(IJRST) 2016, Vol. No. 6, Issue No. III, Jul-Sep **e-ISSN: 2249-0604, p-ISSN: 2454-180X**

LAND USE/LAND COVER CHANGE PREDICTION USING CLUE-S MODEL

***Miss.Maria Jobi Sahana.C, *Miss.J.Jacinth Jennifer, *Miss.S.Vanmathy**
**PG student: Department of Civil Engineering,*
Anna University Regional Campus
Tirunelveli, India

ABSTRACT

Rapid urban expansion has been experienced in cities and hence prediction of future is very useful for urban planning and management of environment of the cities that are rapidly growing. In this study Tirunelveli and Palayamkottai taluk regions are considered and their urban expansion for the past 10 years has been studied to predict the future urban expansion in the year 2025 using the CLUE-S model. Landsat satellite images of 2005 and 2015 are used for this study. After processing the imagery, land use land cover images are developed in Arc GIS and the logistic regressions using SPSS software were also conducted to evaluate the relationships between the land use and its driving factors. The output images are used for predicting the future land use land cover. An accuracy of more than 80% was obtained in every stage.

Keywords: Land use land cover, Landsat imagery, CLUE-S model, driving factors, SPSS, logistic regression, Arc GIS, Prediction, Urban expansion

INTRODUCTION

Land use land cover change is an important driver for the changes in the environment on all the spatial and temporal scales. The land use land cover pattern of a region is the result of the natural and socio economic factors and their utilization by mankind in time. Land cover refers to the observed bio physical cover on the earth's surface and the immediate subsurface. Land use is the intended employment and management underlying human exploitation of a land cover. It is characterized by the arrangements, activities and the input people undertake in a certain land cover type to produce, change or maintain it. Consequently, there is a link between land cover and the human activities in the environment because contemporary land cover is changed mostly by human. Land use land cover change is an important factor for many management and planning activities. A remote sensing technique along with the geographical information systems has been found to be a powerful and cost effective tool in detecting the land use land cover change. Satellite remote sensing provides both multi-temporal and multi-spectral data in a cost effective way and they are transformed into valuable information for monitoring the development patterns for the various land use/land cover. The GIS technology provides an environment that is flexible for analyzing, storing and displaying digital data that are required for the change detection.

The prediction of the future land use land cover research carried out plays a vital role in urban planning and environmental management activities. Modeling of land use land cover is

rapidly growing in the scientific field. There are a variety of modeling tools and techniques to predict the future land use land cover among which the most commonly used models are the Markov chain, GEOMOD, Cellular Automata (CA), Land Change Modeler (LCM), etc.

For this study, the Prediction of the future land use land cover is performed by using The Conversion of Land Use/Land Cover and its Effects for a Small Region (CLUE-S) model. Tirunelveli taluk and the palaymkottai taluk regions are considered as the study area. By comparing with the change detection in the land use land cover that has occurred in the past ten years (2005-2015) in the study area, the future land use land cover prediction map for the year 2025 is generated depending upon its driving factors. The resulting output map shows the rapid urbanization that occurs in the study area. This study is very essential for the purpose of urban planning.

CLUE-S MODEL

CLUE-S model (Conversion of Land Use and its Effects of Small District) which was built based on CLUE model by Verburg and other scholars in 2002 has been successfully applied into regional LULC research. CLUE-S model is divided into two modules as shown in figure 1. One is non-space module, other is space module. By analyzing the LULC drivers, non-space modules calculates demand in different types of land use changes in the study area each year, then the space module will distribute the changes to suitable areas to suitable areas to get the spatial LULC simulation according to land cover features which affect the spatial distribution.

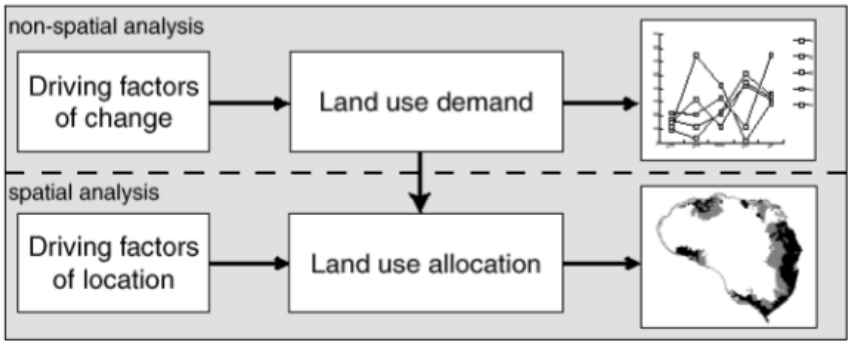

Figure 1. Structure of CLUE-S model

STUDY AREA DESCRIPTION

Tirunelveli taluk and Palayamkottai taluk regions are located in Tirunelveli district which is located in the southern part of Tamil Nadu. The geographical extension of the study area is (Latitude of $8^{o}05'$N to $9^{o}30'$N and Longitude of $77^{o}05'$E to $78^{o}25'$E) which consists of 6823 Km^2 geographical area. The district is irrigated by several rivers originating in the Western Ghats which flows into the perennial Tambaraparani River. The Tambaraparani River divides the Tirunelveli and palayamkottai area. The district contains mountains and lowland plains, including sandy, clayey and loamy soil and a variety of flora and fauna. The district experiences rainfall benefits from both northeast and southwest monsoons. Most precipitation

(IJRST) 2016, Vol. No. 6, Issue No. III, Jul-Sep **e-ISSN: 2249-0604, p-ISSN: 2454-180X**

comes from the northeast monsoon (548.7mm) followed by the southwest monsoon (147.8mm) and summer rains (184.2mm). The climate is generally hot and humid. The average temperature during summer (March to June) ranges from 25^0C to 41^0C and 18^0C to 29^0C during the rest of the year. The district has a population of 3,077,233. The district has an extensive transport network and is well connected to other major cities by road, rail and air.

DATA DESCRIPTION

Data gathering is often the most time consuming aspect of the CLUE-S model. Both bio-physical as well as socio-economic data are needed; many sources must be consulted to complete the data set. Not only maps but also spatially explicit tabular data connected to map layers (e.g. census data) can be used. It is, of course, important that the spatial resolution of the different data sources is comparable.

SPATIAL DATA

Landsat satellite images are downloaded from USGS earth explorer website. Landsat satellite equipped with Enhanced Thematic Mapper Plus (ETM+). The observation bands are essentially the seven bands as TM, the newly added panchromatic band 8, with a high resolution 15m was added. The satellite image collects images of earth with 16-day repeat cycle, referenced to the Worldwide Reference System-2. The image data are radiometrically and geometrically corrected and are available in GeoTIFF. The figure 2 shows the Landsat image of Tirunelveli taluk and palaymkottai taluk regions for the years 2005 and 2015.

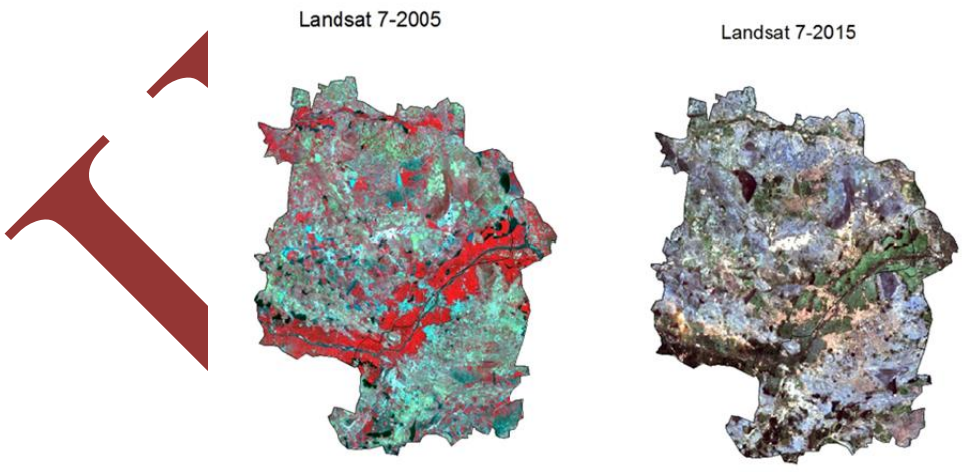

Figure 2. Landsat 7 data of Tirunelveli & Palayamkottai taluk for 2005 & 2015

NON-SPATIAL DATA

Based upon the input for the CLUE-S model the simulation of dynamics of spatial pattern of the land use land cover types, both bio-physical (soil) and socio-economic (population density) parameters are considered as important potential drivers causing changes in the land

(IJRST) 2016, Vol. No. 6, Issue No. III, Jul-Sep e-ISSN: 2249-0604, p-ISSN: 2454-180X

use land cover pattern. Since CLUE-S model relates the land use land cover and its related driving factors and predicts the future changes that would occur.

SOFTWARE USED

This study uses the following softwares for processing and then creating relation between the drive factors and thus predicts the output result using Arc GIS 9.3, SPSS, Erdas Imagine 14.

METHODOLOGY

The land use land cover classification is performed from the satellite images for the years 2005 and 2015 using Arc GIS 9.3 and the study area is finally classified into five categories: water body, settlement, agriculture, shrub land and barren land. Soil ph and population density are selected as the drive factors for study area. These drive factors are converted into the ASCII format and are then related to the land use land cover map to obtain the logistic regression variables that derives their relationship in the SPSS software and then the land conversion matrix is also generated. Finally the demand for the land use land cover is forecasted with the analysis that is obtained from the study of the past 10 years (2005-2015). The methodology flow chart is described in figure 3 below.

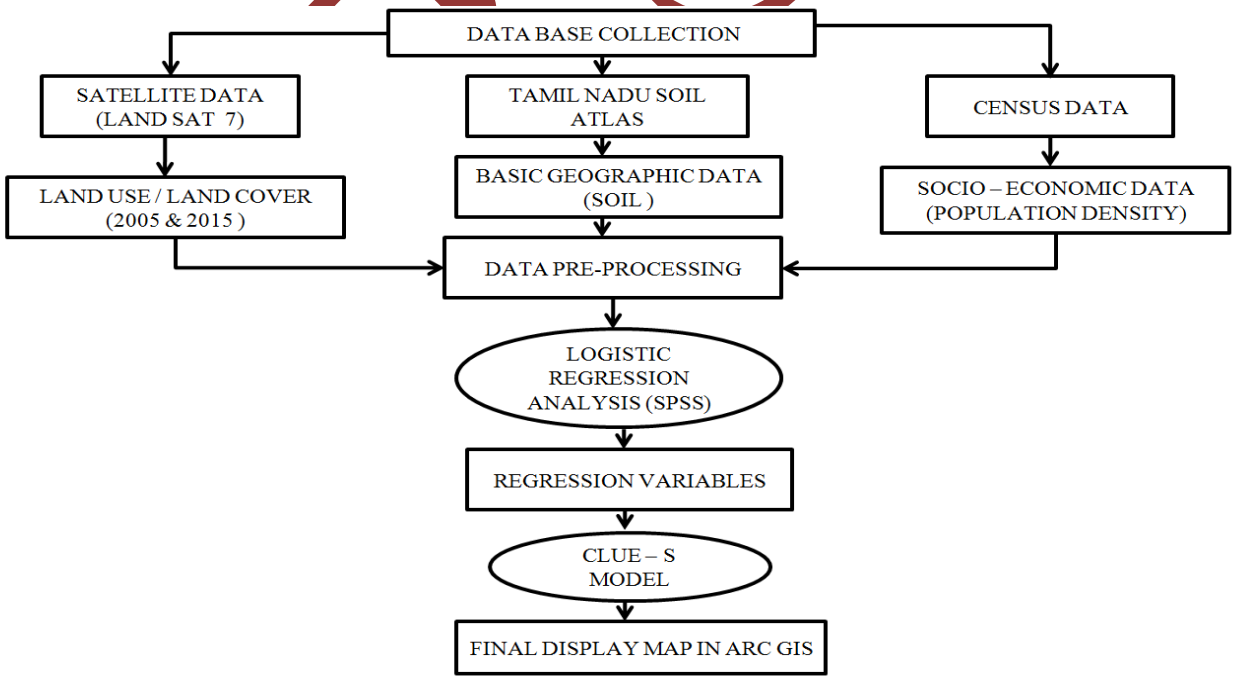

Figure 3. Methodology flow chart for future prediction

(IJRST) 2016, Vol. No. 6, Issue No. III, Jul-Sep **e-ISSN: 2249-0604, p-ISSN: 2454-180X**

RESULTS AND DISCUSSION

The output images of land use land cover and their analysis is presented. The land use land cover images generated for the years 2005 and 2015 along with the future predicted land use land cover image of the year 2025 are presented in the following figure 4. Table 1 shows the statistical change analysis of the land use land cover between the years 2005, 2015 and 2025. An overall change in the land use land cover in all the three years is shown in figure 5. From the change analysis of the land use land cover between 2005 and 2015 it is observed that there is an increase in settlement, barren land and shrub land and a decrease in water body and agriculture. The decreased land use land cover is mostly utilized for the settlement based upon the increase in population density.

A significant change has been occurred between the years 2015 and 2025. It is observed that there is a greater increase in the area of settlement. The barren land, shrub lands and the agricultural areas are converted into settlement regions due to the increase in population density and the soil conditions. Tirunelveli and palaymkottai taluk regions would experience rapid urbanization as predicted in the final output land use land cover image. This prediction would be an effective tool for urban planning and environmental management plans.

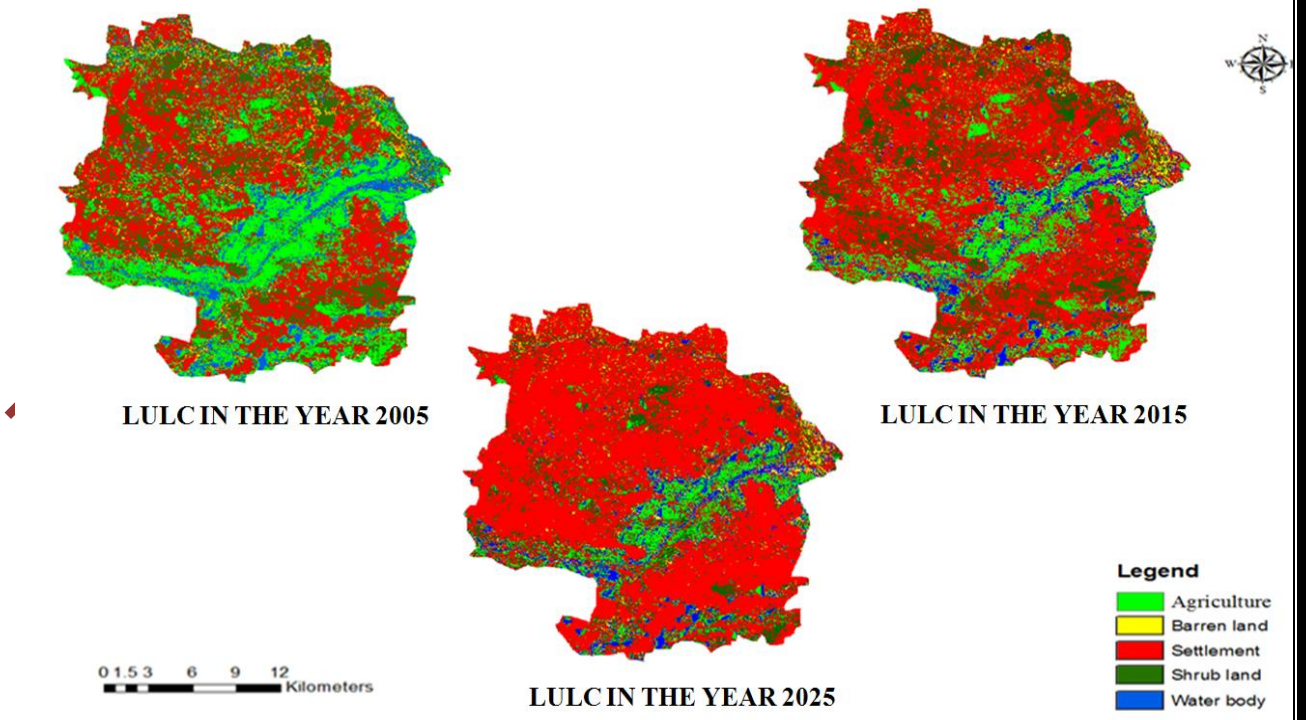

Figure 4. Land use land cover obtained for the different years

(IJRST) 2016, Vol. No. 6, Issue No. III, Jul-Sep e-ISSN: 2249-0604, p-ISSN: 2454-180X

LULC	Area in Sq.Kms		
	2005	2015	2025
Water body	186.761	95.164	77.208
Agriculture	301.298	182.740	136.460
Shrub land	151.591	201.398	116.686
Barren land	114.148	132.903	75.175
Settlement	108.177	248.732	457.220

Table 1. Change analysis of the land use land cover in the years 2005, 2015 and 2025

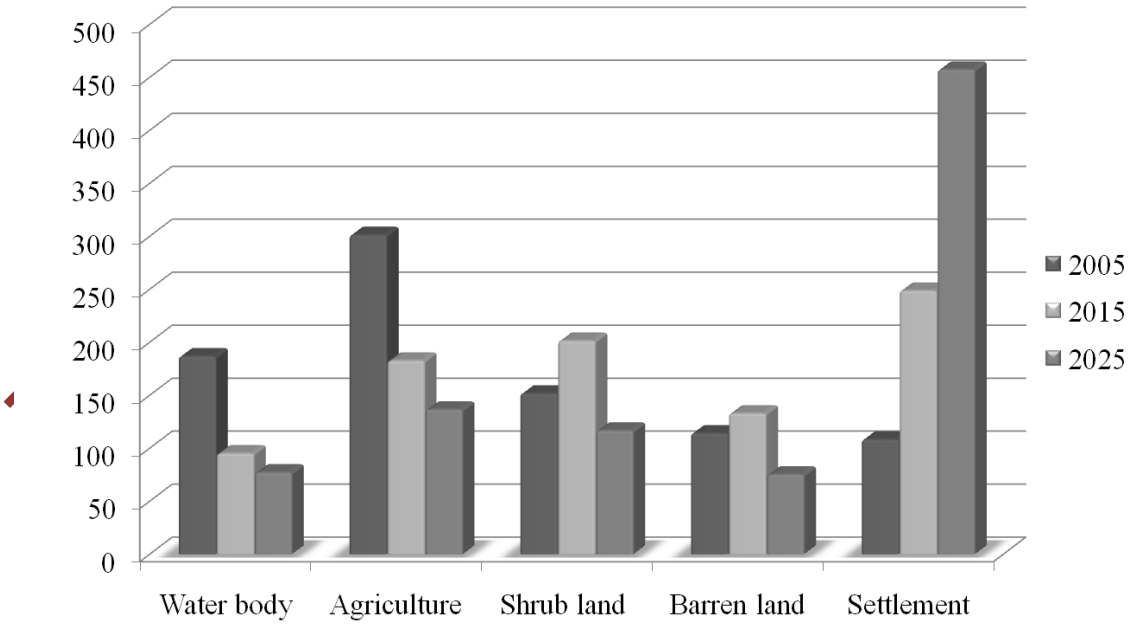

Figure 5. Land use land cover (LULC) changes in different years

CONCLUSION

In this work urban expansion of the rapidly growing regions Tirunelveli taluk and Palayamkottai taluk has been studied over the past 10 years (2005-2015) to predict the future urban expansion in the year 2025. Satellite images from Landsat for the years 2005 and 2015 are used for this study. The total area of the study area is 6823 square kilometers. Land use

land cover images are developed in ERDAS Imagine and the future land use land cover image was predicted using the CLUE-S model. The output results predict that there is a great increase in the growth of settlement due to the conversion of barren land, shrub land and agriculture land areas in the year 2025. An accuracy of more than 80% was obtained in all stages. This rapid and massive conversion of the agricultural and shrub land into settlement would lead to serious environmental impacts unless proper environmental management plans were implemented for the rapid urban area.

REFERENCES

[1] Guo Yanfeng, Yu Xiubo, Jiang Luguang, Zha Liangsong Scenarios analysis of land use change based on CLUE model in Jiangxi Province by 2030. Geographical Research, 2012, 31(6): 1016-10282..

[2] Liang Youjia, Xu Zhongmin, Zhong Fanglei. Land use scenario analyses by based on system dynamic model and CLUE-S model at regional scale: A case study of Ganzhou district of Zhangye city. Geographical Research, 2011, 30(3): 564-576.

[3] Verburg PH, Veldkamp A (2004) Projecting land use transitions at forest fringes in the Philippines at two spatial scales. Landscape Ecology 19:77-98.

[4] Verburg PH, Soepboer W, Limpiada R, Espaldon MVO, Sharifa M, Veldkamp A (2002) Land use change modelling at the regional scale: the CLUE-S model. Environmental Management 30: 391-405.

[5] Verburg PH, Schot P, Dijst M, Veldkampo A (2004) Land use change modelling: current practice and research priorities. GeoJournal 61:309-324 Veldkamp and E.F. Lambin. Editorial: Predicting land use change, Agriculture, Ecosystems and Environment, 2001,85: 1-6.