International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163
Issue 3, Volume 2 (March 2015) www.ijirae.com

STUDY OF LAND USE CHANGES AND URBAN EXPANSION OF VIJAYAWADA CITY USING REMOTE SENSING DATA

K. SUNDARA KUMAR[1]*, MANOJ KUMAR KALURI[2], LEELA GOWTHAMI GAJULA[3], SUDHEESH VANGURU[4] & SHANMUKA SAI GUTTA[5]
[1]*Associate Professor and Head, Department of Civil Engineering,*
[2-6] *Final B.Tech., Usha Rama College of Engineering & Technology,*
Telaprolu, Krishna District, Andhra Pradesh, India

ABSTRACT- ***Urban expansion has increased the exploitation of natural resources and has changed land use and land cover patterns. Land cover change is a major concern of global environment change. The modeling of land cover change is essential to the assessment of consequent environmental impacts. In this work Vijayawada city is taken as case study to observe the extent of urban sprawl in 40 years from 1973 to 2013. Landsat images of Vijayawada city for 1973 MSS, and for 2013 OLI-TIRS which were, rectified and registered in Universal Transverse Mercator (UTM) of zone 44 N, are collected from USGS. The Toposheet and city map are geo-referenced and converted into UTM for sub setting the study area from the Landsat image. After image pre-processing, supervised image classification has been performed to classify the images in different land use categories. Four land use classes have been identified: Urban (Built-up), Light vegetation, Dense vegetation, and Open or Barren land. Change detection analysis shows that there is an increase in built-up area by 308.59% and light vegetation or grass land area 53.97%. Also there is a decrease in dense vegetation area by 24.86% and open land or barren area by 54.57%. Information on urban growth, land use and land cover change study is very useful to local government and urban planners for the betterment of future plans of sustainable development of the city.***

Keywords: Urban sprawl, Remote sensing, Image classification, Change Detection, Land use, Landsat imagery.

1. INTRODUCTION

Vijayawada is the largest city in Andhra Pradesh and new capital for the state. It is experiencing a rapid urbanization.Urban growth and sprawl has severely altered the biophysical environment. Land-use and land-cover change, as one of the main driving forces of global environmental change, is central to the sustainable development debate. Land use and land-cover changes have impacts on a wide range of environmental and landscape attributes including the quality of water, land and air resources, ecosystem processes and function, and the climate system itself through greenhouse gas fluxes and surface effects.[1] The land use/land cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure Land use and land cover change is scalar dynamic.[2] The change is land cover occurs even in the absence of human activities through natural processes where as land use change is the manipulation of land cover by human being for multiple purposes- food, fuel wood, timber, fodder, leaf, litter, medicine, raw materials and recreation.[3] So many socio-economic and environmental factors are involved for the change in land use and land cover.

Land use and land cover change has been reviewed from different perspectives in order to identify the drivers of land use and land cover change, their process and consequences. Urban growth, land use and land cover change study is very useful to local government and urban planner for the betterment plan of sustainable development.[4] Urban growth, particularly the movement of residential and commercial land to rural areas at the periphery of metropolitan areas, has long been considered a sign of regional economic vitality. But, its benefits are increasingly balanced against ecosystem impacts, including degradation of air and water quality and loss of farmland and forests, and socioeconomic effects of economic disparities, social fragmentation and infrastructure costs.[5,6]

2. STUDY AREA

Vijayawada is a historical city situated at the geographical centre of Andhra Pradesh state and it has the Krishna River flowing through the city. It is also a major railway junction connecting all states in the country. The population growth has been rapid registering almost three fold increase in 3 decades ending 2001 with a population account of 8.45lakhs. the overall gross density as of 2001 was 13600 per sq km where as the net density was 25700 per sq km. Vijayawada municipality was set up in 1888 with an area around 30 sq km has now spread to 61.88 sq km and inclusive of the contiguous suburbs like Gollapudi, Nunna, Kanuru, Poranki, Tadigadappa, Enamalakuduru and Ramarvappadu commands a total development area of 87.32 sq km. As per the master plan of Vijayawada municipal corporation, the land use composition in Vijayawada city covering 61.88 sq.km comprises of 37.53 sq.km as developed area and 24.35

sq.km in undeveloped area. Where 46 % of it is occupied by residential land use 23% is for transportation and communication. 12 % is for public and semi public use. The location of the study area is shown in Fig.1 (a) and the city map collected from municipal corporation is shown in Fig,1(b).

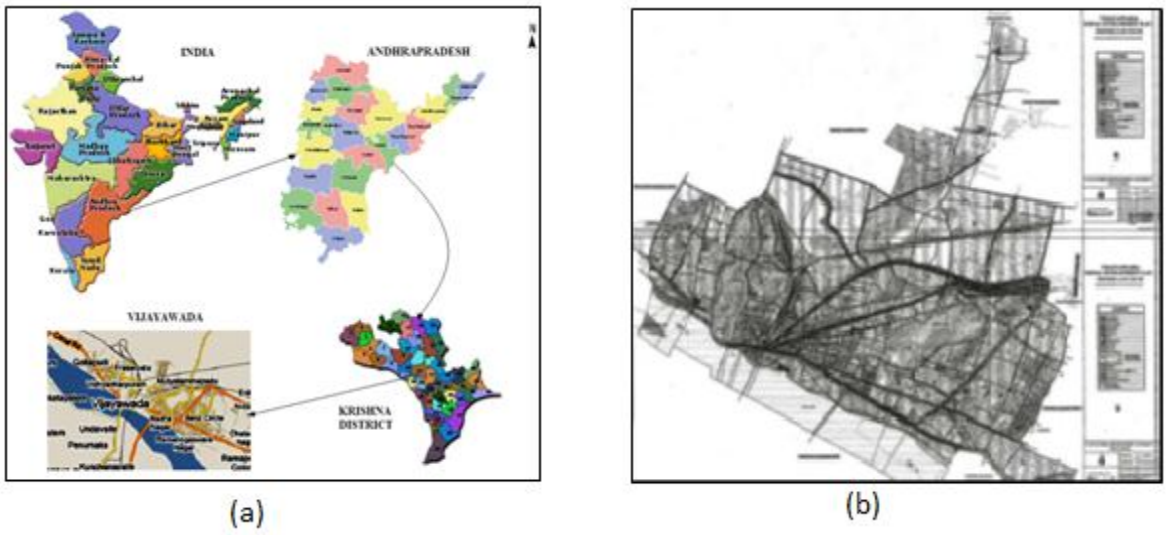

Fig.1. (a) Location of the study area (b) City map

3. METHODOLOGY

The present study involves the collection of Toposheet, city map from relevant authorities. The required satellite imagery for the study area is to be down loaded from the USGS Earth Explorer. Processing the imagery and image interpretation for development of Land use and Land cover maps is to be done. The obtained maps are to be studied and analyzed to detect the change in urban expansion and urban sprawl. The methodology adopted is shown in the Fig.2.

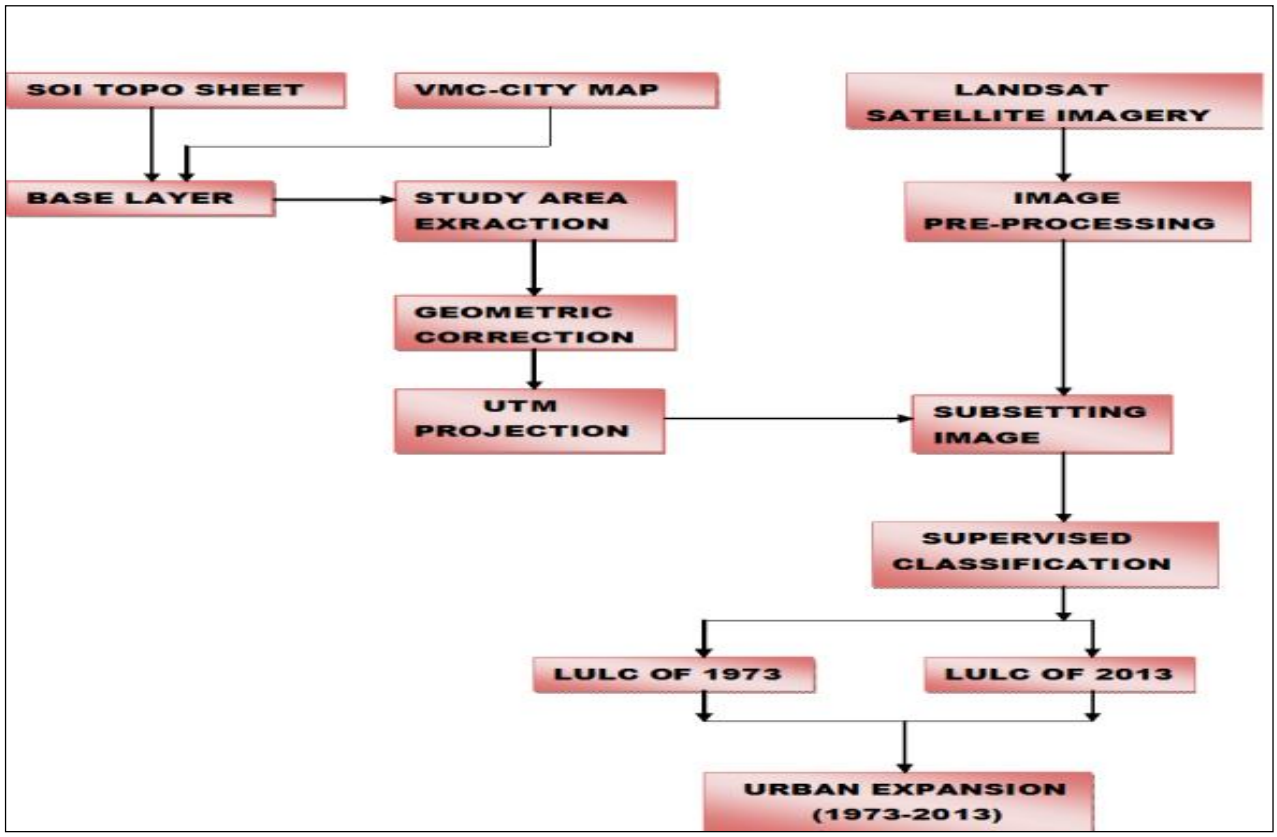

Fig.2. Methodology adopted in this work

3.1 DATA COLLECTION

We have collected the Toposheets of Vijayawada of scale 1:50,000 with number 65 D/10. We have collected the city plan and data from the Vijayawada municipal corporation. Landsat Images were collected from official web site of USGS. Landsat I Multi Spectral Scanner satellite image (MSS) with path /row 153/49 of the year 1973 and Landsat VIII Operational Land Imager Thermal Infrared Sensor (OLI-TIRS) Image with path/ row 142/49, of the year 2013 has been down loaded from Earth explorer web site of USGS. The Vijayawada city located in Krishna district falls under the Zone 44.The Landsat images of 1973 and 2013 were shown in Fig. 3(a) &3(b) and cut images are shown in Fig.3(c) &(d).. All data were used in this study were projected to the Universal Transverse Mercator (UTM) projection system with WGS 84 geo reference system.

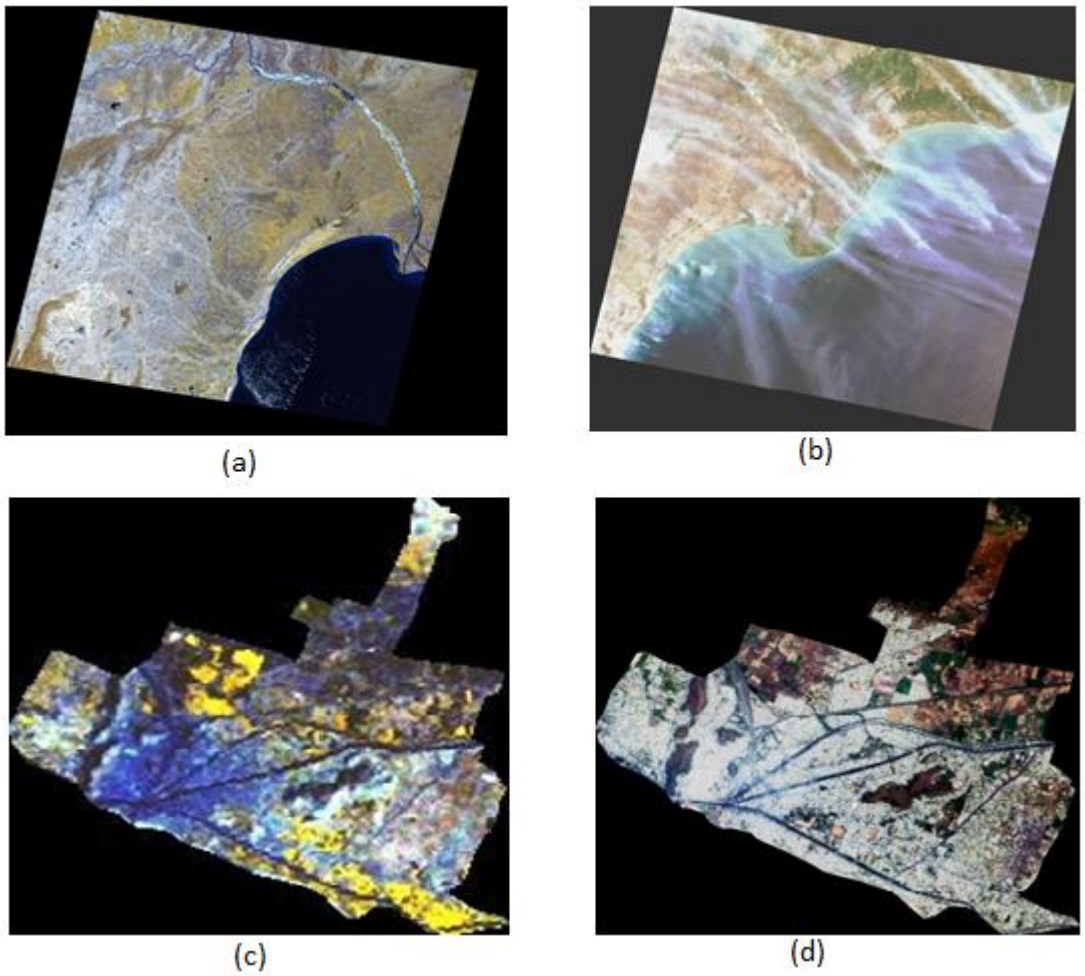

Fig.3. (a) Landsat images of 1973 (b) Landsat images of 2013 (c) Cut image of 1973(d) Cut image of 2013

3.2 IMAGE PREPROCESSING

After downloading the images required for the present work, they image pre processing was performed to make them suitable for interpretation. The image processing software ERDAS 9.1 was used for this work. Using this area of interest the satellite imagery were subset so that only Vijayawada area remains in the image. Now the image is ready for classification.

3.3 CLASSIFICATION OF IMAGES

The classification of the satellite images is done by two ways: unsupervised and supervised. In the unsupervised classification, by giving the number of classes the software itself will do the classification, where as in supervised classification we define the training data (or signature) that tells the software what types of pixels to select for certain land use.

3.4 LAND USE AND LAND COVER IMAGE DEVELOPMENT

The supervised classification involves picking up of the pixels of known land use class to develop training sites which are called signatures of a particular class. We have to develop as much number of training sites as we can so that number of signatures was sufficient for number of classes required. For the reference Google Earth has been used to observe the land use type for the present date. The resulting image is called land use land cover image. These images provide the information about the land use pattern of the study area.

4. RESULTS AND DISCUSSION

The classified images obtained after preprocessing and supervised classification which are showing the land use and land cover of the Vijayawada city are given in the following figures viz., Fig.4(a) and 4(b). The red colour represents the urban built-up area, dark green colour shows the dense vegetation area which maybe agriculture or forest area, light green colour shows the light vegetative areas like grass land and brown colour represents the barren or open land including hills. The main objective of the present study is to observe the expansion occurred in the built-up or urban area which is known as urban sprawl over the past 40 years. Hence the land use land cover images of past (1973) and present (2013) were developed for comparison. There is a significant change that was taken place in all the four classes of the land use selected.

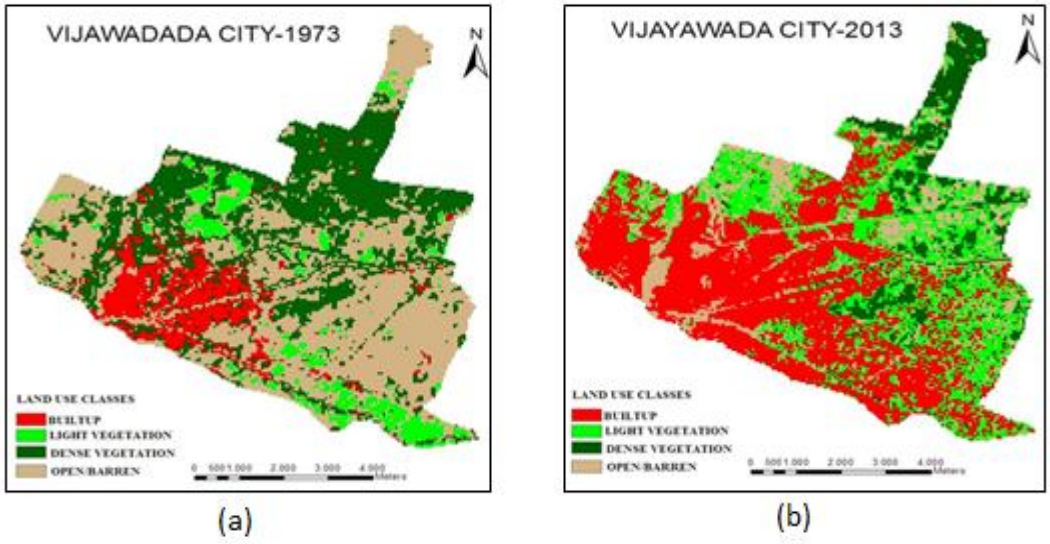

Fig.4. (a) Land use land cover image of 1973 (b) Land use land cover image of 2013

Table.1 Change Detection Analysis

Land Use Class	Area in Hectares		Change in area(Hectares)	% Change
	1973	2013	1973- 2013	
Built-up	617.63	2523.6	1905.98	308.59
Light Vegetation	408.07	628.31	220.24	53.97
Dense Vegetation	1985.4	1491.8	-493.57	-24.86
Open land	2991.4	1358.7	-1632.65	-54.57
Total Area	6002.4	6002.4	--	--

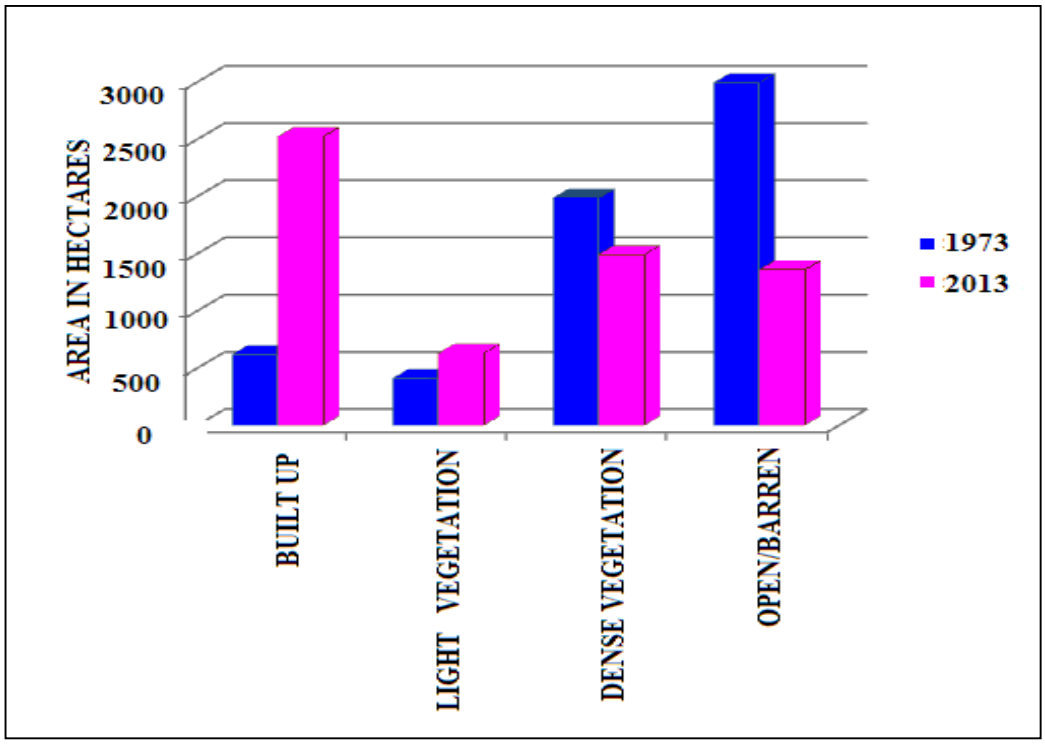

Fig.5. Land use land cover statistics derived from classified images

4.1 CHANGE DETECTION

Change detection analyses describes and quantify differences between images of the same scene at different times. The built-up area been changed drastically from 1973 to 2013. Built-up area has been increased by 308.59%, dense vegetation like agricultural and forest area has been decreased by 24.86%. Light vegetation area like grass land has been increased by 53.97%. This is due to the growth of grass and other plants on the abandoned agricultural lands. Open or barren area was reduced by 54.57%. This is due to the urban expansion. The increase in built-up area has many reasons. Vijayawada is famous for educational institutions, large numbers of institutions are coming in to existence and corresponding infrastructure development leads to the increase of built-up area. Increase in merchant establishments and industrial areas are contributing o the loss of agriculture area. It was observed that Eutrophication phenomena is taking place in all the lakes and small water bodies are disappeared because of the deposition of sediments and indiscriminate dumping of solid waste. The results of change detection analysis are presented in the Table.1. The land use statistics derived from the classified images are shown in Fig.5 in the form of a bar chart.

4.2 ANALYSIS

Urban or built-up area has been increased by 3 times in the span of 40 years and most of the built-up area spread parallel to the Krishna river from Gollapudi to Poranki. There is little development perpendicular to the stretch parallel to the Krishna river. There is lot of scope for urban development in this direction. The remarkable increase in the light vegetation or grass land indicates the conversion of agricultural lands to sites for real estate. This land covered with soil develops grass and other light vegetation before any construction taken place in that area. The decrease in barren area is due to the construction of residential buildings.

The reduction in greenery and increase in built-up area may cause the urban environment un-sustainable. This is mainly due to the development of urban heat island, accumulation of solid wastes, increase in noise pollution, surface runoff drainage problems etc. Proper planning is required to manage the urban environment so that the city dwellers do not face discomfort. Development of greenery through social forestry, development of green belts on either side along the road lines, restriction on conversion of agricultural area in to construction site are some of the measures that can be helpful for sustainable development of the city.

5. CONCLUSION

The urban sprawl is seen as one of the potential threats to sustainable development where urban planning with effective resource utilization and allocation of infrastructure initiatives are key concerns. This study attempted to identify such urban sprawls change for 1973-2013. Remote sensing has the capability of monitoring such changes, extracting the change in information from satellite data. In this work we have taken Landsat images of Vijayawada city collected from USGS earth explorer web site. The images of 1973 MSS, and 2013 OLI-TIRS which are, rectified, registered and projected in Universal Transverse Mercator (UTM), are obtained. The land use land cover maps of the study area are developed by supervised classification of the images. Four land use classes have been identified: Urban (Built-up), Light vegetation, Dense vegetation, and Open or Barren land. Change detection analysis shows that there is a remarkable increase in built-up area by 308.59% and light vegetation or grass land area 53.97%. This is due to the growth of real estate activities and industrial developments in the city. Also there is a decrease in dense vegetation area by 24.86% and open land or barren area by 54.57%. Information on land use / land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population.

6. ACKNOWLEDGMENT

We express our sincere thanks to the United States Geological Survey (USGS) for supplying Landsat imagery for the study area of the present work. We thank the Survey of India for supply of Toposheets. We thank Municipal Corporation of Vijayawada for providing the master plan of Vijayawada city.

7. REFERENCES

[1] K. C. Seto, C. E. Woodcock, C. Song, X. Huang, J. Lu And R. K. Kaufmann (2002), Monitoring land-use change in the Pearl River Delta using Landsat TM,Int. J. Remote Sensing, Vol. 23, No. 10, 1985–2004.

[2] J.Li and H.M.Zhao, (2003), Detecting Urban Land Use and Land Cover Changes in Mississauga using Landsat TM images, 2(1), 38-47.

[3] S.Tamilenthi1, J. Punithavathi1, R. Baskaran1 and K. Chandra Mohan (2011), Dynamics of urban sprawl, changing Salem city, Tamilnadu, India, Achieves of Applied Science Research, 3(1):277-286

[4] Shdhira, T.V Ramachandra and K.S. Jagadeesh (2004),Urban sprawl: metrics, dynamics and modelling using GIS, International Journal of Applied Earth Observation and Geoinformation,5,29-39

[5] M. Turker and O.Asik, (2005), Land Use Change Detection At The Rural- Urban Fringe Using Multi-Sensor Data In Ankara, Turkey, International Journal of Geoinformatics, Vol.1, No.3.

[6] Bassam Saleh and Samih Al Rawashdeh (2007),Study of Urban Expansion in Jordanian Cities Using GIS and Remote Sensing, International Journal of Applied Science and Engineering,5,1:41-52

