International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 12, Issue 7, 2020, pp.-9706-9709.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

EVALUATING URBANISATION BY LAND USE / LAND COVER CHANGE DETECTION IN COIMBATORE USING REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

BALAJI K.[1]*, KUMARAPERUMAL R.[2], RAGUNATH K.P.[2] AND JAGADEESWARAN R.[3]

[1]Department of Soil and Water Conservation Engineering, Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu, India

[2]Department of Remote Sensing and Geographic Information System, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu, India

[3]Agricultural College and Research Institute, Kudumiyanmalai, 622104, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu, India

*Corresponding Author: Email-balajikannan@tnau.ac.in

Received: March 30, 2020; Revised: April 12, 2020; Accepted: April 13, 2020; Published: April 15, 2020

Abstract: The fast expansion of built-up areas due to increase in population and economic growth is creating more demand on natural resources thereby causing dramatic changes in the Land Use and Land Cover (LULC). Remote sensing and GIS are ideal tools for understanding the changes in land use /land cover for any temporal resolution. The present work evaluates the LULC changes and urban expansion in Coimbatore, Tamil Nadu, India. Landsat 7 and Landsat 8 data has been used in this study for 2001 and 2014 respectively and analysis is done using Quantum GIS. The results indicate that the built-up area has been extensively increased during the study period, which indicates Urbanisation is on the growth in the study area.

Keywords: *Urbanisation, Remote sensing and GIS, LULC*

Citation: Balaji K., *et al*., (2020) Evaluating Urbanisation by Land Use / Land Cover Change Detection in Coimbatore Using Remote Sensing and Geographic Information System. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 12, Issue 7, pp.- 9706-9709.

Academic Editor / Reviewer: K. Balasubramani, Dr P K Bhanja

Introduction

Urbanisation is the increase in the number of people residing in the towns and cities. This occurs because people move from rural areas to urban areas for their better living. This usually occurs for any developing country. In India, urbanisation began to increase in the post-independence era, due to the country's acceptance of a mixed economy, which gave birth to the development of private industries. Urbanisation does occur at a faster rate in India. Population living in urban areas in India was 11.4% according to 1901 census. According to 2001 census, it has increased to 28.53% and stands as 31.16 % as per 2011 census [1]. The process of urbanisation, in general, is concerned with Satellite remote sensing, in conjunction with Geographic Information Systems (GIS), has been widely applied h conversion of cultivable lands into paved surfaces and hence leading to reduction in the greenery of the area. Urban development coupled with unsustainable land management practices has a great impact on the micro climate of an area and leads to creation of Urban Head Islands [2]. Since urban environments are largely influenced by anthropogenic activities, significantly more attention is presently being focussed on monitoring changes in urban land use and land cover (LULC) [3]. Ever increasing population in developing cities has caused swift changes in LULC and bigger environmental degradation [4]. Satellite remote sensing, in combination with Geographic Information Systems (GIS), has been extensively applied and been recognized as a powerful and effective tool in detecting land use and land cover change [5]. These kinds of studies are of paramount importance because the spatial characteristics of LULC are useful for understanding the various impacts of anthropogenic activity on the overall ecological scenario of the urban milieu [6]. Land cover is that which covers the surface of the earth and land use describes how the land is put to use. Land cover encompasses water, snow, grassland, forest, and bare soil. Land Use means agricultural, built-up, recreation area, wildlife management area, *etc*. Of late, remote sensing has been adopted for land use and land cover mapping in different parts of nation and also internationally across countries [7]. The advantage of using remote sensing and GIS is that it leads to study the phenomenon in land cover in less time, at low cost and with better accuracy. Also it provides efficient methods for analysis of land use problems and provides necessary tools for land use planning and modelling. In this present study, an investigation has been carried out in Coimbatore district which is getting urbanised at an alarming rate, also this area is well known for extensive development of industrial growth activity in recent years. However, there is no proper methodology and attempts to scientifically arrive at the proper facts and figures regarding the rate of urbanisation. In this study, the changing pattern of the land use land cover in Coimbatore district during the last decade is observed using remotely sensed data with the following objectives:

To prepare classified maps of land use / land over for Coimbatore during 2001 and 2014

Comparing two temporal classified maps to understand the change in land use and land cover

Materials and Methods

Study area

Coimbatore is a district in the Indian state of Tamil Nadu. It lies between 10°13.21' to 11°24.39'N latitude and 76°39.34' to 77°23.23'E longitude with an elevation of 411 metres above mean sea level on the banks of the Noyyal River, in western Tamil Nadu. It covers an area of 4555 km^2. According to 2011 census, Coimbatore city has a population of 34, 72,578 and with a population density of 572 km^{-2}. The map of study area is represented [Fig-1].

Data Used

Landsat 7 and Landsat 8 satellite images were used in this study.

The Orthorectified data are available for free download in the USGS Earth Explorer at http://earthexplorer.usgs.gov. The satellite data for Coimbatore district is covered under two tiles constituting the path-144 and rows-52 and 53. The satellite data for 2001 and 2014 has been downloaded from the above website and the details are given in [Table-1].

Table-1 *Satellite data download details*

Sensor	Year	Path /Row (144/52)		Path /Row (144/53)	
LANDSAT 7	2001	3rd March	30th November	3rd March	30th November
LANDSAT 8	2014	11thFebruary	18th May	11thFebruary	18th May

Fig-1 Map of study area

Software

Quantum GIS (QGIS) is a cross-platform free and open-source desktop geographic information system application that provides data viewing, editing, and analysis. QGIS 2.12.2-Lyon was used to process the data. Semi-Automatic Classification Plugin 4.3.3 was used for Image Classification and Change Detection.

Methodology

The methodology adopted for preparation of land use and land cover map are discussed in the following sections.

Pre-processing of satellite data

Semi-Automatic Classification Plugin (SCP) of QGIS was used for pre-processing. The pre-processing phase in the SCP automatically converts Landsat bands from Digital Numbers (DN) to reflectance. The Plugin have additional option for atmospheric correction using the DOS1 method (Dark Object Subtraction1). Dark Object Subtraction searches each band for the darkest pixel value.

Standard False Colour Composite

A standard false colour composite was created by stacking 3 raster layers (bands) to serve as a background image during selection of training samples and subsequent image classification. One band is displayed in shades of red, one in shades of green and one in shades of blue. To create RGB composite for Landsat 7, Band_2, Band_3, and Band_4 was used [Fig-2]. Similarly, for Landsat 8, Band_3, Band_4, and Band_5 was used. In QGIS, virtual raster option was used from the raster tool to create colour composite [Fig-3].

Land Use and Land Cover (LULC) Classification

The methodology for conversion of raw satellite data into Land Use and Land Cover classifies is as follows.

Creation of Training shape file and Regions of Interest (ROIs)

Training shape file was created from the ROI creation option of the SCP Plugin. Several ROIs were created according to the land cover classes. ROIs were created by manually drawing polygon for each class. The Land Use classes used for classification are defined in [Table-2].

Table-2 *Land Cover classes*

Class name	Class ID
Vegetation	1
Water	2
Built-up	3
Barren land	4

Fig-2 Standard False Colour Composite Landsat 7 acquired on 30th November, 2001

Fig-3 Standard False Colour Composite Landsat 8 acquired on date 18th May, 2014

Classification

Different classes will differ spectrally and hence the spectral signatures for classes were observed for its uniqueness. Once the selected classes had different spectral signatures then the classification procedures are initiated. Classification was performed using SCP Plugin. The output is a raster file (.tif) where each pixel value corresponds to a land cover class. The methodology of LULC classification followed in this study is depicted [Fig-4].

Results and Discussion

LULC Classification

The LULC change over a period of 13 years was analysed using temporal satellite image. The analysis was carried out for the year 2001 and 2014. Landsat 7 and Landsat 8 data acquired during 30th November 2001 and 18th May 2014 were used, respectively. The images were classified using the spectral angle mapping algorithm.

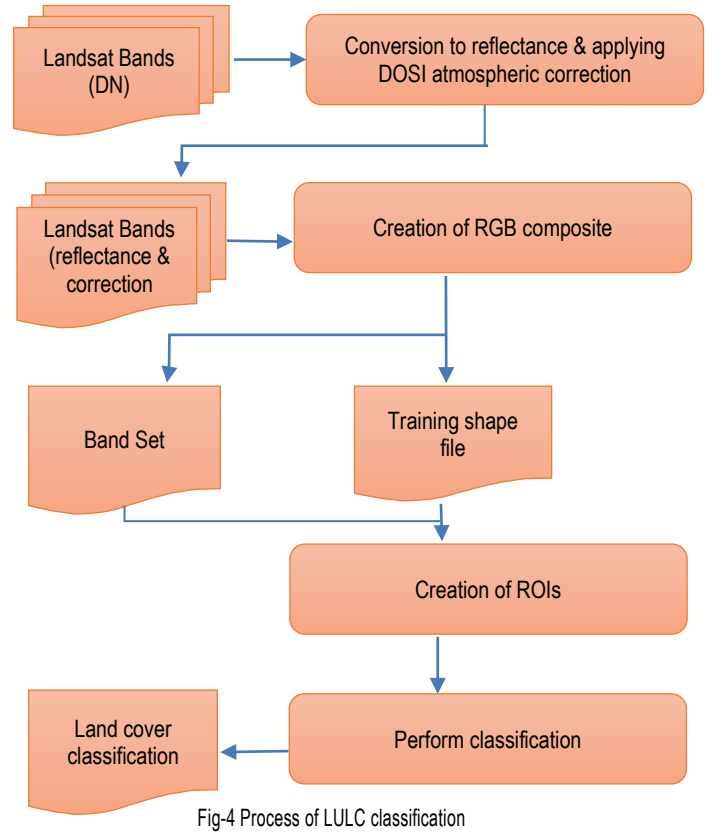

Fig-4 Process of LULC classification

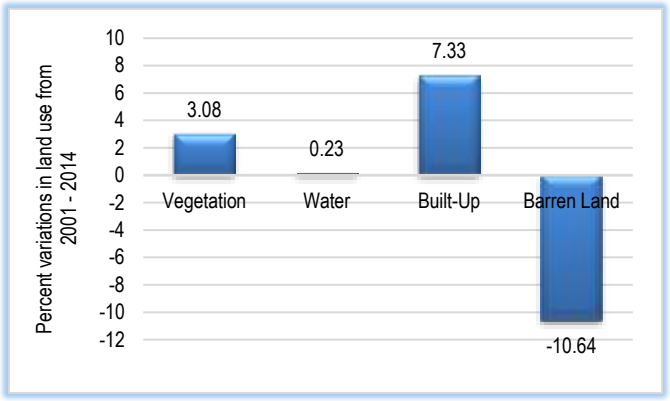

Fig-5 Comparison of different LULC classes between 2001 and 2014

The analysis of LULC change statistics [Table-3] shows that between 2001 and 2014 there exists a marginal change in vegetation and substantial change in built-up and barren land. Built-up area has been extensively increased from 291.23 km^2 (6 percent of total area) in 2001 to 625.24 km^2 (14 percent of total area) in 2014 [Fig-5]. Barren land has been considerably reduced from 1017.84 km^2 (22 percent of total area) in 2001 to 533.03 km^2 (12 percent of total area) in 2014 [Fig-5] which may be due to increasing population and massive urbanisation and it is in line with the conclusion drawn by [8]. The classified maps of Land Use and Land Cover were generated and shown in [Fig-6] and [Fig-7] for 2001 and 2014 respectively.

Table-3 *Area statistics of different LULC from year 2001 to 2014*

Class Name	Area(km^2)	
	30thNovember, 2001	18thMay, 2014
Vegetation	3121.63	3261.85
Water	126.61	137.18
Built-Up	291.23	625.24
Barren Land	1017.84	533.03

LULC Change Detection

The classified maps of 2001 and 2014 were compared by cross tabulation and the results are presented in the [Table-4]. The cross tabulation represents the changes of four classes during 2001 to 2014.

Fig-6 Land Use and Land Cover map for 30th November, 2001

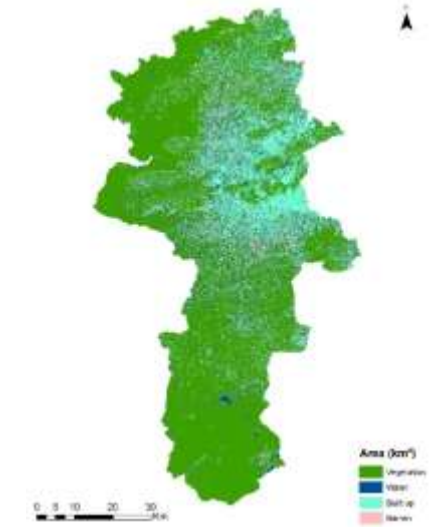

Fig-7 Land Use and Land Cover map for 18th May, 2014

It was found that there was no change in 2492.08 km^2 of vegetation area, 13.53 km^2 of water body, 117.06 km^2 of built-up and 196 km^2 of barren land classes during the study period. It was evident that during the study period, there was immense change from vegetation and barren land to built-up area (255.4 km^2 of vegetation and 248.62 km^2 of barren land were changed to built-up area). It was also observed that 540.69 km^2 of barren land was converted to vegetation area. Out of the total of 625.24 km^2 built-up areas, only 18.72 percent remained over the years and remaining 40.85 percent vegetation area and 39.76 percent of barren land was converted to built-up area. It is evident from the result that urban area is growing in a very fast trend. A related study was done by [9] for Coimbatore and the results were found to be similar.

Table-4 *Class to class change (Area in km^2)*

		2014				
	Class Name	Vegetation	Water	Built-Up	Barren Land	Total
2001	Vegetation	2492.08	85.79	255.4	288.37	3121.63
	Water	100.24	13.53	4.16	8.68	126.61
	Built-Up	128.85	5.34	117.06	39.98	291.23
	Barren Land	540.69	32.53	248.62	196	1017.84
	Total	3261.85	137.18	625.24	533.03	

Conclusion

The analysis of LULC change statistics shows that between 2001 and 2014 there is marginal change in vegetation and substantial change in built-up and barren land. Built-up area has been extensively increased from 291.23 km^2 (6 percent of total area) in 2001 to 625.24 km^2 (14 percent of total area) in 2014.

Barren land has been considerably reduced from 1017.84 km^2 (22 percent of total area) in 2001 to 533.03 km^2 (12 percent of total area) in 2014 which may be due to increasing population and massive urbanisation. It was also found that there was no change in 2492.08 km^2 of vegetation area, 13.53 km^2 of water body, 117.06 km^2 of built-up and 196 km^2 of barren land classes during the year 2001 to 2014. Out of the total of 625.24 km^2 built-up areas, only 18.72 percent remained over the years and remaining 40.85 percent vegetation area and 39.76 percent of barren land was converted to built-up area.

Application of research: Remote sensed images give a better understanding of change in land use classes, especially increasing urban landscapes.

Research Category: Remote Sensing and Geographic Information System

Acknowledgement / Funding: Authors are thankful to Department of Soil and Water Conservation Engineering, Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu, India

****Principal Investigator or Chairperson of research: Dr Balaji Kannan**
University: Tamil Nadu Agricultural University, Coimbatore, 641003, India
Research project name or number: Research station study

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Coimbatore, India

Cultivar / Variety / Breed name: Nil

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Patil B.D. and Patel R.C. (2016) *International Journal of Scientific Research*, 5(4), 4-5.
[2] Rajendran P. and Mani K. (2015) *The International Journal of Engineering and Sciences*, 4(11), 19-23.
[3] Stow D.A. and Chen D.M. (2002) *Remote Sensing of Environment*, 80(2), 297-307.
[4] Holdgate M.W. (1993) *Ambio*, 22(7),481-482.
[5] Weng Q. (2002) *Journal of Environmental Management*, 64, 273-284.
[6] Yeh A.G.O. and Li X. (1999) *Habitat international*, 23(3), 373-390.
[7] Brahmabhatt V.S., Dalwadi G.B., Chhabra S.B., Ray S.S. and Dadhwal V.K. (2000) *Journal of the Indian Society of Remote Sensing*, 28(4), 221-232.
[8] Chakraborty S., Chatterjee S., Das K. and Roy U. (2015) *Asian J. Res. Social Sci. Humanities*, 5 (5), 169-181.
[9] Santhosh Baboo S. and Renuka Devi M. (2010) *International Journal on Computer Science and Engineering*, 2(9), 3085-3088.