RESEARCH ARTICLE

AN ANALYSIS ON LAND USE / LAND COVER USING REMOTE SENSING TECHNIQUES- A CASE STUDY OF PUDUKKOTTAI DISTRICT, TAMIL NADU, INDIA

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ARTICLE INFO	ABSTRACT
	The present study aims to find out the land use/ land cover of Pudukkottai District. The total area of the District is 4,663 sq.km. Pudukkottai District is situated in the centre of Tamil Nadu State. The study has made use of satellite imagery for identifying the land use/ land cover of the study area. Arc-GIS software was used to demarcate the land used/land covered divisions of Pudukkottai District. The District has been classified into five classes in Level I and 11 sub classes of level II. The major land use is under agriculture 1,691sq.km. (39%) Built up land use 1,292.65 sq.km (27.72 %), waste land 1,079 sq.km (24.32 %) and water bodies 321 sq.km (6.88%).

INTRODUCTION

Land use / Land cover exhibits the physical and economical situation of any region. Land use / Land cover determines the standard of living of the people and the natural resources found in a region. The development of human race started to develop from when man started to convert the land cover region to land use. The process of land use is dynamic. Man alters the land cover according to his need and necessity. The increase in population growth, increase in consumer demand land tenure arrangements, customs and urbanization have changed the land cover to intense land use regions. Land use is defined 'as the total of all the arrangement, activities and inputs that people undertake in a certain land cover type'. Land cover is the physical and biological cover of the earth surface such as, vegetation, rocks, water body (U.N.F.A.O. 1997). Land use and land cover changes degrade and have an instant impact on the global carbon cycle. The global cycle can add or remove carbon di- oxide from the atmosphere, contributing to climate changes which lead to global warming. The Intergovernmental Panel on Climate Change (I.P.C.C. 1998).

The information on land use/land cover patterns, their spatial distribution and changes over a time scale are prerequisite for making development plans (Gautam and Narayan, 1982 and 1985; Dhinwa *et al.,* 1992; Ibrahim and Loulou, 1994). Remote sensing, the latest advancement in space technology

has the capabilities to overcome the shortcomings of the conventional methods. It makes a major technological breakthrough in the method of acquiring information on land resources, agriculture, forestry, ocean resources and other studies (NRSA, 1989; Rao, 1991). The present study describes the various land use/land cover changes and categories of the study area.

Study Area

Pudukkottai District is the seventh largest District of Tamil Nadu with an area extent of, 4,663sq.km. It lies between the latitudinal extent of 9° 50 N to 10° 40 N and longitudinal extent of 78° 25 to 79^o15 East. Pudukkottai lies in the central part of Tamil Nadu bounded with Thanjavur to the north east, Thiruchirappalli to its northwest, Sivagangai to the south, Ramanathapuram to the southwest and Palk Strait to the east. The District is divided into 11 Taluks and 13 blocks with a total population of 1,45,369 persons according to 2001 census. The physiography of this region consists of few residual hills in the Northwest and central part of the District. Alluvial soil, Red soil and Laterite soil are the major types of soil found in Pudukkottai District (Fig. 1).

MATERIALS AND METHODS

The study has made use of various primary and secondary data. These include Survey of India (SOI) topographic maps (58 J/9, 10, 11, 14, 15, 16, 58 N/2, 3, 4 and 58 O/1&2 of 1:50,000 and IRS LISS – III Geo coded data of 1: 50,000 scale

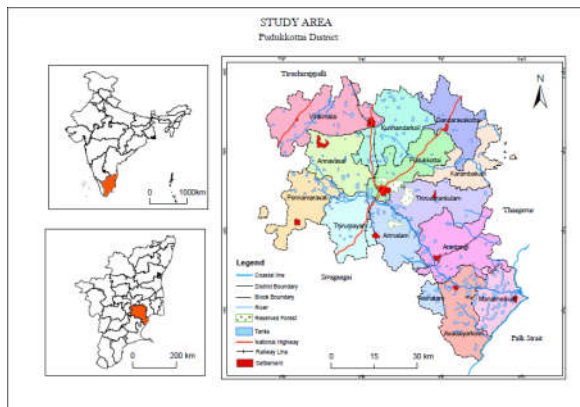*Corresponding author:* srijpunithavathi@yahoo.in

Fig.1. Study area map

for July 2008. The Indian Remote Sensing Satellite (IRS) data were visually and digitally interpreted by using the image interpretation element (such as tone, texture, shape, pattern, association etc) and by using Arc-GIS software. Adequate field checks were made before finalization of the thematic maps.

RESULTS AND DISCUSSION

Analysis of Land use / Land cover by Remote Sensing Data

The land use/ land cover categories of the study area were mapped using IRS ID LISS III data (FCC of bands 2, 3 and 4) of 1: 50, 000 scales. The satellite data was visually interpreted and after making thorough field check, the map was finalized. The various Land use / Land cover classes were interpreted further. The various Land use / Land cover classes interpreted in the study area include, built-up land, agricultural land (crop land, fallow land and agricultural plantation) forest (dense and degraded forest), wastelands, (land with scrub, land without

the periphery. These features have a coarse texture. In the study area the settlements are randomly distributed. The well developed settlements in this region are Pudukkottai, Arantangi, Thirumayam, Kulathur, Alangudi, Gandarvakottai and Avudayarkoil. Many smaller settlements such as Arimalam, Annavasal, Thiruvalankulam, Kunandavarkoil and Manalmelkudi are also identified on the satellite image. The total area covered by the settlements, network of road and railways and other built up areas accounts to 1292.65sq.km (27.2per cent) respectively.

b) Agricultural land

Agriculture crops include land used to raise food crops, commercial crops, plantation crops and horticulture crops. With the help of satellite data, it is possible to identify the various agricultural lands into level II. The various categories of the agricultural lands identified in the study area are described in detail.

i) Crop land

The crop land includes all the agricultural areas. The agriculture lands are identified by their characteristic like red tone, square or rectangular shape of the agricultural fields, association with the water bodies, and topography. The crop lands are well distributed throughout the foot hill zones and plain regions of the study area. The Kharif crops (paddy, groundnut and cotton) are cultivated in the months of June, July and August. These crops are cultivated mostly in the central and southern part of the study area. The rabi crops mostly paddy, sorghum, pearl millet, maize and finger millet are cultivated in the months of October, November and December. The crops cultivated during the rabi season are distributed all over the study area.

Table 1.1 Land Use/ Land Cover Classification of Pudukkottai District.

S. No	Level I	Level II	Area in sq.km	Percentage of District Area
1	Built up land	Built up land	1,292.65	27.72
2	Agricultural land	Crop land	1,491.24	31.97
		Fallow land	18.12	0.38
		Plantations	110.87	2.37
		Total	1,620.23	34.72
3	Forest	Dense & Open forest	197	4.22
		Degraded forest	44.03	0.94
		Total	241.03	5.16
4	Waste land	Land with scrub	482.08	10.33
		Land without scrub	388.09	8.32
		Barren Rocky	308.09	6.66
		Salt affected area	10.02	0.21
		Total	1,188.28	25.52
5	Water bodies	River/Stream/Tank/canal	321.04	6.88
		Grand Total	4,663.00	100.00

scrub and barren rocky areas) and water bodies, which are shown in table 1.1. Detailed accounts of these Land Use / Land Cover classes of the study area are described in the following section (Fig. 2).

a) Built-up land

The built-up lands are areas of human inhabitation developed due to non-agricultural activites like building, industries and transportational network. These features are identified with their dark bluish green tone in the center and bluish tone on

The crop land covers about 1491.25sq.km (31.72 per cent) of the total land use in the study area.

ii) Fallow land

These lands remain vacant without crops. The fallow lands are identified by their dark greenish tone, smaller size and medium texture. In the study area, such fallow lands are found in the western and central portions. This type of land occupies a total areal extent of 18 .12sq.km (0.38 per cent).

iii) *Plantations*

The plantation crops include cashew nuts, eucalyptus, coconut trees etc. Such areas were found in dark red colour tone in the eastern part and western parts of the District including the blocks of Gandarvakkottai, Arimalam, Karambakudi and Thiruvarankulam. Approximately the plantation cropped area occupies about 2.37 per cent of the agriculture land wide spread for an area extent 110.87 sq.km.

c) Forest

Forest, comprises of thick and dense canopy of tall trees. These lands are identified by their red to dark red tone and varying in size. They are irregular in shape with smooth texture. The forests are found on the central and western side of the District. Thiruvarankulam Reserved Forest and Sengarai Reserved Forest are the main forest cover present here. Apart from the forest cover, thick vegetation is seen in the hills of Narthamalai, Annavasal, Sevalimalai, and Kudumiyanmalai. Based on the tonal variation, the forest area is divided into three categories as dense, open and degraded forest. In the study area the distribution of the forest cover are further divided as follows.
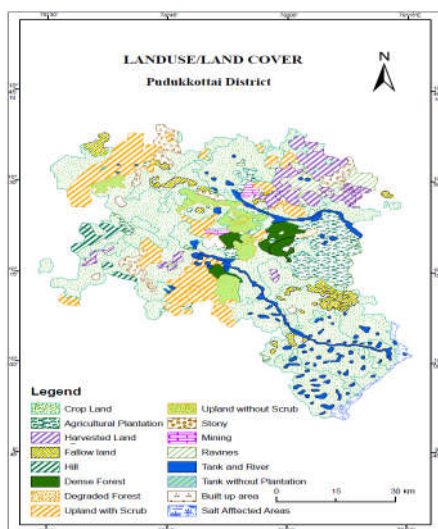

Fig. 2. Land use/land coved of Pudukkottai District

i) *Dense and open forest*

Dense forests depict dark red tone with smooth texture and irregular shape on the satellite image. In the study area, such dense forests are found in the central and western part of the study District. Open Reserved Forests are found in the central and western area of the study area. Approximately such dense forest covers about 197sq.km i.e., 4.22 per cent of the total land cover of the study area.

ii) *Degraded forest*

The degraded forest covers 44.02 sq.km (0.94per cent) of the total Land Use/ Land Cover. The relative concentration of scrubs, bushes and smaller trees are predominant in this category. Taller trees also are identified in this group. In the satellite image such forest are identified by yellow tone with

smooth texture. These forests are found in lower altitudes of the hill area and found associated with other forest.

d) Wastelands

Land, which does not support any vegetation are known as wasteland. Ravinous, sheet rocks, mining and stony regions include this category. Such lands are formed due to the chemical and physical properties of soil, temperature, rainfall and local environmental conditions. In the study area, there are four categories of wastelands, which could be easily identified from the image.

i) *Land with scrub*

These lands include the uplands or high grounds with scrubs. These lands are subject to degradation, erosion or thorny bushes. Such areas are identified from their yellowish tone and their association with uplands, and their irregular shapes. These areas are found near Viralimalai, Kunnandavarkoil and their surroundings. The total area under this category is about 483sq.km. (10.33 per cent)

ii) *Land without scrub*

These lands are found associated with higher topography and are formed by degradation or erosion. It is identified in the satellite data by its yellow tone and association with the higher altitudes. The absences of vegetation differentiate from the land covered with scrub. In the north western part of Viralimalai, Annavasal and Kunandavarkoil such area is found. Out of the total land cover of Pudukkottai District land without scrub occupies 388 sq.km (8.32 per cent).

iii) *Barren rocky*

These are rocky exposures of varying lithology often barren and devoid of soil cover and vegetation. They occur amidst hill forest as openings or scattered as isolated exposures or loose fragments of boulders or as sheet rocks on up lands and plains. In the study area, these lands appear in brownish colour and they have irregular shape. These barren rock stony and mining wastes are found in the surrounding hills. The barren rocky region covers 303 sq.km (6.64 per cent).

iv) *Salt affected area*

The salt affected areas are identified along the coast of Pudukkottai District. It has an adverse effect on the growth of plants. These areas are identified by white colour tone with smooth texture. Due to aquaculture and salt pans the area is affected by salt and the land becomes a wasteland in course of time. Along the coast of Manalmelkudi and Avudayarkoil such regions are identified. About 10sq.km. (0.21per cent) is affected by salt.

e) Water bodies

The water bodies include both natural and man- made water features in this category. i.e., rivers/streams/lakes/tanks and reservoirs. The water features appear black in tone in the satellite image. The shallow water and deep water features appear in light blue to dark blue in colour. In the study area a

number of tanks with plantation and without plantation are well distributed. Tanks with plantation are identified by the square/rectangle shape and red colour tone. Tanks without plantation are recognized by the shape and light blue to dark blue tone.

Conclusion

The study has shown the major land use/land cover types**.** The Indian Remote Sensing Satellite (IRS) data was used for visually interpretation by using the image interpretation element such as tone, texture, shape, pattern, association etc. The land use categories were built-up lands, agricultural lands, forests, waste lands and water bodies. The agricultural land has predominant in the present study, which is about 1620 sq.km. (34.72 %) (Table 1). The agriculture land is well distributed throughout the District. Agriculture is the main occupation of the people. The agriculture land includes crop land 1420.24 sq.km. (31.97%), fallow land, 18.12 sq.km (0.38%) and plantation 110.87 sq.km.(2.37%). The waste land has occupied around 1188 sq.km. and sharing 24.32 % of the total land use and land cover of the District. The waste land include scrub land and other waste lands. The forests occupy 241.07 sq.km. and sharing about 5.16 % of the total land use land cover of the District. The forest categories include deciduous forest, evergreen forest and degraded. forest. There forest are indentified to the hill slopes of the blocks of Ponamaravathy, Thiruvalankulam. In the water body category includes rivers, streams, tanks and reservoirs. River Agniyar, River Vellar River Pambar, and River Kovalar are the major non perennial rivers flowing here. The tanks were found well distributed throughout the District. It covers 321.04 sq.km (6.88%). The built-upland occupies 1292.6sq.km (27.72%) of the total land use/land cover of Pudukkottai District.

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