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Resource Evaluation Using Remote Sensing and GIS: A Case Study of Madurai North Taluk of Madurai District

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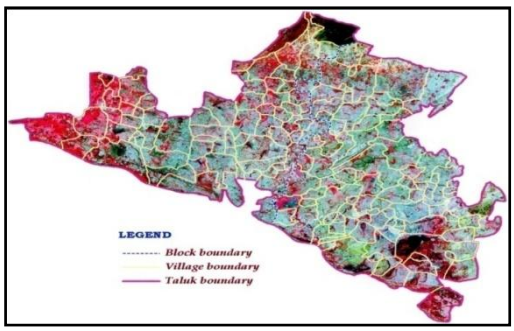
***ABSTRACT**: Land use/ land cover interpretation and mapping for the year 2001 have been carried out for the "Madurai North Taluk" in Madurai district. For this study, LANDSAT-7 ETM+ 2001 imagery was used. Different land use / land cover features have been identified using visual interpretation techniques. The findings are, major part of the study area is Agricultural land, which covers about 194.20 sq. km. Rest of the area is covered by natural vegetation about 41.38 sq. km; wasteland about 60.91 sq. km, built-up about 41.17 sq. km and water bodies about 45.73 sq. km.*
***Keywords:** Land use/land cover, LANDSAT, Madurai, Visual interpretation.*

I. INTRODUCTION

Land is the most important natural resource, which comprises the total eco system. Understanding the spatial distribution of land use and land cover is vital in management of the resource in sustainable manner (Jansen et al., 2004: Gong et al., 2009: Singh and Singh, 2011). Land use can be defined as the use of land by human, usually with importance on the practical use of land in economic activities. The land use/land cover is an outcome of natural and socio-economic factors and their utilization by humans over a period of time. It is dependent on the growth of population and socio-economic parameters. Inappropriate land use causes environmental degradation. In order to use the land resource in a sustainable way it is vital to map the natural characteristics, extent and location, its quality, productivity, suitability and limitations of various land uses (Alaguraja et al., 2010: Sateesh and Sandip, 2011). The classification has been categorized using visual image interpretation technique with elements like tone, texture, size, shape, pattern and associated features are very helpful for analyzing the existing land parcels. Land use classification and evaluation surveys using visual and image interpretation have been conducted successfully for many studies (Wu et al., 1985: Baban and WanYusof, 2001: King, 2002: Jansen and Gregorio, 2004: Ademiluyi et al., 2008: Singh and Singh, 2011). By using the GIS environment, evaluation, estimation of the spatial distribution of the land uses and integration of non-spatial data sources could be done without conventional methods of surveying. These techniques may give the accurate information about the existing land use/land cover. For the present study LANDSAT-7 ETM+ (2001) imagery was used to classify according to the modified USGS classification scheme.

II. DATA PRODUCTS USED

LANDSAT-7 ETM+ (Enhanced Thematic Mapper Plus), imagery acquired on 15th May 2001 is used in the present study (fig.1). Surveys of India (SOI) Toposheets were used to map the topography and other local information. Administrative map of Madurai district at village level is used as the collateral data. Census of India 2001 statistical records, TWAD Board and Department of Agriculture statistical data were also used for the present study.



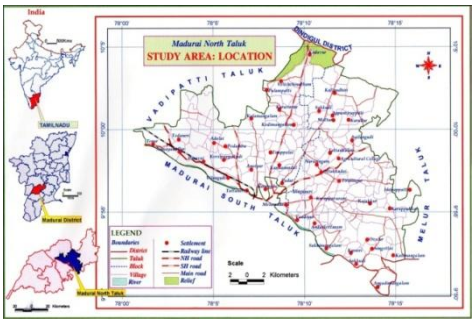
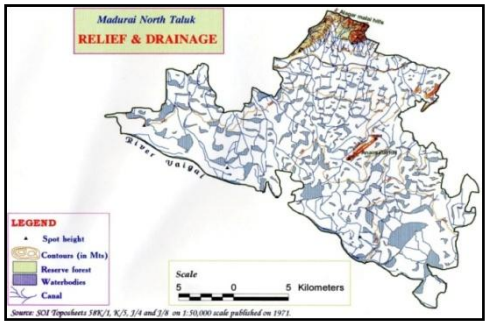


Figure 1 Imagery of the study area ***Figure 2 Location map of the study area***

III. STUDY AREA

For the present study Madurai North taluk of Madurai district is selected as the study area. The taluk covers nearly 10% of the total area of the district,. The longitudinal extent is from 77º 58'58.5'' to 78 º 18'27'' E and the latitudinal extent is from 77 º 50' 49" to 10 º 05' 05'' N (fig. 2). It is located at the northern region of River Vaigai. Kiluvamalai Reserved Forest (R.F) in the North West, Alagarmalai R.F in the North East are the important relief in the study area. Periyar Irrigation Channel is the main channel in the study area which flows from northwestern direction (fig.3). The maximum temperature of Madurai ranges from 38°C - 40°C and the minimum temperature ranges from 21°C - 26°C. The average rainfall amount is 100.25 mm. Humidity is varying from 55% to 60% (fig. 5). The soil map showing the spatial distribution of the soil types is given in the figure 4. Areal extent of the soil series of Vylogam is 26.19%, Anaiyur is 15.59% Madakkur is 11.97%, Palaviduthi is 52.78%, Padugai is 6.92% and Miscellaneous is 11.41%, of the total study area.



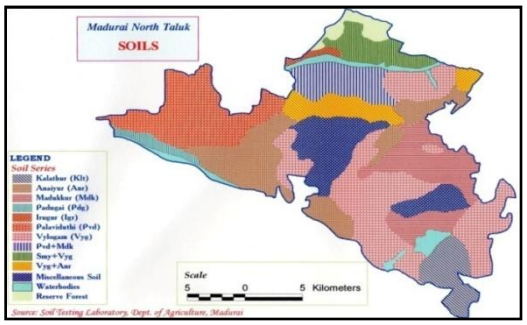


Figure 3 Relief and drainage map of the study area ***Figure 4 Soil map of the study area***

The total population of Madurai North Taluk is 3, 48, 925 persons. In this rural population is 1, 76, 125 persons and the urban population is 1, 72, 801 persons as per 2001 census. The population density is 910.19 per sq.km (Fig. 7). In the urban area the institutions, recreational lands, and other tourist important places are well developed. Tourist important places like Alagar Hills which is located in the north part of the region is also considered as the religious place in the study area. East and west part of the study area is covered by stone quarries, rocky outcrop, boulders. The ground water level of the present study is shown in figure 6.

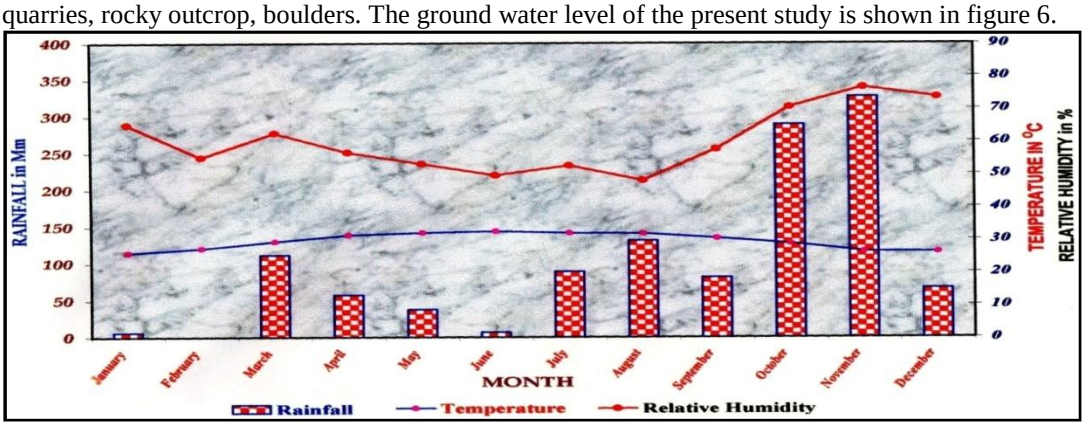


Figure 5 Climate profile of the study area

IV. METHODOLOGY

The primary step in this methodology is importing the satellite imagery and geo-referencing the imagery to Toposheets. Then the interpretation is done by using visual image interpretation technique using ArcGIS 9.3. Land use features such as Built-up, Water bodies, Agricultural lands, Natural Vegetation and Wasteland land uses are identified (fig .8). Area estimation & spatial distribution of the land use/land cover features is done for the study area. All the interpreted land use/landcover features are elaborately discussed in the following topics.

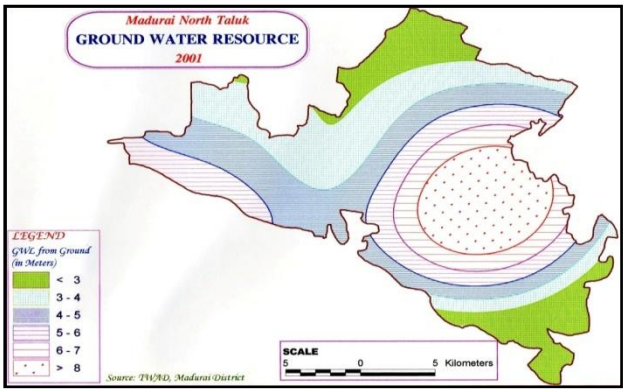


Figure 6 Ground water resource map of the study area.

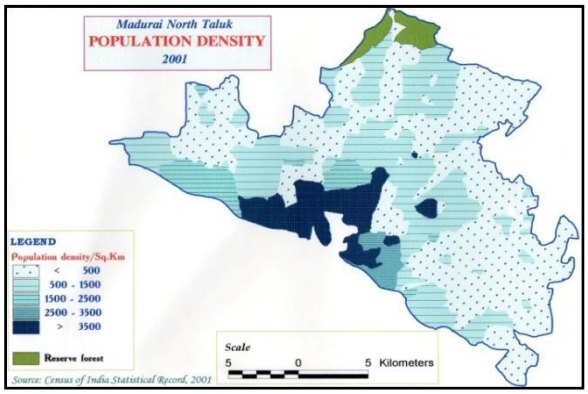


Figure 7 Population density map of the study area

4.Built-up land

In the study area, built-up land is identified by its cyan tone (fig.1). These built-up exhibits the coarse texture, i.e., its boundary could not be clearly delineated from other features. Its size and shape are varying in nature. However, it is easily identified by the dense arrangement along the transportation network. This built-up is classified into urban and mixed built-up. Under this built-up land, we have classified urban built-up, industrial, institutional, recreational, and public utilities with the help of SOI Toposheets and field visits. The total area of the built-up is calculated as 41.16 sq.km from total study area (TABLE 1).

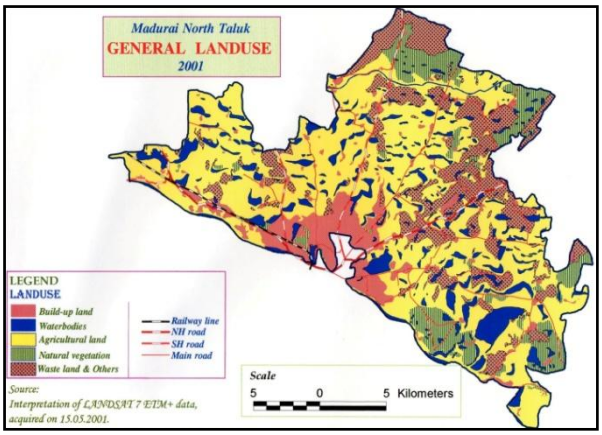


Figure 8 Landuse map of the study area

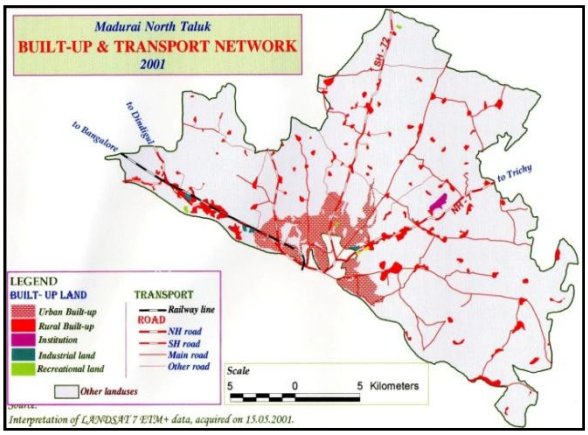


Figure 9 Built-Up & Transport map of the study area

4.1.1 Urban built-up land

It is identified by its cyan tone with coarse texture. The urban built-ups are identified by their irregular rising of the buildings. By using the other collateral data and field survey, built up is classified into residential, commercial, industrial, institutional and recreational land for the study area. The total area of the urban built-up is 25.83 sq. km of the total study area (TABLE 1).

4.1.2 Industrial land

It is identified by its bright cyan tone due to the reflectance of the roofing material of the industries with medium to fine texture. Its size and shape are irregular but the buildings are regularly arranged. Other cotton mills are identified in the southwest part of the imagery. The area of the industrial built-up land is 0.48 sq.km.

Table 1: Land Use Classification

LANDUSE	Area in 2001 (sq.km)	LANDUSE	Area in 2001
1. BUILT-UP	**41.17**	**3. AGRICULTURAL LAND**	**194.20**
1.1 Urban Built-Up	25.83	3.1 Crop land	81.09
1.2 Mixed Built-Up	15.34	3.2 Fallow land	102.69
2. WATER BODIES	**45.73**	3.3 Plantation	10.42
2.1 River with water	0.57	**4. NATURAL VEGETATION**	**41.38**
2.2 Dry river bed	1.32	4.1 Open scrub	41.38
2.3 River bed vegetation	0.13	**5. WASTE LAND**	**60.91**
2.4 Tank with water	4.86	5.1 Boulders	1.87
2.5 Dry tank bed	14.59	5.2 Reserved forest	10.52
2.6 Tank bed vegetation	23.75	5.2 Stone Quarries	7.2
2.7 Canal	0.51	5.3 Rocky Outcrop	0.24
		5.4 Uncultivable Wasteland	41.08

4.1.3 Institutional land

It is identified by its cyan tone with mixture of red tone due to the presence of vegetation. It is identified by its medium to coarse texture. It has regular size and shape buildings. It is associated with settlement. The area of the institutional built-up is 0.689 sq.km (Fig. 8).

4.1.4 Recreational land:

It is identified by its cyan tone with red tone due to the presence of buildings mixed with vegetation. It is identified by its medium to fine texture. It has distinct size and shape according to their purpose. The recreational lands like park, race course are identified into the urban built-up with their regular shape. The area of the recreational land is 0.186 sq.km (TABLE 2).

4.1.5 Public utilities

It is identified by its cyan tone with medium texture. It is identified by its regular size and shape. These lands are mostly present along the transportation network. It covers the area of 0.069 sq.km (TABLE 1).

4.3 Water bodies

In the study area, River Vaigai is located in the southern part. River is categorized into Dry river bed, River coarse, River bed vegetation (Fig.11). Dry river bed is identified by its bright yellow to white tone due to the exposure of the sand presented in the river bed. It is identified by its fine texture. It is identified by its curvilinear pattern (Fig.1). River coarse with water surface is identified by its black to blue tone due to the absorption of sunlight. River bed vegetation is identified by its brighter red tone with coarse texture. This river extends to the southern districts. From this interpretation, River area is calculated as 2.02 sq.km. In this River with water surface area is calculated as 0.57 sq.km and dry river bed is calculated as 1.32 sq.km and river bed vegetation is calculated as 0.13 sq.km. (TABLE 1)

4.3.1Canals

Canals are identified by its red tone due to the presence of vegetation in the curvilinear pattern. It flows from northwest to northeast region of the study area. The water from the channel is mostly used for cultivation. The area of channel is 0.51 sq.km (TABLE 1).

4.3.2 Tanks

Tanks with water are identified by its blue tone to black tone due to the presence of quantity as well as quality of the water. It is identified by its fine texture. It has irregular size and shape. It covers the area of 4.86 sq.km (TABLE 1).

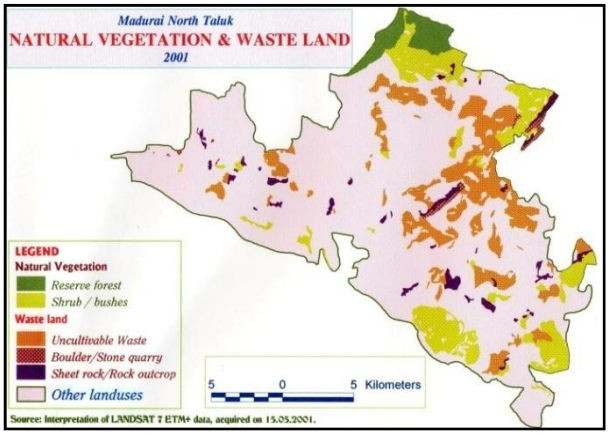


Figure 10 Water bodies & Agricultural map

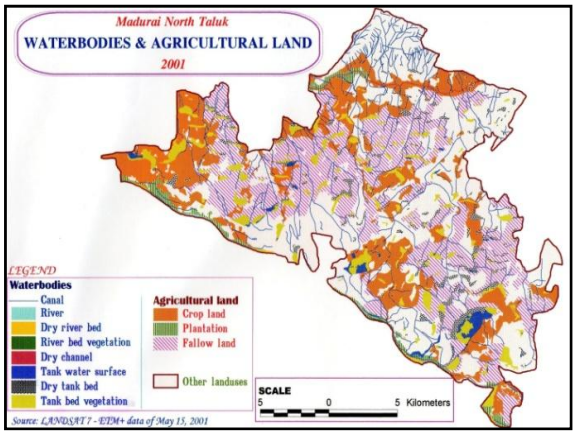


Figure 11 Natural vegetation and wasteland map

Dry tank is identified by its brighter tone due to the exposure of soil with fine to coarse texture. Their boundary is delineated by using the secondary data. It covers the area of 14.59 sq.km (TABLE 1). Tank bed vegetation is identified by its different tones of red and green due to the presence of different types of natural vegetation. In the study area, the major tanks are fully covered with vegetation. It covers an area of 23.75sq.km (TABLE 1).

4.4 Agricultural land:

It is identified by its different tones with their different stages. In the study area, the agricultural lands are differentiated as crop land, fallow land, and plantation. The total are of the agricultural land is calculated as 194.20 sq.km (TABLE 1)

4.4.1 Crop land

It is identified by its different red tone (Fig 1) due to their different stages of the crop and types of the crops. It identified by its fine to medium texture. It is identified by its regular size and shape. It is associated with water bodies. It is mostly presented in the west part of the imagery. It occupies the area of 81.09 sq.km (TABLE 1).

4.4.2 Fallow land

It is identified by its brown and blue tone (Fig 1). Fallow lands are the agricultural lands which are not cultivable or these lands are the after harvested lands of agriculture. It is identified by its blue tone due to the stagnant of water. Its reflectance tone is varied due to the presence of different soil types. Black soil is identified with water by its bluish white tone. Red soil is identified as its light green tone due to the different content of soil materials. It is identified by its medium to coarse texture. It covers the area of 102.69sq.km (TABLE 1).

4.4.3 Plantation

It is identified by its red tone with medium to coarse texture (Fig 1). It is identified by its curvilinear pattern of the area along the river bank and channel banks. It exhibits its medium to coarse texture. In the study area, the plantation like coconut, banana, and sugarcane are the important crops. It covers the area of 10.42 sq.km.

4.5 Natural vegetation

In the study area, open scrub is identified as the natural vegetation. It exhibits red tone due to the presence of the vegetation, irregular in pattern (Fig 1). Scrub lands are mostly presented at the bottom of the relief. It covers the area of 41.38 sq.km (Fig. 11). Reserve forest is identified by its dark red tone due to the presence of vegetation and different species of trees. It covers the area of 10.52 sq.km (Fig .10)

4.6 Waste land

Boulders, rocky outcrop, relief, stone quarry, uncultivable wastelands are categorized into wasteland. The total area of the wastelands is 60.91 sq.km (TABLE1). Stone quarry is identified by its white tone due to the reflectance of different features like rock, stone etc. It is identified by its medium to coarse texture with irregular shape and size. Rocky outcrop is identified by its brighter tone with medium texture. It exhibits irregular shape (Fig.1). Boulders are identified by its dark brownish tone with medium to fine texture. It covers an area of 1.87 sq.km (Table1). Relief is identified by its brownish green tone due to the reflectance of vegetation and the structural hill. It is identified by its fine to medium texture. It covers the area of 10.52 sq.km (TABLE1).

V. Conclusion

Remote Sensing data products are highly useful to study 'Resource Evaluation'. This interpretation also gives the area of the different features without conventional method of surveying. In the study area, it is found that 50% of the total area is fully covered by the agriculture land. But, in this agricultural land 41% is covered with crop land and 5% is covered with plantation. So, the remaining agricultural land is covered with fallow land. These agricultural lands are mostly presented in the north part of the study area. In this study area 94% of the total area of the water bodies is tanks. These tanks are non-perennial in nature. By using the proper management as well as utilization of the tank water, and the cyclic method of cultivation, agricultural production can be improved. In this study 15% of the total area is covered by wasteland. The built-up land is nearly 11% of the total study area. In this urban built-up is 62%. These urban built-up are mostly presented in the south part of the study area. The urban culture attracts the rural people. So they are shifting from rural to urban. The government should control the unplanned urban sprawl by introducing new technologies for agriculture activities.

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