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LAND USE LAND COVER CHANGE DETECTION THROUGH QGIS AND REMOTE SENSING TECHNIQUES: A CASE STUDY ON WARANGAL URBAN DISTRICT, TELANGANA, INDIA

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Abstract*— Land Use land Cover (LULC) change detection is the digital process that helps in determining the changes associated with Land Use Land Cover properties. The earth surface is undergoing hasty land use land cover changes due to various socioeconomic activities such as natural resource management and sustainable development. The main aim of the study was to gain a quantitative understanding of land use and land cover changes in Warangal urban district, Telangana, India over the time period of 2008-2016. Unsupervised classification was done using ERDAS imagine in this study to detect land use land cover changes observed in Warangal urban district. The study area was categorized into four major Land use Land cover classes which are vegetation, water bodies, urban built-up area and other open lands of Warangal urban district. Change detection analysis and LULC maps were executed using QGIS to compare the quantities of land cover class conversions between the time intervals 2008 and 2016. The results revealed both increase and decrease of the different LULC classes. The major changes were taken place in open land and others as there is high growth in urban built-up area. About 41% of the other open lands and a part of vegetation were changed to built-up area in the period from 2008 to 2016. The area of built-up is increased from 12163 to 39247 ha which is about 223% over the period of 2008 to 2016. In addition to this, areas under vegetation were decreased from 74814 ha to 65221 ha which is about 13% and water bodies were decreased from 4944 ha to 3562 ha which is about 28%. The reasons for the change detection were also discussed.

Keywords— *Land use land cover, QGIS, Remote sensing, Unsupervised classification, Change detection.*

I. INTRODUCTION

Land is the most important natural resource on which all human activities are based. Land use is the series of operations carried out by human beings, with an intention to obtain benefits by using land resources. Whereas Land cover is the solid material on the surface of the earth which includes vegetation, water bodies, open land and various constructions such as buildings, roads, bridges, culverts etc., The change detection in land use and land cover is the measure of the separable data with noticeable change in the information of the area to be studied. With the increasing diversification of economic activities, urbanization, a number of cities and towns in India expand at a higher rate. Level of urbanization in India increased from 17 per cent in 1951 to 31 per cent in 2011. It has been estimated that the share of urban population in India will be 55 per cent in India by 2050. Proper planning is needed to fulfil the increasing demand of urban space (Savitree Patidar and Vimit Sankhla, 2015).

In this study unsupervised classification was made on four different classes such as vegetation, water bodies, urban built-up area and other open lands of Warangal urban district. GIS and Remote sensing plays an important role to show the actual change in Land use and Land cover classes. The main aim of this study was to produce LULC maps of Warangal urban district for the two time periods 2008 and 2016, in order to detect the changes that have been taken place using QGIS and ERDAS imagine. The main objective of this study is to assess the land use and land cover change of the study area by utilizing open source software QGIS. Various studies have been conducted all over the world on the topic of the change analysis of land use land cover through different methods (Amna Butt et al., 2015; Jyotishman Deka et al., 2014; Mercy C Cheruto et al., 2015; Surya Prakash Pattanayak and Sumant Kumar Diwakar., 2016)

II. STUDY AREA

Warangal Urban district is located in the northern region of Indian state of Telangana. Warangal Urban covers an area of 1314.69 Sq. Km. The Warangal Urban district lies between latitude of 17° 47' 8.1" to 18° 15' 46.0" N, and Longitude of 79° 13' 53.51" to 79° 40' 19.24" E (Fig 1). The map boundary for this area stretches to khila Warangal, Kazipet in the south and Hasanparthy in the north. The district is at a distance of 143 km from the state capital Hyderabad. The district is bounded by Karimnagar district to the north, Siddipet district to the west, Jangaon district to the south, Warangal Rural district to the east. Warangal is well known for its granite quarries and as a market for rice, chilli peppers, cotton, and tobacco. Warangal is the second biggest city in Telangana after Hyderabad. Warangal was filled in as the capital of the Kakatiya dynasty which was built up in 1163 AD. The landmarks left by Kakatiya's are incorporate forts, lakes and stone doors assisted the city to turn into a huge tourist attraction. The Kakatiya Kala Thoranam was incorporated into the emblem of Telangana by the state government. The significant railway stations in the city are Kazipet railway station and also Warangal railway station. The Warangal Fort and Thousand Pillar Temple are the World Heritage sites recognised by UNESCO. Bhadrakali Temple, Padmakshi Temple are other notable destinations of various religions. Bhadrakali Lake, Waddepally Lake, and Dharmasagar Lake are the water bodies notable for tourism. It has an average mean sea level (MSL) elevation of 302 metres. It is settled in the eastern part of Deccan Plateau made up of granite rocks and hill formations which left the region barren making the cultivation depend on seasonal rainfalls. There are no river flows nearby Warangal, which makes it to rely on Kakatiya canal which originates from Sriram sagar project to meet the drinking water requirements. Warangal has a predominantly hot and dry climate located in the semi-arid region of Telangana.

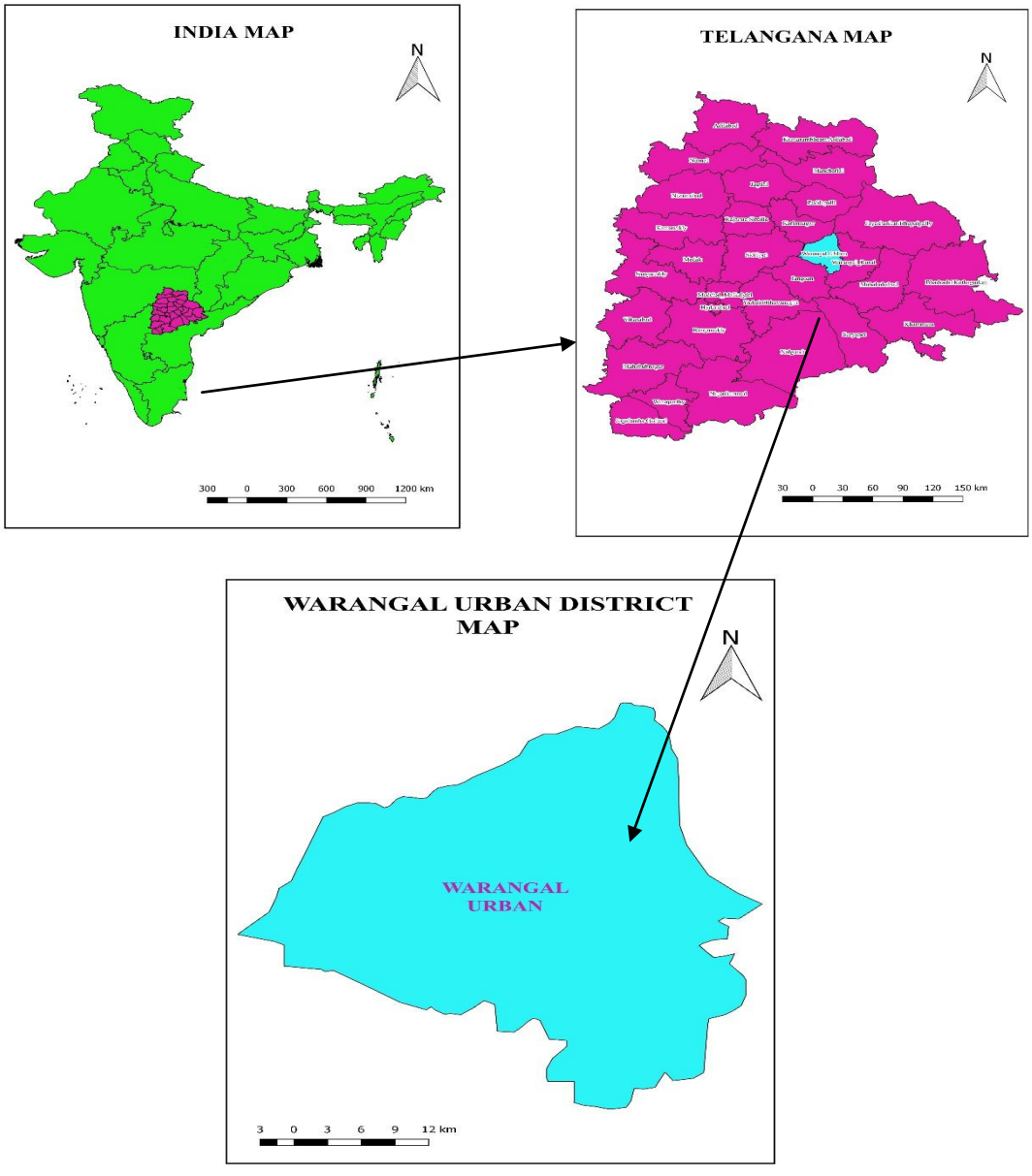
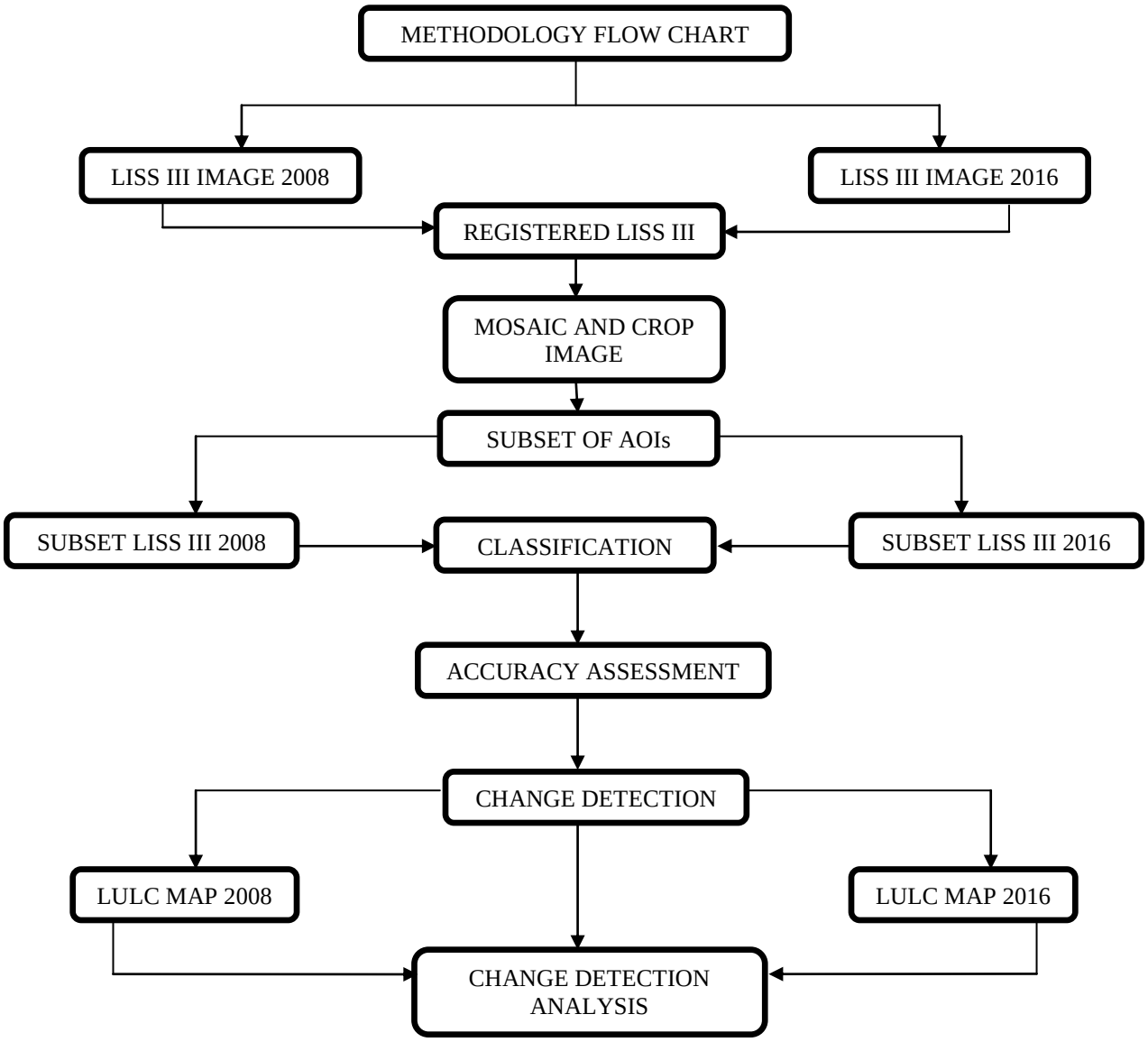


Fig. 1. Location map of Warangal Urban district

III. METHODOLOGY



1) Data Collection:

IRS (Indian Remote Sensing) – P6, LISS-III (Linear Imaging Self Scanning Sensor) multi spectral satellite imageries for the year 2008 and 2016 with spatial resolution of 23.5m were used for the study area (Table.1 and Fig. 2). These images are downloaded from Bhuvan website, ISRO/NRSC (Indian Space Research Organization/National Remote Sensing Centre), Government of India, to detect changes for the four broad categories i.e., Vegetation, Water bodies, Urban built-up area and other open lands were also considered to prepare LULC maps [*Savitree Patidar and Vimit Sankhla 2015*].

Table 1. Satellite data specifications.

Satellite	Year of acquisition	Sensor	Band & Spectral resolution	Spatial resolution (m)	Swath width (km)	Source
IRS P6	2008 & 2016	LISS-III	Green : 0.52 to 0.59 Red : 0.62 to 0.68 NIR : 0.77 to 0.86 SWIR : 1.55 to 1.7	23.5	142	Bhuvan Website ISRO/NRSC

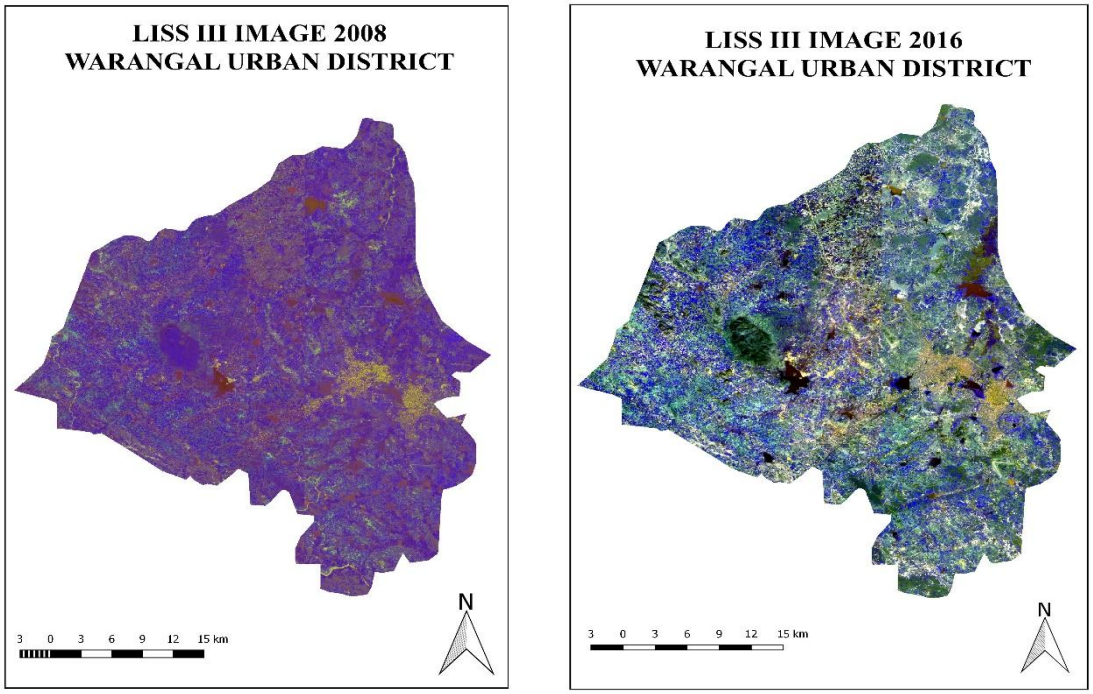


Fig. 2. Subset of Warangal Urban district LISS III images (2008 and 2016)

2) Image Pre-Processing and Classification:

Satellite image pre-processing prior to change detection is a very essential procedure and has a unique aim of building a more direct association between the biophysical phenomenon's of the acquired data [Mercy C Cheruto et al., 2016]. LISS III Satellite images for the year 2008 and 2016 were downloaded from Bhuvan website, ISRO/NRSC, and are registered, mosaic, cropped to make subset images of 2008 and 2016. Then the classification was done on these two images to detect the changes.

Classification is one of the very basic and important parts of geospatial technologies. Satellite image generally have 256 (0-255) discrete values. Classification is basically a method which divides all these discrete values to different classes such as vegetation, built-up area, water bodies etc., Therefore classification can be defined as the process of grouping all the pixels of an image into a specified number of classes. In this study the area is specified into four classes such as vegetation, built-up area, water Bodies and other open fields. Primarily there are two types of classification, i.e., Supervised and Unsupervised classification. For the study of Warangal urban district unsupervised classification is used as there are less number of classes. This is the simplest way of classifying an image. The user defines the number of classes and thereby the system will classify the image, based on the DN values of the pixels into number of classes. DN values having same and close by values will be clubbed into one class. K-Mean resampling method was used to classify the LISS III images of Warangal Urban district for the years 2008 and 2016.

3) Accuracy assessment:

Accuracy assessment was performed on two classified LULC maps of 2008 and 2016 Warangal Urban district to measure the reliability with ground reality using Google earth maps and classified maps.

IV. RESULTS AND ANALYSIS

The study area of Warangal Urban district covers a total area of 131469.25 ha. Out of which in the year 2008 it covers the area of water bodies 4944.26 ha, vegetation 74814.39 ha, built-up 12163 ha, and other open land covers 39547.60 ha. In the year 2016 due to the changes occurred on land surface the area covered for water bodies 3562.34 ha, vegetation 65221 ha, built-up area 39246.55 ha and other open area covers 23439.39 ha (Fig 3, 4 and Table 2). The results shown that in the year 2008 the area percentage of waterbodies, vegetation, built-up area and other open filed are 3.76, 56.9, 9.25 and 30.09 respectively. In the year 2016 the area percentage of waterbodies, vegetation, built-up area and other open filed are 2.71, 49.61, 29.85 and 17.83 respectively (Fig 5).

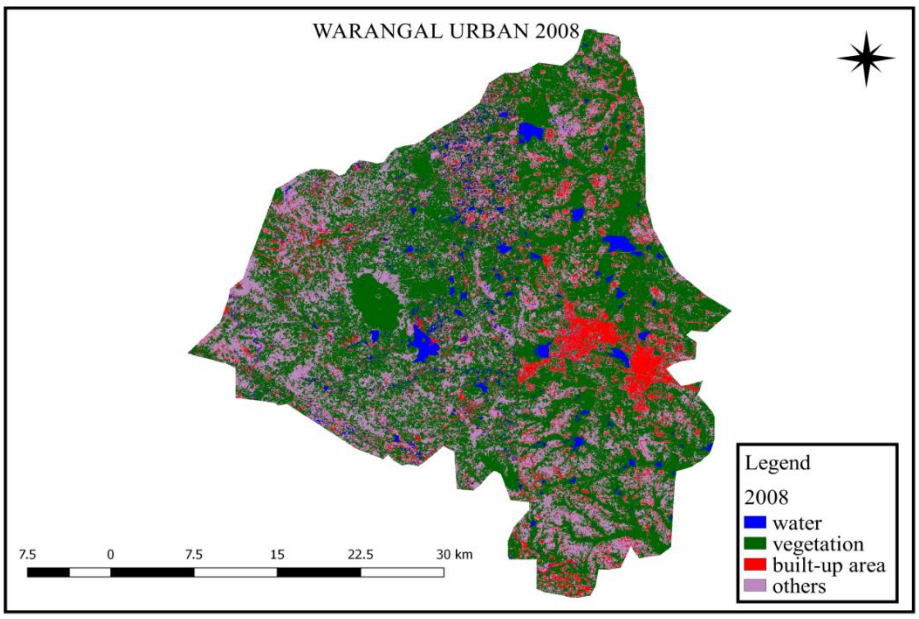


Fig. 3. LULC map of Warangal Urban district for the year 2008.

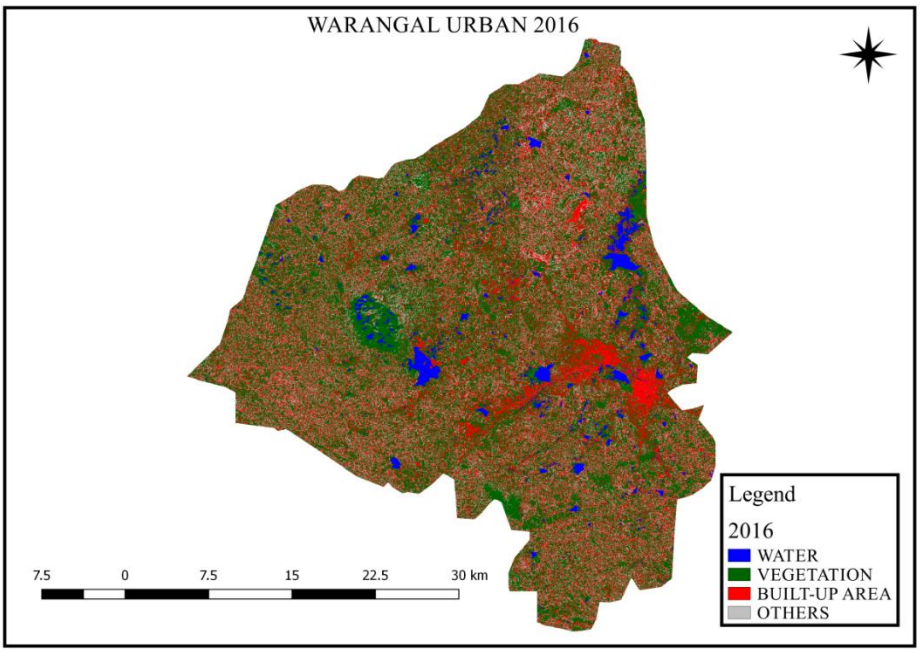


Fig. 4. LULC map of Warangal Urban district for the year 2016.

Table 2. *Comparison of change detection of four LULC classes between 2008 and 2016 of Warangal Urban district*

Land use categories	**2008**		**2016**		**Change in Hectares**	**Change in % from 2008 to 2016**
	In Hectares	**%**	**In Hectares**	**%**		
Water bodies	4944.26	3.76	3562.34	2.71	- 1381.92	- 27.95
Vegetation	74814.39	56.9	65220.97	49.61	- 9593.42	- 12.82
Built-up area	12163	9.25	39246.55	29.85	27083.55	222.67
Other open fields	39547.60	30.09	23439.39	17.83	- 16108.21	- 40.73

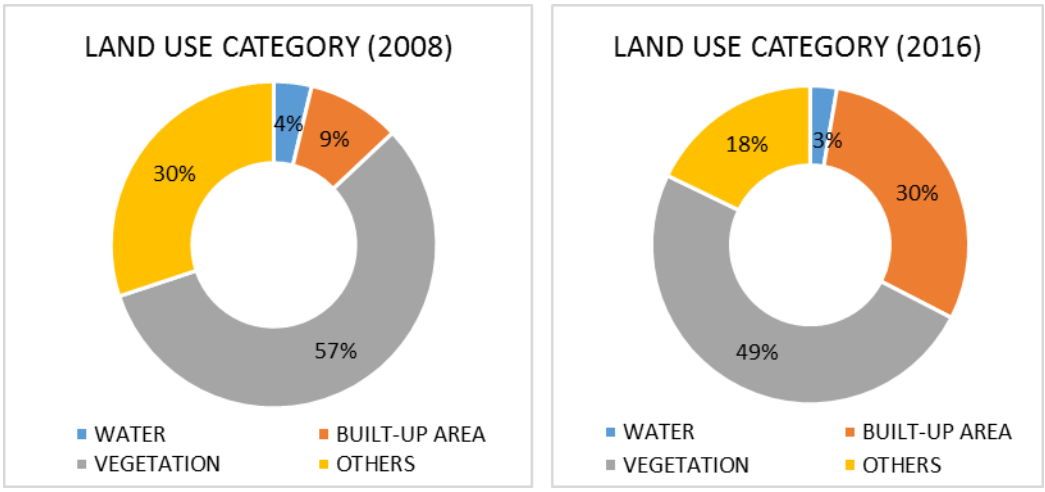


Fig. 5. Pie chart showing land use classes area percentage of Warangal urban district for the year 2008 and 2016

Therefore the results reveal both increase and decrease in the LULC classes (Fig 5). Water bodies which were 4944 ha in 2008 were decreased to 3562 ha in 2016. Therefore the percentage decrease in water bodies is 28%. Vegetation is also decreased from 74814 ha to 65221 ha which is about 13%. There is an extreme increase in built-up area from 12163 to 39247 ha that is about 223% (Fig 6). It shows that urban area is increasing drastically and proper planning is required for urban area to sustain the natural resources. The result also shows that the other open lands are also decreased from 39547 to 23439 ha which is about 41% indicates that open land is occupied by built-up area. The major changes were occurred in other open lands as there is high growth in urban built-up area. About 41% of the other open lands and a part of vegetation were changed to built-up area. Therefore suitable measures are to be taken for efficient city planning and to preserve natural resources.

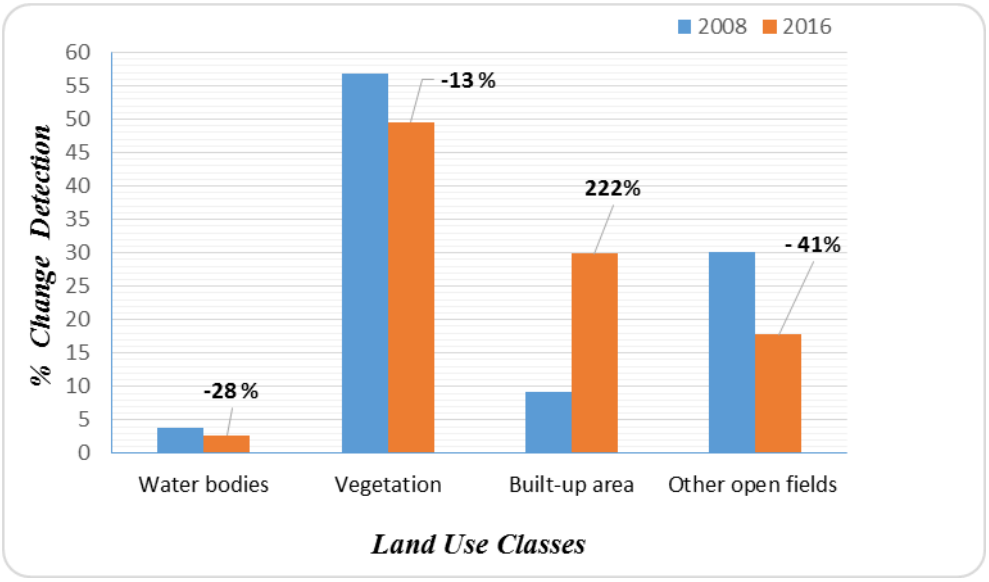


Fig. 6. Graph shows change detection of various LULC classes for the year 2008 and 2016 of Warangal Urban District.

V. CONCLUSIONS

LULC change detection for the four classes was detected and is tabulated in Table 2. As water bodies are decreased by 28% it indicates that there is more usage of water. Therefore suitable measures are to be taken for appropriate utilization of water. Also there is severe increase in urban area, hence proper planning with long term vision for roads, drains and buildings is essential to keep our natural resources safe and clean. An ideal balance between natural vegetation cover and built up area should be maintained by encouraging urban planning in vertical growth instead of horizontal growth.

VI. ACKNOWLEDGEMENT

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