

## IDENTIFICATION OF URBAN SPRAWL AND ITS TREND THROUGH LAND USE/LAND COVER CHANGES IN TIRUPPUR CORPORATION AND ITS ENVIRON

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### ABSTRACT

The study area was formed in 2009, carved out of the Coimbatore and Erode districts making it the 32nd district of Tamil Nadu and one of the ten most industrialized and economically developed districts of Tamil Nadu. Within a very short time it has gone on to become one of the most industrialized cities in India. It has a vibrant economy and the reasons behind it are its famous, for the textile industry of Tiruppur, the cotton market and several other things. In this scenario, there is a need to understand and quantify the urban sprawl. This study attempts to analyze the impact of the urban sprawl in Tiruppur Corporation using the land use/land cover dynamics. It has been monitored from 1992 to 2019 using Landsat-5 Thematic Mapper (1992 and 2001) and Sentinel-2 (2019) respectively. By mapping the land use / land cover at different time periods to identify the changes in the aerial coverage of the urban area. This study is helpful to identify causes of urban expansion and also to identify which direction is rapidly developing for sustainable urban growth.

**Keywords:** Urban Sprawl, Tiruppur Corporation, Landuse/landcover.

### INTRODUCTION

The significant transformation of the earth has been marked in this 21<sup>st</sup> century due to both natural and anthropogenic factors linked to the satisfaction of human needs (Foley et al., 2005). Ecosystem function and structure have been compromised by human activities, resulting in greater vulnerability of places, people, economic dynamics, and the climatic system (Kasperson&Kasperson, 2001; Ogle, Delparte, & Sanger, 2017; Tyson, Steffen,Mitra, Fu,

&Lebel, 2001).The magnitude and extent of land use/land cover (LULC) changes underway in many parts of the world (Feranec, Soukup, Taff, Stych, & Bicik, 2017; Fuchs, Herold, Verburg, Clevers, & Eberle, 2015) are influenced by socio-economic and biophysical factors. These determinants are directly related to the functioning of local and national markets, international land external policies, as well as demographic and environmental conditions (Turner, Ross, & Skole, 1993). Urban growth, urban extension, and urban sprawl are sometimes used synonymously, even though they differ conceptually. Urban growth is an increase in the urbanized land cover. One possible means of urban growth is by urban extension. Urban growth according to spontaneous or unplanned urban development is called urban sprawl. Urban sprawl usually has negative connotations, associated with the generation or intensification of complex urban problems, such as land, water, and air pollution, with their consequent negative impacts on human health (Alberti, 1999; Antrop, 2004; Dickson, Baker, Hoornweg, & Asmita, 2012; Kumar & Pandey, 2013; Marshall, Pielke, Steyaert, & Willard, 2004; Pathan, Shukla, Patel, Patel, & Mehta, 1991; Rivas, Hernandez, & Cueto, 2003). The spatio-temporal analysis is significant in the urban studies which makes to define and monitor the surrounding area trends to development and render the precise advances in the urban area (Masilamani, 2012). Geographic information system (GIS) allows quantification of these changes using remote sensing data, expressed spatially and temporally, to dynamically visualize spatial patterns and LULC composition. These changes can be integrated with social and biophysical data to determine the factors that influence the process of LULC change or its consequences. Often, the resulting linear or nonlinear relationships can be modeled mathematically and statistically analyzed. Advances in GIS and information technologies have contributed to a substantial increase in research studies since the end of the 20th century, focused on patterns of urban growth and its impacts on human life and natural resources (Terzi & Bolen, 2009). In the identification of the urban extension, the reason for the development and to sketch the functional establishment is much needed to understand deeper the agglomeration (Masilamani, 2019).

### **Aim**

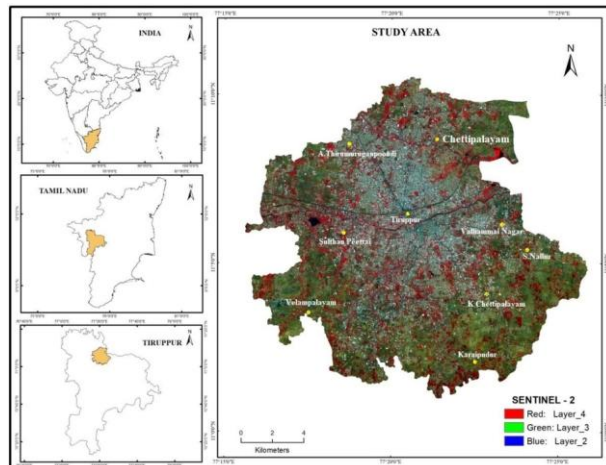
The core aim of the study is to identify the Urban sprawl and its trend through Land Use/Land cover change detection.

## OBJECTIVES

- To prepare the Landuse/Landcover map for the following years of 1992, 2001 and 2019.
- To detect the urban changes from 1992 to 2019.

## STUDY AREA

Tiruppur is considered to be the most urbanized developing districts in recent times. In this study Tiruppur corporation is selected as the study area and is monitored to be the fifth most agglomerated urban Centre of Tamil Nadu based on census of India 2011. Tiruppur Corporation is located at 10°14' N to 77°27' E and 11°20' N and 77°56' E on the banks of the Noyyal River. It covers an area 199.28 sq.km and situated 450 kilometers southwest of the state capital Chennai and about 50 kilometers east of Coimbatore. The climate in Tiruppur is tropical with the mean maximum and minimum temperatures varying between 35 to 22 °C (95 to 72 °F).The total population of the corporation as per the 2011 census is 8,77,778 individuals. Study area is shown in the figure 1.1.

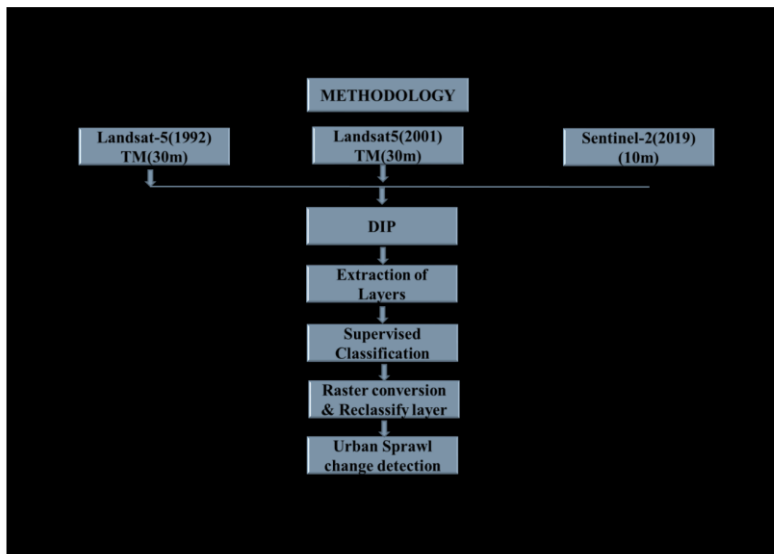


Source: Compiled with SENTINEL-2 by Author

Fig: 1.1

## DATA AND METHODOLOGY

The data products utilized in the study includes Landsat-5TM (30m) data and FCC (Blue, Green, Red & NIR) combination of band 1,2,3&4 for preparing LU/LC map for the year 1992 and 2001. Then, Sentinel-2(10m) data and FCC (Blue, Green, Red & NIR) combination of band 2,3,4 & 8 for preparing LU/LC map for the year 2019. The initial step of this study is to collect the precise data of Landsat-5TM for the planned years of 1992 and 2001. Followed by, Sentinel-2 of ten meter resolution for the year 2019. All those remote sensing data were included in the process of digital image processing. Then the area was masked, stacked in the arc map. The supervised classification is done through the maximum likelihood techniques performed in ENVI software. This supervised classification needs the training datasets for each class of Land use and Land cover classification. For each class datasets were trained accordingly in a manual way so as to obtain a clear result. The obtained results were reclassified and the output is prepared. The percentage of area for each class in each year is evaluated with the other years and the change detection is evaluated.



## RESULTS & DISCUSSION

### LAND USE / LAND COVER OF 1992, 2001, 2019

In 1992 most of the study area was covered by fallow lands, while the Noyyal River flows in the center of the study area, was the source for the agricultural activity and anthropogenic made structures. The settlements are developed along the river bank and also along the connecting state highway road sides. Though Tiruppur was the industrial zone, the urban growth was comparatively high among the other districts like Ariyalur, Villupuram, Dharmapuri and Pudukkottai. (Director of census operations 2011, Tamil Nadu)

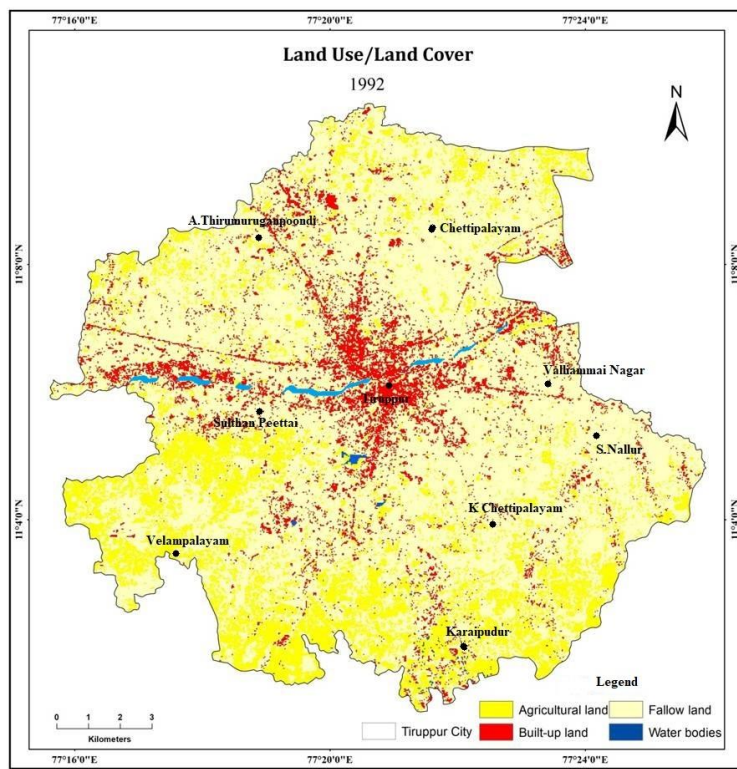


Fig: 1.2

In 1992 the fallow land occupy about 139.30 sq.km followed by agricultural land covers an area about 39.86 sq.km followed by built up land 16.82 sq.km and water bodies 3.32 sq.km in the total 199.28 sq.km of the study area is shown in the figure 1.2.

When compared to 1992 the boundary of the urban settlements are expands, this clearly shows the urban sprawl in the study area, where the urban areas are increased in core Tiruppur Corporation, Sulthan Peettai, Thirumuruganpoondi and Valliammai Nagar areas. The fallow lands in the previous decade of 1992 were majorly converted into agricultural lands and built up lands is shown in the figure 1.3.

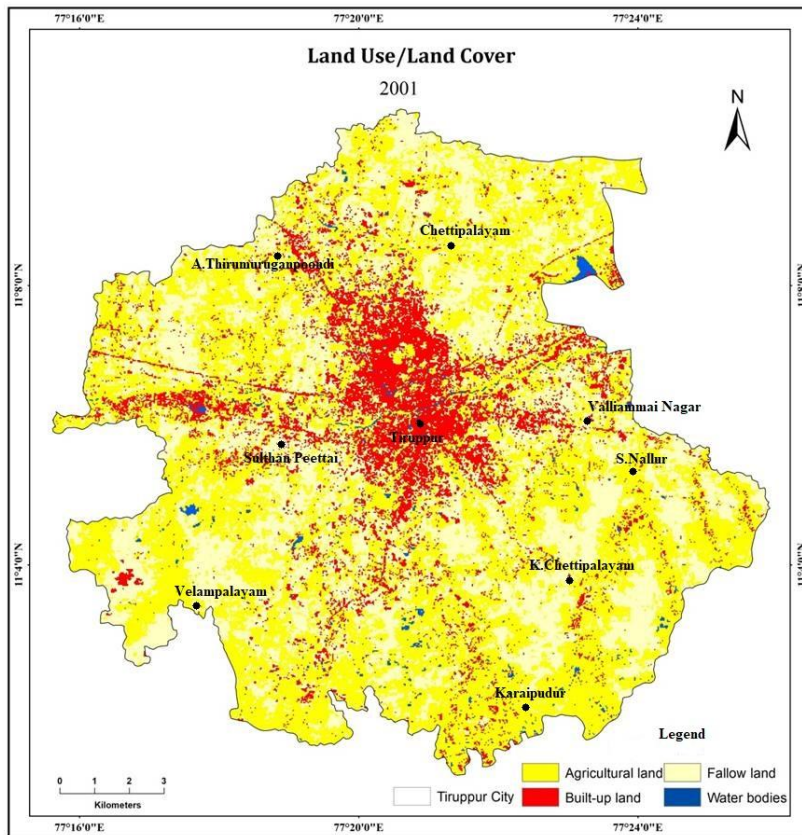


Fig: 1.3

In 2001 agricultural land covers an major area about 88.23 sq.km followed by fallow land covers an area about 80.28 sq.km followed by built up land 29.34 sq.km and water bodies 1.44 sq.km in the total 199.28 sq.km of the study area.

In the year 2019 almost the Tiruppur corporation region was engulfed by the urban structures, most of the agricultural and fallow land in the previous decade were undoubtedly converted into built up, this shows the massive urban sprawl in the study area is shown in the figure 1.4.

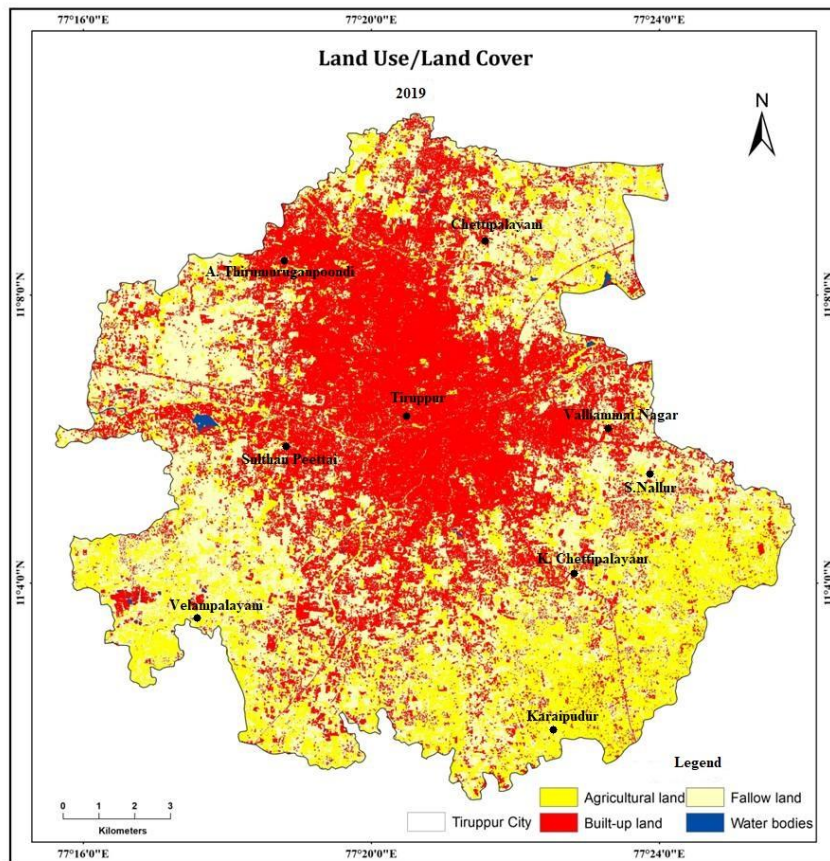


Fig: 1.4



In 2019 built up land covers an major area about 98.24 sq.km followed by fallow land covers an area about 50.64 sq.km followed by agricultural land 49.87sq.km and water bodies 0.54sq.km in the total 199.28 sq.km of the study area.

### EXPANSION OF THE TIRUPPUR CORPORATION AND ITS ENVIRON (1992, 2001, 2019)

The expansion of built up has taken place mostly along the Noyyal river and NH 47 towards the north and the state highways which connects Tiruppur to the adjutant districts also a phenomena for the circular pattern of urban sprawling. Thus the increasing built up indicate high rate of land consumption that were either fallow land or agricultural land. Therefore, the annual growth rate of built up is calculated with the help of Annual Land Use Change Rate (ALUCR), defined by (Tain et al., 2012) as follows.

$$ALUCR_{a,t} = \frac{(LU_{a,t} - LU_{a,t-1}) / LU_{a,t-1} \times 100}{N_t - N_{t-1}}$$

Where ALUCR<sub>t</sub>(%) is the land use change rate, LU<sub>a, t-1</sub> are the total land area of the land use class 'a' in kilometer at the time t (current year) and time t-1 (former year), N is the total number of years from time 't' (current year to time t-1 (former year))

Growth rate for 1992 to 2001

$$\frac{29.34 - 16.82 / 16.82 \times 100}{9} = 8.27\%$$

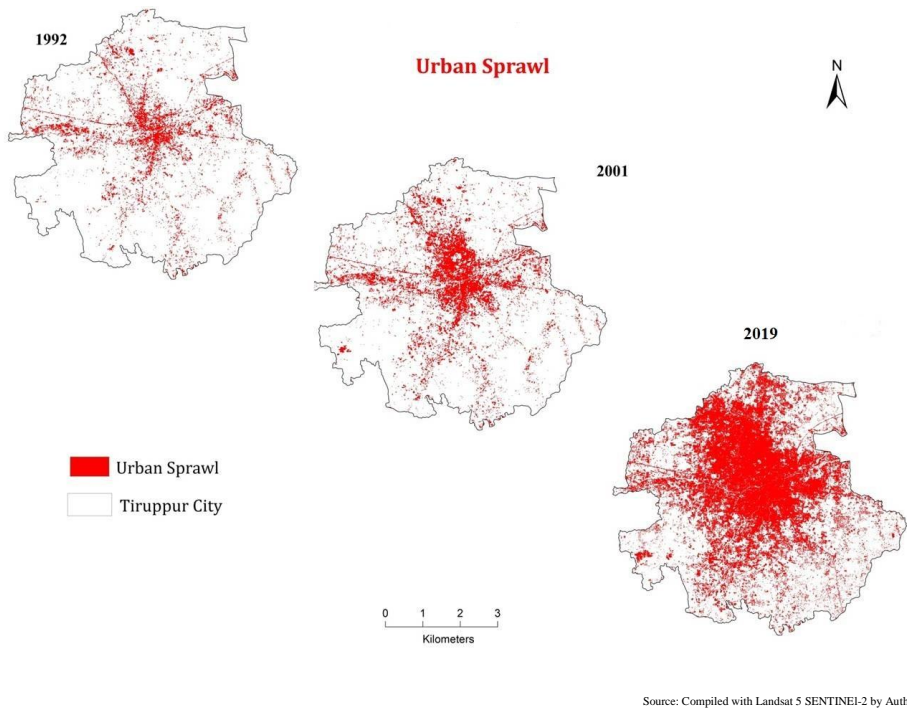
Growth rate for 2001 to 2019

$$\frac{98.24 - 29.34 / 29.34 \times 100}{18} = 13.02\%$$

Calculating the growth rate of expanding built up area it is found that, during the year 1992 to 2001 the rate of growth was 8.27% (during 9 years), between the year 2001 to 2019 the rate of growth was 13.04% (during 18 years). The ALUCR indicates a sudden expansion of built up



area during 1992 to 2001 and gradually expansion takes place during 2001 to 2019 of spatial distribution is shown in the figure 1.5



**Fig 1.5**

### **Land use / Land cover change detection:**

The present study focuses to delineate the changes occurred in the built-up land of the Tiruppur Corporation. The study has been carried for a period of 27 years from 1992 to 2019 through the change detection analysis. The change detection analysis is performed through generating land

use/ land cover map for different time periods i.e. for 1992, 2001 and 2019. The areal coverage of overall land use changes have been given in table 1.1

Table 1.1 Change Detection Table

LU/LC class	1992	2001	2019	Changes in sq.km (2001-1992)	Changes in sq.km (2019-2001)	Changes in sq.km (2019-1992)
Agricultural land	39.86	88.23	49.87	48.37	-38.36	10.01
Built-up land	16.82	29.34	98.24	12.52	68.9	81.38
Fallow land	139.30	80.28	50.64	-59.02	-29.64	-88.66
Water bodies	3.32	1.44	0.54	-1.88	-0.9	-2.78

Note: (-) represents a decrease in the percentage of aerial coverage. (+) represents an increase in the percentage of Aerial coverage.

The present study reveals that built-up land has been increased 81.38% from 1992-2019 and it has been gradually increasing from 12.52% in 1992-2001 and 68.9% in 2001-2019, this result reveals that built-up area in and around the Tiruppur corporation is rapidly expanding.

## CONCLUSION

This study clearly shows the tremendous growth of the Tiruppur and its environ, it leads to the environmental impacts, like the soil nature of the area has been changed, which results in land degradation. Majority of the textile and allied industries are distributed around the study area. The industrial waste merged into the river and contaminated it, as much as possible. Then dramatic increase in population and pollution problem is also merely reflected in this study area. The study area has undergone large urban land use changes in the last few years. During the year 1992 to 2001 the rate of growth was 4.74% (9 years), between the years 2001 to 2019 the rate of

Comment [WU1]: Small case

growth was 7.82% (18 years). Therefore, rapid increases in both urban/built-up expansions led to dramatic changes in land use and land cover, which were witnessed by sharp decreases in agriculture and fallow land. The expansion of built up has taken place mostly along the Noyyal river and NH 47 towards the north and the state highways which connects Tiruppur to the adjacent districts also a phenomena for the circular pattern of urban sprawling. Thus the increasing built up indicate high rate of land consumption that were either fallow land or agricultural land. Thus, rational urban planning policy must be made to decrease the adverse effects of urbanization and enhance to the society.

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