International Journal of Advanced Information Science and Technology (IJAIST)
ISSN: 2319:2682 Vol.6, No.7, July 2017 DOI:10.15693/ijaist/2017.v6i7.38-44

GEO-INFORMATICS TECHNOLOGY BASED LULC CHANGE DEDUCTION IN TIRUCHIRAPPALLI DISTRICT, TAMIL NADU

[1]T. Sathya, [2]M. Gowtham Shakthi, [3]K. Yuvaraja
[4]P. Thirupathi,[5] N. Kalaivanan

Department of Civil Engineering
MAM College of Engineering
Affiliated to Anna University, Chennai
Siruganur, Trichy.
Gowthamshakthi200@gmail.com

Abstract- Land has been used for various purposes in our universe according to the needs and gains. On the whole, the major landuse and land cover feature found in this world are: Agriculture and Forest. But, presently the Agricultural and the Forest lands have been converted and utilized for human development activities; as a result the drastic changes happened in temperature increase and depletion in groundwater table as well as the groundwater quality. These changes made by the human activities are in turn reflects in changes in the natural Geological and climatic phenomenon, because of several adverse factors besides human activities. It causes changes in our living environment like loss of Agricultural and Forest Lands. The recent innovative idea for finding out the changes in the landuse and land cover in an easy, quick and accurate way is through the use of Remote sensing and GIS techniques. This dissertation work dealt with the delineation of total percentage of changes in the land pattern from one and a half decade before the year 2016, the possible reasons behind such changes and suitable suggestions or measures for sustainable future development. The Remote Sensing and GIS can also be useful for monitoring the post implementation changes of LULC pattern of the area.

I. INTRODUCTION

Geo – informatics is the science and the technology which develops and uses information science infrastructure to address the problems of cartography and geo-sciences and also in related branches of other sciences and engineering. This technology includes GIS (Geographic Information System) and Remote Sensing. Both are useful in finding out the transformations in the land surface. **Remote sensing** is an art, science and technology of acquisition of information about objects or phenomenon without making physical contact with the object and thus in contrast to on-site observation. A **Geographic Information System** (**GIS**) is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. **GIS** can handle many different kinds of both spatial and non-spatial data on one map. This enables people to more easily see, analyze, and understand the patterns and relationships.

Remote Sensing and Geographic Information System are used to ascertain the LandUse and Land Cover for certain area even to the entire world. **Land use** involves the management and modification of natural environment or wilderness into built environment such as settlements and semi-natural habitats such as arable fields, pastures, and managed woods. **Land cover** is the physical material at the surface of the earth. **Land covers** include grass, asphalt, trees, bare ground, water, etc. Earth **cover** is the expression used by ecologist Frederick Edward Clements that has its closest modern equivalent being vegetation. Project describes about the LULC changes for Tiruchirappalli district for the difference in 15 years since 2001. LULC changes explain the conversions and differences made in the selected particular land.

Various main parameters that can be helpful to detect the changes in LULC are NDVI (Normalized Difference Vegetation Index), LST (Land Surface Temperature), DEM (Digital elevation modal), unsupervised and supervised classification etc.

NDVI is the main parameter to sense the vegetations in land surface by the satellite image. It is a graphical indicator of natural vegetation in white to black color and it represents the low to high vegetations. Land Surface Temperature is the radiative skin temperature of ground. It depends on the albedo, the vegetation cover and the soil moisture. In most cases, LST is a mixture of vegetation and bare soil temperatures. A DEM image is a digital modal or 3D representation of a terrain surface commonly for a planet (including universe), moon, or asteroid created from terrain elevated data.

STUDY AREA - For the present study, it is decided to carry out the project work for the entire Tiruchirappalli district colloquially called 'Trichy' as the area has a spectrum of morphologic, lithologic and landuse/land cover features. Moreover, the Tiruchirappalli is situated in the

middle part and thus it is mentioned as heart of Tamil Nadu. It is a vast place and it measures about 167.2 square kilometers. In this area, more features are presented and useful for the everyday human activities.

There are various features like roads, railway line, tanks, built-up lands, agricultural lands etc. Tiruchirappalli is the second capital of Tamil Nadu and value added city to the state. River Kaveri is draining in the midst of the district and flourishing the delta region and agricultural activities over the area also for the potable purposes and industrial works. Other than the water source, rock is also available in this district.

The two major rivers draining Tiruchirappalli are the Kaveri and its tributary the Kollidam, but the city is also drained by the Uyyakondan Channel, Koraiyar and Kudamuritti river channels. The land immediately surrounding the Kaveri River crosses Tiruchirappalli city from west to east, consists of deposits of fertile alluvial soil on which crops such as finger millet and maize are cultivated. Further south, the surface is covered by poor-quality black soil. The region falls under Seismic Zone III, which is moderately vulnerable to earthquakes.

II. RELATED WORKS

A classical project namely 'Demarcation of environmental pollution in Tiruchirappalli by the use of Geo-informatics technology carried out to find the ground water potential and ground water depletion by R. Muthukumar, A.P. Aruneswari, B. Kanimozhi (2016) of Bharathidasan University. This project is very much helpful to know the LULC changes of Tiruchirappalli districts by the impacts of ground water. This project helps us to deduct the LULC with the ground water pollution and depletion.

Another project has been carried out with the Classification of LULC, Change Detection using Remotely Sensed Data for Coimbatore City; Tamil Nadu, India by Y. Babykalpana, K. Thanush Kodi (2007) explains the changes of LULC pattern using the Geo-informatics Technology which is also used for deducting the LULC changes in Tiruchirappalli district.

BASE MAP - Base map is a fundamental map which gives information about the facilities and features available at Tiruchirappalli. These features are separately shown n the map called base map and it can give crystal clear information about Tiruchirappalli district. This Base map includes Road Network (National Highway, State Highways, Local Roads), Railway Lines, Major and Minor settlement, River / Stream, Tanks or reservoirs and Mountains. Using the information provided in the base map all other maps can be created and explained.

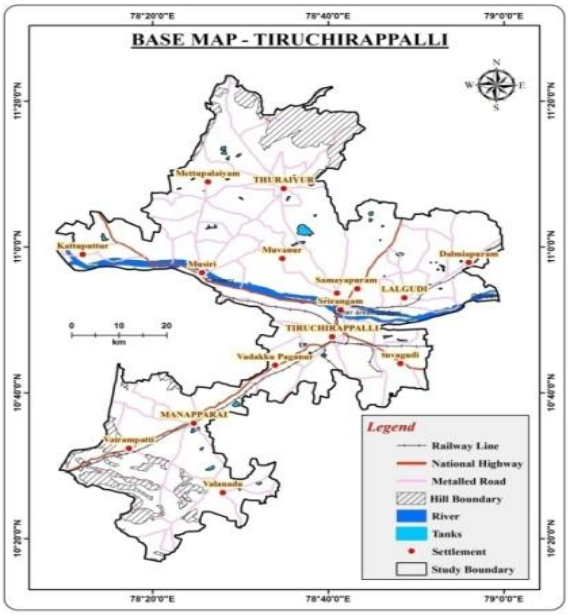

Fig. 1 Base map

III. METHODOLOGY

A. DATABASE GENERATION:

For any project data are important to give input. Here, satellite data are the most important data and they are gained from the satellite called LANDSAT series. LANDSAT-7 and LANDSAT-8 are employed in this project as input.

LANDSAT series satellite has several bands that give the information about the land surface with the clear image. Data are available in the various bands such as NIR band, Red band and Green band. This satellite images shows the image in the form of FCC (False Color Composite) and TCC (True Color Composite). TCC shows the original image of the land and FCC shows the image in the colors of red, green and blue for every color of the original image based on the reflection of the source. LANDSAT-7 satellite has 8 bands and LANDSAT-8 satellite has 11 bands in that extra 3 bands from above satellite are thermal bands.

B. SATELLITE DATA USED:

The satellite data are taken from the most prominent satellites like LANDSAT series. The series of satellite are launched in USA and working under all circumstances. These data which are downloaded from the internet NASA website and used for this project taken from the satellites and their date of acquirement are:

i. LANDSAT – 7

Months: April and December, 2001

ii. LANDSAT – 8

Months: April and December, 2016.

EXAMPLE:

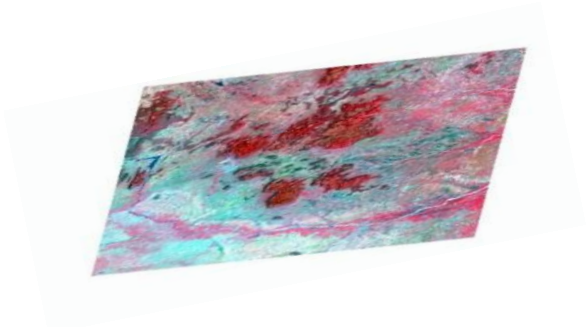

Fig. 2 PATH: 143 ROW: 52

IV.GENERATION OF DIGITAL GEO-SPATIAL DATABASE

A. NDVI:

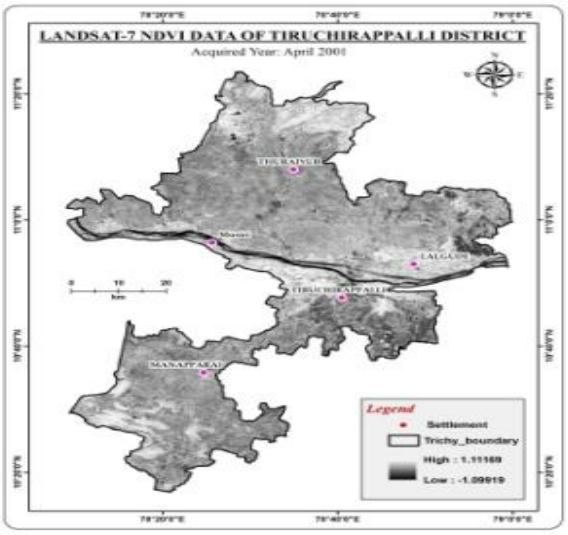

Fig. 3 April 2001

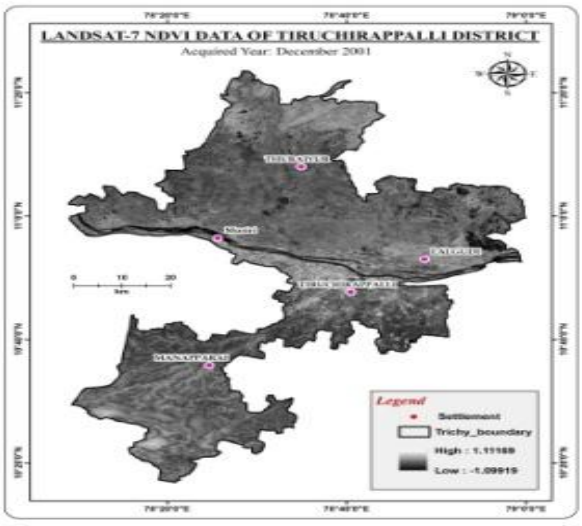

Fig. 4 December 2001

In this, NDVI image we have shown the vegetation index of 2001 and 2016. This image will clearly give information about the vegetation that has been broadly occupied in Tiruchirappalli. Layout for this satellite image has been shown for the year of 2001 and after the 15 years of 2001. The satellite image was taken from the USGS website for the respective years and the main impacts due to the weather conditions are removed in ArcGIS software. Then image is processed using this software.

B. DEM:

A **Digital Elevation Model** (**DEM**) is a digital model in a 3 Dimensional representation of a terrain's surface, commonly for the planets (including Earth), moon, or asteroid created from terrain elevation data. This DEM is produced using the data collected from SRTM (Shuttle Radar Topographic Mission).

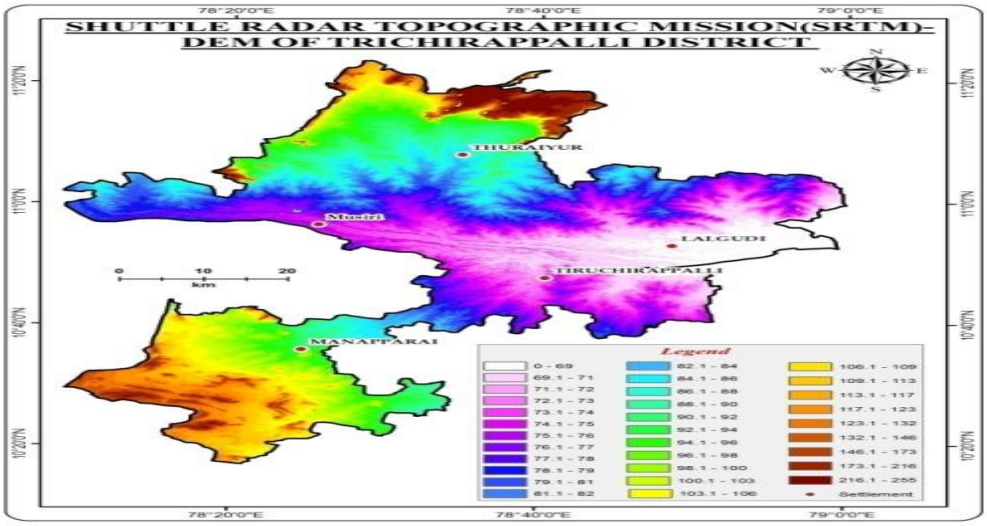

Fig. 5 SRTM DEM

C. LST:

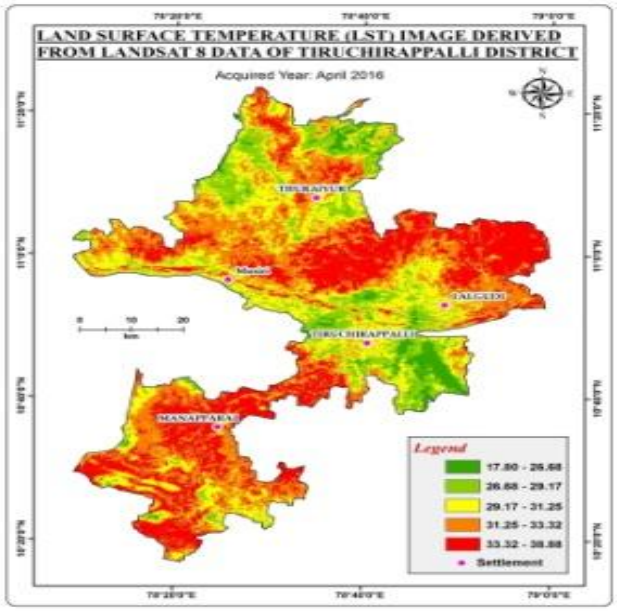

Fig. 6 April 2016

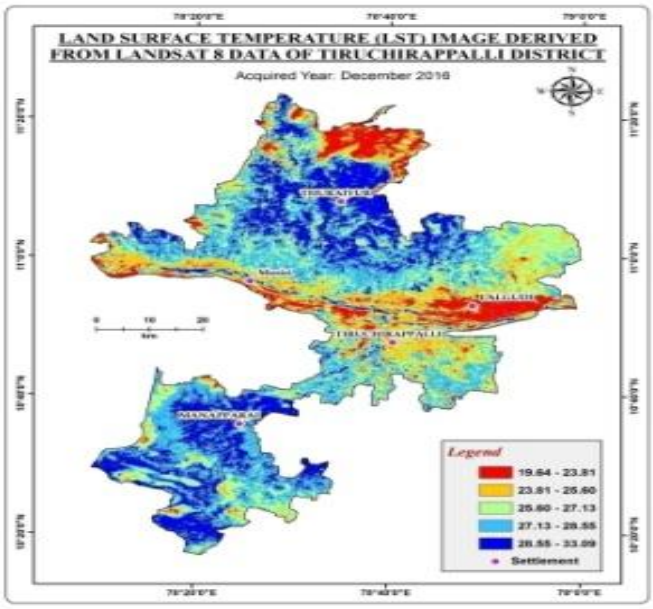

Fig. 7 December 2016

From the LST image of April 2016, a very high temperature range is observed all along the waste lands of Kadavur and its north east as well as in the northeast of Musiri and Lalgudi. At the same time, the city area had faced medium temperature range of 29.68 to 30.25 ^{o} C. Along the southern deltaic plains of Cauvery, in Tiruverumpur region had faced low temperature range.

From the LST image of December 2016, a very high temperature range is observed all along the South and middle to North and Centre of Tiruchirappalli. Lowest temperature is found in the Centre and the North parts.

LANDUSE /LAND COVER

According to the NRSC Classification, the satellite image has been splits up and categorized on the various levels. They are built – up land, Agricultural land, waste land, Land with or without scrub, Forest, Water bodies.

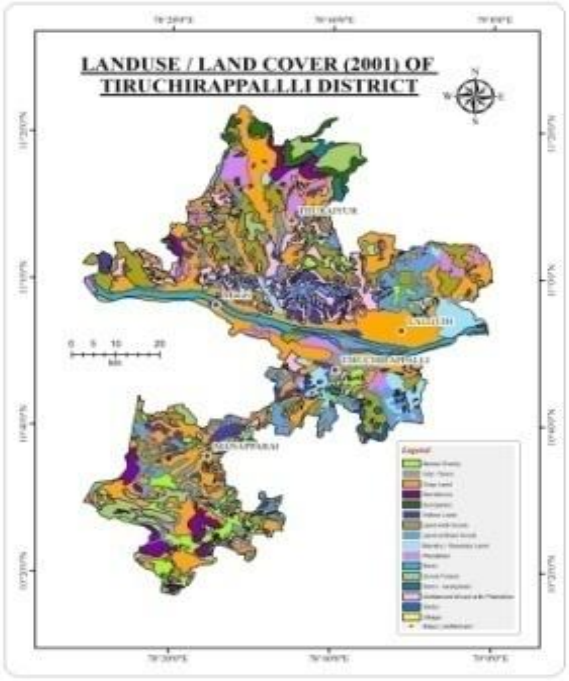

Fig. 8 LULC 2001

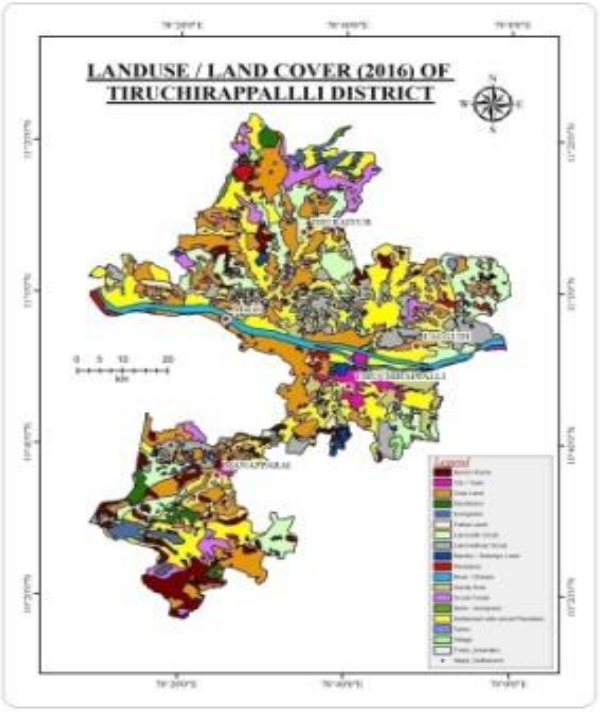

Fig. 9 LULC 2016

V. RESULTS AND CONLUSIONS

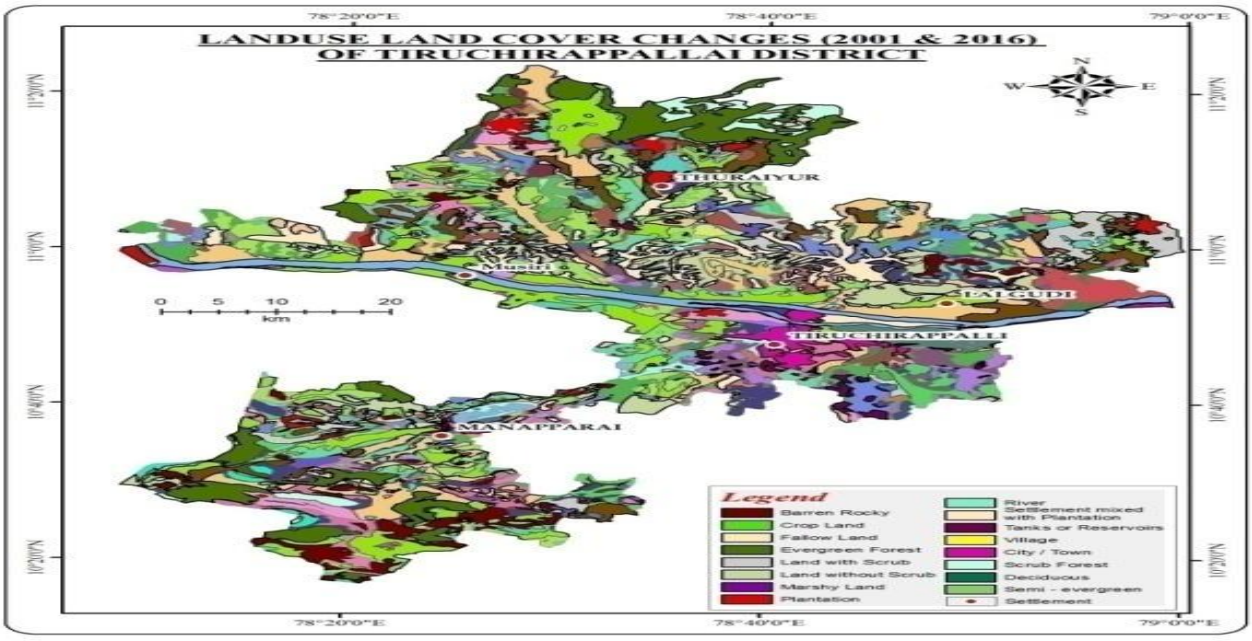

Fig. 10 Overall LULC changes

Table – Overall changes in features

S.No	2001 – 2016 LULC OVERALL CHANGES	Percentage of Changes (%)
1.	Barren Rocky / Stoney Waste / Sheet Rock Area	7.12
2.	City / Town	1.07
3.	Crop Land	30.71
4.	Deciduous	3.24
5.	Evergreen	1.98
6.	Fallow Land	3.19
7.	**Land with Scrub**	**14.13**
8.	**Land without Scrub**	**11.00**
9.	Marshy / Swampy Land	4.24
10.	Plantation	5.19
11.	River	3.20
12.	Scrub Forest	4.54
13.	Semi – evergreen	0.60
14.	**Settlement Mixed with Plantation**	**8.28**
15.	Tanks	1.38
16.	Village	0.07

Above shown results is the percentage changes happened in the Tiruchirappalli district and it shows thevariations among the features over the district individually and at last the pie chart shows the overall changes over the period of 15 years since 2001 to 2016.

From this study, it is clear that there are many changes observed in Tiruchirappalli district in several landuse and land cover patterns. The major changes found in this study area are: Conversion of Croplands, Plantations, Forest and Rivers, Waste lands into Settlements, Land with scrub and Land without Scrub.

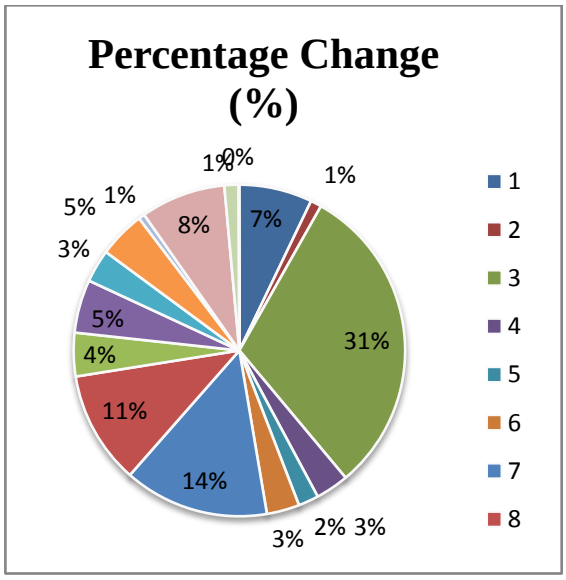

Chart – Overall changes in percentage

Overall, the usage of land for human activities should leave a way for vegetations to grow. Everyone should encourage growing trees and plants in their house to reduce the rise in temperature and to increase the rainfall. This will improve the quality of air to breath and this is the best way to produce good environment for future generations.

CONCLUSIONS

1. As per the aim and objectives designed for the study, for Tiruchirappalli district, following the well-defined methodology, the work has been carried out using Geospatial Technology. Initially, layers for Base map and Landuse and Land Cover maps of Pre- and Post-monsoon of the year 2001 and 2016 have been prepared using the advanced virtues of Geospatial Technology. This involves, the Digital Image Processing of satellite images such as the preparation of Land Surface Temperature (LST), Normalized Difference Vegetation Index (NDVI), Digital Elevation Model (DEM), 3D visualized and FCC wrapped DEM, and GIS integration module have been in order to increase the interpretability of LULC features in Trichy district and mapped them separately.
2.Using GIS integration module LULC maps of 2001& 2016 have been integrated to bring out single map having all the spatial changes, a pattern of changes and their aerial extents.
3.Followings are the LULC changes and their pattern:

3.1 Deciduous Forest to Settlement
3.2 Crop Land to land with Scrub
3.3 Crop Land to settlement mixed with Plantation
3.4 Evergreen Forest to Settlement mixed with Plantation
3.5 Land with Scrub to Crop Land
3.6 Land without Scrub to Land with Scrub
3.7 Marshy / Swampy Land to Settlement with plantation
3.8 Land without Scrub to Crop Land
3.8 Fallow Land to City / Town and
3.9 Settlement mixed with Plantation to City / Town.

4. From this it is understood very clearly that the deciduous forest, crop lands, fallow lands, plantation, waste lands-Land with scrub, Land without scrub, Barren rocky, tanks and rivers have become settlement area and thus habitations have been increased dramatically to a maximum of 26 % in total.

5. From this newer approach it is concluded that the advance tools of Geo-informatics such as Remote Sensing, Digital Image Processing, DEM & GIS are very much useful in delineating & determine the LULC pattern & changes over a longer period specially.

REFERENCES

[1] U.P. Narayan Chopra Sr. Astt. Prof., Civilian Gazetted Officer, Gp 'A', Deptt. of Geography, National Defence Academy. Land Use/ Land Cover information at various levels from different scales of Remote Sensing data of Southern part of Sonbhadra district.

[2] Kharol S K, Kaskaoutis D G, Badarinath K V S, Sharma A R, Singh R P , 2013. Influence of land use/land cover (LULC) changes on atmospheric dynamics over the arid region of Rajasthan state, India.

[3] James R. Anderson, Ernest e. Hardy, John T. Roach, and Richard E. Witmer Geological Survey Professional Paper 964. A Land Use Land Cover Classification System for Use With Remote Sensor Data.

[4] Selçuk Reis, Aksaray University, Faculty of Engineering, Department of Geodesy and Photogrammetry. Analyzing Land Use/Land Cover Changes Using Remote Sensing and GIS in Rize, North-East Turkey.

[5] A review of the international researches on land use / land cover change. Li Xiubin Institute of Geography,Chinese academy of Science and the State Planning commission of P.R.China,Beijing.

[6] C. Parker, Steven M. Manson, Marco A. Janssen, Matthew J. Hoffmann & Peter Deadman. Multi-Agent Systems for the Simulation of Land-Use and Land-Cover Change: A Review Dawn.

[7] Nagaraju Arveti1, Balaji Etikala1, Padmanava Dash2 Department of Geology, Sri Venkateswara University, Tirupati, India. Land Use/Land Cover Analysis Based on Various Comprehensive Geospatial Data Sets: A Case Study from Tirupati Area, South India.

[8] Gregory A. Baxes, Digital Image Processing: Principles and Applications.

[9] Dr Kuldeep Pareta, LULC and climate change impact on carbon storge and sequestration a case study of ranthambhore tiger reserve, rajasthan.

[10] R. Muthukumar, A.P. Apuneswari, B. Kanimozhi (2016) "Demarcation of environmental pollution in Tiruchirapalli". of Bharathidasan University.

Authors Profile

Prof.T.Sathya received the **B.E.** degree in Civil Engineering from Alagappa Chettiar College of Engineering and technology in 2001 and **M.E.** Environmental Engineering in Periyar Maniammai College of technology for women , Tanjore in 2007. Currently working as Asocciate Professor in M.A.M. College of Engineering, Trichy, with 15 years of Teaching Experience. Area of interest is on Environmental Engineering and Structural Engineering.

M. Gowtham shakthi received B.E Civil engineering degree in MAM College of Engineering Trichy, Affiliated to Anna University, Chennai, India, in 2017.

K.YuvarajareceivedB.ECivil engineering degree in MAM College of Engineering Trichy, Affiliated to Anna University, Chennai, India, in 2017

P.Thirupathi received B.E Civil engineering degree in MAM College of Engineering Trichy, Affiliated to Anna University, Chennai, India, in 2017.

M. Kalaivanan received B.E Civil engineering degree in MAM College of Engineering Trichy, Affiliated to Anna University, Chennai, India, in 2017.