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LANDUSE, LANDCOVER AND URBAN DEVELOPMENT OF COIMBATORE NORTH ZONE FOR TWO DECADES: A CASE STUDY

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Abstract - *The number of remote sensing platforms increased during the last two decades significantly and produced an ascend of geographical data availability at variable scale. The development of last generation satellites leads to a revival in sensor research. Land cover, land use is one of the most important information for planning authorities and their decision-making procedure implies greatly with urban development. Land and urban development changes are observed in the study area, further recommendations are followed. The developed classification procedure lead to land cover and land use maps in a semi-automated approach. Desirable pattern of the land systems and uses are developed, in-order to prevent the wasteful development and promotes the efficient utilization of the land, acquisition and deposition of land, ensures the highest and best use of the land and ensures knowledge on data collection .Land use/land cover (LU/LC) changes were determined in an urban area, Coimbatore North, from 1997 to 2017 by using Geographical Information Systems (GISs) and remote sensing technology. These studies were employed by using the Survey of India topographic map and the remote sensing data of LANDSAT-8, LANDSAT-7, LANDSAT-4, LANDSAT-5 which determines the data's of 1997, 2007 and 2017. The study area was classified into six categories on the basis of field study, geographical conditions, remote sensing data and reservation. The comparison of LU/LC in 1997 and 2017 derived from toposheet and satellite imagery interpretation indicates that there is a drastic increase in built-up area and a small scale development in forest and other land categories. It is also noted that substantial amount of scrub land, fallow land, cropland, water spread areas, and dense forest area meet with the rational growth as well as depletion, during the period of study which may be due to rapid urbanization of the study area.*

Key Words: **Landuse, land cover, landSAT, Toposheet**

1. INTRODUCTION

1.1 GENERAL

The surface of the Earth is continuously changing at many levels; local, regional, national, and global scales. Changes in land use and land cover are pervasive, rapid, and can have significant impacts for people, the economy, and the environment.

Infrastructure forms an integral part for growth and development of any region. Satellite images, owing to their spatial, temporal and spectral characteristics, provide valuable information about the land-use/ land-cover (present and past), existing infrastructure, terrain characteristics etc., which are vital to facilitate infrastructure planning, monitoring and management in a timely and cost-effective manner. Geographical Information System (GIS) with customized decision support tools facilitate integrated analysis of different datasets and their visualization.

The study of LULC changes requires an analysis of a large amount of spatio-temporal data that were traditionally collected through ground-based field surveys. Over the past couple of decades, rapid improvements in remote sensing technologies, especially due to their affordable prices, large spatial coverages, repetitive observations, and efficient data-processing capabilities, has encouraged urban researchers and city planners to use remote sensing data to examine the spatio-temporal LU/LC changes and urban development. The methods of identification of LU/LC changes using remote sensing data fall into pre-classification and post-classification categories. The pre-classification method processes a set of multi-temporal remote sensing images to create maps identifying areas of change or no-change in LU/LC without classifying the nature of changes . In contrast, the post-classification method compares two classified temporal remotely sensed images

to produce maps that would depict changes within and between LU/LC classes over time. Therefore, it helps researchers and planners to detect the nature and direction of LU/LC changes and urban development around cities.

This present study examines the LU/LC changes and the nature of urban development in the city of Coimbatore North using remotely sensed data for the years 1997, 2007, and 2017. It aims to classify LU/LC types in each year; detect changes that occurred in each LU/LC class; and measure the rate and direction of urban development in response to population growth in the city over the past two decades. Chapter 3 describes the study area, data, and methods used in the study while the results and the discussions of the findings are presented in chapter 4.

Land management and land planning requires a knowledge of the current state of the landscape. Understanding current land cover and how it is being used, along with an accurate means of monitoring change over time, is vital to any person responsible for land management. Measuring current conditions and how they are changing can be easily achieved through land cover mapping, a process that quantifies current land resources into a series of thematic categories, such as forest, water, and paved surfaces. By using remotely sensed imagery and semi-automated classification method various sector are made in our decided study area, which clearly designates the location and various classifications in the result map.

Satellite data provide baseline information on land-use/ land-cover, topography, vegetation cover, water bodies etc. , which are vital for infrastructure planning.

1.2 LANDUSE

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. It also has been defined as "the total of arrangements, activities, and inputs that people undertake in a certain land cover type."

Land cover indicates the physical land type such as forest or open water whereas land use documents how people are using the land. Land cover data documents how much of a region is covered by forests, wetlands, impervious surfaces, agriculture, and other land and water types.

1.3 LANDCOVER

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, E.g.: Frederick Edward Clements that has its closest modern equivalent being vegetation.

1.4 URBAN DEVELOPMENT

Land use is the human use of territory for economic, residential, recreational, conservational, and governmental purposes. The concept of land use is closely intertwined with human community development. Patterns of human development and land use have shaped the environment locally and globally since prehistoric times. Current development patterns, together with features of the natural environment and the consequences of past development activities, determine future development opportunities, and also the need for restoration or enhancement of environmental resources.

The urban development deals with the drastic growth especially for the past two decades ,in the mentioned area. Based on the landuse there are different cropping patterns and also there are various categories such as fallow land, crop land, water spread areas ,forest land , built up land and scrub land.

1.5 REMOTE SENSING

In an urban environment natural and human-induced environmental changes are of concern today because of deterioration of environment and human health. The study of land use/land cover (LU/LC) changes is very important to have proper planning and utilization of natural resources and their management. Traditional methods for gathering demographic data, censuses, and analysis of environmental samples are not adequate for multicomplex environmental studies, since many problems often presented in environmental issues and great complexity of handling the multidisciplinary data set; we require new technologies like satellite remote sensing and Geographical Information Systems (GISs). These technologies provide data to study and monitor the dynamics of natural resources for environmental management.

Remote sensing has become an important tool applicable to developing and understanding the global, physical processes affecting the earth . Recent development in the use of satellite data is to take advantage of increasing amounts of geographical data available in conjunction with GIS to assist in interpretation. GIS is an integrated system of computer hardware and software capable of capturing, storing, retrieving, manipulating, analyzing, and displaying geographically referenced (spatial) information for the purpose of aiding development-oriented management and decision-making processes.

Remote sensing and GIS have covered wide range of applications in the fields of agriculture, environments , and integrated eco-environment assessment. Several researchers have focused on LU/LC studies because of their adverse effects on ecology of the area and vegetation .Present study area witnessed rapid development during past decades in terms of urbanization, industrialization, and also population increase substantially. The main objective of this paper is to detect and quantify the LU/LC in an urban area, Coimbatore North, from 1976 to 2003 using satellite imagery and topographic map.

SCOPE AND OBJECTIVE

3.1 OBJECTIVE

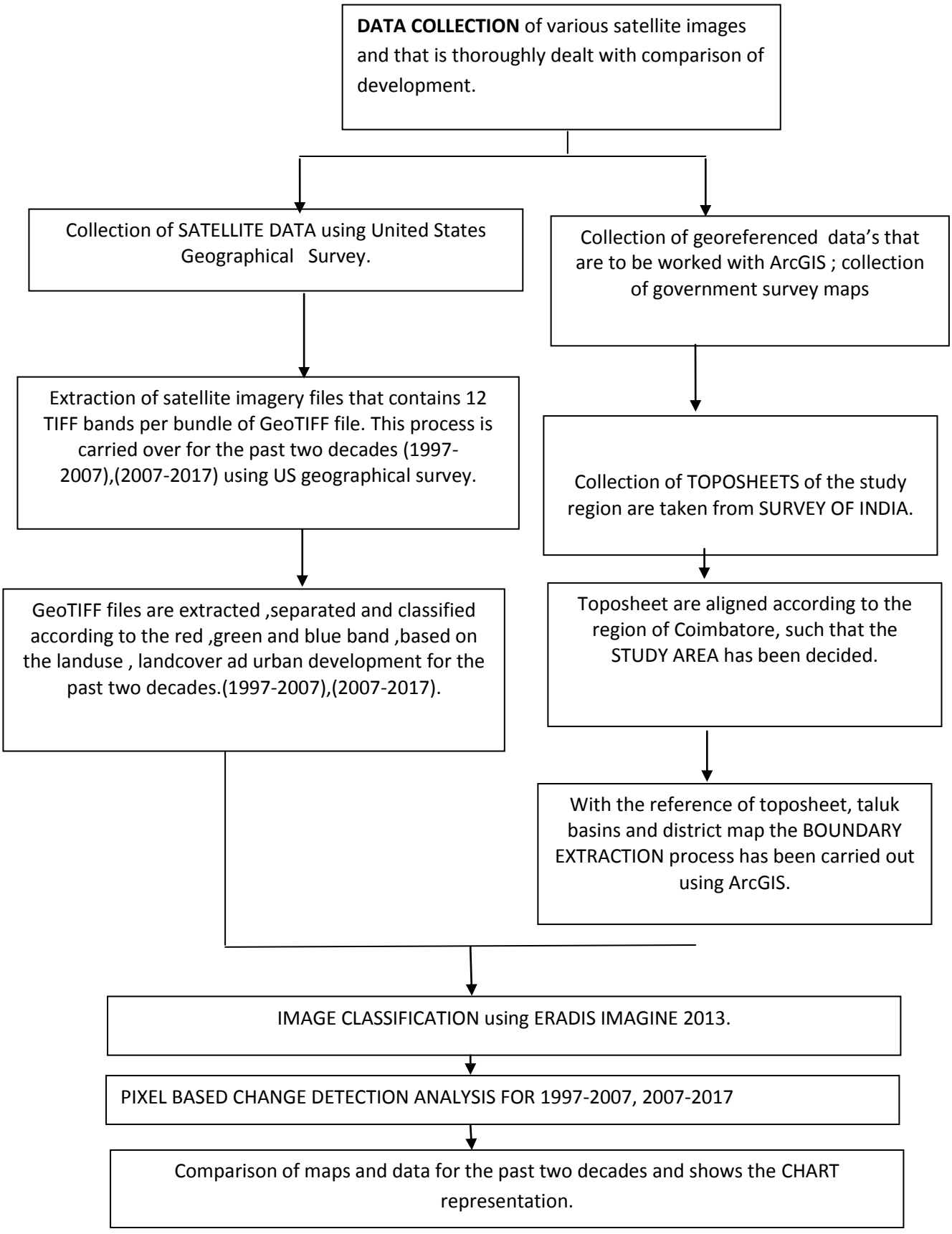
1. The main objective of the study is to analyze the nature and extent of LU/ LC at Coimbatore north for past twenty years .
2. To create the image classification of the study area and to determine the occupied land patterns and land development with depletion and rational growth from the extracted data.
3. To determine the changes over the land pattern by change detection analysis and to clearly exhibits in charts for two decades such as (1997-2007),(2007-2017).

3.2 SCOPE

The landuse, landcover and urban development of the study area has given a complete belief of growth for the land patterns and classifications .The scope ,which developed over the study area shows high occupancy.

1. Industrial development in these areas withstand the typical land usage at various blocks of study region.
2. Depletion of crop land , fallow land , scrub land of the categories of different land pattern over the time period.
3. The image classification shows the forest land development over the south-west borders of the study region, but also felt with the depletion by coverage of land.
4. The classified images shows the drastic variation in built-up area and creates an assumption of high rational growth in the region for upcoming decades.
5. Major settlement and routes has shown the major usage.

4. METHODOLOGY –



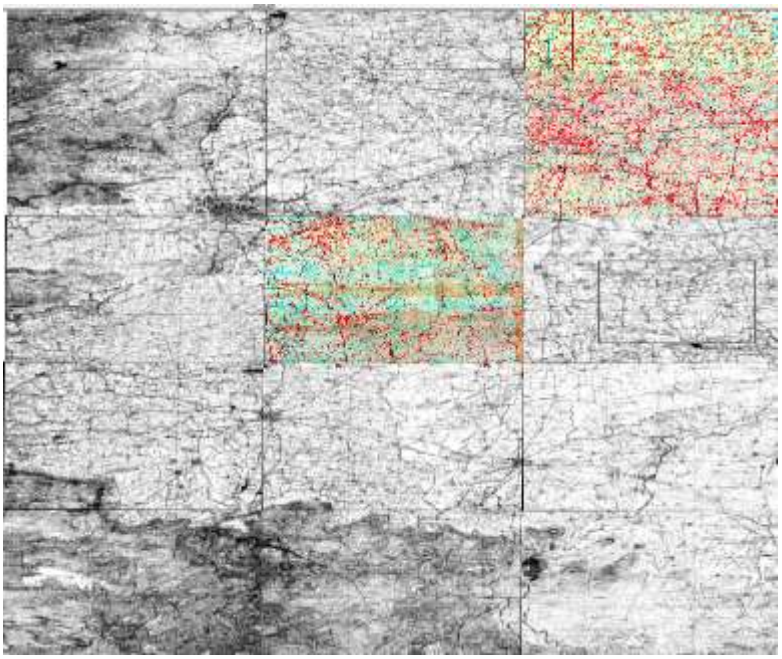


Figure 1 : Toposheets of Coimbatore region in form of blocks.

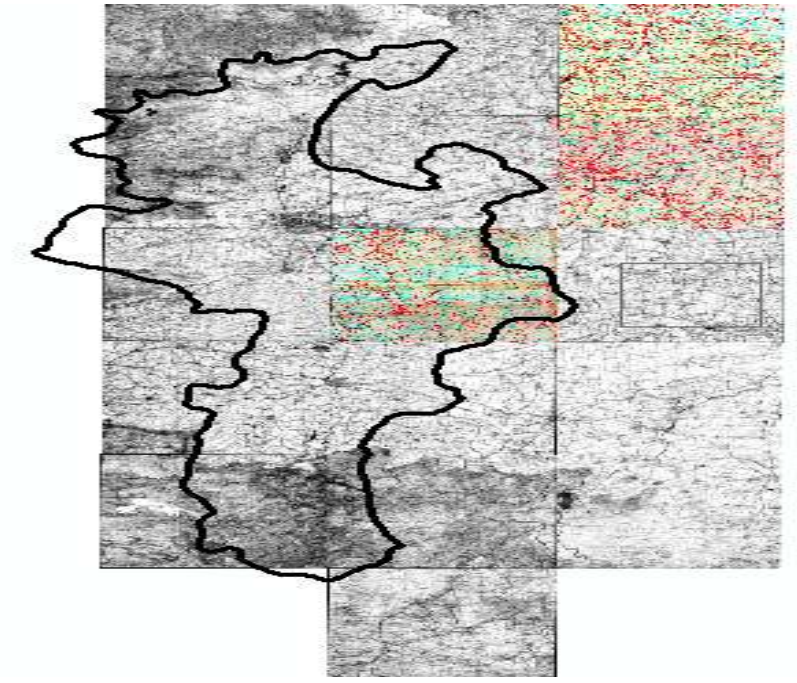


Figure 2 : Toposheet fitted with Coimbatore Region

Latitude: 11.004556

DMS Lat: 11 0' 16.4016'' N

Longitude: 76.961632

DMS Long: 76 57' 41.8752'' E cropping the selected boundary, which is Coimbatore north region.

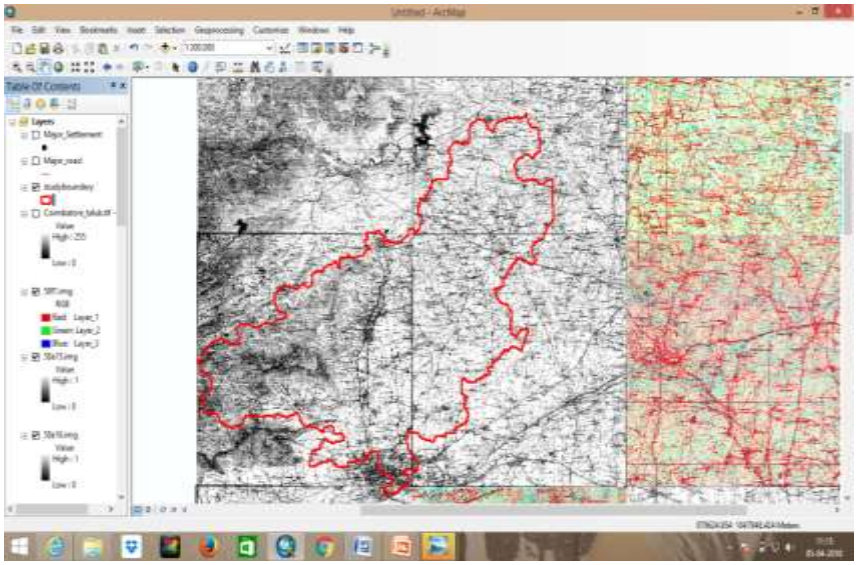


Figure 4: Working with ArcGIS for the extraction of study area

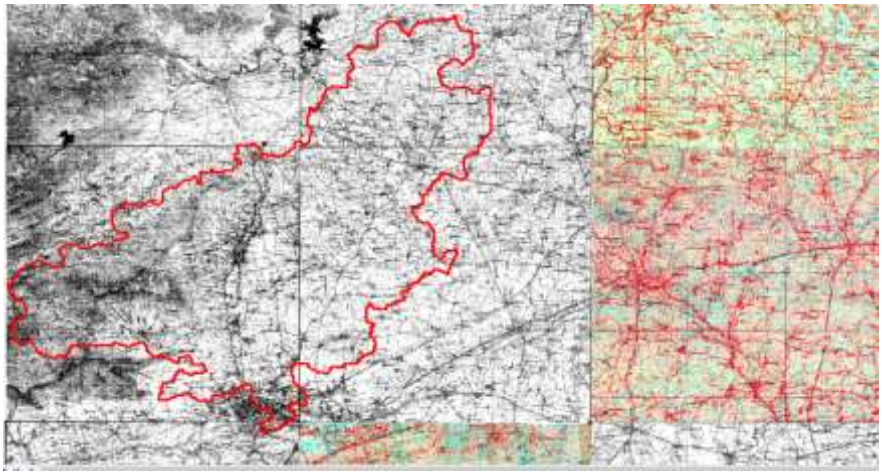


Figure 5 : Working with the boundary extraction with the setup of taluk boundary.

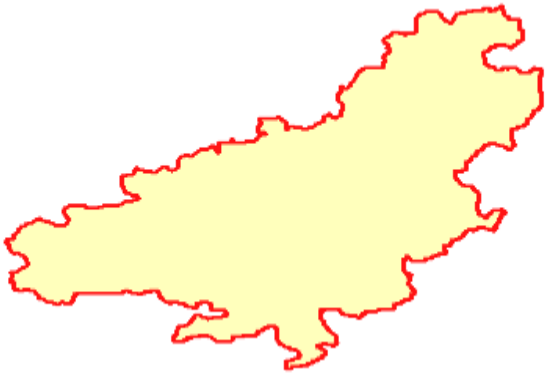
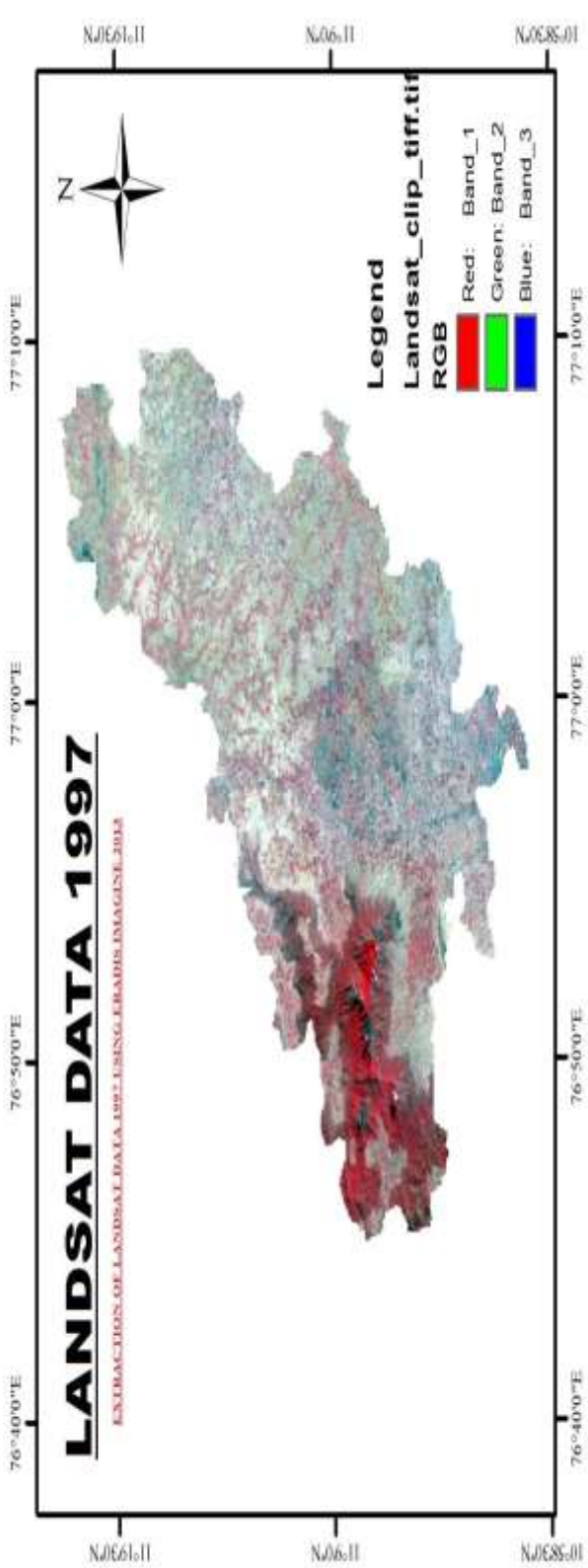
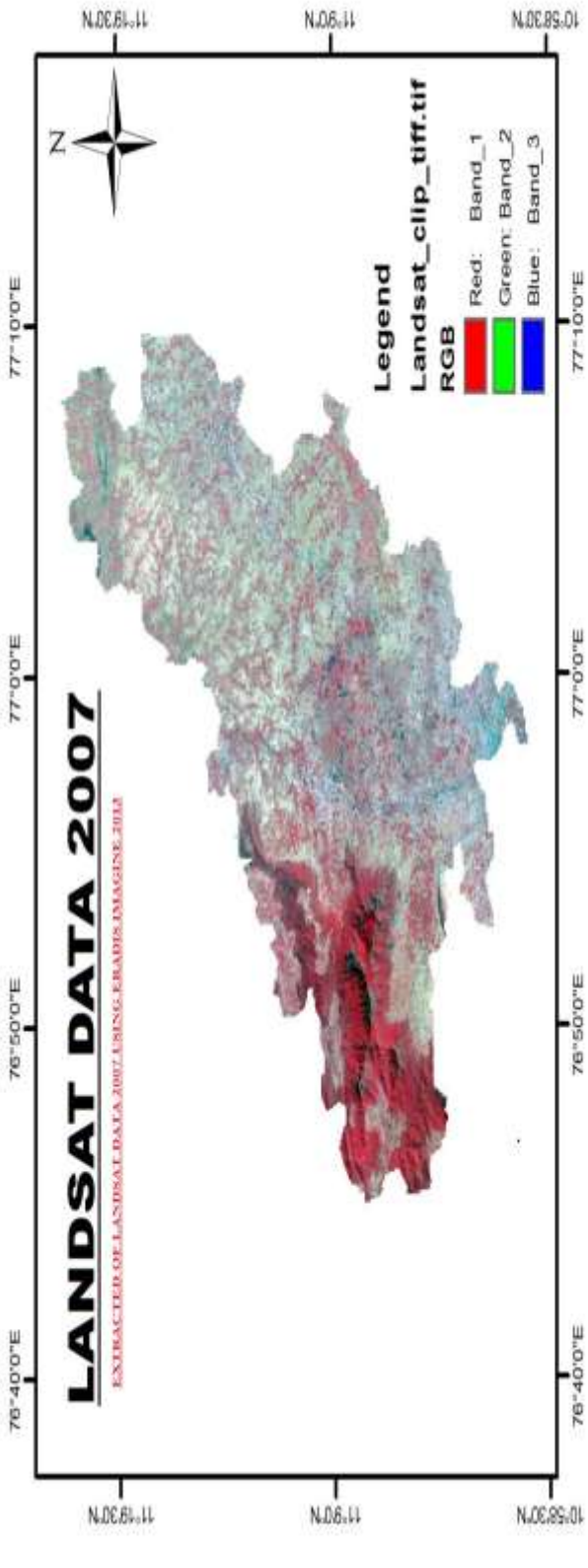
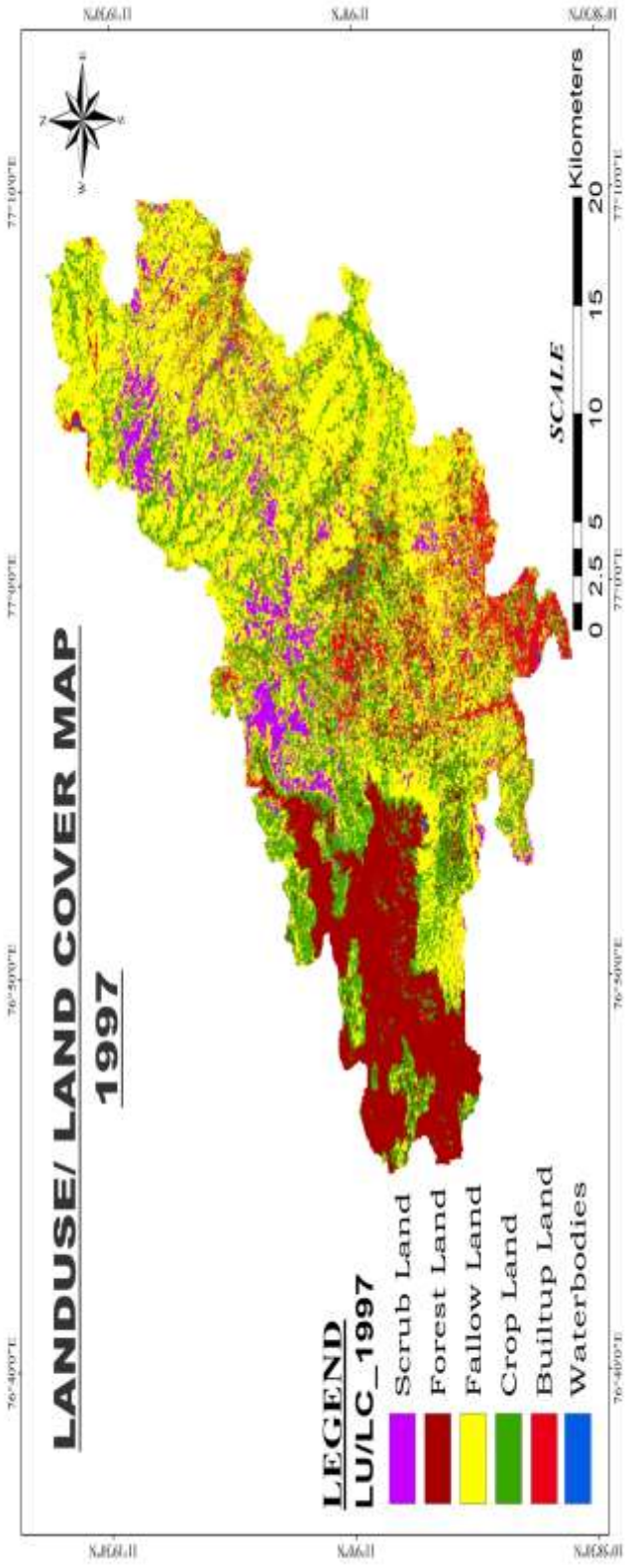


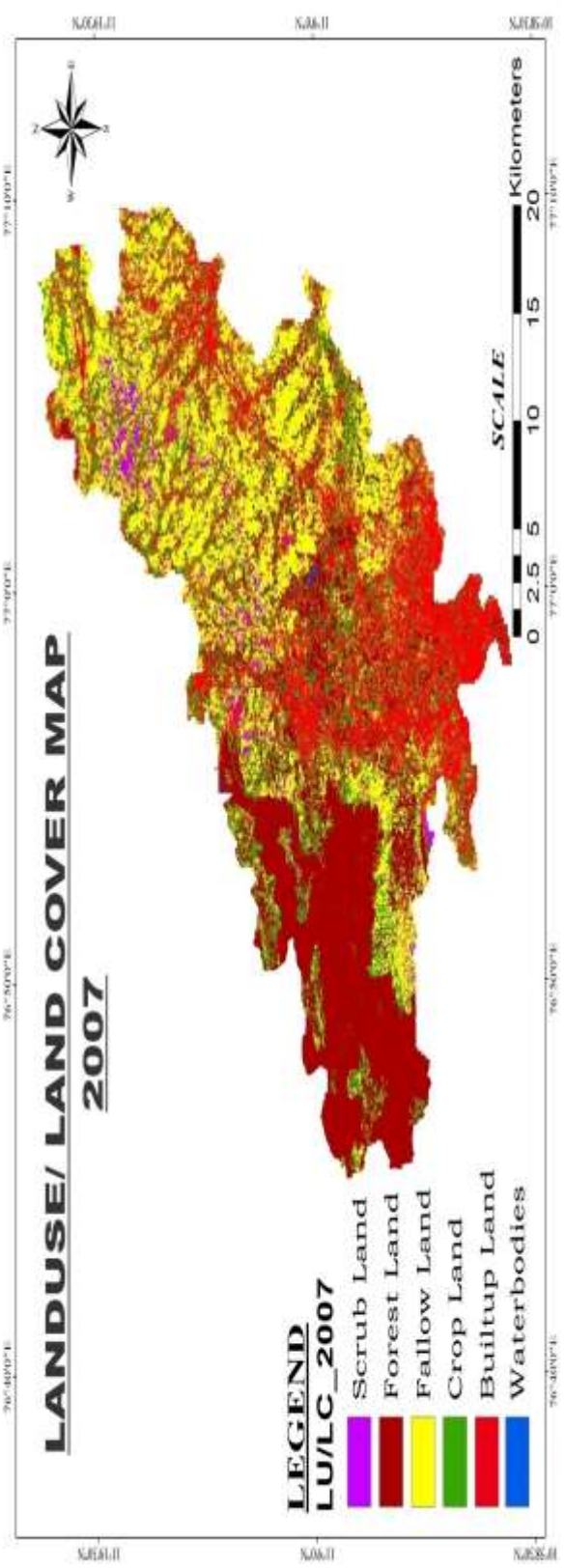
Figure7: detected study region with toposheet

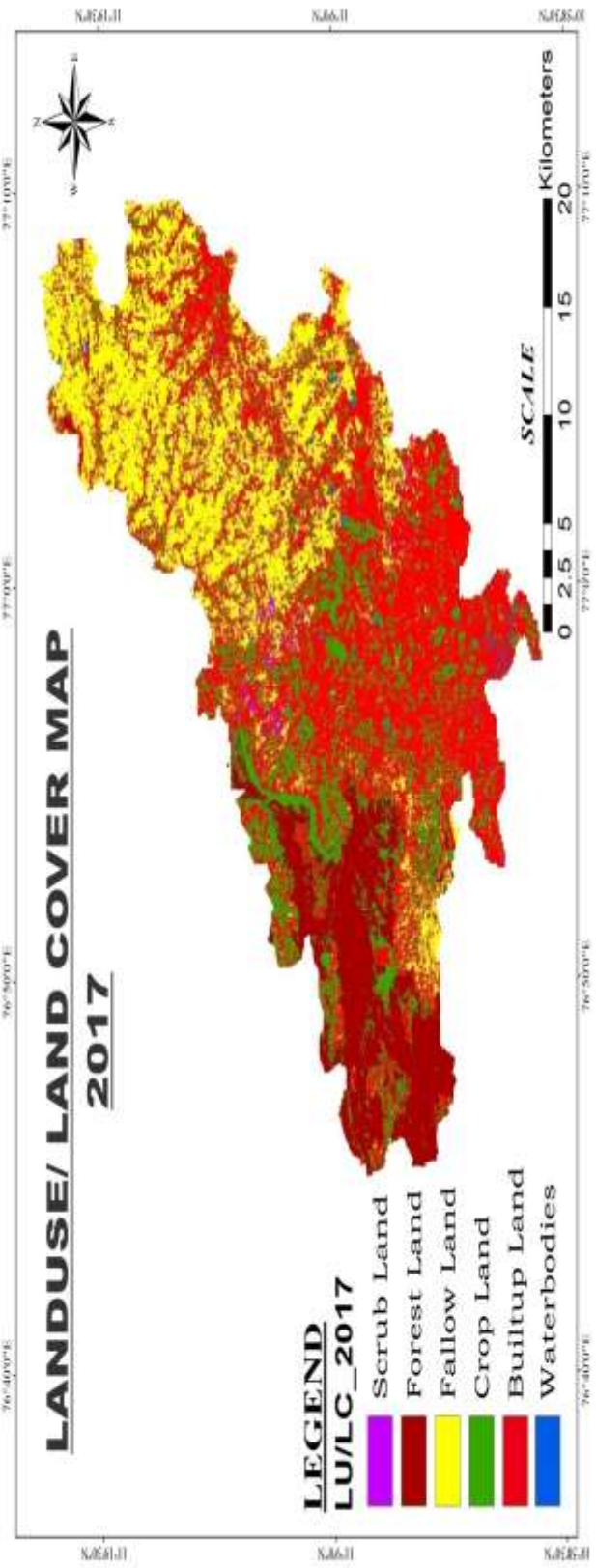

LANDSAT DATA 1997
Legend
Landsat_clip_tiff.tif
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
N
77°10'0"E
77°0'0"E
76°50'0"E
76°40'0"E
11°19'30"N
11°9'0"N
10°58'30"N


LANDSAT DATA 2007
Legend
Landsat_clip_tiff.tif
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
N
77°10'0"E
77°0'0"E
76°50'0"E
76°40'0"E
11°19'30"N
11°9'0"N
10°58'30"N


LANDSAT DATA 2017
EXTRACTION OF LANDSAT DATA 2017 USING ERADAS IMAGINE 2013
Legend
Landsat_clip_tiff.tif
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
N
76°40'0"E
76°50'0"E
77°0'0"E
77°10'0"E
11°19'30"N
11°9'0"N
10°58'30"N


LANDUSE/ LAND COVER MAP
1997
LEGEND
LU/LC_1997
Scrub Land
Forest Land
Fallow Land
Crop Land
Builtup Land
Waterbodies
SCALE
0 2.5 5 10 15 20
Kilometers


LANDUSE/ LAND COVER MAP
2007
LEGEND
LU/LC_2007
Scrub Land
Forest Land
Fallow Land
Crop Land
Builtup Land
Waterbodies
SCALE
0 2.5 5 10 15 20
Kilometers

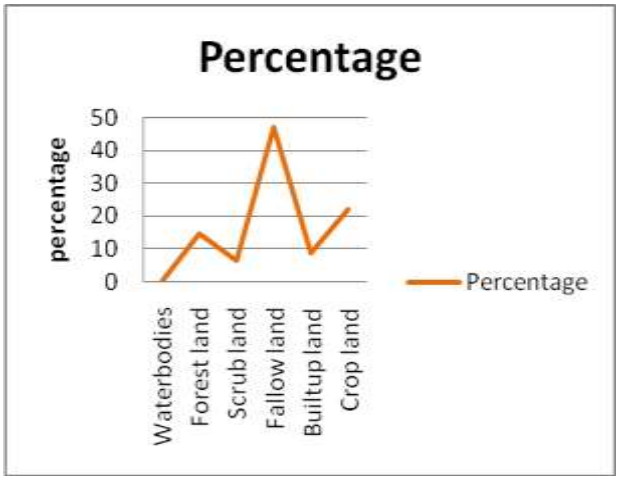

LANDUSE/ LAND COVER MAP
2017
LEGEND
LU/LC_2017
Scrub Land
Forest Land
Fallow Land
Crop Land
Builtup Land
Waterbodies
SCALE
0 2.5 5 10 15 20
Kilometers

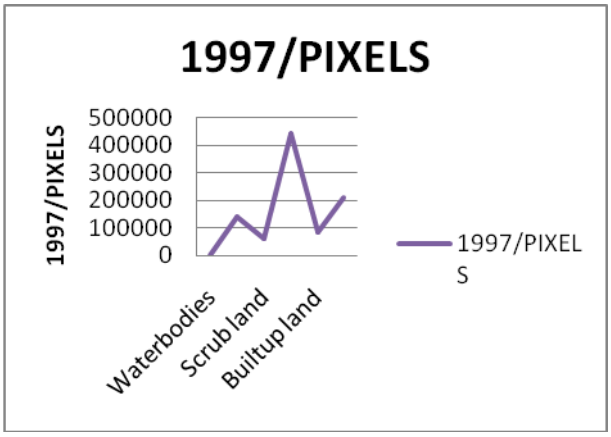
5. CHARTS AND TABLES BASED ON LANDCOVER/LANDUSE

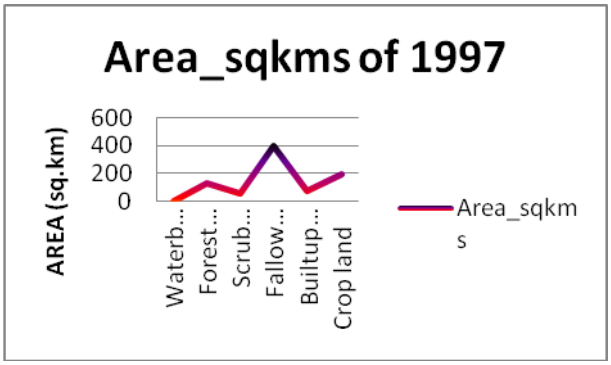
5.1 LANDUSE/LANDCOVER OF 1997

LU/LC	1997/PIXELS	AREA sqkms	PERCENTAGE
Water bodies	3060	2.754	0.325213966
Forest land	138619	124.7571	14.73229895
Scrub land	63135	56.8215	6.709929335
Fallow land	444143	399.7287	47.20310675
Built-up land	83302	74.9718	8.85325942
Crop land	208660	187.794	22.17619157
Total		**846.8271**	**100**

5.2 CHARTS OF 1997



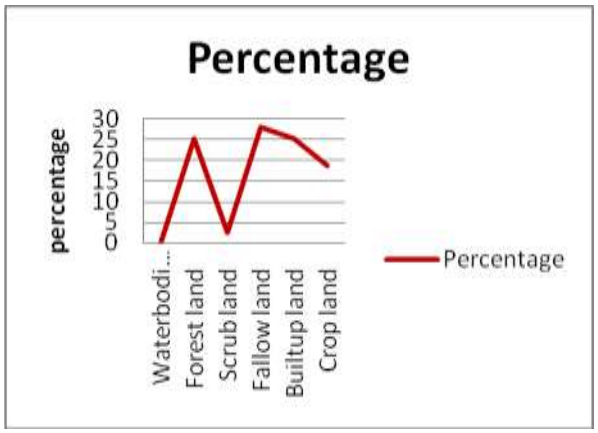


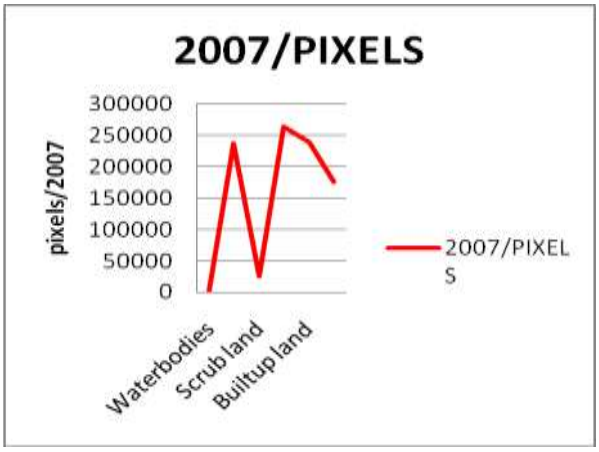


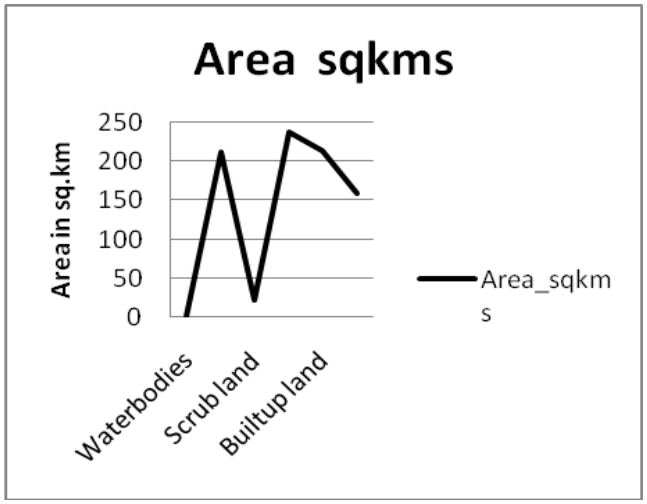
5.3 LANDUSE/LANDCOVER OF 2007

LU/LC	*2007/PIXELS*	*AREA sqkms*	*PERCENTAGE*
Water bodies	*2007*	*1.8063*	*0.213302101*
Forest land	*235942*	*212.3478*	*25.07569727*
Scrub land	*25398*	*22.8582*	*2.699275921*
Fallow land	*263531*	*237.1779*	*28.00783064*
Built-up land	*237779*	*214.0011*	*25.27093193*
Crop land	*176262*	*158.6358*	*18.73296214*
TOTAL		***846.8271***	***100***

5.4 CHARTS OF 2007



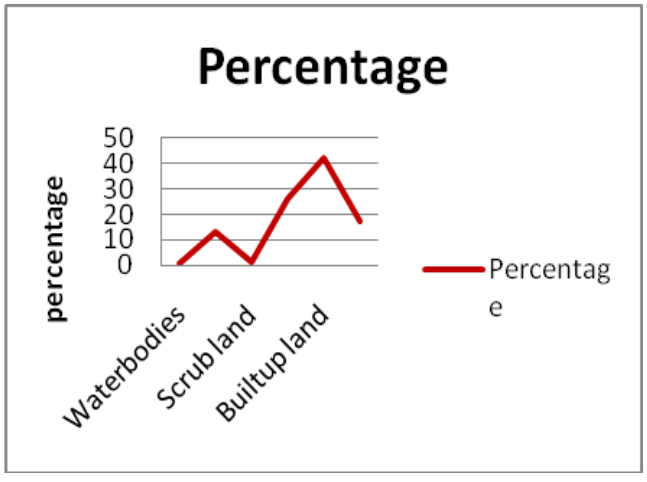


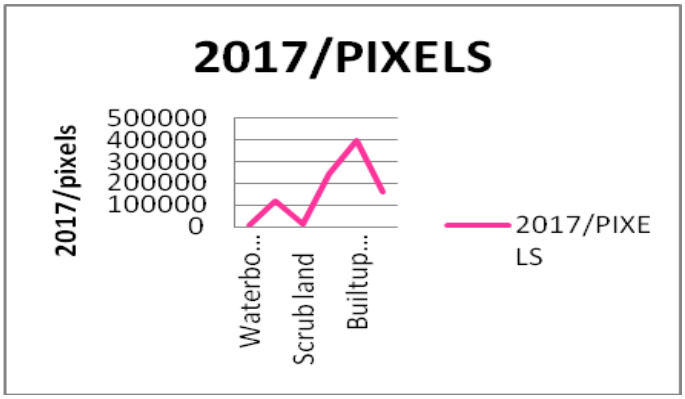


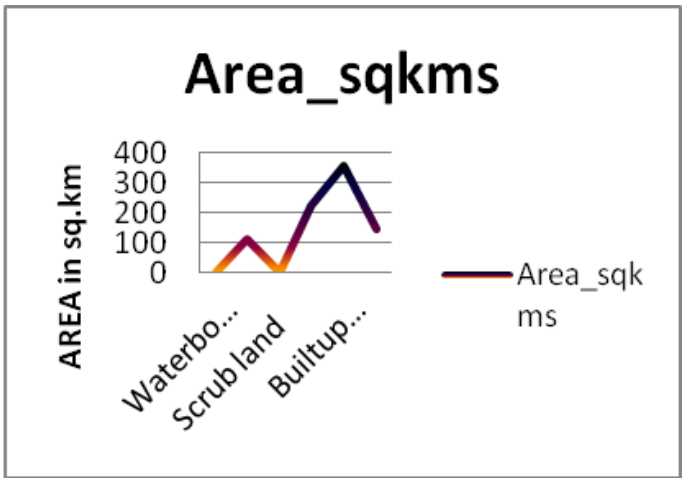
5.5 LANDUSE/LANDCOVER OF 2017

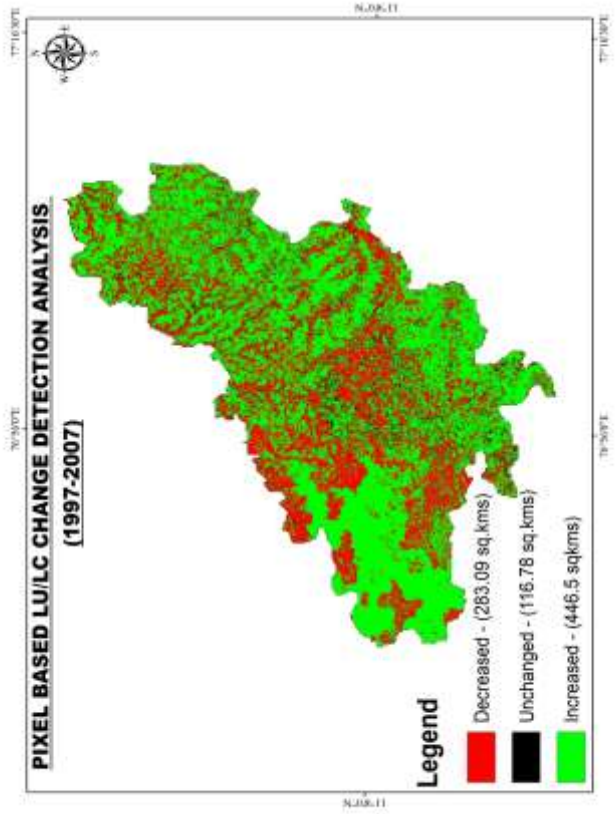
Lu/lc	*2017/PIXELS*	*Area_sqkms*	*Percentage*
Water bodies	*5768*	*5.1912*	*0.613018*
Forest land	*121042*	*108.9378*	*12.86423*
Scrub land	*8974*	*8.0766*	*0.953748*
Fallow land	*244846*	*220.3614*	*26.02201*
Built-up land	*398175*	*358.3575*	*42.31767*
Crop land	*162114*	*145.9026*	*17.22933*
Total		***846.8271***	***100***

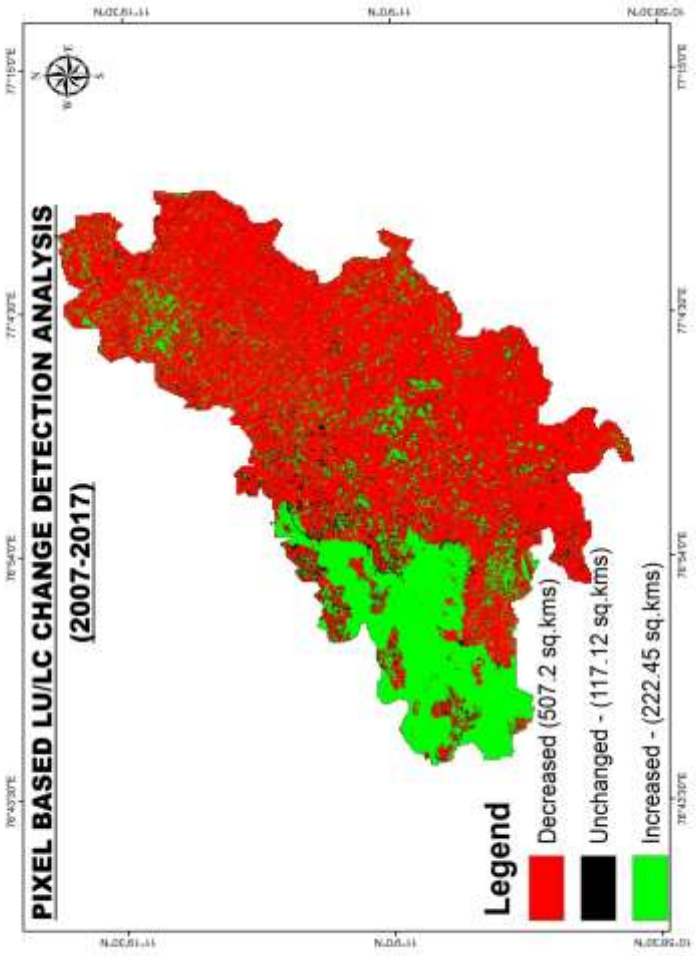
5.6 CHARTS OF2017




2017/PIXELS
2017/pixels
500000
400000
300000
200000
100000
0
Waterbo...
Scrub land
Builtup...
2017/PIXELS

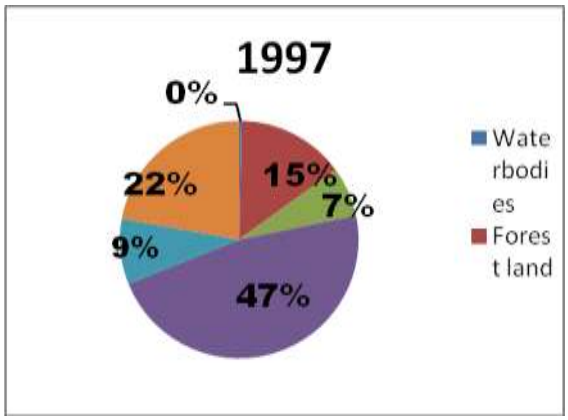

Area_sqkms
AREA in sq.km
400
300
200
100
0
Waterbo...
Scrub land
Builtup...
Area_sqkms

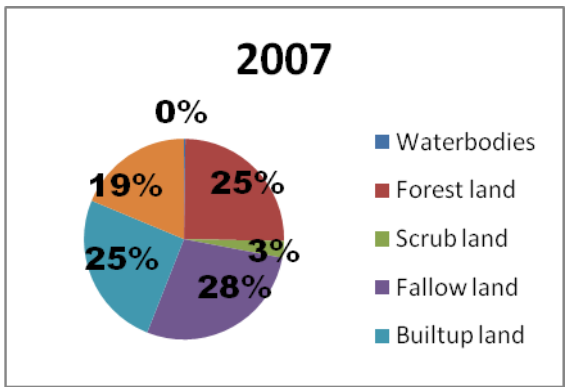

PIXEL BASED LU/LC CHANGE DETECTION ANALYSIS
(1997-2007)
Legend
Decreased - (283.09 sq.kms)
Unchanged - (116.78 sq.kms)
Increased - (446.5 sqkms)



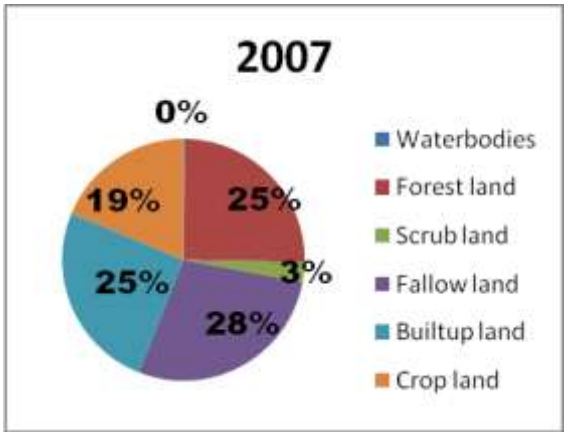
5.7 CHART COMPARISON

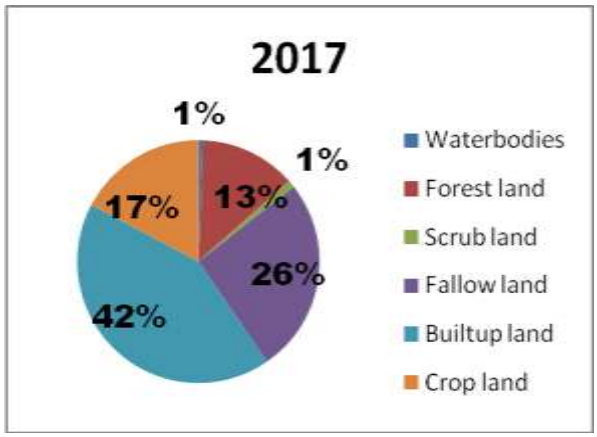
5.7.1 COMPARISON OF CHART (1997-2007)





5.7.2 COMPARISON OF CHART (2007-2017)





CONCLUSION

The study was carried out in the northern parts of Coimbatore, which is considered as the taluk region . The study clearly established that the satellite remote sensing coupled with GIS can be a powerful tool for mapping and evaluation of land use/land cover changes of a given area. The significant changes in the land use/land cover during the study period between the years 1997 to 2007 recorded some interesting observations. The study revealed that the major changes occurred in cropland, wet logged , scrub land and fallow land. The features namely crop land and tanks indicated a decreasing trend where as the features like fallow land and areas under built-up area, forest land and the other settlements indicated an increasing trend. The reasons attributed for this are due to the changes in the pattern of agricultural activity and increased activity of urban development. In general, the land use/land cover data during the study period (1997-2007) of the study area indicated certain significant changes which may not show any significant environmental impact. However, these trends need to be closely monitored for the sustainability of environment in future. Residential / Commercial / Industries (built-up) areas were found to occupy the highest area compared to other land use categories . Fallow land and crop lands were noticed in all parts of the study area in the past decade and the way of development in the future decade (present). Change

detection analysis brings out the actual land loss and land gain on Residential / Commercial / Industrial, Mixed urban, Crop land, Plantation and Land with scrub. Of course, the aerial extent of water body such as tank system has been maintained without neither any loss nor gain during 1997 and 2017. It was also observed that the increase in built-up area has caused the major change of crop land, land with scrub and plantation into Residential / Commercial / Industrial area, mixed urban and other urban areas in Coimbatore north districts. ERADIS IMAGINE and ArcGIS had take on hand with classification of various land pattern and shows the classified areas and the changes of two decades.

Hence, the land use, landcover patterns and the urban development are clearly mapped and the patterns are classified using ArcGIS and ERADIS IMAGINE with the extracted data's from United States Geographic Survey .The LU/LC has shown the classification with 30 metres of spatial resolution and the image interpretation shows the six categories of the land usage and patterns ,which also proves the urban growth and the industrial usage.

Change detection analyses shows the increase and decrease land changes, when it is compared with other decades and the centurial changes .The unchanged areas are least in the ratio in comparison with increase and decrease land changes .The decade of 1997-2007 shows the increase land usage in the high area occupancy and the second decade of 2007-2017 shows the decrease area of land usage over large spread in the study region.

The line charts plotted represents the rise and fall ratio of 1997,2007 and 2017.The pie chart represents the change detection over the two decades such as 1997-2007 and 2007-2017 using pixel bases analyses over the study region.

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By

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Junior Research member: Mr.B.Anand

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