LANDUSE / LAND COVER CHANGE DETECTION IN NOYYAL RIVER BASIN, TAMIL NADU, INDIA

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Abstract

Noyyal River is one of the tributaries of River Cauvery, which covers an area of about 3510 sq.km. It flows through the districts of Coimbatore, Tiruppur, Karur and Erode. It is one of the densely populated industrial regions consisting of two corporations. The present study aims to find out the landuse / land cover change detection between the year 2007 and 2017 in the Noyyal River Basin. Remote Sensing and Geographical Information System (GIS) provide a consistent and accurate platform than many of the conventional surveys employed for such tasks. Landuse / land cover maps were prepared by using supervised classification, and an attempt is made to classify the features of the area consisting of built-up land, agriculture land, water bodies, forest and wasteland. It is observed that there is a rapid expansion of the built-up area, while the agricultural land and forest lands are reducing between the year 2007 and 2017 at a faster rate. The derived landuse / land cover information would help in the optimal landuse planning at the meso and micro level.

Keywords: *Remote Sensing, GIS, Supervised Classification, landuse / land cover*

Introduction

Land is one of the most important natural resources, as life and various developmental activities are based on it. The Landuse/ land cover (LULC) pattern of a region is an outcome of natural and socio-economic factors and their utilisation by the man in time and space (Rawat et al., 2015). Landuse refers to the land utilised by people for different developmental activities. Land cover is the natural surface uninterrupted by the human activities present on the earth surface such as soil, vegetation, water, barren earth and rocks. The population growth and migration of poor rural people to urban areas for economic opportunities result in unplanned and uncontrolled changes in LULC of an area (Seto et al., 2002). The LULC changes may also be from the mismanagement of agricultural, urban, range and forest lands which lead to severe environmental problems such as landslides, floods etc. (Reis, 2008).

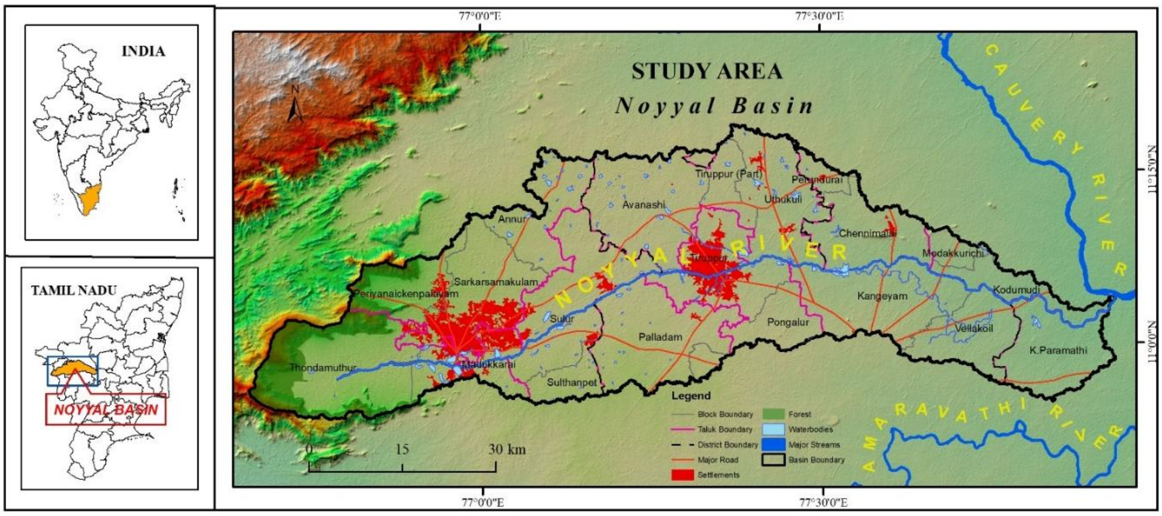
Investigating the Spatio-temporal changes in LULC is one of the effective ways to grasp the current environmental status of a region and also to understand its ongoing changes (Anderson, 1979). The monitoring of changes and time series analysis is quite difficult with the traditional method of surveying. Remote sensing provides data for many spatial related problems in space and time. Hence it provides an excellent platform for assessing the LULC pattern with the higher accuracy even for a large area. With the aid of remote sensing and geospatial technologies, the mapping of LULC becomes easier (Rao et al., 1991). The advancement of satellite data having more excellent spatial resolution and temporal resolution leads to get better results (Carlson et al., 1999, Guerschman et al., 2003, Rogana et al., 2004 and Zsuzsanna et al., 2005). Hence the recent developments of Remote Sensing and Geographical Information System Technology help us to study the LULC changes accurately. Many studies related to land information have increased after the advent of Remote sensing and Geographic Information System (GIS) techniques. The LULC of an area can be derived from the satellite imageries in the ERDAS Imagine image software using Supervised classification with the maximum likelihood algorithm (Hegazy et al., 2015, Butt et al., 2015 and Cheruto et al., 2016). The basic LULC of the National Remote Sensing Centre (NRSC) Level I Classification is built-up, agriculture land, forest land, wastelands and waterbodies.

Many researchers are working in LULC to find the urbanisation and its impacts on humans. Also, they try to look for the proper planning of the urbanised cities. Here a quantitative study has done to find the LULC changes of Noyyal Basin between 2007 and 2017 using remote sensing and GIS techniques.

Study area

Noyyal basin is an active industrial region located in the western part of the Tamil Nadu, India **(Fig. 1).** The location of the basin is the extent from 10º54' to 11º 19' north latitudes and 76º39' to 77º55' east longitudes. The basin comprises of four districts namely Coimbatore, Tiruppur, Erode and Tiruppur. In which the Coimbatore and Tiruppur municipal corporations have come under this basin. The western part of the basin is bordered by the Western Ghats; the northern and southern boundaries are shared by Bhavani and Amaravathi basin, respectively. The average elevation of the basin is 450m above the Mean Sea Level (MSL). The basin is underlain by hornblende biotite gneissic metamorphic rock. The major geomorphology of the basin is fluvial with little structural and Denudational Hills. Noyyal River basin is present in the Upland region experiencing a pleasant climate with cool breeze throughout the year due to the presence of Western Ghats. The mean annual rainfall of the Noyyal basin is 750mm. As per the Census of India 2011 report, the population of the basin is 38,73,873 with an average density of 1,104 persons per sq.km. The industrialisation of the basin leads to several problems such as land degradation, urban sprawl, water scarcity, improper utilisation of available resources, etc.

Fig. 1: Study Area



Methodology

The study has made use of Landsat satellite imageries with 30m resolution for the years of 2007 and 2017 respectively to identify the landuse / land cover changes over the basin. The cloud-free satellite data of Landsat images were downloaded from the USGS Earth explorer for both the year of 2007 and 2017. The details of the data used are given in Table 1.

Table 1. Data Used

Satellite imagery	Resolution	Sensor	Year
Landsat 5 TM	30m	Multi-Spectral	2007
Landsat 8 OLI Series	30m	Multi-Spectral	2017

The image processing techniques such as image enhancement, radiometric corrections were done by ERDAS IMAGINE 2014. The enhanced image is used for landuse / land cover classification. By utilising visual image interpretation techniques with the tone, texture, shape, size, pattern and association of the satellite imageries along with the False Color

Composite (FCC), the LULC of the basin has identified. ERDAS Imagine image processing software was used to classify the LULC. It also incorporates the ancillary data such as Survey of India (SOI) topographic maps with a scale of 1: 50,000 topographic maps, google earth imageries and other published relevant materials for the preparation of 2007 and 2017 LULC of the basin. Supervised classification of Maximum Likelihood Classifier (MLC) is utilised to classify the images. The LULC changes from 2007 to 2017 were analysed with change detection technique. The methodology is given as a flow chart that is followed to achieve the LULC changes in the study area is shown in Fig. 2.

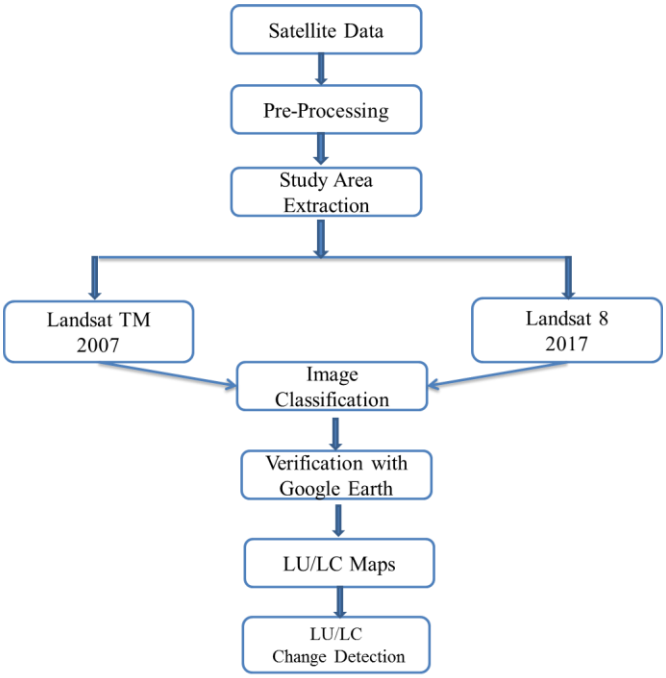


Fig. 2: Methodology

Result and Discussion

The LULC changes of the basin have been identified with a period of ten years between 2007 and 2017. The study shows that there is a drastic change in LULC of the basin within the past ten years. Based on the analysis LULC of the basin has been classified into five categories viz., agricultural land, wasteland, built-up area, water bodies and forest land. Table 2 shows the changes in area and percentage of the above said categories and its sub-categories in detail. The LULC change matrix over the ten years were given in Table 3.

Table 2: Landuse / Land Cover Changes in the Noyyal basin

LEVEL I	LEVEL II	LULC (2007)	LULC (2017)	LULC

		AREA	AREA IN PER CENT	AREA	AREA IN PER CENT	
Built-up	Urban	194	5.53	255	7.27	+1.74
	Rural	235	6.70	339	9.66	+2.96
Agriculture	Cropland	1228	35.01	716	20.41	-14.60
	Plantation	216	6.16	541	15.42	+9.26
	Fallow	1290	36.77	1390	39.62	+2.85
Forest	Evergreen	173	4.93	47	1.34	-3.59
	Forest Scrub	34	0.97	91	2.59	+1.62
Wasteland	Scrub Land	91	2.59	124	3.53	+0.94
Waterbody	Waterbody	47	1.34	5	0.14	-1.20

Table 3: Landuse / Land Cover Change Matrix between 2007 and 2017

Landuse/ Land Cover (2007)		Landuse/ Land Cover (2017)									
		Crop land	Plantation	Fallow	Rural	Urban	Ever green	Forest Scrub	Scrub land	Water bodies	Total Area (2007)
	Cropland	**326**	271	480	87	10	0	0	54	0	1228
	Plantation	53	**104**	33	9	1	0	0	16	0	216
	Fallow	278	120	**819**	30	7	0	0	36	0	1290
	Rural	0	0	0	**198**	37	0	0	0	0	235
	Urban	0	0	0	0	**194**	0	0	0	0	194
	Evergreen	10	24	0	0	0	**47**	81	11	0	173
	Forest Scrub	20	2	0	0	0	0	**10**	2	0	34
	Scrubland	22	0	52	11	3	0	0	**3**	0	91
	Waterbodies	7	20	6	4	3	0	0	2	**5**	47
	Total Area (2017)	716	541	1390	339	255	47	91	124	5	3508

Landuse / Land Cover of 2007

LULC of the study area is classified into nine categories namely Urban, Rural, Crop Land, Plantation, Fallow Land, Evergreen, Scrub Forest, Scrub Land and Waterbodies (Fig. 3). The classified images found that the two-clusters of urban settlements (Coimbatore and Tiruppur corporation) were occupied along the stretch of the Noyyal River. In contrast, rural settlements are found in the peripheral parts of the river. The plantation is found to be high in the western and easternmost part of the study area. The basin has a thickly concentrated evergreen forest in the Western Ghats located in the western part while some of the scrub forest patches are occupied in the eastern part of the basin. The water body accounts only a few areas of the study area.

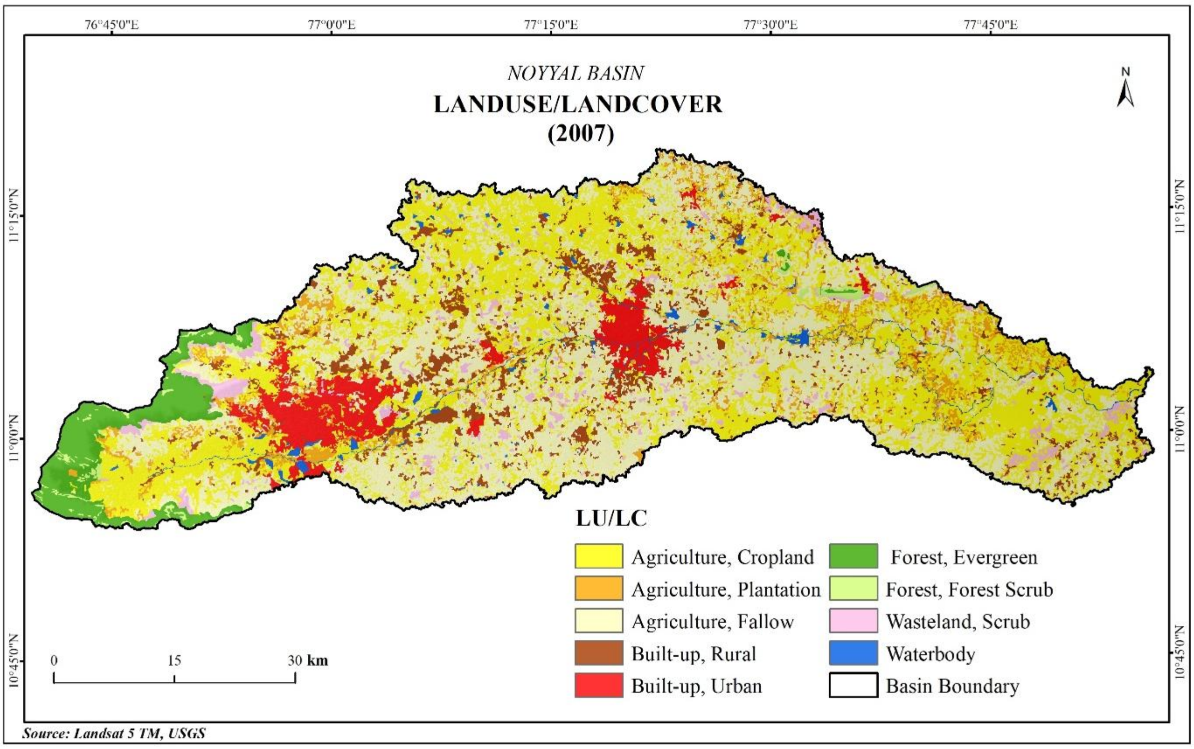
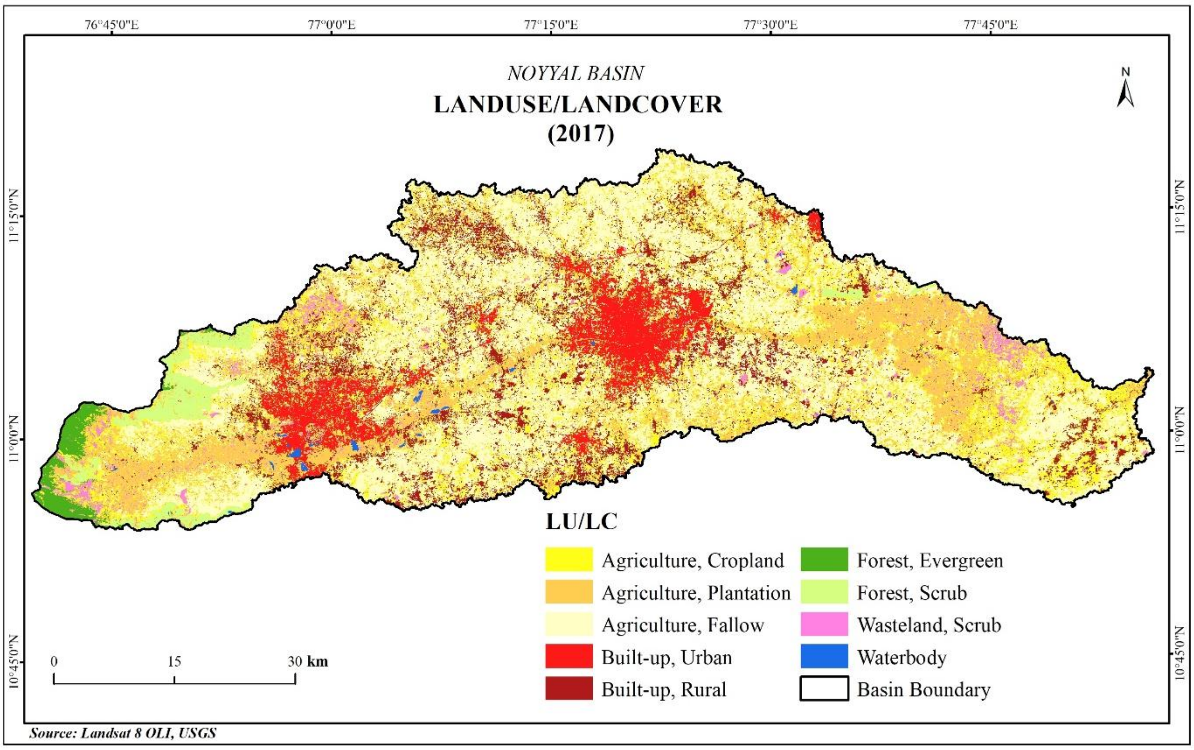


Fig. 3: Landuse / Land Cover - 2007

Landuse / Land Cover of 2017

There is a significant difference have found in LULC between 2007 and 2017 in the study area (Fig. 3). The settlement pattern present in the year 2017 is highly dispersed. Though the major settlement cluster is present in the central part of the study area, it is by visualising; we can understand that there is settlement growth through over the study area. The pattern of settlement growth is found to cluster in the central part and dispersed away from the centre. The agriculture croplands are get decreased which all are converted into fallow lands and built-up lands. The dense forests are drastically decreased and which all are converted to



scrub forest and agricultural plantation. The scrublands are getting increases in the study area.

Fig. 4: Landuse / Land Cover - 2017

Change Detection:

The satellite image of the Noyyal basin was subjected to pre-processing and image classification by the above-said methodology. Then the classified images of Landuse/Land cover of 2007 and 2017 were subjected to area calculation. The area has been calculated for the derived images from the GIS software. From the classified images, the difference in area is calculated for the different types of landuses. The resultant value shows how the landuse / land cover of Noyyal basin changed over the ten years from 2007 to 2017.

By comparing the LULC of the study area, it is found that the Vegetation cover of agriculture land, Forest are found to be high in the year of 2007 and decreases in 2017. In 2007, the area under fallow land was 37 per cent, cropland is 35 per cent, and plantation is 6 per cent whereas in 2017 about 40 per cent of the area under fallow land 15 per cent as plantation and 20 per cent as cropland. Meanwhile, the built-up land, Scrubland, Scrub or degraded forests, are low in 2007 and increases in 2017. The landuse of urban, rural, fallow land, plantation, forest scrub, and scrubland show positive trend; on the other hand, the forest evergreen, cropland and waterbody show the negative trend. The area of Built-up land gets increased from 429 sq.km to 594 sq.km. And at the same time, the cropland has decreased from 1228 sq.km to 716 sq.km over the ten years. The degradation of the forest is occurring at a very bad rate decreased from 173 sq.km. to 47 sq.km. Within a ten year of periods, the forest land was highly degraded. From that, it is clear that the Noyyal basin has under the urbanisation process with well-developed road networks and settlements.

Conclusion

The results found that the LULC of the Noyyal basin is drastically changing over ten years. The agricultural land is found to be decreasing due to the improper growth of urban. Most of the practised agricultural cropland and fallow lands were converted to fallow land and built-ups. The study area possesses a radial type of settlements. Two cluster settlements are found in the central part of the cities, whereas the dispersed settlements are occupied in the peripheral part of the study area. From the result, it is found that the pattern of Built-up is increasing towards the northern part of the existing agricultural area. Hence it understands that the urban sprawl is happening by replacing the existing agricultural land. The growth of urban areas in agricultural land is not good for a countries growth and which will not lead to being sustainable development. The Forest density is degraded drastically in the bottom of the Western Ghats, and it has been recognised using the satellite images.

The increasing of the population will not be controlled by us, which is in-evitable. So, to have a sustainable development, there is a need for optimum urban planning for the landuse of the basin. The results of this study would provide information relevant to contribute to environmental management plans and improve urban planning issues. From the study, it is found that there is a rapid urbanisation process is happening in the Noyyal basin. The study provides information on the status and dynamics of the LULC of the Noyyal basin which assists environmentalist, regional (urban) planners, and decision-makers to consider the potential of geospatial tools for monitoring and planning urban development.

Reference

1. Anderson J.R. (1979). Land use and Land cover Changes: A Frame Work for Monitoring. *Journal of Research,* United States Geological Survey (USGS), 5(2),143-153.

2. Rao D.P., Gautam N.C. and Sahai B. (1991). IRS-1A Applications for wasteland mapping. *Current Science,* 61(03-04),193-197.
3. Butt A., Shabbir R., Ahmad S.S. and Aziz N. (2015). Land use change mapping and analysis using Remote Sensing and GIS: A case study of Simly watershed, Islamabad, Pakistan. *The Egyptian Journal of Remote Sensing and Space Science,* 18, 251-259.
4. Hegazy I.R. and Kaloop M.R. (2015), Monitoring urban growth and land use change detection with GIS and remote sensing techniques in Daqahlia governorate Egypt. *International Journal for Sustainable Built Environment. 4,* 117-124.
5. Cheruto M.C., Kauti M.K., Kisangau P.D. and Kariuki. (2016). Assessment of Land Use and Land Cover Change Using GIS and Remote Sensing Techniques: A Case Study of Makueni County, Kenya. *Journal of Remote Sensing & GIS,* 5(4), 1-6.
6. Rawat J.S. and Kumar M. (2015). Monitoring land use/cover change using remote sensing and GIS techniques: A case study of Hawalbagh block, district Almora, Uttarakhand, India. *The Egyptian Journal of Remote Sensing and Space Sciences*, 18, 77-84.
7. Seto K.C., et al., (2002). Monitoring land use change in the Pearl River Delta using Landsat TM. *International Journal of Remote Sensing*, 23(10), 1985-2004.
8. Reis S. (2008). Analysing Land Use/Land Cover Changes Using Remote Sensing and GIS in Rize, North-East Turkey. *Sensors*, *8*, 6188-6202.
9. Carlson T.N. and Azofeifa S.G.A. (1999). Satellite Remote Sensing of Land Use changes in and around San Jose, Costa Rica. *Remote Sensing of Environment*, *70*, 247–256.
10. Guerschman J.P., Paruelo J.M., Bela C.D., Giallorenzi M.C. and Pacin F. (2003). Land cover classification in the Argentine Pampas using multi-temporal Landsat TM data. *International Journal of Remote Sensing,* 24, 3381–3402.
11. Rogana J. and Chen D. (2004). Remote sensing technology for mapping and monitoring land-cover and landuse change. *Progress in Planning*, 61, 301–325.
12. Zsuzsanna D., Bartholy J., Pongracz R. and Barcza Z. (2005). Analysis of land-use/land-cover change in the Carpathian region based on remote sensing techniques. *Physics and Chemistry of Earth*, 30, 109-115.

