Land Use/Land Cover Mapping in and around South Chennai Using Remote Sensing and GIS Techniques

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ABSTRACT

Land use and land cover change have been among the most important perceptible changes taking place around us. Human interventions in natural systems have resulted in large changes in vegetation, composition and distribution patterns. Changes in land use and hence in vegetation cover, due to climatic change and human activity changes the area constantly. Thus, there is a need for spatial and temporal characterization of vegetation cover at different scales. Satellite remote sensing provides detailed information regarding the spatial distribution and extent of land use changes in the landscape. This study encompasses the quantitative analysis of land use and land cover change in South Chennai using remote sensing technologies. SOI toposheet 1970, Landsat TM (Thematic Mapper) satellite images for year 1991 and 2006 have been utilised to quantify the changes for last three decades. The study concludes that built-up area is increased as 6.8%, 14.7% and 16.1% with a decrease of Forest cover from 20.3%, 16.3% to 15.3%.

Keywords: LULC, Built-up area, GLCF, South Chennai

1. Introduction

Land use and land cover is dynamic in nature and is an important factor for the comprehension of the interaction and relationship of anthropogenic activities with the environment. Knowledge of the nature of land use and land cover change and their configuration across spatial and temporal scales is consequently indispensable for sustainable environmental management and development (Turner et al 1994). According to Long et al (2008), urban landscapes are exemplified by the large concentration of population, and fast expansion of urban zones which lead to alteration in the land use and land cover configuration that consequently impacts the landscape environment (Long et al, 2008). Remote sensing technology is principally appropriate for mapping environmental phenomena such as land use and land cover as field-based mapping is practically difficult, remote sensing

observations provide continuous monitoring across varied spatial and temporal scales (Gibson and Power, 2000). The spatial, temporal and spectral characteristics of the remote sensing data are effectively used in land use and land cover change mapping, hence helping in decision making for sustainable land resource management (Berlanga-Robles and Ruiz Luna 2002). Change detection in land use and land cover can be performed on a temporal scale such as a decade to assess landscape change caused due to anthropogenic activities on the land (Gibson and Power, 2000). These anthropogenic activities on land are as a result of rapid urbanisation and industrialisation. Land use and land cover change have been recognised as important drivers of global environment change (Turner et al 1994). Land use and land cover are two separate terminologies which are often used interchangeably (Dimyati et al, 1996). According to Longley (2001), "land cover refers to the physical materials on the surface of a given parcel of land, while land use refers to the human activities that takes place on or make use of land e.g. residential, commercial, industrial etc." Jensen (2007) in his investigation of urban landscape perceived land use as a way by which human beings utilise land while land cover exists as a natural environmental system. Prakasam (2010) studied the land use and land cover change in Kodaikanal region of Western Ghats in Tamilnadu State of India to observe changes during a span of 40 years from 1969 to 2008, using Landsat satellite data and performing supervised classification techniques, he found that 70% of the region was covered in forests in 1969 but has decreased to 33% in 2008, The built-up lands have increased from 3% to 21% showing that the region is affected by rapid urbanisation which is leading to adverse environmental effects for the identified bio-diversity rich region of Kodaikanal. Thus land use change in terms of urbanisation and industrialisation have a critical impact on the environment, the changes quantified using remote sensing technologies provide observations which may show critical adverse and undesirable environmental impacts, hence requiring crucial sustainable land management policies and practices to avoid the endangering of the environment. The aim of the study is to assess the land cover and land use/land cover in and around South Chennai in last three decades. The following specific objectives will be pursued in order to achieve the aim above (i) to create a land use/land cover classification scheme and (ii) to create various thematic classes and identify the changes.

2. Study area

The study area lies to the South of Chennai City.Total area is 507.538 sqKm. The study area lies between the coordinates 80°5′29.907″E 12°55′7.185″N; 80°16′24.32″E 12°41′9.415″N (figure 1) . To the east is Bay of Bengal, to the West lies the Kolavai Lake, to the North lies the Pulicat Lake and to the South lies Mahabalipuram.

3. Materials and Methods

The detailed methodology adopted in this study is shown in Figure 2. For the present study, multispectral, multi-temporal LANDSAT satellite data of Chennai were acquired for the year 1991 and 2006. All the LANDSAT images have been downloaded from Global Land Cover Facility (GLCF) with the resolution of 30 metres (Table 1). The satellite images were projected to a standand projection of Universal Transverse Marcator (UTM) projection with the zone 44N.

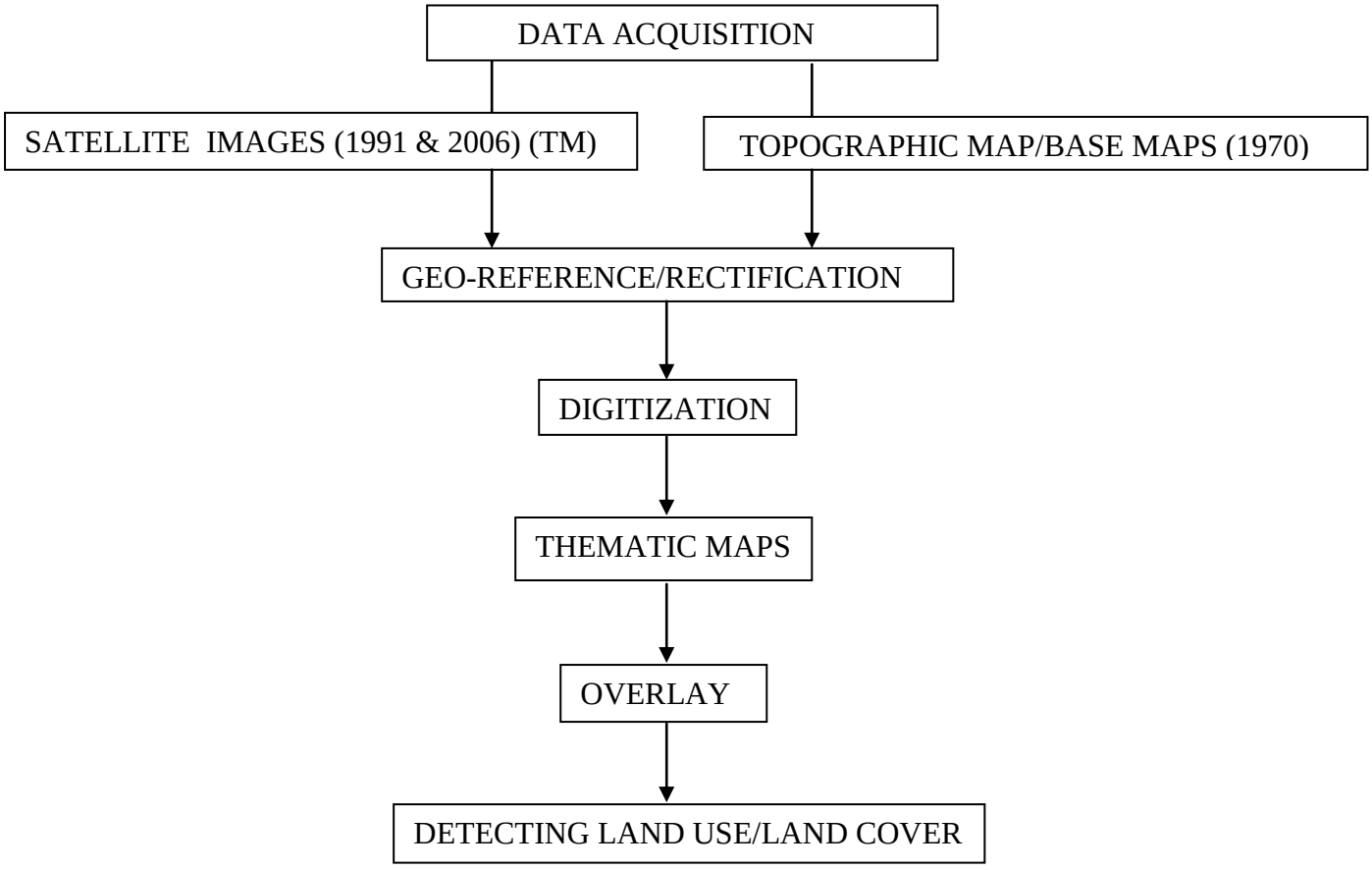

Figure 2 Flowchart of the methodology

Table 1 Data source

Sl.No	Data type	Date Production	Scale	Source
1	SOI Toposheet	1970	1:25,000 Scale	SOI (Survey of India)
2	LANDSAT Image (TM)	25-08-1991	30m	GLCF www.glcf.umiacs.umd.edu
3	LANDSAT Image (TM)	07-02-2006	30m	GLCF www.glcf.umiacs.umd.edu

4. Results and Discussions

The land cover/land use maps with various classes has been determined for the 1970, 1991 and 2006 are shown in figure 1, 4 and 5 respectively. In 1970 map, area occupied by forest was 102.9033 square kilometer, 20.27 percent of the total area. Built up area occupied 34.47 square kilometer, which is 6.81 percent of the total study area. Area of water body was 39.1169 square kilometer, 7.07 percent of the total study area. Area of barren land was 192.5035 square kilometer which was 37.932 percent of the total area. In 1970, water body and built up area occupied the minimum area whereas barren land percentage was the maximum. In 1991, land use land cover pattern has changed drastically with respect to 1970. Area under forest witnessed percentage decrease 3.98 percent. Area under built up area increased from square kilometre 34.5762 to 74.692 square kilometer. This was accompanied by a decrease in water body from 39.1169 square kilometer 38.84 square kilometer. Water body takes up the least percentage of the total class. It is estimated that almost all the decrease in forest area is due to the fact that forest land have been utilized for agriculture and related activities and also due to human pressure on forest for firewood as well as grazing of cattle in the forested area and urbanization. In 2006, built up area increase to 81.4500 square kilometre which is more than 16.05 percent of the study area. There was a decrease in forest area from 82.6766 square kilometre to 77.4139 square kilometre. This decrease can be attributed to the rapid expansion of settlement due to population growth. Water body decreased from 38.84 square kilometre to 37.9033 square kilometre. The total area is 507.5278 sq Km. Built-up area was 4.5762 in the year 1970 which has increased to 74.692 in the year 1991. This has further in increased to 81.4500 in the year 2006 (Table 2).. There has

been significant built up area to the North of the study area near by Injambakkam and Tambaram air force station and along the shoreline. The forest cover is mainly scattered in the form of reserved forest. Some of the major reserved forest are Mambakkam reserved forest, Sonallur reserved forest and Taiyur reserved forest. From the above analysis it is inferd that forest area was 102.9003 sq Km has decreased to 82.6766 which furthur decreased to 77.4139 which signifies that the reduction of forest area from year 1970 to 1991 is about 3.98% which further decreased to 1.04% in 2006. The forest area has shrinked due to conversion of forest area into agricultural land, settlement due to population expansion and migration are the primary reasons for depletion of forest area. Agricultural lands are located mainly in Malaipalacheri, Tiruvancheri and Kolavakkam. The agricultural land has slightly decreased slightly over the three decades. The water bodies also have shrinked due to excessive encroachment, developmental and industrial operations alongside the coastlines. The graphical representation of the LU/LC can be interpreted from the graph below

Table 2. Land use/land cover mapping from 1970- 2006

LULC	1970	%	1991	%	2006	%
	Sq Km					
Barren land	192.5	37.9	176.4	34.8	177.4	34.9
Water body	39.1	7.7	38.8	7.7	37.9	7.5
Built up area	34.6	6.8	74.7	14.7	81.5	16.1
Forest cover	102.9	20.3	82.7	16.3	77.4	15.3
Agriculture	138.4	27.3	134.9	26.6	133.4	26.3
Total area	**507.5**	**100.0**	**507.5**	**100.0**	**507.5**	**100.0**

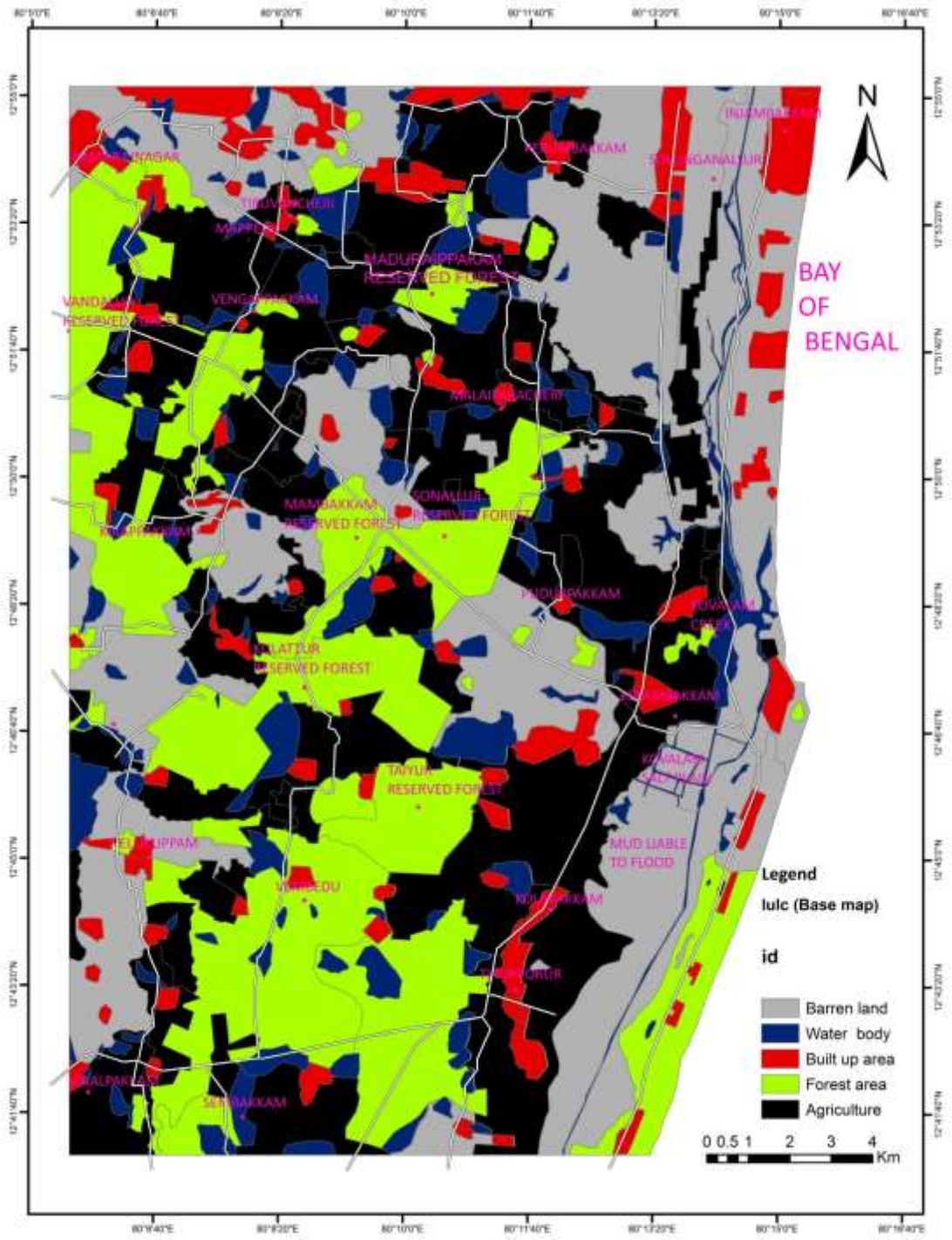

Fig: 1 Base map and LU/LC of Base map (1970)

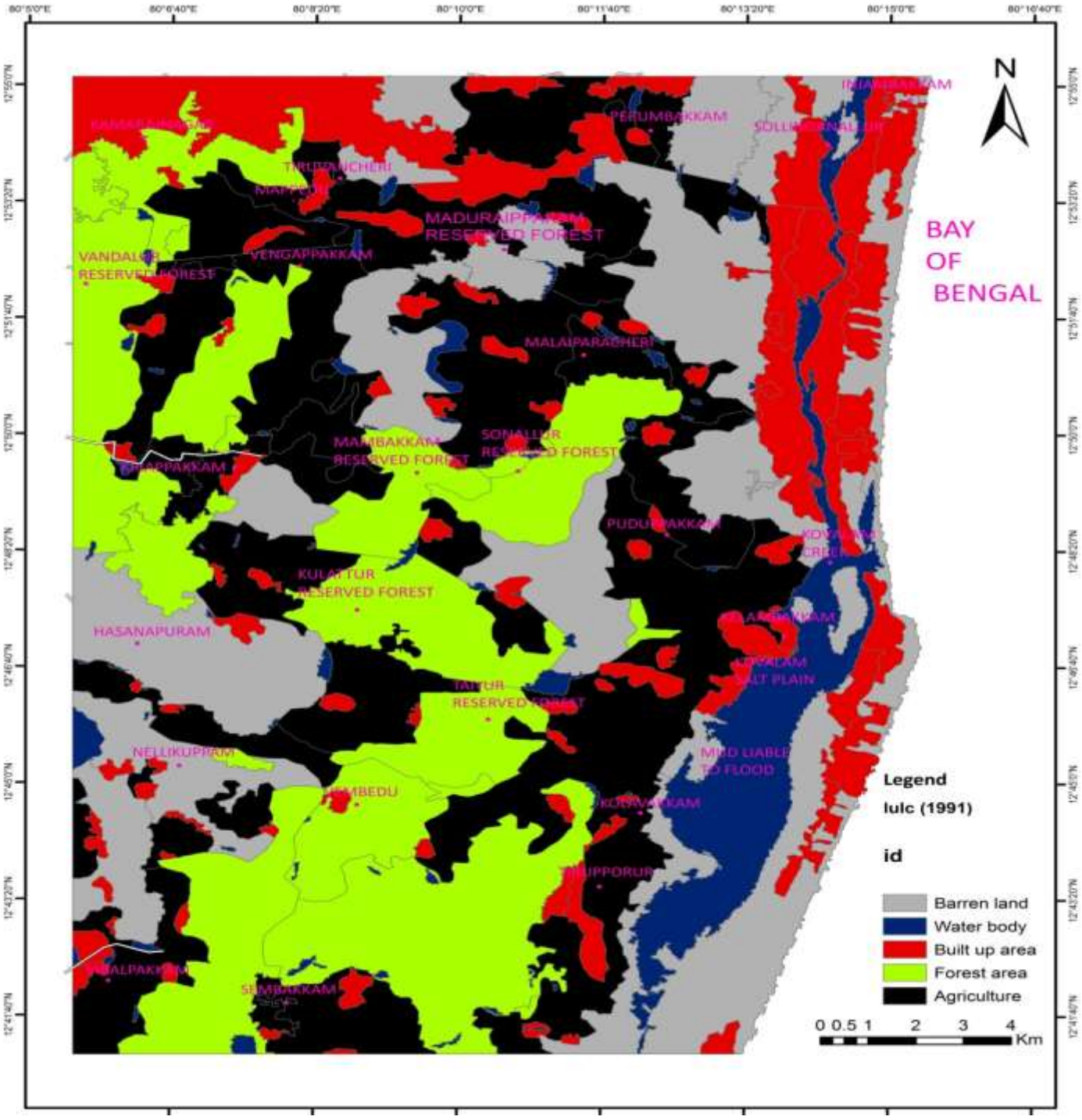

Fig: 4 LU/LC of 1991 map

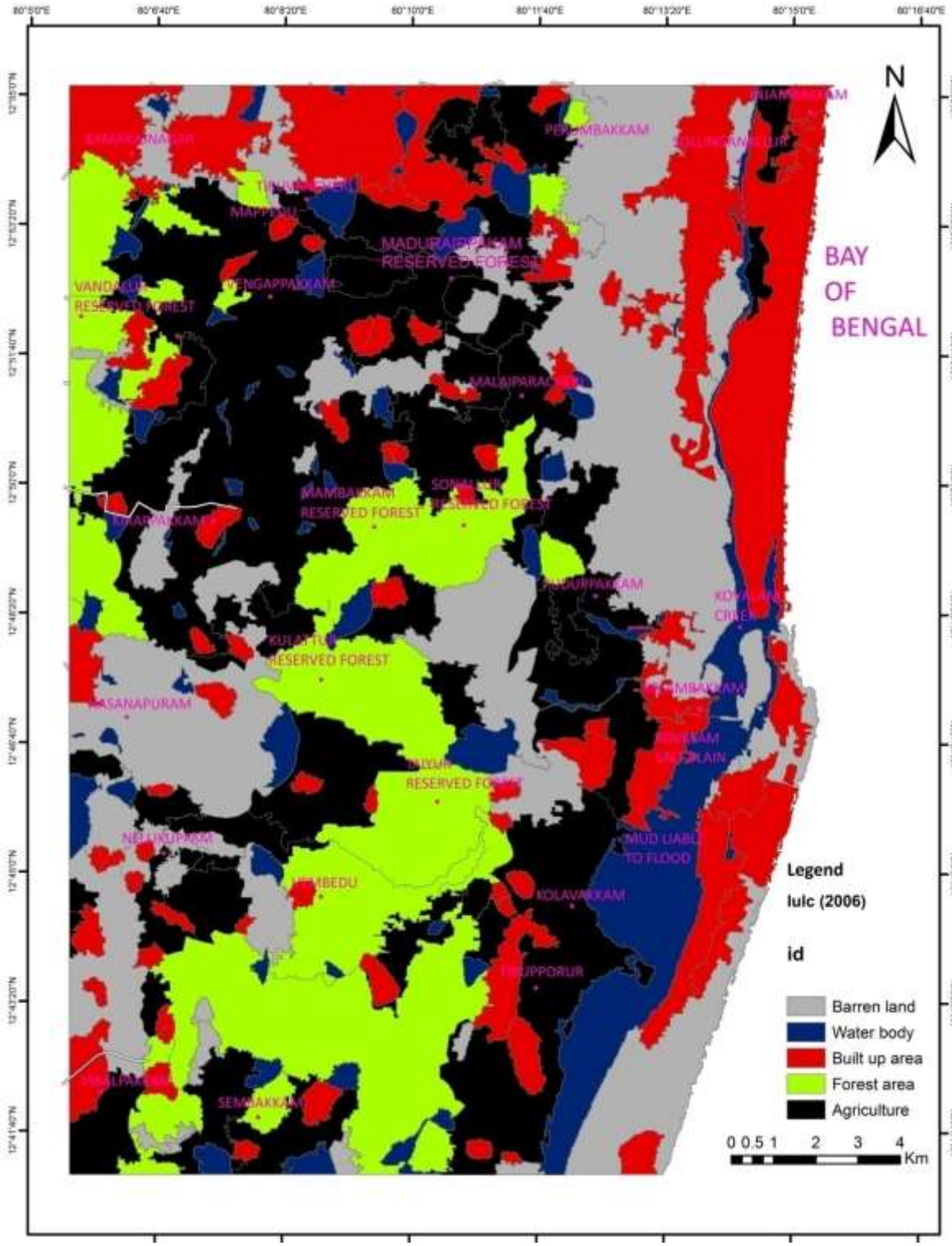

Fig :5 LU/LC of 2006 map

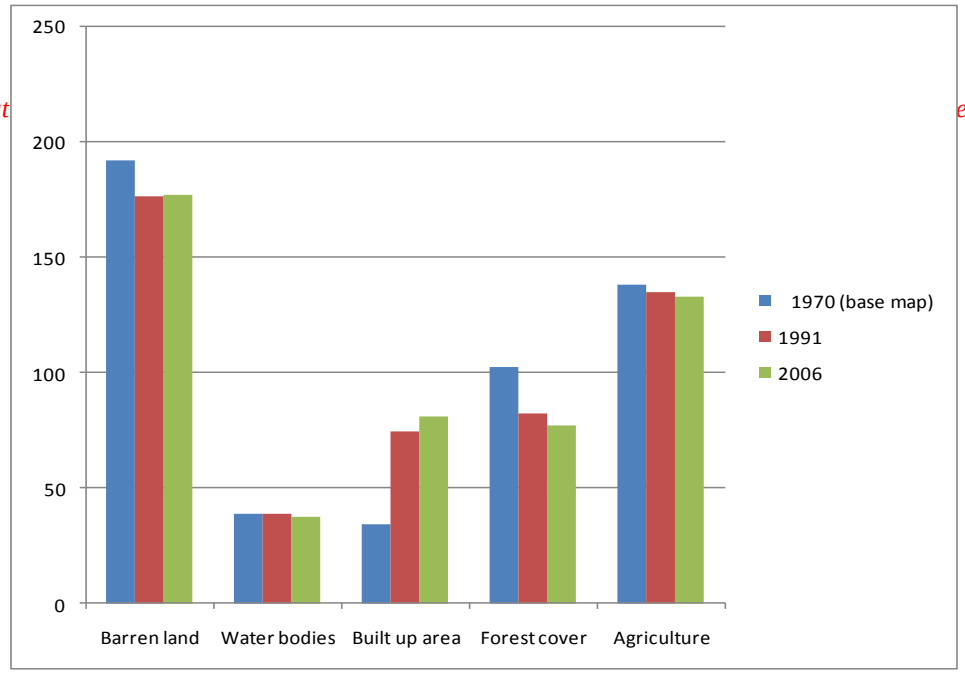

Fig 6. Chart representation of LU/LC

CONCLUSION

The landuse/land cover pattern in Neyveli town was studied by using remote sensing and GIS techniques. Survey of India toposheet (1970) and LANDSAT TM satellite data sets such as 1991 and 2006 were used. By the study, it can be inferred that the coastline areas are rapidly developing. The population density is also increasing in the coastal areas due to industrialization and increased land utilization. This information, in turn, can help people anticipate and plan for future changes.

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