A STUDY OF DEMOGRAPHIC AND LAND USE VARIATION OF THIRUVANANTHAPURAM DISTRICT USING GIS

Charutha Reghunathan *, Anilkumar R.**

**Research scholar, Department of Geography, University College, Thiruvananthapuram*
*** KSTSTE Emeritus Scientist*

Abstract

Land being the most important natural resource on earth and the basis for all development, human beings alter it in a way useful for them. In an era of uncontrollable population growth, it is impossible to keep land free from human interventions. The study was done in Thiruvananthapuram district, the capital of Kerala state. The district is the seat of administrative and commercial functions and also an upcoming IT centre. With the increasing population and high population density, it can be opined that population is the major cause of land use change in the district. The study made use of Survey of India Topographic sheets and satellite imageries for extracting land use data. Demographic details were taken from various census publications. Spatial interpolation and buffer analysis was done using Arc GIS 9.3 software. The analysis revealed that population increase has an active role in the changing land use of the district. Intensity of population increase as well as land use change shows a decreasing trend with the increasing distance from the city corporation area which is the focal point of growth in the district.

Key words*: Land use change, demographic change, interpolation, buffer analysis*

Introduction

The ultimate aim of human development is the overall well being of the people. The changing population contribute to demographic bonus which significantly contributes to economic growth. Detailed analysis of demographics along with other human development indicators of an area can lead to a realistic picture of the diversity settings and to identify the thrust areas. A comparable picture of the population characteristics over a period of time can also explain the development process of a geographic locality (Kerala State Planning Board, 2009). Land uses observed in an area are primarily the result of human actions on land. The interaction of biophysical, social and ecological factors along with human behavioural attributes over time and space (Riebsame, et al. 1994) leads to the changing land use. Understanding these actions and the social forces that drive them is crucial to understanding, modelling and predicting local, regional as well as global environmental change and also for managing and responding to such change (Fazal Shahab, 2000). One of the prime pre-requisites for better use of land is information on existing land use pattern and changes in land use through time. In this context the variations in the demographic attributes of Thiruvananthapuram district and the land use was analysed.

Study area

Thiruvananthapuram, the southern most district of Kerala State lies between north latitudes 8° 17' 27" and 8° 51' 41" and east longitudes 76° 40' 25" and 77° 17' 06 (Fig.1)". The district ranks eleventh in area among the districts of Kerala with an area of 2192 km^2 which is about 5.64 percent of total area of the state. The district is bounded by Kottarakkara, Kollam and Pathanapuram Taluks of Kollam district on the north, Ambasamudram Taluk of Thirunelveli district on the east and Vilavancode Taluk of Kanyakumari district of Tamil Nadu on the south and south east and Lakshadweep Sea on the west.

Methodology

This study used two sets of data which included historical documents (published maps and texts) and remote sensing data. Land use/Land cover of 1966-67 was extracted from topographic maps of 1966-67 (1:50000) and that of 2011 was extracted from Indian Remote Sensing (IRS) LISS III images. Visual interpretation techniques were incorporated for the work. For the preparation of recent land use/cover maps field verifications were made as well as Google earth images were consulted. This provided a platform for the detailed analysis of land use changes. Arc GIS 9.3 software was used for editing, labelling, projecting and for analysing land use and demographic pattern.

Results and Discussions

A wide variety of changes occurred in the land use scenario of the district. The perusal of data of 1966-67 and 2011 revealed the following characteristics of the district.

Land Use / Land Cover during 1966-67

During the starting of the second half of the 20th century, major portion of the district was covered with settlement with mixed trees. Almost 61 percent of the area of the district was devoted for this land use category as shown in the table.1. This was the dominant land use along the midland and lowland areas of the district. This land use included plantation cropping area and the major plantation crop cultivated was coconut. The next important category consisted of forest as 20 percent of the area of the district was under forest cover which was seen along the eastern portion of the district (Fig.2). Paddy fields occupied 10 percent of area in the district. It is seen in scattered patches all along midland and lowland areas. All other land use types covered only very little area in the district. About 3 percentage area was under forest plantations. Major forest plantations included eucalyptus, tea, teak and rubber. Only 2 percent area was under water bodies where as built up land covered only about 1 percent area in the district. All other land uses including scrub land, scrub forest, sandy area and wastelands together occupied less than 1 percent area respectively in the district (Table1).

Land Use / Land Cover during 2011

The analysis of the 2011 data on land use revealed that built up area shows an increasing trend and now covers 16.48 percent area of the district (Fig. 3). The areas surrounding corporation and also the Technopark area are developing in a faster pace. Another land use showing notable increase was scrub forest with 7.68% areal coverage (Table 1). Majority of the forest area was changed to this category. All other land uses show reduction in the area compared to the 1966-67 data. Settlements with mixed trees currently cover 56.32 percent of total area of the district. The major difference which could be noticed was the changing preference in the types of plantation crops grown. Rubber became the major crop cultivated followed by coconut. Paddy cultivation was limited to only about 2.35 percent area of the district. This class faced the most serious impact in the history of land use in the district. Reduction in area under forest cover continued during 2011 and occupied only 13.17 percent area of the district. Area under forest plantation covered 1.13 percent area which shows slightly higher areal coverage compared to the previous data (Table 1). Scrub land (0.48%), wasteland (0.38%), water bodies (1.57 %) and sandy area (0.28%) are other land use types prone to reduction in area in the district.

Variations in the Growth of Land Use types

The study revealed that, scrub forest exhibited a growing trend in the last forty years, with a tremendous growth of 3888.86 percent (Table 2). Built up land also showed high growth rates and presents a growth of 1062.97 percent. Scrub land had 103.07 percent growth in the study period. Area under airport also showed increase in the area with about 89.79 percent growth. The change in this land use is because of the development process that took place in connection with the constructions done subsequent to the up gradation of the airport as an international one. The paddy cultivation is showing a constant decreasing trend in the district. For the study period a reduction of 77.45 percent could be noticed.

Spatial Variations in the Population Density

It is seen that variations occurring in the population and land use characteristics are likely to follow certain common patterns and so in the succeeding session deals with the population variations observed in the district. For studying the pattern existing in the population density of the district, isopleth map for the year 2011 where prepared using the interpolation technique. The investigation revealed that, the population density of the district showed a rising trend toward the western direction (Fig. 4). A high density pocket showing population density above 5000 persons/sq.km could be noticed along the north western coastal side of the district. High density pockets are also seen along the corporation area and its surroundings. Population density above 3000 could be noticed in the four localities that lie within the low land region. Major portion of the district has population density between 1000 and 1500 persons/km.sq. and it covers majority of the midland region. The areas to the eastern side of the district with most of its area under forest cover have less population density. The trend of land use change reveals that the Corporation regions and its surroundings are areas of high building concentration and the same can be noticed from the population density map.

Changing trends in the Demographic and Land Use Characteristics of the District

To facilitate the analysis of relationship between population density variations and distance, Thiruvananthapuram city was taken as the core point as this region possessed very high growth rate and population density in comparison to other areas in the district. The region has been considered as the nucleus of all administrative, commercial, and to some extent residential activities. Circular buffers of 1 km radius were used for this analysis.

The fig 5 explains the density variation of population away from the city centre at a uniform interval of 1 km from the city centre and as per this, the regions near to the city centre reports the highest density. The population density showed decreasing trend upto 3 km, then for another two kilometers an increase in population density could be noticed which was again followed by decreasing density which continued for the rest of the areas in the district. So generally, it can be seen that the district posses' high population density which is clearly defined by the distance from the city centre and that the city and it's near by portions can be considered as the core of population concentration. Thus there exists an inverse relationship between population density and distance from the city centre in Thiruvananthapuram district. Another notable factor visible from the analysis is the tendency of increasing population density after 3 km from the city centre. This can be ascribed to the increasing preference of these areas by commuters and also by upper middle class in the society, as the area provide ideal position from which all the facilities offered by the city centre can be availed and the compactness of urban centre can also be avoided.

Using the concentric circular buffer, the variation in land use from the city centre was also attempted. The study utilized land use maps of two temporal periods ie of 1966-67 and

2011. The analysis supported the fact that the land use variations are also directly connected with distance. For this purpose, the area covered by three land use types including built up land , settlement with mixed trees and paddy fields were used as these where the land use categories which faced notable changes in the district during the last four decades as revealed by the earlier analysis. The areas covered by different land uses in each concentric buffer were extracted. In the four decades, area under built up extended much to the outskirts of the city. During 1966-67, almost 81 percent area within one kilometre from city centre was dominated by built up land (Fig 6) which increased to 96 percent as per the 2011 data (Fig.7).The change is higher along the areas bordering the city centre. The suburban areas are being increasingly used for built up purposes and it includes both residential and commercial buildings. Variations in the build up space are seen more after 3 km from the city centre and by about 6 km, the increase retarded.

Notable reduction can be identified in the area under settlement with mixed trees. In the 1966-67, this land use dominated along the areas with 2 km and more distance from the city centre (Fig.6). During this period, for a distance of 1 km, this category shared 12 percent area but is reduced to about 4 percent in 2011. And also as per the latest data, the area covered by this land use type considerably decreased and could retain its pervious glory only after a distance of 8 to 9 km away from the city centre (Fig.7).

The situation is more alarming in the case of paddy fields. This land use which owned substantial position in the land use history, is reduced to such an extent that there is only a minor portion under this land use upto the 2 km distance, ie in 1970's about 7 percent area in the city was under paddy but now it is almost nil (Fig.7). This contradicts the situation existed in 1970's during which paddy fields overtook the area under built up along the suburban areas. The study supports the fact that land use changes are largely modulated by distance. As per the work, present situation is positive for built up land as the increasing population needs more land area to live and so the area under mixed trees and paddy shows a relentless decrease.

Table 1. Area occupied by various land use categories in Thiruvananthapuram District (1966-67 and 2011)

Sl.No.	Land Use Categories	Area (sq.km.)	Area (%)	Area (sq.km.)	Area (%)
		1966-67		2011	
1	Settlement with mixed trees	1327.43	60.63	1234.52	56.32
2	Aerodrome	1.47	0.07	2.79	0.13
3	Built-up land	31.06	1.42	361.22	16.48
4	Paddy field	228.08	10.42	51.42	2.35
5	Forest	440.89	20.12	288.71	13.17
6	Forest Plantation	55.67	2.54	24.72	1.13
7	Grassland	5.79	0.26	0.36	0.02
8	Sandy area	19.86	0.91	6.35	0.29
9	Scrub forest	4.22	0.19	168.33	7.68
10	Scrub land	5.20	0.24	10.56	0.48
11	Wasteland	18.36	0.84	8.44	0.39
12	Waterbody	53.84	2.36	34.46	1.57
13	Total	2191.87	100.00	2191.88	100.00

Table 2. Growth rate of various land use categories in Thiruvananthapuram District 1966-67 to 2011

Sl.No.	Land Use Categories	1966-67-2011
1	Settlement with mixed trees	-6.99924
2	Aerodrome	89.79592
3	Built-up land	1062.975
4	Paddy field	-77.4553
5	Forest	-34.5165
6	Forest Plantation	-55.5955
7	Grassland	-93.7824
8	Sandy area	-68.0262
9	Scrub forest	3888.863
10	Scrub land	103.0769
11	Wasteland	-54.0305
12	Waterbody	-35.9955

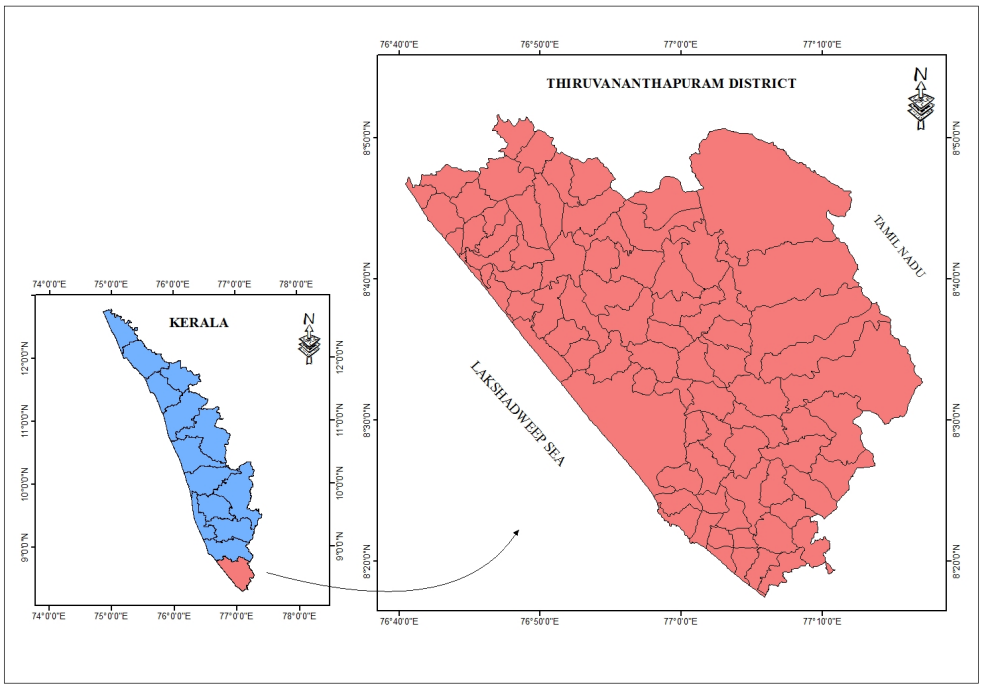

Figure 1. Location Map

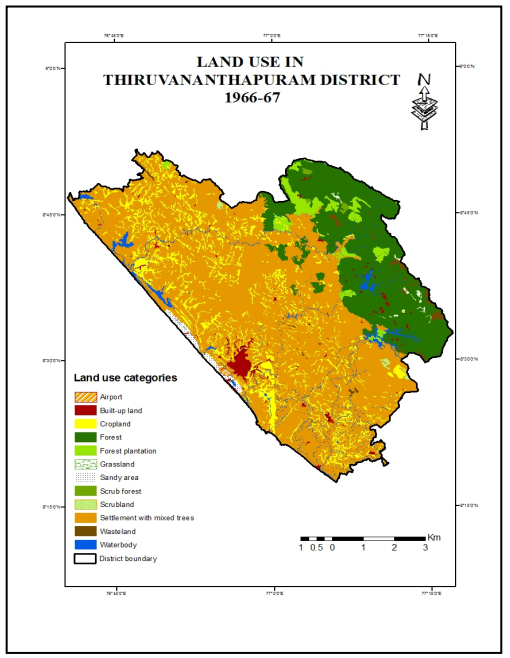

Figure 2. Land use 1996-67

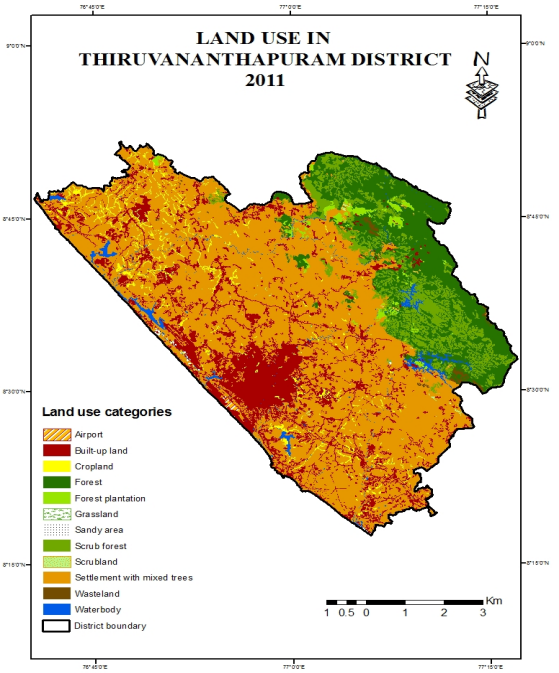

Figure 3. Land use 2011.

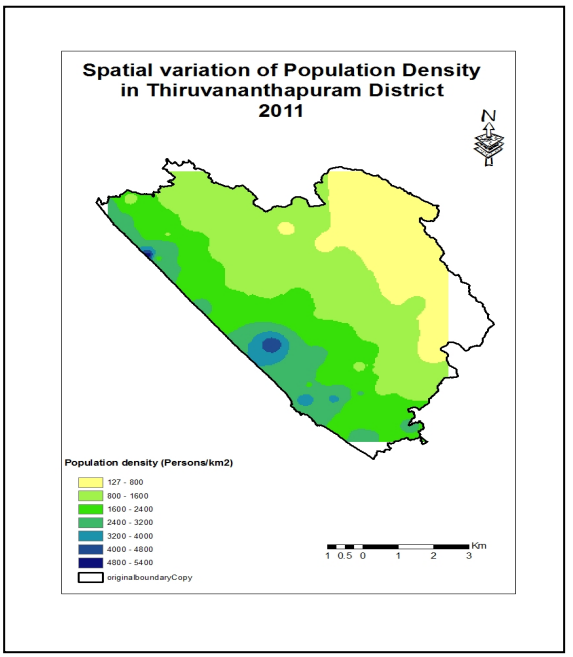

Figure 4. Spatial variation in population density.

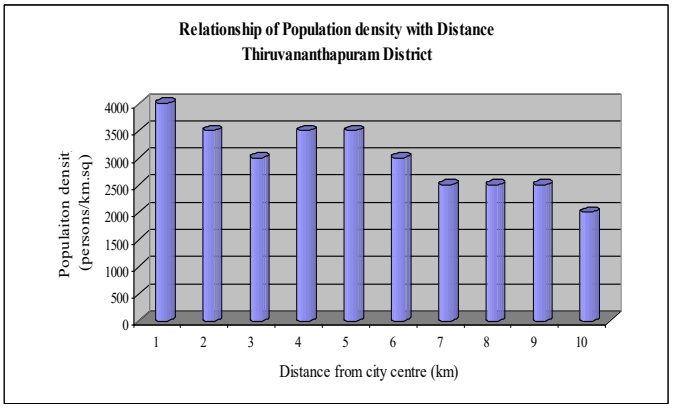

Figure 5. Relationship of population density with distance

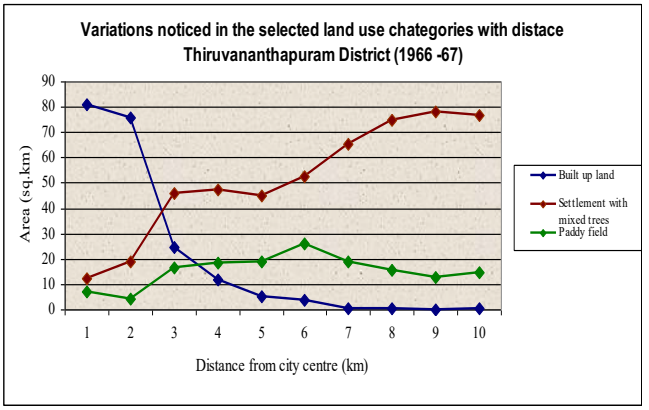

Figure 6. Variation noticed in the selected land use.

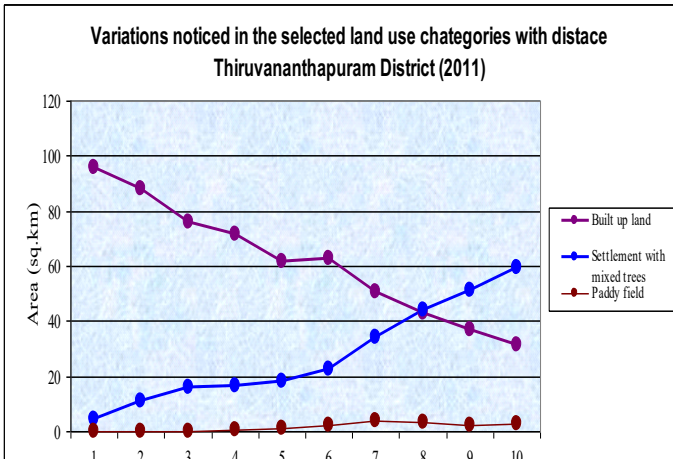

Figure 7. Variation notices in the selected land use 2011.

Conclusion

Land use data is needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current level. Remote sensing and GIS techniques provide strong base for these studies. The present study could reveal the fact that in Thiruvananthapuram district, the increasing population is the major cause of land use change. The area near to the city corporation is the main area of land use development. This changing trend is seen spreading and is also driven by the IT sector activities which is mainly based along the city outskirts. The analysis facilities offered by GIS was effective in dealing with the status and pattern of changes observed in the district.

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