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LANDUSE /LAND COVER IN PONDICHERRY USING REMOTE SENSING AND GIS

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Abstract

Coastal areas are highly dynamic and undergoing rapid change. In view of this fact, it is essential to review decisions made and developments undertaken pertaining to the coast from time to time. The knowledge of landuse / land cover changes is very important in understanding natural resources, their utilization, conservation and management. In recent years remote sensing and Geographical Information System have gained importance as vital tools in the analysis of temporal data at the district and city level. The present study evaluates the effectiveness of high-resolution satellite data and computer aided GIS techniques in assessing landuse / land cover change detection for the period 1990 to 2002 within the study area, Pondicherry.

Introduction

Land use is obviously constrained by environmental factors such as soil characteristics, climate, topography, and vegetation. But it also reflects the importance of land as a key and finite resource for most human activities including agriculture, industry, forestry, energy production, settlement, recreation, and water catchment and storage. Land is a fundamental factor of production, and through much of the course of human history, it has been tightly coupled with economic growth. Often improper landuse is causing various forms of environmental degradation. For sustainable utilization of the land ecosystems, it is essential to know the natural characteristics, extent and location, its quality, productivity, suitability and limitations of various land uses. Landuse is a product of interactions between a society's cultural background, state, and its physical needs on the one hand, and the natural potential of land on the other (Balak Ram and Kolarkar 1993). In order to improve the economic condition of the area without further deteriorating the bio environment, every bit of the available land has to be used in the most rational way. This requires the present and the past landuse/ land cover data of the area (Chaurasia et al., 1996).

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 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).

The present study was carried out to evaluate the effectiveness of data in and around Pondicherry on 1:25,000 scale by using satellite data of LANDSAT (TM), IRS 1C, ID and Base information from Toposheet .

Study Area

Pondicherry district is located on the Coramandal coast between 11 52' 56" and 11 59' 53" of north latitude and between 79 45' 00" and 79 52' 43" of east longitude. It is limited on the east by the Bay of Bengal and on the other three sides by the Cuddalore district of Tamil Nadu State. The layout of Pondicherry district above which is enclave within Tamil Nadu presents a peculiar picture of territorial jurisdiction perhaps the only one of its kind in the world. The district headquarters is located at Pondicherry. The physiographic map of the district presents more or less a flat land. There are no hills or forests in this district. The main soil types met with in this district are red ferrallitic black clayey and coastal alluvial. There are 2 main drainage basins, the Gingee River which crosses diagonally from northwest to the southeast and the other, Pennaiyar which forms the southern border of the district. Pondicherry attracts a large percentage of tourists visiting India.

Data Used

Survey of India Topographical map on the 1: 50,000 scale for the year 1970, and LANDSAT (TM), IRS LISS II and III FCC for the year 1990, 1998 and 2002 have been used in the present study.

LAND USE/LAND COVER FROM 1970-2002

Land use Category	Area in Sq Km				Percentage			
	1970	1990	1998	2002	1970	1990	1998	2002
Barren land	-	6.23	9.19	11.54	-	2.74	5.07	9.19
City Area	16.36	18.12	18.82	25.51	7.19	7.97	8.27	11.21
Crop land	92.74	19.53	18.04	14.01	40.76	8.59	8.17	6.39
Fallow land	1.55	8.72	8.12	6.36	0.68	3.83	3.57	2.80
Gully Erosion	1.31	1.12	0.39	0.25	0.59	0.49	0.17	0.11
Industrial Area	-	0.22	0.34	0.70	-	0.10	0.15	0.31
Marshy Vegetation	-	-	0.09	0.15	-	-	0.04	0.07
Mud	0.61	0.77	0.36	0.09	0.26	0.34	0.16	0.04
Plantation	10.46	32.08	15.91	17.56	4.59	14.10	6.99	7.72
Plantation with Settlement	-	40.43	47.23	52.08	-	17.77	20.75	21.30
Rocky Coast	-	0.29	0.25	0.53	-	0.13	0.11	0.23

Sand	3.82	2.75	5.43	2.13	1.68	1.23	2.38	0.94
Sand Dune	-	0.41	0.40	0.39	-	0.18	0.18	0.18
Scrub	4.97	4.77	2.59	0.97	2.18	2.10	1.14	0.43
Settlement	9.20	10.54	10.63	12.21	4.04	4.63	4.67	5.37
Tank	4.29	4.49	3.95	3.34	1.89	1.97	1.73	1.47
Water body	0.48	0.29	0.84	0.29	0.21	0.13	0.37	0.13

Methodology

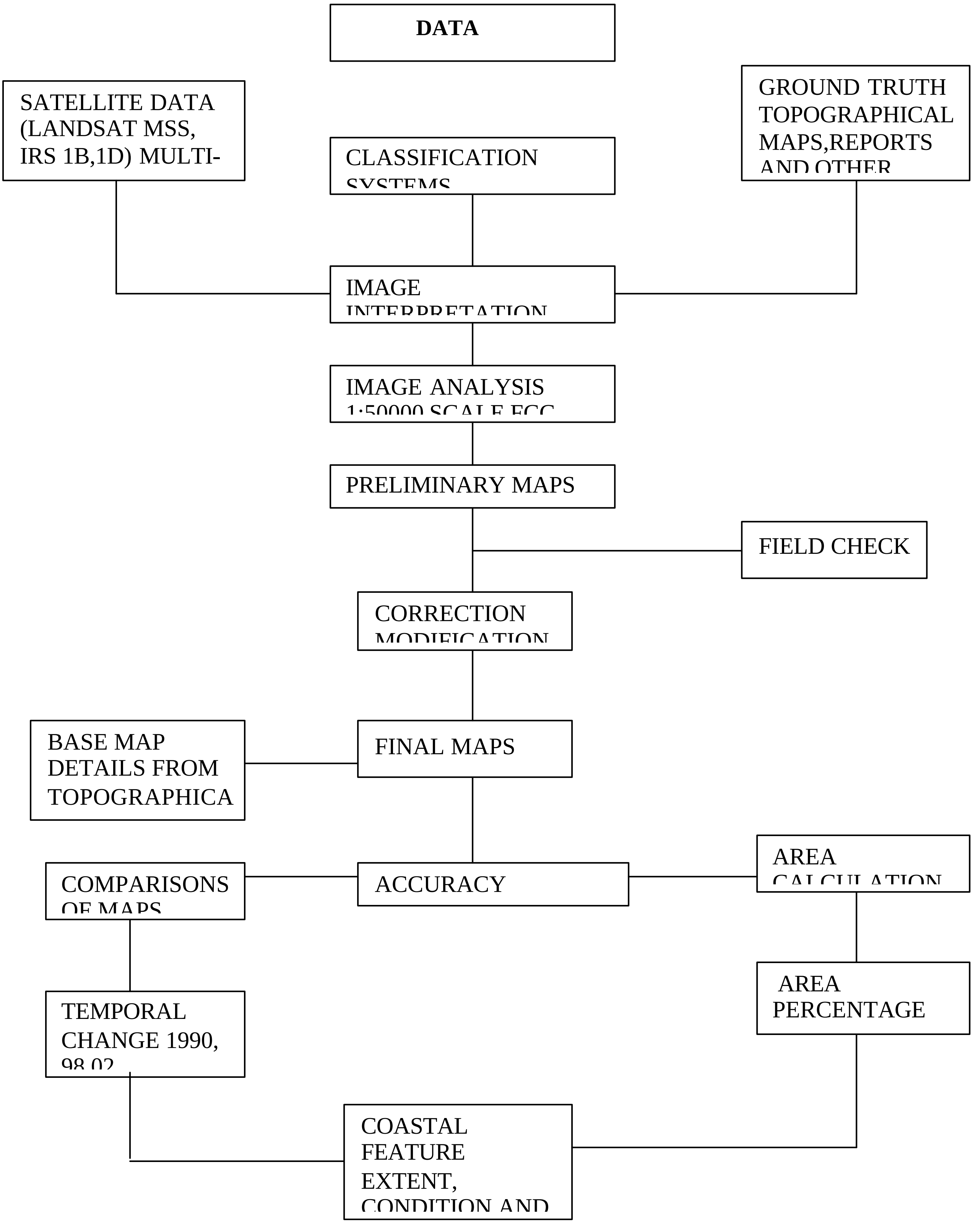
Satellite imagery in the Print form (1990) and digital data (1998and 2002) was visually interpreted. The variation in the image characteristics like tone, texture, pattern etc. was used to identify various land use classes. The information obtained from the imagery was transferred to base map prepared from SOI topographical map. The digital data procured for landuse land cover mapping was geo-referenced with Survey of India (SOI) topographical sheets.

- In designing the database, the study area boundaries were determined from the topographic as well as land use land cover maps.
- Spatial data were digitized using Calcomp 9100 digitizer table.
- 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 CLEAN and BUILDS commands. The topology was reconstructed when errors were found.
- This stage requires getting attribute data into ARC/INFO. Data file names were assigned to all the files created. While the JOINITEM command was used to link attributes from data file with the related coverage.
- In managing the database all coverage from digitizer units were converted to real world co ordinates using UTM system.
- At this stage graphic analysis was carried out:

➢ Landuse and land cover 1990
➢ Landuse and land cover 1998
➢ Landuse and land cover 2002

Area of each category was calculated. The flow diagram indicating the methodology for landuse/cover mapping is given in Fig 1.

Fig 1: Methodology for coastal land use/cover change detection



Results and Discussions

The results of land use/cover assessment based on visual interpretation for three different years of satellite data between 1990, 1998 and 2002. It has a total area of about 227.00 sq km. and a total population of about 9,73,829 people. The dominant landuse categories in 1990 were settlement with plantation, which occupied 17.77% of the study area, plantation covering 14.10%, settlement occupying 12.01%, cropland covering 8.59% while other landuse features occupied a negligible area. The trend of the landuse and land cover continued in the same manner in 1998 with the same order of importance. However, settlement with plantation, plantation, and settlements showed an increase in hectarage while cropland showed a significant reduction. In 2002, the three categories continued to dominate the area (settlement with plantation 21.30%, settlement 16.84%,plantation 7.72%), here plantation decreased while settlement (housing, industries, towns)increased due to the change in population density, labour force in agriculture and population growth. In short the most common variable explaining the changes in landuse and landcover in Pondicherry is population growth. The variations in area covered under agriculture and fallow land attributed to changes in crop rotation, harvesting time and conversion of these lands into plantation.

Variation in coast is due to erosion. The Rocky coast has shown an increasing trend from 0.29 sq. km in 1990 to 0.53 sq.km. Fishermen were affected, by income and lost property. Last year 18 houses were washed off in to the sea. The study identified that the satellite data derived baseline inputs would contribute to the regional efforts to assess and monitor the coastal marine ecosystems as well as to formulate policies and measures to mitigate the undesirable effects.

Conclusion

The study has revealed that satellite data has the unique capability to detect the changes in landuse quickly and accurately. From the analysis it has been found that the satellite data is very useful and effective for getting the results of temporal changes, with this effective data it has been found that the cropland is decreasing at the cost of haphazard growth of plantation and settlements. This will help in maintaining the ecological balance and improving microenvironment of the region.

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