# APPLICATION OF REMOTE SENSING AND GIS IN LAND USE/LAND COVER MAPPING AND CHANGE DETECTION IN HYDERABAD, INDIA

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**ABSTRACT**

*This research study demonstrated the ability of GIS and Remote Sensing in retrieving and analysing spatial-temporal data. An attempt was made in this study to develop a spatial data of LULC of Hyderabad District. A comprehensive LULC map was developed for four distinct years for a period of 20 years to study the urbanization in Hyderabad and evaluate the Change Detection of the study area and showing the result into change matrix. Therefore, LULC were distinctly developed for each study years. The study has demonstrated that urbanization and Spatial-temporal growth can be quantify and compared across different years. Landsat & IRS data proved to be adequate data source for the analysis of large and fast changing urban growth in Hyderabad.*

**KEYWORDS:** *Land use, land cover, change detection, remote sensing*.

## INTRODUCTION

Land use / land cover (LULC) change detection based on remote sensing (RS) data has been established as an indispensible tool for providing suitable and wide-ranging information to various decision support systems for natural resource management and sustainable development (Sobrino et al., 2000; Yang et al., 2002). LULC change is one of the major influencing factors for landscape changes (Chan et al., 2001). There are many change detection techniques developed over decades, in practice, it is still difficult to develop a suitable change detection method especially in case of urban and urban fringe areas where several impacts of complex factors are found including rapid changes from rural land uses to residential, commercial, industrial and recreational uses. Although these changes can be monitored using several techniques of RS application, adopting a suitable technique to represent the changes accurately is a challenging task (Loveland et al., 2002; Matinfar et al., 2007). There are a number of challenges in RS application for analysis of LULC change detection (Deng et al., 2005; Rymasheuskaya et al., 2007). This study applies object-oriented (OO) method for mapping LULC and performing change detection analysis using post-classification technique (Lu et al., 2004). The city population in 1897 was 415,039.Today the city of Hyderabad, India cover an area of 650 square kilometres (250 sq mi), has a population of 6,809,970 making it the fourth most populous city in India. Today, due to indiscriminate urbanization and lack of planning, the Musi River has become a receptacle for all the untreated domestic and industrial waste waters coming out of Hyderabad and has therefore become polluted. Numerous efforts to clean it have failed. The river water downstream to city is highly polluted.

## STUDY AREA

The study area covers (Fig.1) an area of 178.9 sq. km. Hyderabad is the capital of southern India's Telangana state. The latitude and longitude of Hyderabad can be projected as 17° 22' 31" N and 78° 28' 27" E. The city is nestled on the Deccan Plateau and is positioned at a height of around 500 meters from the sea level. Major parts of the city feature rocky terrain and in some parts hills can also be noticed. Hyderabad experiences the semi-arid tropical climatic conditions. The average annual rainfall is 810 mm. the total population leaped

from 3,637,483 in 2001 census to 6,809,970 in 2014 census, an increase of over 87%. Migrants from rest of India constitute 24% of the city population. In Hyderabad the roads occupy 10% of the total city area.

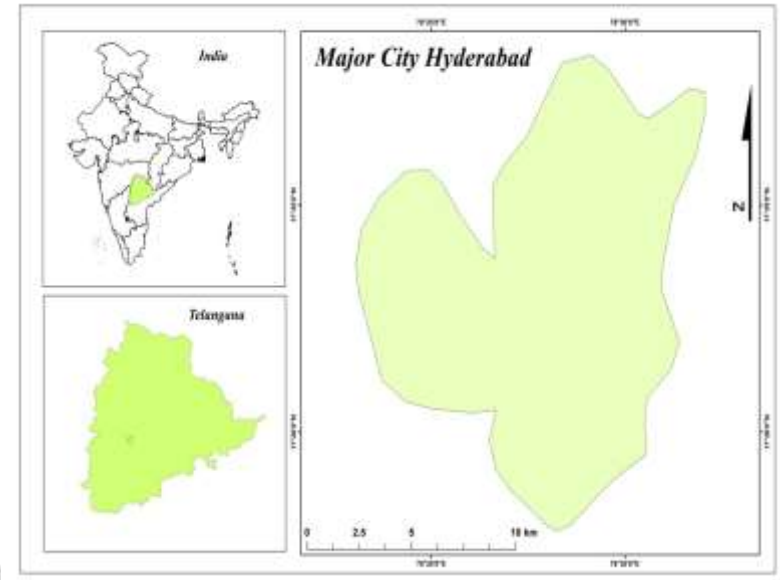


**Fig.1:** Location Map of study area

## METHODOLOGY

Land use/ Land cover of HYDERABAD District was carried out from four sets of satellite imageries retrieved for four different time periods (1993, 2000, 2008, and 2013). Hybrid land use land cover classification techniques was used for image processing in addition, ground truthing was carried out for several point those are helpful to evaluate accuracy assessment of classification of 2013 imageries.

### Data Set

For the study, Landsat satellite images of Hyderabad state were acquires for four time periods (Table. 1), 1993,2000, 2008 and 2013 from United State of Geological Survey, an earth science data interface(earthexplorer.usgs.gov).The administrative state boundary was also brought to Universal Mercator projection in zone 43 and later the satellite imageries were clipped with the administrative boundary of HYDERABAD.

**Table1**: Satellite Datasets used for study area

| Satellite | Date | Sensor | Path | Row |
|---|---|---|---|---|
| Landsat 4 | 22-04-1993 | TM | 144 | 48 |
| Landsat 4 | 02-10-2000 | TM | 144 | 48 |
| Landsat 4 | 17-05-2008 | TM | 144 | 48 |
| IRS 1C | 03-0302013 | LISS III | 100 | 60 |

### Software and Platforms

Image processing was carried out by standard method followed by ground truthing through Google earth imagery. Preparation of thematic maps from the digital satellite data was carried out by using ERDAS Imagine ver. 9.1 and Arc GIS ver. 10.1 Standard methods, which include use of image element like tone, texture, shape, location, association, pattern, etc., of digital image processing were adopted for vegetation mapping and ancillary information like elevation and landforms.

### Land Use Land Cover Classification

After using radiometric correction or image enhancement of image are then classified by using supervised classification techniques. In the supervised classification techniques the maximum likely hood algorithm will classify the image based on the training classes (signature) provide by the user based on his field knowledge (Lewinski et al., 2004). The training data given by the user tells the software, that what types of pixel are to be selected for certain land cover type. The classification finally gives the land use, land cover image of the area on which analysis. Four land classes namely built up, Open space, Vegetation, Water body identified in the study area.

### Change detection Analysis

Change detection analysis describes and quantifies difference between images of the same scene at different times (Laliberte et al., 2004). The classified images of the four dates can be used to calculate the area of difference land cover and observed the changes that are taking place in the span of data.
The algorithm applied for change detection analysis:

$$Dij = DNij(t2) - DNij(t1)$$

This difference is done pixel by pixel. Therefore, a high standard is required. If geometric correction between the two images is poor spurious change may be identified. Theoretically, if D deviates from zero, a change has happened in practice, this may not be a true. There may be a systematic shift as where the threshold values are between changes stable pixels. Such systematic shift may be caused by sensor degradation atmospheric condition phonology etc. determining the threshold for change and non- change is the critical step for these techniques.

## RESULT AND DISCUSSION

### Base map:

A map containing geographic features used for location reference is called base map. Roads, rivers, settlements etc. are commonly found on base maps (Fig.2). A base map is used for locational reference and often includes a geodetic control network as part of its structure.

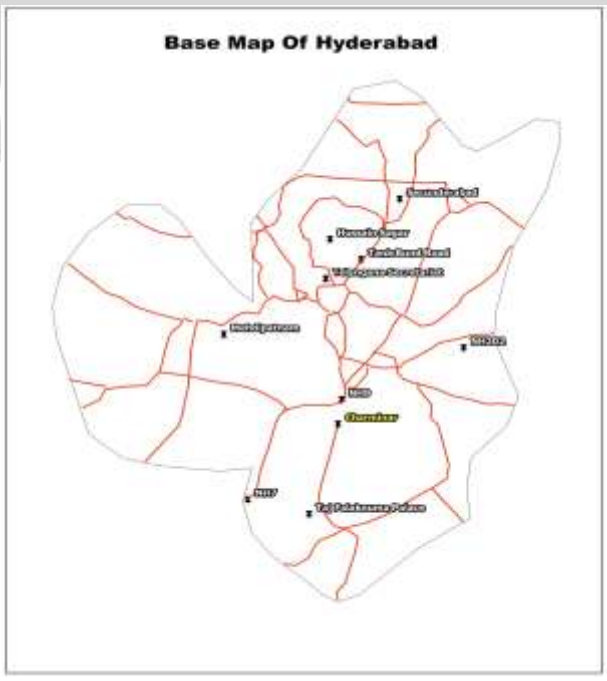


**Fig 2:** Base Map of Hyderabad District

**Land use/ Land cover**

Land Use/ Land Cover (LULC) maps (Fig.3; Fig.4; Fig.5; Fig.6) of different years were compared. The LULC of the study area had changed dramatically during the period of 20 years. Therefore, the data interpretation and data analysis is based on the comparison of LULC for three different periods. Between 1993 and 2013 there are huge changes in the study area (Table 2).

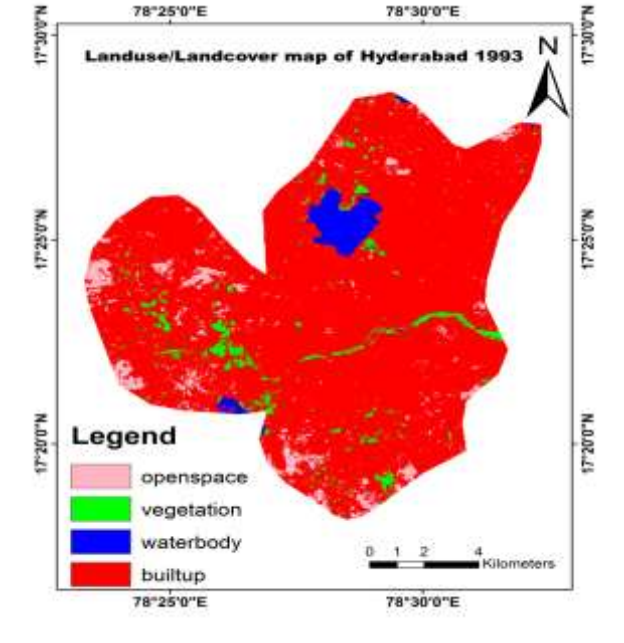


**Fig 3:** Land use/Land cover map of Hyderabad 1993

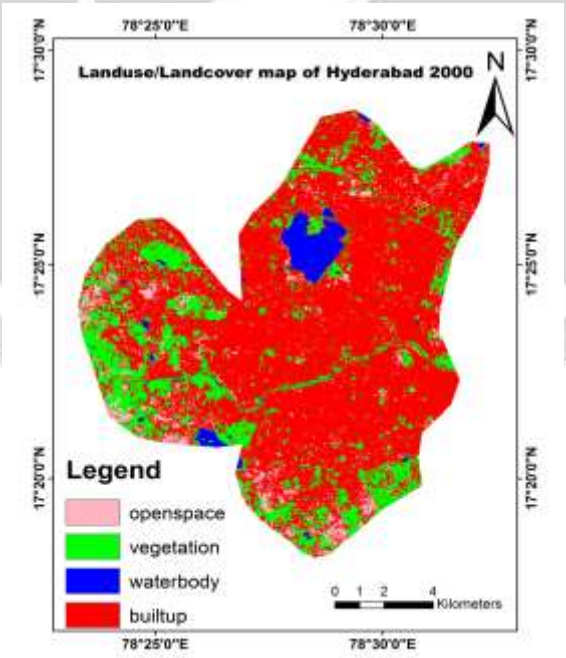


**Fig 4:** Land use/Land cover map of Hyderabad 2000

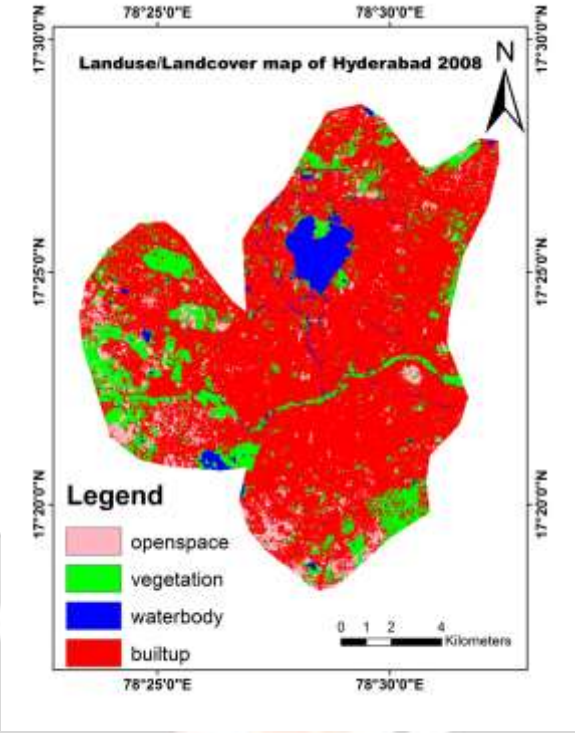


**Fig 5:** Land use/Land cover map of Hyderabad 2008

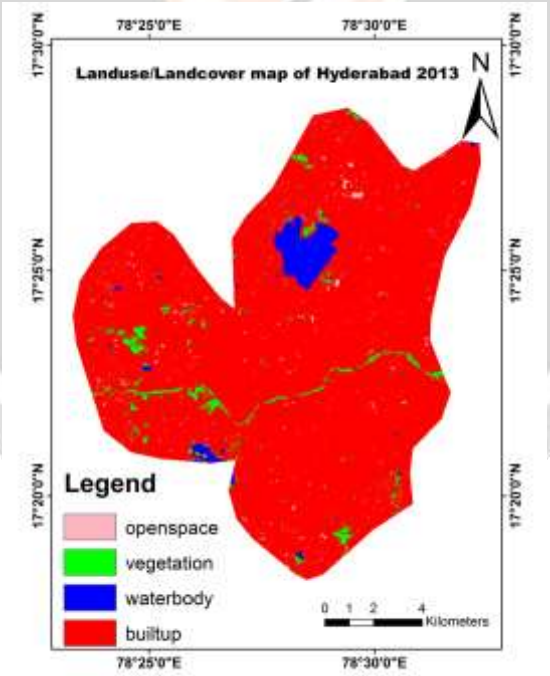


**Fig 6:** Land use/Land cover map of Hyderabad 2013

**Table 2:** LULC classification of study area in Hectares

| LULC Category | 1993 | 2000 | 2008 | 2013 |
|---|---|---|---|---|
| Water body | 5.2 | 5.93 | 7.44 | 17.81 |
| Vegetation | 6.07 | 33.56 | 25.18 | 15.376 |
| open Space | 9.5 | 12.81 | 14.42 | 6.21 |
| Built-up | 158.13 | 126.67 | 131.94 | 139.6 |
| Total | 178.9 | 178.9 | 178.9 | 178.9 |

## Change Detection Analysis

The change analysis presented in this paper was based on the statistics extracted from the four land use and land cover maps of the Hyderabad city.

## Changes Occurred in Hyderabad during 1993 – 2000

As per the Observation and Analysis from the Data collected from year 1993-2000, we observe that there is a change much seen in Vegetation in Hyderabad of 29.399sq.kms of area that too specifically Built-Up to Vegetation Change is seen Mostly 27.37sq.kms (Fig. 7).

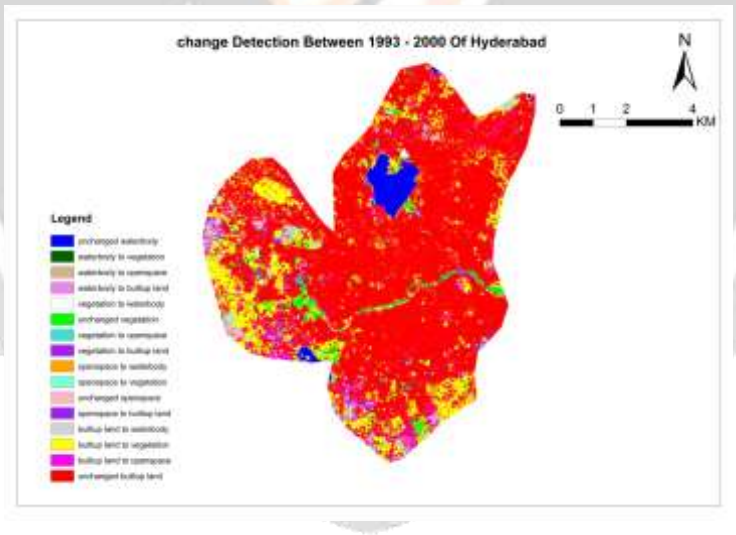


**Fig. 7**: Change matrix between 1993-2000 of Hyderabad

## Changes Occurred in Hyderabad during 2000 – 2008

As per the Observation and Analysis from the Data collected from year 2000-2008, we observe that there is a change much seen in Built-Up in Hyderabad of 17.6sq.kms of area that too specifically Vegetation to Built-Up Change is seen Mostly 10.37sq.km (Fig 8).

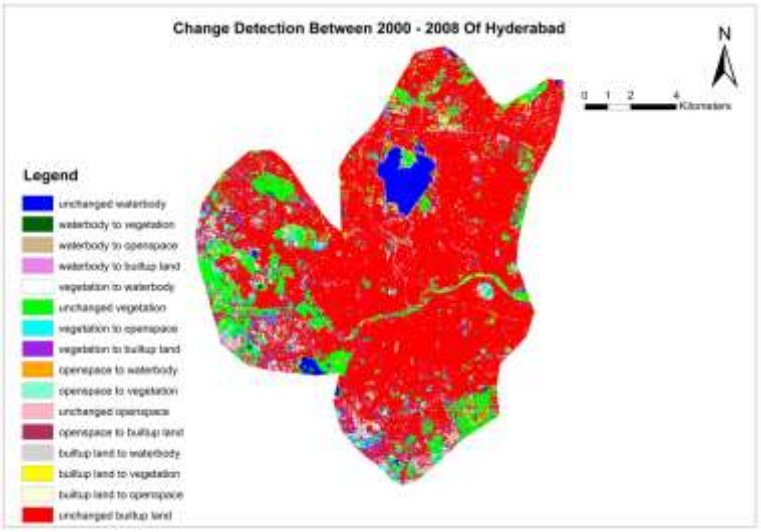


**Fig 8:** Change matrix between 2000-2008 of Hyderabad

## Changes Occurred in Hyderabad during 2008 – 2013

As per the Observation and Analysis from the Data collected from year 2008-2013, we observe that there is a change much seen in Built-Up in Hyderabad of 36.67sq.kms of area that too specifically Vegetation to Built-Up Change is seen Mostly 21.33sq.kms (Fig 9).

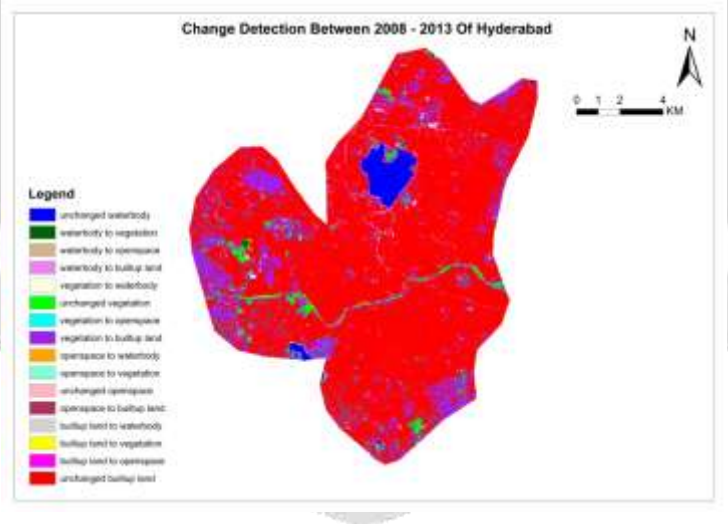


**Fig 9:** Change matrix between 2008-2013 of Hyderabad

## Changes Occurred in Hyderabad during 1993 – 2013

As per the Observation and Analysis from the Data collected from year 1993-2013 ((Fig.10), we observe that there is a change much seen in Built-Up in Hyderabad of 13.537sq.kms of area that too specifically openspace to Built-Up Change is seen Mostly 8.92sq.km (Fig.11).

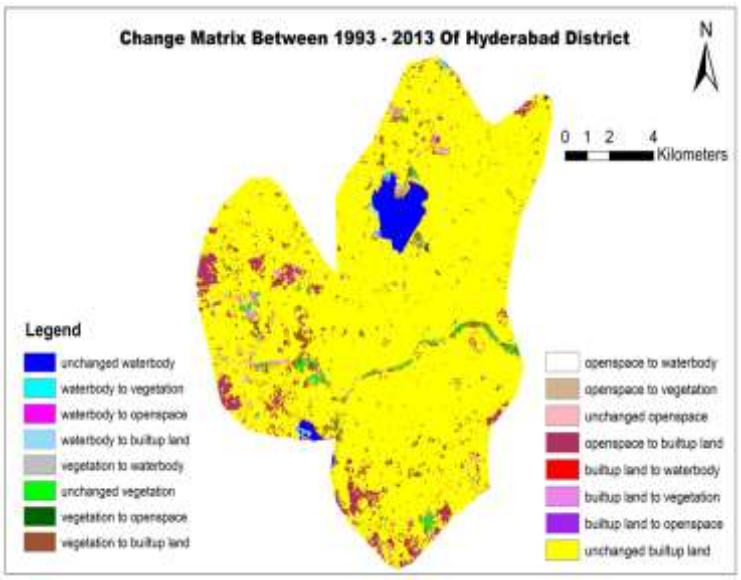


**Fig 10**: Change matrix between 1993-2013 of Hyderabad

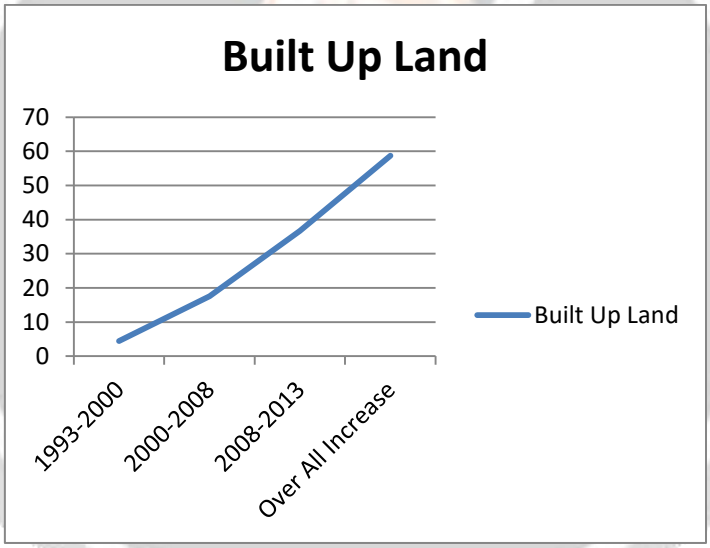


**Fig. 11:** Built-Up growth of Hyderabad area since 1993 – 2013

## CONCLUSION

This study has developed a comprehensive LULC database for four time periods. Furthermore, it has enabled to assess Spatial-temporal growth. Spatiotemporal growth can be quantified by a Built-up area for different periods. At last the population growth vs. built-up area shows a positive correlation i.e., higher the population growth larger the built-up area.

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