GEO-SPATIAL AND CHANGE DETECTION ANALYSIS OF URBAN GROWTH IN THANJAVUR CITY, INDIA

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Abstract: Thanjavur Municipality, located in South India has experienced rapid urbanization over the past three decades. Urban growth in Thanjavur city began two decades ago, but has yet to be empirically measured or characterized. Major processes that influenced sprawl in the city were the rise in standard of living, consumer preference for low-density and single-family housing in the suburbs, and the arrival of nearby village people. All these processes led to a massive transformation of agricultural land into urban land-uses and provide some evidence that sprawl is taking place as a pattern of development. This study attempt to measure and analyze urban sprawl in Thanjavur, based on urban land use/land cover. This paper focuses on the urban growth integrating remote sensing and geographic information systems (GIS) that will help the planner to identify the elements at risk associated with different forms of urban hazards.

***Index Terms*: Urban growth; urban land use/land cover; GIS and Remote Sensing.**

1. INTRODUCTION

Rapid urban expansion necessitates a proper planning by the government to avoid negative environmental and socio-economic impacts. It is really a great challenge nowadays to provide adequate housing, sanitation health and other facilities in an urban area and urban sprawl makes such development to a complexity. Sustainability of those services can be achieved only by proper monitoring at a regular base. Urban planners should know about the urban growth trend in order to develop future urban planning. Monitoring urban growth is important to take good measures for planned urban development.

As there is increase in the population of the country, during the city expansion vegetative cover is in decreasing trend. Multi-storey residential and commercial buildings are getting raised nearby. Spaced built houses which in turn affects our biosphere. If this situation continues there will arise drainage problems, water problems, electrical problems, traffic problems, rooted to other secondary problems. Congestion on the one hand, on the other hand, due to the congestion product price too will get exaggerated that the lower people cannot afford that much increase. But one thing is for sure, if the city's population increases weaker section people will definitely roll off into the margin of the city. In the form of urbanization newer cities were generated by the government. For the newer cities many trees and agricultural lands will be deteriorated and new industries will be developed. The real time situation is people in the villages sold their existing lands with low value to move out and these lands were being put to sale to a higher price.

In the past two decades, Indian cities have grown tremendously not only in terms of population, but also in geographic size. Urban growth in Thanjavur reveals a distinctive pattern and reflects most of the aforesaid problems. Finding growth pattern using spatio-temporal analysis would be helpful in urban planning. In the present study, an attempt is made to analyze urban growth using geo-spatial techniques.

Many literatures were collected from library books, journals, newspapers, internet, online journals etc for the present study. **Bhatta (2012)** studied the administrative and natural boundary and delineating the extent of the city is a real difficult task. To differentiate between rural and the urban also used several models for the analysis of urban growth and sprawl for the study area to evaluate their results and suitability. **Padigala Bhaskar (2012)** confronted about nearly 7.2 sq.km of vegetative area has been lost between 1999-2009 in the city of Pune and also the urban green spaces are one of the most significant elements of any urban ecosystem. **Chadchan and Shankar (2012)** dealt with in-depth analysis of various urban development and issues with the post LPG and increase in urban housing shortage.

Nina Singh, and Jitendra kumar, (2011) alarmed that the extent and pace of urban transformation will raise concern about the city sustainability and there is a need for equitable distribution of public resources and balanced spatial and territorial development, particularly through investments in urban infrastructure and services. **Farooq and Ahmad (2008)** has given attention on identifying areas along the urban rural fringe, where development is feasible and restrictions on conversion of agricultural land lying outside identified zones, developing a land information system, generation of databases for cadastral applications, training the municipal staff to adopt and promoting the use of these databases in urban planning and management. **Anthony Gar On Yeh and Xia Li (2004)** have studied that the entropy is a good indicator to identify the spatial problem of land development and in identifying which town has better spatial efficiency in land development. Furthermore, two dimensional entropy spaces can be used to differentiate various growth patterns clearly.

I. STUDY AREA

The present study is to access the urban growth in study area shown in Fig .1. Thanjavur, a historical and cultural city is located in the centre of Cauvery delta region with agricultural land surrounding the city. It is located at 10°45' North latitude and 79°8' East longitude is at a distance of 350 km from Chennai, which is state headquarter. City spreads over an area of 36.33 sq.km area. The city is well connected by roads with the adjoining towns and the city and its surrounding area forms part of small plateau called Vallam table land.

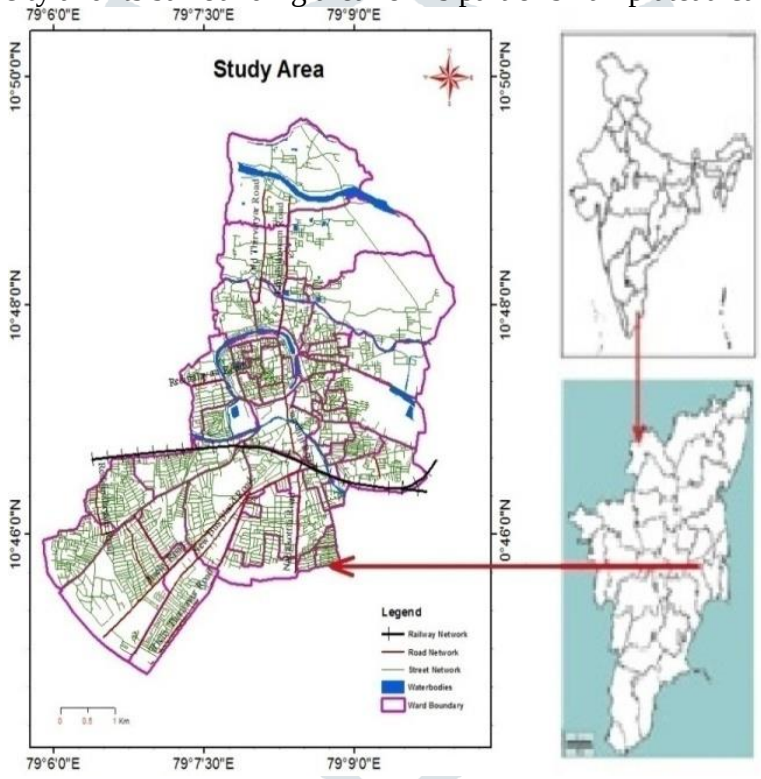

Fig 1. Study Area Map

The soil are as fertile as richer, which comes in the next order, but irrigated crops are raised chiefly with the help of Grand Anaicut canal. This area has a gentle plain slope towards from west to east. The climate is fairly healthy with average annual temperature of 31° Celsius and mean rainfall of 104 cm.

II. METHODOLOGY AND MATERIALS

The methodology involves the urban land use mapping with various methods, tools and techniques that are used to assess the urban growth. GIS techniques were used for finding the urban growth. Remote Sensing data and geo-spatial data of the study area have also given spatio-temporal information on the urban Land-Use/Land-Cover practices. In order to analyses the change of spatial extent of growth SOI topographical data and satellite data was used for different periods from 1970 to 2016.

III. LAND-USE/LAND-COVER CLASSIFICATION

The NRSA Level II land use/ land cover classification has been followed in the study area, second level classification has been mapped viz., land with scrub, land without scrub, mixed built-ups, other built-ups, vegetation and water bodies are executed for the three years 1971, 1991 and 2016 as the study area taken is mainly confined to agriculture practice.

4.1 Mapping of Level II Land-Use/Land-Cover for 1971

The topographical data of 1971 were utilized for mapping and are classified into six categories as land with scrub, land without scrub, mixed built-ups, other built-ups, vegetation and water bodies and are shown in Fig 2. For level II classification vegetation categories occupy more area with 14.19 sq.km area followed by land without scrub category with 7.69 sq.km and mixed built-ups area occupied by 4.19 sq.km and water bodies occupied by an area of 1.25 sq.km.

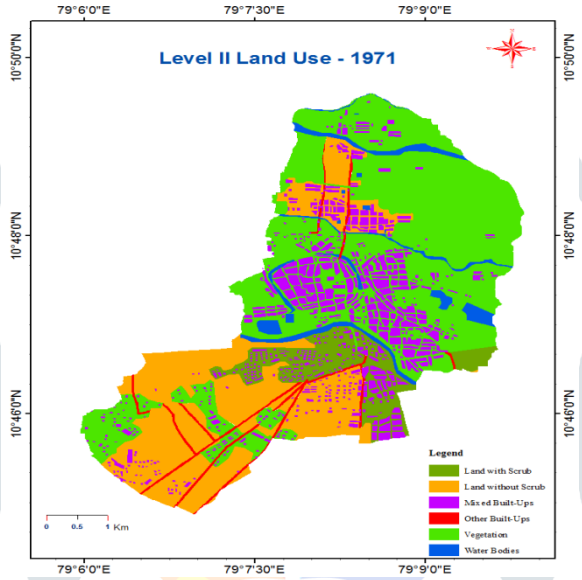

Fig 2. Level II Land-Use/Land-Cover-1971

4.2 Mapping of Level II Land-Use/Land-Cover for 1991

The level II categories of Land-Use/Land-Cover of the study area were mapped using IRS satellite data for 1991 were interpreted. It has been observed into six categories as land with scrub, land without scrub, mixed built-ups, other built-ups, vegetation and water bodies are shown in Fig 3. The vegetation and mixed built-ups categories occupies nearly area with 10 sq.km area followed by other built-ups category with 5.02 sq.km. Here the eastern and western parts of study area were engulfed mostly by the builtups. Also due to the development of new bus terminus in the southern city, urban growth started towards southern direction.

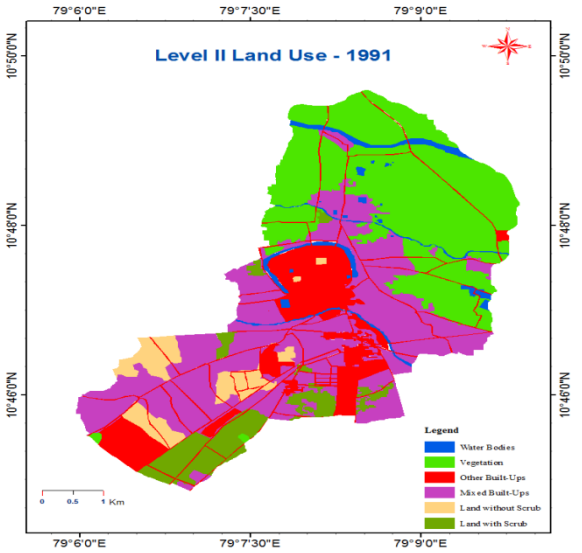

Fig 3. Level II Land-Use/Land-Cover-1991

4.3 Mapping of Urban Land-Use/Land-Cover for 2016

From Resourcesat LISS IV satellite data, the Level II land use categories were mapped and are shown in Fig 4. It was found that mixed built-ups occupied more area nearly 13.08 sq.km and by vegetation occupying 8.89 sq.km. The land without scrub category here occupied less area of 0.92 sq.km. Here the built up areas were near the saturation level and pave way to sprawl towards the outer city.

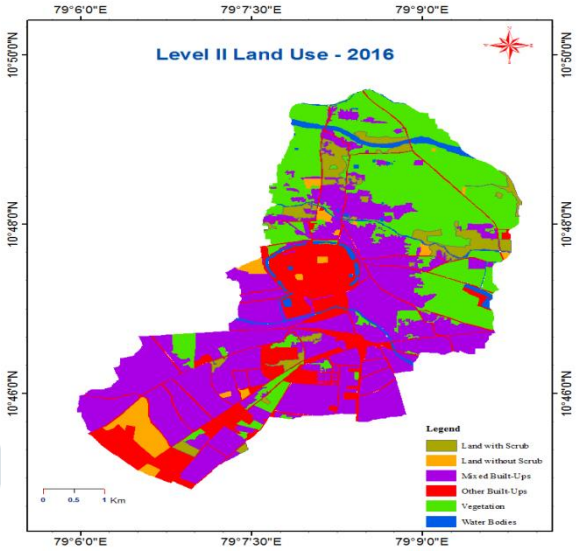

Fig 4. Level II Land-Use/Land-Cover-2016

4.4 Change Detection Analysis - Level II

To understand the level II categories changes of Land-Use/Land-Cover pattern of the study area using overlay analysis of GIS. The urban land use changes were detected; the changes of each category percentage wise area occupied were calculated and tabulated and shown in Table 1.

In the study area, nearly around 8.9 sq.km mixed built-up category has been increased, 4.4 sq.km other built-up category has been increased, 6.8 sq.km land without scrub category has been decreased, 5.3 sq.km vegetation category has been decreased and 0.8 sq.km land with scrub category has been decreased and lastly 0.4 sq.km water bodies category has been decreased from 1971 to 2016.

Table 1 Level II Land-Use/Land-Cover Classification

Sl. No	LULC	1971		1991		2016		Changes in sq.km between 1971 and 2016
		Area (sq.km)	%	Area (sq.km)	%	Area (sq.km)	%	
1	Land with Scrub	2.2	7.3	2.1	6.8	1.4	4.7	-0.8
2	Land without Scrub	7.7	25.4	1.5	4.8	0.9	3	-6.8
3	Mixed Built-ups	4.2	13.9	10.9	35.5	13.1	43.3	8.9
4	Other Built-ups	0.7	2.3	5.1	16.3	5.1	16.6	4.4
5	Vegetation	14.2	46.9	10.4	33.6	8.9	29.4	-5.3
6	Water Bodies	1.3	4.2	0.9	3	0.9	2.9	-0.4

It shows that both the Mixed built-up and Other built-up land has been increased at most compared to other four categories as they show declining percentage. The mixed built-ups category area increased from 14% to 43.3%, while land without scrub category decreased more from 25.4% to 3%, vegetation category decreased from 46.9% to 29.4% and water bodies category from 4.2% to 2.9%. Vilar, Nanjikottai, Neelagiri and Pudupattinam are the Census town of Thanjavur Urban Agglomeration. The Street network is also one of the key factor in finding the direction and the extent of urban growth has been shown in Fig.5.

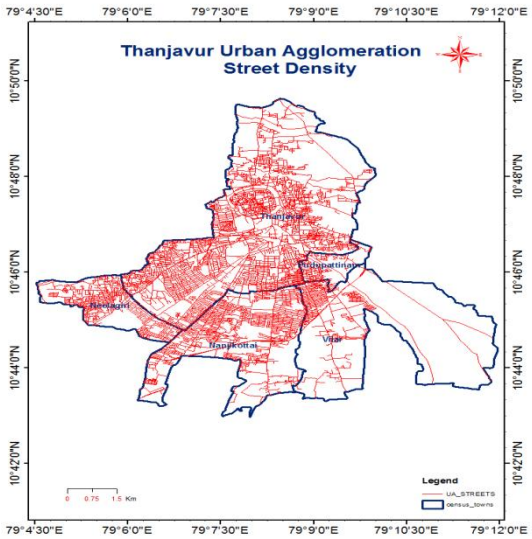

Fig.5 Street Network Density

The street network for the study area was drawn using GIS and that were overlaid to understand the correlation between them. From this it is clearly understood that the prediction of future urban growth will become easier. From the study it is known that the Nanjikottai and Neelagiri census towns have higher concentration of street network among other census town near by it. To find out at which extent the growth of study area is taking place the urban agglomerations were also taken into consideration for the study.

IV. RESULTS AND DISCUSSION

Urban growth in the study area reveals a distinctive increasing trend by using spatio-temporal analysis . The level II Land-Use/Land-Cover categories of the study area shows that around 8.9 sq.km mixed built-up category has been increased, 4.4 sq.km other built-up category has been increased, 6.8 sq.km land without scrub category has been decreased, 5.3 sq.km vegetation category has been decreased and 0.8 sq.km land with scrub category has been decreased and lastly 0.4 sq.km water bodies category has been decreased from 1971 to 2016. Street network for the study area are drawn using GIS and were overlaid to understand the correlation between them. From this method it is clearly understood that the prediction of future urban growth areas will become easier. Therefore it is better to make good arrangements for the existing city with suitable smart arrangements like smart transportation network, smart energy efficiency without polluting the nature and minimizing the conversion of agricultural land into others, establishing all the amenities ease to the people.

V. ACKNOWLEDGMENT

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