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Land Use and Land Cover Assessment along Pondicherry and its Surroundings Using Indian Remote Sensing Satellite and GIS

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Abstract: Land use/land cover mapping serve as a basic inventory of land resources through out the world. Whether regional or local in scope, remote sensing offers a means of acquiring and presenting land cover data in timely manner. Land use/land cover pattern of Pondicherry and its surroundings were studied using IRS IC LISS III data. The land use/land cover patterns were visually interpreted and digitized using ERDAS IMAGINE software. The study observed that agriculture area (52.89%) is dominant in Pondicherry and its surroundings followed by settlement with vegetation (18.35%). The study recommends the use of satellite imageries for future environmental monitoring studies.

Key words: Land use · Land cover · Satellite · Pondicherry · Agriculture

INTRODUCTION

Coastal areas are highly dynamic and undergoing rapid change. The knowledge of land use/land cover change is very important to understand the natural resources, their utilization, conservation and management [1]. Land use is obviously constrained by environmental factors such as soil characteristics, climate, topography and vegetations. But, it also reflects the land as a key and finite resource for most human activities including agriculture, industry, forestry, energy, production, settlement, recreation and water catchments and storage. The main emphasis of agricultural development all over the world was on increasing productivity per unit area of land used for production to feed the ever increasing population [2]. It has been tightly coupled with economic growth. Improper management of land use is causing various forms of environmental degradation.

Identifying delineating and mapping land cover are important for global monitoring studies with the component of resource management and planning activities. Identification of land cover establishes the base line from which monitoring activities can be performed and provides the ground cover information for base line thematic maps. Land use refers the purpose of the land serves, for example, recreation, wild life habitat, agriculture [3]. Land use applications involve both baseline mapping and subsequent monitoring. Since, the timely information is required to know the current quantity of land which is in use and to identify the land changes from year to year [4].

The remote sensing techniques are used to measure the land cover, from which land use can be inferred particularly with ancillary data or priority knowledge [1,5]. Land use/cover studies are multidisciplinary in nature and thus the participants involved in such work are numerous and varied, ranging from international wild life and conservation foundation to government researchers and forestry departments. In addition, facilitating sustainable management of the land, land cover and use information may be used for planning, monitoring and evaluation of development, industrial activity or reclamation. Detection of long term changes in land cover may reveal an idea for the shift in local or regional climatic conditions and analyzing the basis of terrestrial global monitoring [6].

In order to improve the economic condition of the area without further deteriorating the ecosystem, every bit of the available land has to be used in the most rational

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way. For this type of mapping it requires the present and the past land use/land cover data of the area [7]. In this context, remote sensing technology plays an effective role in the sustainable development and management of our environment and resources [8].

Though many studies were undertaken to understand the land use and land cover in different parts of India, not much studies were carried out in the union territory of Pondicherry and its surroundings. So, a preliminary study was carried out to understand the present overlay of land use and land cover. The study also focuses on the effectiveness of the satellite for land use/land cover studies.

MATERIALS AND METHODS

Study Area: Pondicherry is one of the important tourism spot in India. 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. Pondicherry state is one of the Union territories of India. It is limited on the east coast by the Bay of Bengal, south by Cuddalore and the other sides by Villupuram district of Tamilnadu state. It is being attracted by travelers from in and around the world. The lay out of Pondicherry district above which is enclave within the Tamilnadu, presents a peculiar picture of territorial jurisdiction perhaps the only one of its kind in the world [1].

MATERIALS AND METHODS

The following materials were used for the present study IRS 1C LISS III digital data of 2005 and Survey of India toposheet No: 58 M/13. As the digital data did not have any real earth coordinates, data were geometrically corrected using ground control points viz. road–road intersection, road–rail intersection, canal–road intersection, etc. were taken from the toposheet using ERDAS IMAGINE 8.5 image processing package. False Colour Composite of the Pondicherry was generated with the band combinations of 3, 2, 1 in Red Green Blue LISS III data (Fig. 1). The displayed image with the above classes was spectrally enhanced by histogram

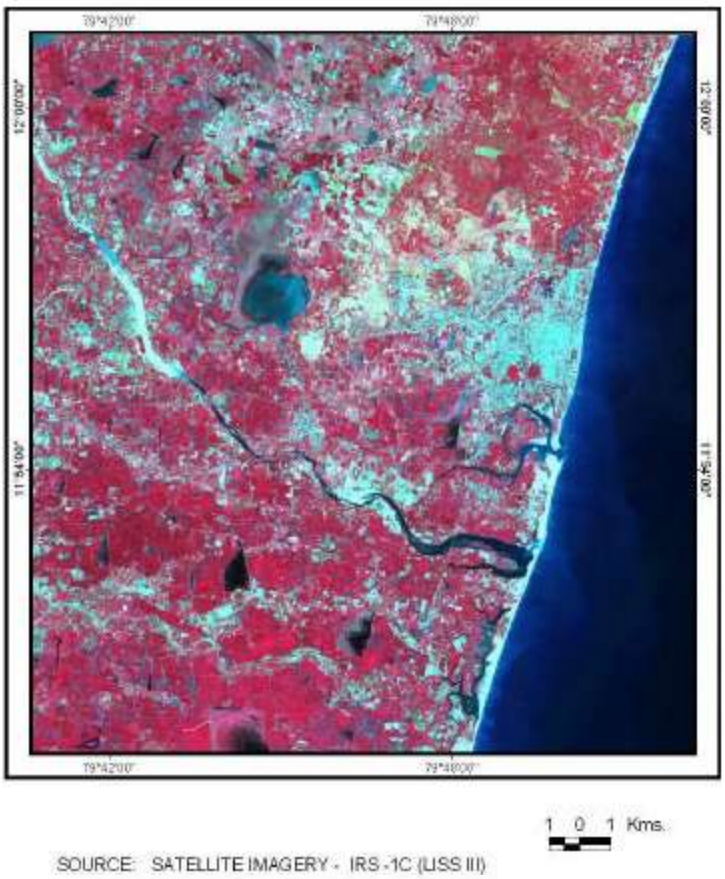

Fig. 1: IRS IC LISS III satellite imagery of the study area

equalization method. Land use/land cover map of Pondicherry was then prepared by on-screen visual interpretation method using ERDAS IMAGINE 8.5.

Different land use/land cover classes like agriculture, settlement with vegetation, fallow land, plantation, sand, river etc. were then identified using visual interpretation keys such as colour, tone, texture, pattern, size and shape. Land use/land cover map with the above classes was then transferred to base map of 1:50,000 scale, which was used for ground truth collection. Based on the ground truth data, land use/land cover map of Pondicherry and its surroundings were corrected and finalized.

RESULTS AND DISCUSSION

Land cover mapping serves as a basic inventory of land resources for all levels of government, environmental agencies and private industry throughout the world [9]. Pondicherry is being of the important tourism spot in India with shore area and areas of rapid developments, there is a need for real time monitoring of the land based changes. In the present study, 37920Ha area in and around Pondicherry was selected to delineate the present overlay of land use/land cover changes. The various features in the study area was depicted using the visual interpretation of the satellite imagery IRS 1C and was described with the area coverage. Land use classes can be effectively delineated from the digital remote sensing data [3,10].

The study revealed that nearly 20057.56Ha of the area was covered by agriculture, 6958Ha of the area covered with settlement with vegetation and 4454.51Ha was under plantation whereas settlements alone hold 2939.81Ha of the study area. Tank (1127.75Ha), Fallow land (1107.02Ha), River (593.12Ha) and sandy area (460.20Ha) constitute fare area coverage in the study area, whereas Muddy area (109.64Ha), Sandy beach (102.98Ha) and aquaculture area (9.41Ha) were observed in a smaller area. Land use/ land cover map of the study area was shown in Fig. 2. The classified image map of the study area (In and around Pondicherry) showed that most of the lands were used for agricultural purposes.

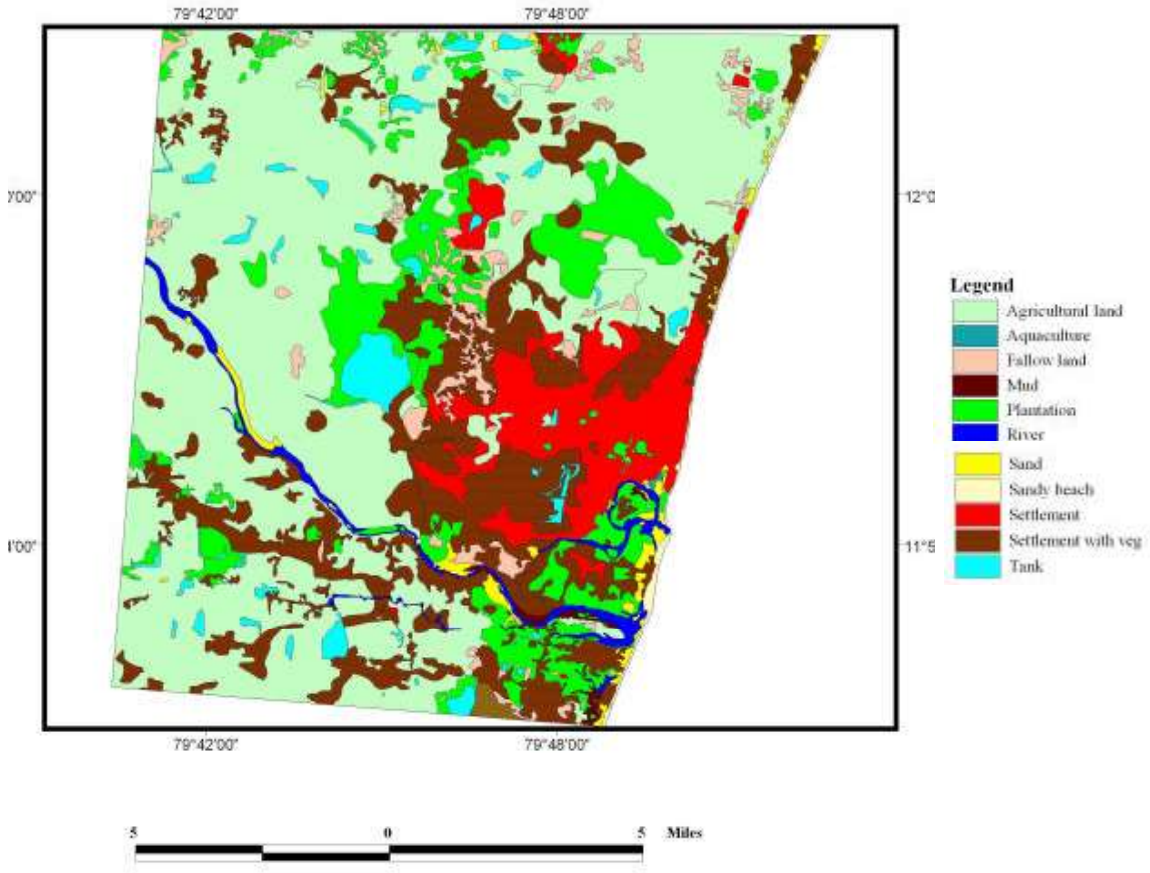

Fig. 2: Classified Land use/Land cover map of the study area

Table 1: Areal extend of different land use/land cover features

Name of the feature	Total area (Ha)	% of occupation
Agricultural land	20057.56	52.89
Aquaculture	9.41	0.03
Fallow land	1107.02	2.92
Mud	109.64	0.29
Plantation	4454.51	11.75
River	593.12	1.56
Sand	460.20	1.21
Sandy beach	102.98	0.27
Settlement	2939.81	7.76
Settlement with Vegetation	6958.00	18.35
Tank	1127.75	2.97
Total area	37920.00	100.00

Agriculture is the world's major user of land, water and biological resources. It is the major source of livelihood of more than 70% of the people of the country [6]. In the present study the agricultural land are seen to be occupied by nearly 52.89% of the study area, which is the major land use activity in this area. Further agricultural area can be increased by identifying cultivable fallow lands using remote sensing followed by field verification. The percentage of agricultural area may decrease during the years to come as over population and the setting up of more industries in the vicinity. Land use/ land cover inventories of Kolli hills of Tamilnadu [11] using Landsat TM and IRS 1C data provided due importance to various resource sectors like agricultural planning, settlement surveys, environmental studies and operational planning based on agro-climatic zones.

In the study area, settlement with vegetation covers nearly 18.34% of the total area. The dominant land use categories in 1990 were settlement with plantation, which occupied 17.77% of the study area. In 1998 the settlement with plantation showed an increase in hectares. In 2002 settlement with plantation covered nearly 21.30 % of Pondicherry area [1]. This increase is due to population explosion and the construction of buildings and factories. Increasing population and industrialization along the coastal areas are adding pressure on the coastal ecosystems [6,12]. Nearly 11.75% (4454.51 Ha) of the study area are covered by plantation alone. In 1970 the plantation cover of Pondicherry region was only 4.59% but it showed a gradual increase in the area from 1990 to 2002 as 6.99 to 7.72 % respectively [1]. The settlement area alone is occupied by 7.76% (2939.81 Ha) of the study area.

Information needs for water security and management area of diverse nature ranging from mere inventory of surface water bodies to more complex irrigation performance, water storage, reservoir sedimentation ground water exploration etc. In the present study tanks are observed in many locations. It is the main source of irrigation in the agricultural land and also for drinking in the villages. It occupies nearly 2.97% (1127.75 Ha) of the total 37920Ha study area. Remote sensing data in conjunction with sufficient ground truth information provides the wise use and supply of drinking water to deprived villages [6].

In the present study, nearly 2.92% (1107.02 Ha) of the area comes under fallow land (Table 1). Information on land use/land cover also provides a better understanding of the cropping pattern and spatial distribution of fallow lands, forests, grazing lands, wastelands and surface water bodies, which are vital for developmental planning [9]. 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. Available land can be effectively used in the most rational way by knowing land use/land cover data [7].

River area covers nearly 1.56% of the study area. River is the important source for agricultural and drinking purposes in Pondicherry. Due to variation in the monsoons and rainfall in the study area the river areas are seen to be covered by sand and mud in different seasons. Nearly 1.21% of the study areas of the coastal line and riverbank are covered by sand. Sand deposited in the river banks are temporary, they are seen mainly in summer season. Mud is mainly found on the banks of two rivers on the study area. It occupies about 0.29% (109.64 Ha). Mud areas are seen found varied in the study area; these changes may due to variation in the rainfall and river water input. Sandy beach of Pondicherry is attracted by many tourists every year. Pondicherry is having sandy beach of nearly 102.98 Ha (0.27%). Sandy beach is varying with respect to the wave and tidal variation. Beach area of Pondicherry showed only minor variation from 2002 to 2005 [1]. Aquaculture is being practiced in lesser areas. The area cover is about 9.41 Ha (0.03%). Aquaculture is only practiced in smaller areas comparing to other dominant features. This is because the availability of land for aquaculture purpose in Pondicherry was very less.

CONCLUSION

The present study revealed using the satellite imagery confirm that Pondicherry and its surroundings still retain more agricultural land when compared to all other land use/land cover features, though the rate of

conversion of agricultural land for other purposes like industries and building construction were increased alarmingly for the past few years. The present study also found that remote sensing coupled with GIS can be effectively used for real time and long term monitoring of the environment. The baseline information generated on land use/land cover pattern of the area would be of immense help in formulation of policies and programmes required for developmental planning.

REFERENCE

1. Nagamani, K. and S. Ramachandran, 2003. Land use/Land Cover in Pondicherry using Remote Sensing and GIS. In the Proceedings of the Third International Conference on Environment and Health held Chennai, India, pp: 300-305.
2. Bhat, N.R., M.K. Suleiman and M. Abdal, 2009. Selection of Crops for Sustainable Utilization of Land and Water Resources in Kuwait. World Journal of Agricultural Sciences, 5(2): 201-206.
3. Ram, B. and A.S. Kolarkar, 1993. Remote sensing application in monitoring land use changes in arid Rajasthan. International Journal of Remote Sensing, 14(17): 3191-3200.
4. Kumaraswamy, K. and R. Narayanakumar, 2005. Thrust areas of research and applications of remote sensing. In National Workshop on Remote sensing for Environmental Studies, Bharathidhasan University, Tamilnadu, pp: 36-50.
5. Kachhwala, T.S., 1985. Temporal monitoring of forest land for change detection and forest cover mapping through satellite remote sensing. In the Proceedings of the 6th Asian Conference on Remote sensing, Hyderabad, pp: 77-83.
6. Navalgund, R.R., V. Jayaraman and P.S. Roy, 2007. Remote sensing application: An overview. Current Science, 93(12): 1747-1766.
7. Chaurasia, R., D.C. Closhali., P.K. Minakshi Sharma., M. Kudrat and A.K. Tiwari, 1996. Land use change analysis for agricultural management- a case study of Tehsil Talwandi Sabo, Punjab. Journal of Indian Society of Remote Sensing, 24(2): 115-123.
8. Kasturirangan, K.R., B.L. Aravamudan, Deekshatulu, George Joseph and M.G. Chandrasekhar, 1996. Indian remote sensing satellite (IRS)-1C, the beginning of new era. Current Science, 70(7): 495-500.
9. Vijith, H. and R. Satheesh, 2007. Evaluation of Land use Pattern and Geomorphology of Parts of Western Ghats using IRS P6 LISS III Data. IE (I) Journal-AG, 88: 14-18.
10. Vijayakumar, S.P., S.P. Rai and D.S. Rathore, 2004. Land use Mapping of Kandi Belts of Jammu Region. Journal of Indian Society of Remote Sensing, 32(4): 323-328.
11. Jayakumar, S. and D.I. Arockiasamy, 2003. Land use/Land Cover Mapping and Change Detection in Part of Eastern Ghats of Tamilnadu using Remote Sensing and GIS. Journal of the Indian Society of Remote Sensing, 31(4): 251-260.
12. Madan, K., M. Usha Natesan and S. Rajendran, 2006. A study on the dynamic changes of land use/land cover for Muthupet wetland using remote sensing and geographical information system. Groundwater Journal, 14(3): 53-57.