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Identification of land use and land cover changes in Coastal Zone of Chidambaram Taluk, Tamilnadu with the help of Remote Sensing and GIS technology

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ABSTRACT

Chidambaram coastal zone is covered by Survey of India Toposheet no 58 M / 15 and it is the part of southeast coast of India. During evolution of coastal zone of India was affected many natural hazards like storms, cyclones, floods and tsunami. December 2004 Tsunami was severely affected geomorphology of study area. The present study deal with land use and land cover classification and demarcation of changes in it by the help of Landsat satellite data (1973 and 2009). On the basis of analysis of land use class, we find that built up area class is fastest growing class from 1973 to 2009 and it flow the same trend after 2009. The fastest growth of built up class is result of population explosion and urbanization. The impact of these growths is inversely related to forest class. The dominant land use category is crop land and covered 15.22% of total land in 1973. The present study shows that GIS and remote sensing techniques can play important role for making better planning and rational use of natural resources in future.

Introduction

Land use reflects the importance of land as key and finite resources for most of the human activities including agriculture, industry, settlement, recreation, storage and energy production. While, land cover is that part of land which is created by nature like forestry, water bodies, rivers and reservoirs etc. Land use / land cover also constrained by environmental factors such as soil characteristics, extent, Quality, climate and topography. One side Land use is a product of interactions between a society's cultural background, state, and its physical needs, while on the other side the natural potential of land (Ram and Kolarkar 1993). We require present and past data of Land use, land cover of area for planning better economical development without harming bio environment and one can use every piece of land in the rational way (Chaurasia et al., 1996).

During the last two decades, numerous studies have been published concerning accuracy assessment of land cover classifications (Rosenfield and FitzpatrickLins, 1986; Foody, 1992; Congalton, 1996). The information being in digital form can be brought into a Geographical Information System (GIS) to provide a suitable platform for data analysis, update and retrieval. Improvements in satellite remote sensing, global positioning systems and geographic information systems techniques in the past decade have greatly assisted the collection of land cover data and the integration of different data types (Star et al., 1997). In many remote sensing change detection studies, land use and land cover change often are used interchangeably (Green et al., 1994: Dimyathi et al., 1996; Heikkonen & Varfis, 1998). Temporal changes in land cover have become possible in less time, at lower cost and with better accuracy through remote sensing technology (Kachhwaha, 1985 and Sharma et al., 1989). The present study is mainly focused on the demarked changes in coastal zone of Chidambaram taluk, Tamilnadu with the help of LANDSAT imagery, Survey of India toposheet and previous data by GSI.

Location

The study area falls in Survey of India toposheet no. 58 M / 11 and 15 on scale 1:50,000. The study is bounded by latitude from 11° 20' to 11° 35' and longitude from 79° 27'30" to 76° 49'. The study area is bordered by Bay of Bengal in East and in South by Kollidam River. Location map of study area is shown in Fig – 1.

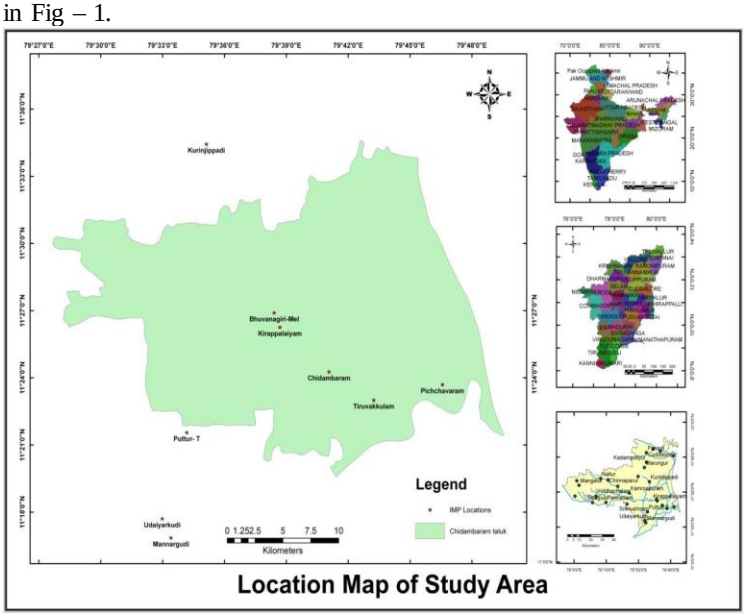

Fig 1: Location map of Study area.

Rainfall and Climate

The average rainfall of the district is 54.46".it is heaviest along the coast and varies with the distance of each locality form the coast and becomes less and less as the monsoon travels

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inland. Porto Novo has usually the heaviest rainfall. The north – east monsoon rainfall is more than double that of the south – west monsoon rainfall on the coast. The average temperature recorded is 82.7F the hottest months are April to June. And the coolest months are December and January. The highest recorded temperature was 110F and lowest 52F. The coastal parts of the district are naturally moist and damp. The tidal range throughout the East coast is about ½ meter. It is also the same for the study area. The tidal range is max during the northeast monsoon period. The average wind speed is highest in June, July, August i.e. about 12.3to 10.3kmph and least in February and March when the average the wind speed is 5.4 to 5.3kmph.

Geomorphology

The eastern part of the district represents a flat plain and the western part slightly hilly area. The slope varies from 8˚ to 4˚ towards east and in the west, and in the coastal plains it is less than 1˚. The area is typified by residual hills, pediments and Pedi plains formed due to denudational processes. The fluvial zone comprising flood plains of Vellar, Gadilam, Kollidam and Ponnaiyar rivers with associated landforms such as levees, channel bars, point bars, meander scars, palaeo channels and flood basin / back swamp deposit. A narrow fluviomarine zone comprising palaeo-tidal flats and inter-distributary flood basin is seen between fluvial and marine regimes. The marine landforms of east coast formation include beach tidal flats, mud flats, mangrove swamps, spit, lagoon and estuary. Aeolian action is reflected in the form of barrier dunes along the coast. A number of strand lines depict the progradation of the Cauvery delta during the Holocene period. Geomorphological Map of the Chidambaram taluk is shown in Fig – 2.

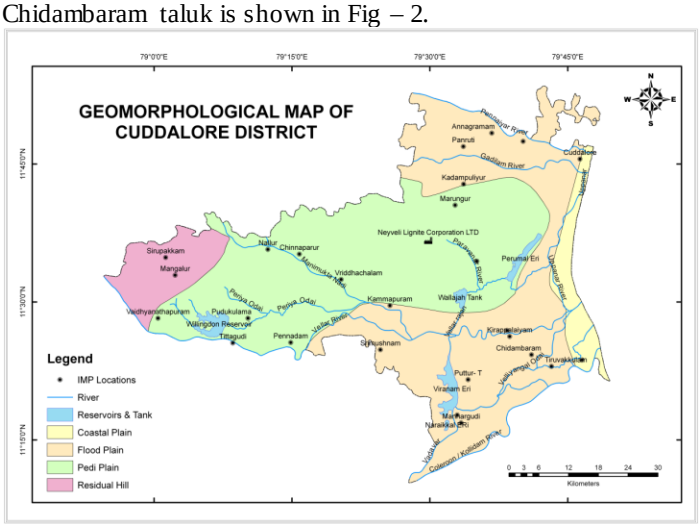

Fig 2: Geomorphology Map of Cuddalore District.

Drainage

Ponniyar, Gadilam, Uppanar, Vellar and Coleroon are the major rivers of Cuddalore District. The Ponniyar and Gadilam rivers are drain district northern side as well as Vellar and Coleroon Rivers drain Southern part of Cuddalore District. Ponniyar and Gadilam Rivers flow from NW to E direction, Vellar and Coleroon rivers flow in W to E direction while Uppanar river flow in sub parallel to the coastal line of Cuddalore District. Vellar and Coleroon rivers flow in sub parallel pattern to each other. All these rivers are ephemeral and carry flood during the Monsoon. The eastern part of Cuddalore coast near Porto Nova is characterized by the lagoon and back water area. The drainage system is mostly parallel to sub parallel except then Uppanar River and drainage density is very low in the Cuddalore district. Drainage map of Cuddalore district is shown in Fig – 3.

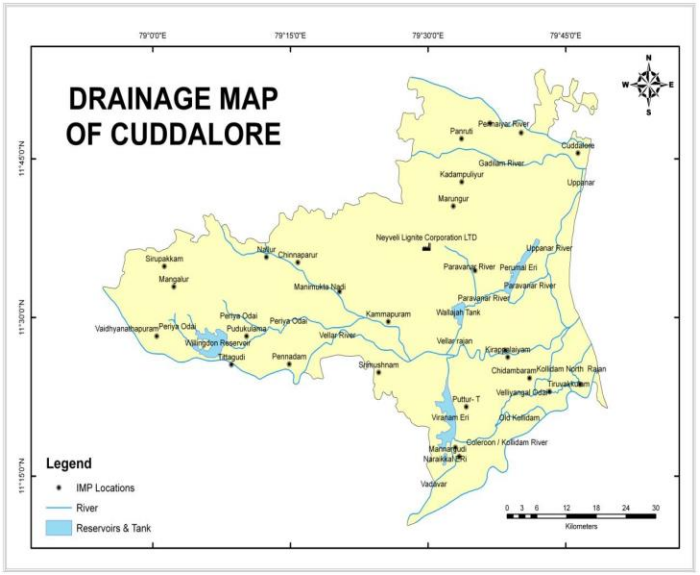

Fig 3: Drainage map of Cuddalore district.

Material and Methods

In present study we are used LANDSAT imagery for year 1973(MSS) and 2012(TM), Survey of India toposheet 58 M / 11 and 58 M / 15, ArcGIS 9.1 software for GIS work and Erdas Imagine 8.5 software for the satellite image analysis. LANDSAT image is not geometric corrected as well as contains striping effect. So we are doing the radiometric correction and getting the de – striping image after this we were doing the geometric correction by creating ground control points in image as well as in toposheet by the help of image to image registration process. Then we make an area of interest (AOI) of our study area and we are used this area of interest for further analysis of image. We are using visual interpretation techniques for the image analysis. For better analysis we are use image enhancement techniques. In visual interpretation of image we are use visual interpretation key likes colour, tone, texture, shape, size and Pattern. After visual interpretation of images we are define several classes for the supervised classification of AOI image. After identification of classes in image we were carried out the field survey with help of GPS for the accuracy and correction in classification of AOI. At last we were prepared final map of study area. Complete LANDSAT imagery MSS and TM+ (1973 and 2009) is shown in Fig – 4 and 5.

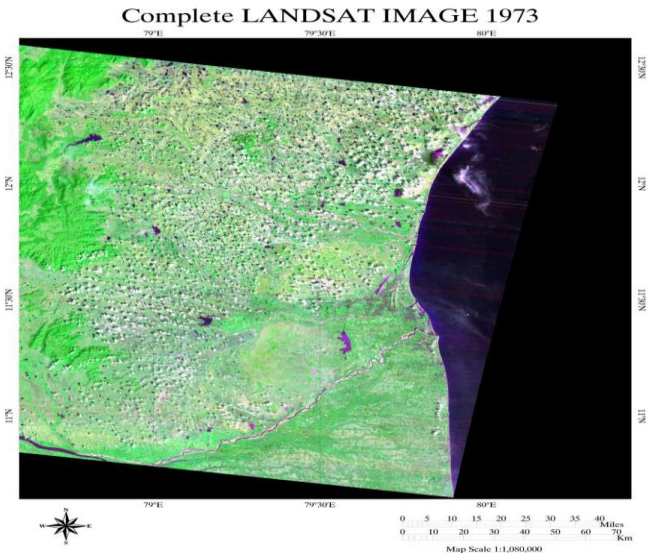

Fig 4: Complete View of LANDSAT MSS Image 1973.

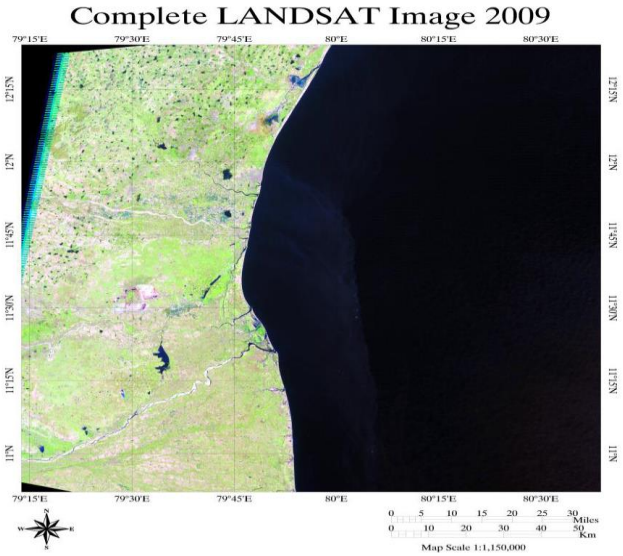

Fig 5: Complete view of LandSat TM Image 2009.

Result

An increasingly common application of remotely sensed data is for 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). Change detection is an important process in monitoring and managing natural resources and urban development because it provides quantitative analysis of the spatial distribution of the population of interest. Change detection is useful in such diverse applications as land use change analysis, monitoring shifting cultivation, assessment of deforestation, study of changes in vegetation phenomenology, seasonal changes in pasture production, damage assessment, crop stress detection, disaster monitoring, day/night analysis of thermal characteristics as well as other environmental changes (Singh, 1989).

According to Macleod and Congalton (1998) list four aspects of change detection which are important when monitoring natural resources such as: a) Detecting that changes have occurred, b) Identify the nature of the change, c) Measuring the areal extent of the change, d) Assessing the spatial pattern of the change. Land cover mapping serves as a basic inventory of land resources for all levels of government, environmental agencies and private industry throughout the world.

In present study area of interest (AOI) of LANDSAT MSS (1973) and TM+ (2012) data occupied nearly 447 km2, 446 km2 respectively. In 1973 study area is majorly covered with forest (94.30km2), mangrove (65.39km2) and crop land (53.90km2), While in 2009 these class was shown prominent change of its coverage. We were defined total 9 classes for detection changes in land use and land cover, these were Settlement, Sea water, River, Back Water, Mangroves, Barren land, Crop land, Forest and Sand. The resultant occupied area by land cover and land use display in Table no. – 1. Land use and land cover classified images were shown in Fig No. – 6, 7, 8 and 9.

In the study area, forest and crop land covers nearly 29.66% of total area. The dominant land use category in 1973 is crop lands which occupy 15.22% of stud area. While in 1973 the settlement is least occupies area category 2.90%. But in 2009 the fastest growing categories is also settlement. The increment is due to population growth and construction buildings. Increasing population and industrialization along the coastal areas are adding pressure on the coastal ecosystems.

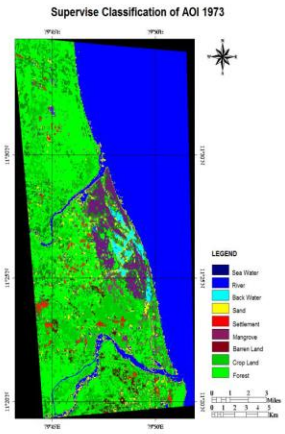

Fig – 6.

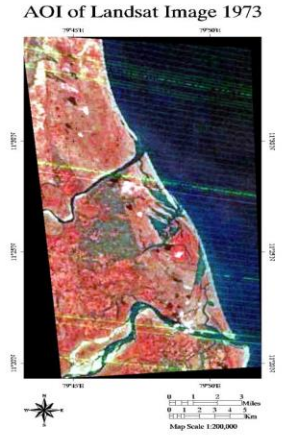

Fig – 7.

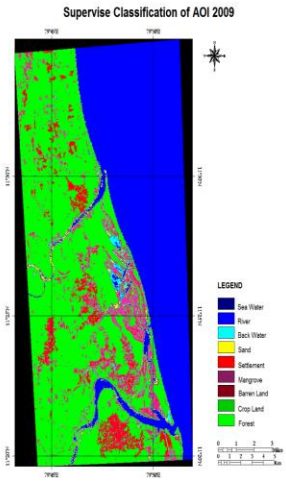

Fig – 8.

Fig – 9.

Land Use and Land Cover classification of Study Area							
1973				**2009**			
Class	**No of Pixel**	**Area (Km²)**	**Percentage**	**Class**	**No of Pixel**	**Area (Km²)**	**Percentage**
Settlement	19,265	12.96	2.9	Settlement	71,240	47.96	10.75
Sea water	1,97,983	133.15	29.79	Sea water	2,03,553	137.03	30.72
River	3,826	2.57	0.58	River	5,346	3.6	0.81
Sand	22,752	15.3	3.42	Sand	31,321	21.09	4.73
Mangrove	86,221	57.99	12.97	Mangrove	51,143	34.43	7.72
Back Water	52,748	35.48	7.94	Back Water	57,879	38.96	8.74
Crop land	1,01,145	68.03	15.22	Crop land	95,356	64.19	14.39
Forest	1,50,208	101.02	22.6	Forest	1,01,208	68.13	15.28
Barren land	30,478	20.5	4.59	Barren land	45,460	30.6	6.86
Total	**6,64,626**	**447**	**100**	**Total**	**6,62,506**	**446**	**100**

Table No 1: Showing different area (KM²) and its % of total Area of Image.

The increment in sea water and river class show it effect of global warming, while reduction in mangrove and increment in back water classes are show the impact of tsunami. Decrement of forest and crop land classes are resultant of anthropological and socio-economical activities. Table – 2 is given gives more

emphasized on changes of land use and land covers. Available land can be effectively used in the most rational way by knowing land use/land cover data. River area covers nearly 0.81% of the study area. River is the important source for agricultural and drinking purposes in Chidambaram taluk. Sand is varying with respect to the wave and tidal variation as well as near to banks and point bars of river. Beach area of Chidambaram showed only minor variation from 1973 to 2006.

Table No 2: * Show reduction and ** show gain.

Percentage Variation in land Use and Land Cover (1973 - 2009)			
Classes	**Area (Km^2) in 1973**	**Area (Km^2) in 2009**	**% variation**
Settlement	12.96	47.96	370.15**
Sea water	133.15	137.03	102.91**
River	2.57	3.6	139.86**
Sand	15.3	21.09	137.80**
Mangrove	57.99	34.43	59.37*
Back Water	35.48	38.96	109.83**
Crop land	68.03	64.19	94.37*
Forest	101.02	68.13	67.44*
Barren land	20.5	30.6	149.30**
Total	447	446	99.78*

Conclusion

The present study shows that Chidambaram coastal zone dominant changes in settlement, forest, crop land, barren land and mangrove classes. Settlement, forest crop land are shows the result of population growth and socio-economical factors, while on the other hand barren land and mangrove classes shows the result of environment and hazard impact on the study are. The baseline information generated on land use and land cover pattern of the area would be of immense help in formulation of policies and programmes required for developmental planning.

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