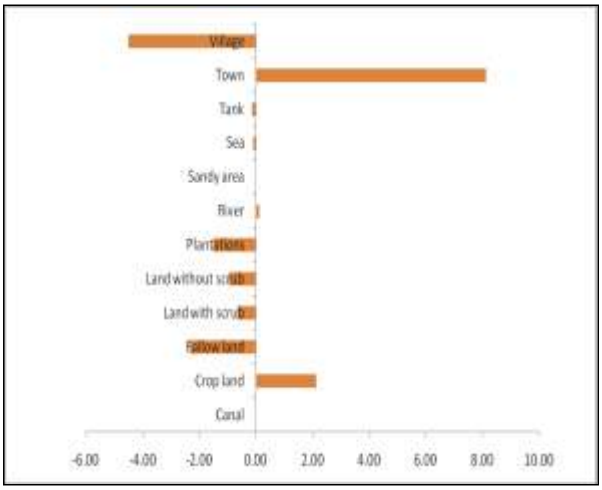


Fig. 5 Land covers changes from 2000 to 2011

Graph 1 Percentage of Land use / land cover changes from 2000 to 2011



Land cover changes from 2000 to 2011							
SL No	Land use	2000		2011		Changed Areas	Changed Areas in %
		Area in Sq. Km	Area in %	Area in Sq. Km	Area in %		
1	Canal	0.12	0.08	0.09	0.06	-0.03	-0.02
2	Crop land	15.63	11.05	18.62	13.17	2.99	2.11
3	Fallow land	14.61	10.33	11.28	7.98	-3.33	2.38
4	Land with scrub	1.41	1.00	0.48	0.34	-0.93	0.72
5	Land without scrub	2.46	1.74	1.08	0.76	-1.38	1.25
6	Plantations	46.10	32.60	43.94	31.07	-2.16	1.52
7	River	4.29	3.03	4.45	3.15	0.16	-0.29
8	Sandy Area	1.31	0.93	1.28	0.91	-0.03	0.02
9	Sea	0.74	0.52	0.59	0.42	-0.15	0.11
10	Tank	1.11	0.79	0.89	0.63	-0.22	-0.26
11	Town	29.32	20.74	40.80	28.85	11.24	-7.95
12	Village	24.30	17.19	17.90	12.66	-6.50	4.60
	Total	141.40	100	141.40	100		

Table 1 Land use / land cover and its changes from 2000 to 2011