Land Use and Land Cover Change Detection for Delhi Region through Remote Sensing Approach

Shravya.S[1] Sridhar.P[2]
[1]M. Tech. Student [2]Assistant Professor
[1,2]Department of Geoinformatics
[1,2]SVECW, Bhimavaram, A.P, India

Abstract— In this paper an attempt is made to study the changes in land use and land cover categories for Delhi region using remote sensing data and to generate the statistical of the changes that occur in the area of various land use/ land cover categories during the period 1990 to 2015. Remote sensing data and GIS techniques provide efficient methods for analysis of land use issues and tools for land use planning and modeling. A comprehensive LULC map was developed for four distinct years for a period of 25 years to study the urbanization in Delhi and evaluate the Change Detection of the study area and showing the result into change matrix, as well as also find out the impact of Delhi urbanization in urban rural fringe area and evaluate the change matrix of fringe area. Therefore, LULC were distinctly developed for each study years but with more emphasis on Built-up area to assess and quantify the urbanization. The study has demonstrated that urbanization and Spatio-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 Delhi.

Key words: Land Use, Land Cover, Change Analysis, Remote Sensing

I. INTRODUCTION

Remote sensing data and GIS techniques provide efficient methods for analysis of land use issues and tools for land use planning and modeling (Wani et al., 2011; Tripathi et al., 2012). Timely and accurate change detection of earth's features provides the foundation for better understanding relationship and interaction between human and natural phenomena to better manage and use resources (Tomlin et al., 1998; Prakasam et al., 2010; Kalpana et al., 2011). Also the requirement of suitability in present day urban planning and management need continuous, accurate and up to date the data (Gajbhiye et al., 2012). Some of the important field of urban planning for change detection in built-up are monitoring the urban extension, monitoring growth of urban rural population, analyzing the impact of urban area on their surrounding zones and predict future changes based on past change analysis (Subramani et al., 2014; Congalton et al., 1991; Liu et al., 2004). With the population growth, built-up area in Delhi is rapidly increasing and it is leading to several environmental consequences such as air and water pollution, traffic congestion, urban heat island formation etc. Hence the urban environmental in Delhi is under severe stress due to the pressure of rapid urbanization consequently urbanization has deteriorated the overall quality the urban environment in Delhi in order to mitigate and minimize the detrimental effect associated with urban growth on the environment and to maintain optimal ecosystem functioning spatial and temporal land use land cover pattern and the factor affecting these change are considerably important in developing rational economic, social and environmental policies.

II. STUDY AREA

The study area (Fig.1) covers an area of 1483 sq. km. which fall under Delhi metropolitan city as per Census, 2011. Delhi city is the capital of India and it is located in the coordinates of 28°23'46.23"N to 28°55'1.20"N Latitude and 76°50'42.74"E to 77°21'18.49"E Longitude. Beside Delhi is adjoined by couple of large small cities comprise Gurgaon, Noida, Ghaziabad, Faridabad. Delhi is the second most populated city in India. Delhi has an extreme climate which is very cold in winter and terribly hot in summer.

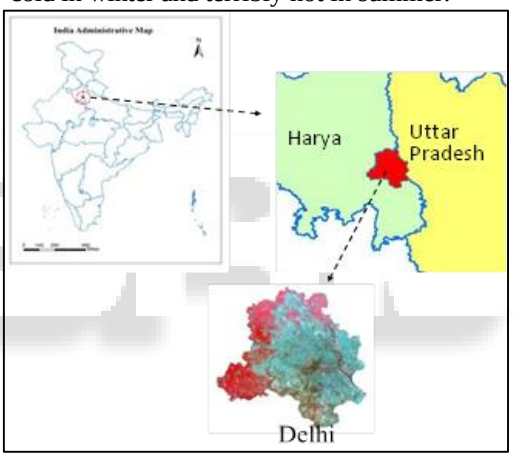

Fig. 1: Location map of the study area.

III. METHODOLOGY

Land use/ Land cover of entire Delhi NCT was carried out from four sets of satellite imageries (Table.1) retrieved for four different time periods (1990, 2000, 2010, and 2015). A hybrid land use land cover classification technique was used for image processing. In addition, ground truth was carried out for several point those are helpful to evaluate accuracy assessment of classification of 2015 imageries. The administrative state boundary was brought to Universal Mercator projection in zone 43 and later the satellite imageries were clipped with the administrative boundary of Delhi as well as Gurgaon, Ghaziabad and Faridabad also. Furthermore, population census of Delhi was also acquired from census data 2011. Population of Delhi from 1981-2011 was used into correlate between population growths to urban growth.

Preparation of thematic maps from the digital satellite data was carried out by using ERDAS IMAGINE 9.1 and Arc GIS 10.2.2 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 (Butt et al., 2015; Alqurashi et al., 2013). These interpretation elements were followed by the preparation of interpretation key.

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 (Kalpana et al., 2010; Arveti et al., 2016). 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 (Macleod et al., 1998). Five land classes namely built up, Agriculture land, Open space, Vegetation, Water body identified in the study area.

Satellite	Sensor	Path/row	Date	Band in Use
Landsat 4	TM	157/040	03-5-1990	1,2,3,4
Landsat 5	ETM+	146/040	12-2-2000	1,2,3,4,5,7
Landsat 8	OLI	141/040	24-4- 2010	2,3,4,5,6,7
Landsat 8	OLI	152/040	02-1- 2015	2,3,4,5,6,7

Table 1: Data sets used in the present study

IV. Results and Discussion

Remote sensing and GIS play a vital role for examine LULC. In this paper Land Use Land Cover (LULC) maps of different years were compared (Table. 2). The LULC of the study area had changed dramatically during the period of 19 years. Therefore, the data interpretation and data analysis is based on the comparison of LULC for three different periods during 25 yearperiod. Between 1990 and 2015 there is huge changes in study area Delhi those ore shown into maps or as well as graph also.

In 1990 the built-up area covered 18870 hectare 13% of the total area, Agriculture area covered 15297 hectare 10% of the total area, water body covered 939 hectare 1% of the totalarea area, Open space covered 45070 hectare 30% of the total area and Vegetation covered 68842 hectare 465 of the total area (Fig.2). In 2000 after one decade the built-up area was extant 18870 hectare to 31691 hectare, Agriculture land was reduce from 15297 hectare to 11153 hectare, water body also be increase from 939 hectare to 1393 hectare, Open space was increase may be agriculture turn into open space or a vegetation turn into open space and Vegetation also reduce from 68842 hectare to 46377 hectare (Fig.3). There are huge change seen between 1990 classification to 2015 classification those are easily identify by analyze this maps (Fig. 4, Fig.5).

During this 2.5 decade Open space are also convert in major quantity into Built-up or Agriculture region. Water body have no major changes in seen but Vegetation also affected by built up or agriculture increase. Between 90-2000 Vegetation loss in large Quantity Approximately 20,000 hectare but after 2001 the government policy save tree the loss of tree are in control on Delhi government. The urban change analysis presented in this paper was based on the statistics extracted from the four land use and land cover maps of the Delhi city (Fig.6 and Fig.7).

	1990	2000	2010	2015
Built-up	18870	31691	52281	67119
Agriculture	15297	11153	9451	18655
Water body	939	1391	951	908
Open space	45070	58410	39587	13965
Vegetation	68842	46372	44727	41777

Table 2: LULC area of Delhi in hectare

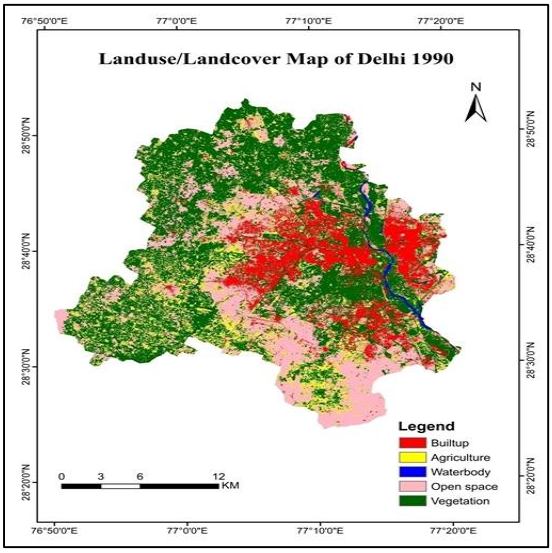

Fig. 2: Land use/Land cover map of Delhi 1990

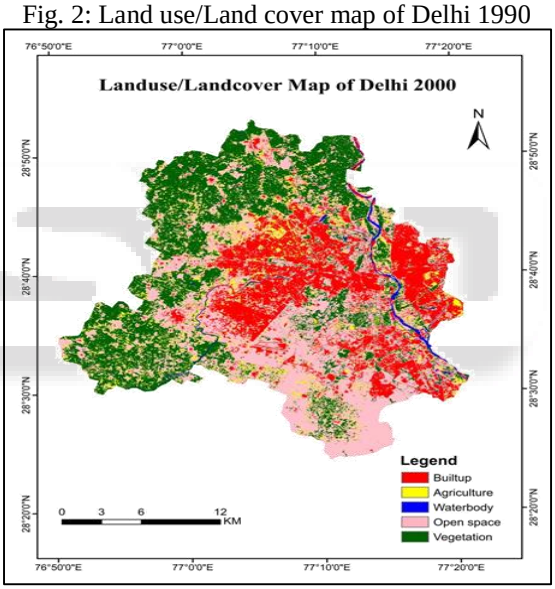

Fig. 3: Land use/ Land cover map of Delhi 2000

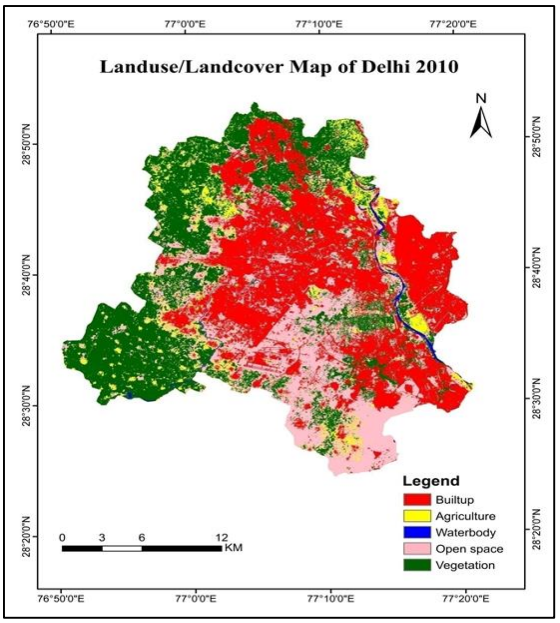

Fig. 4: Land use/ Land cover map of Delhi 2010

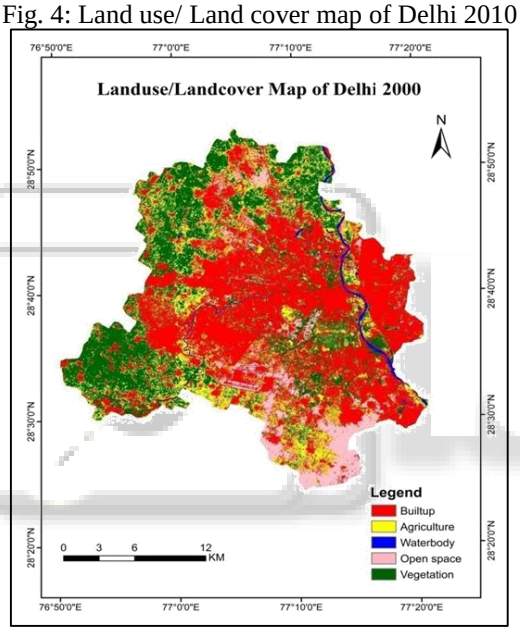

Fig. 5: Land use/ land cover map of Delhi 2015

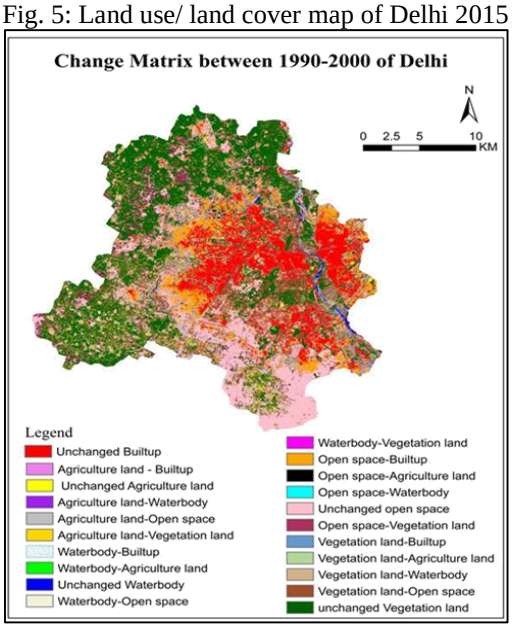

Fig. 6: Change matrix between 1990-2000 of Delhi

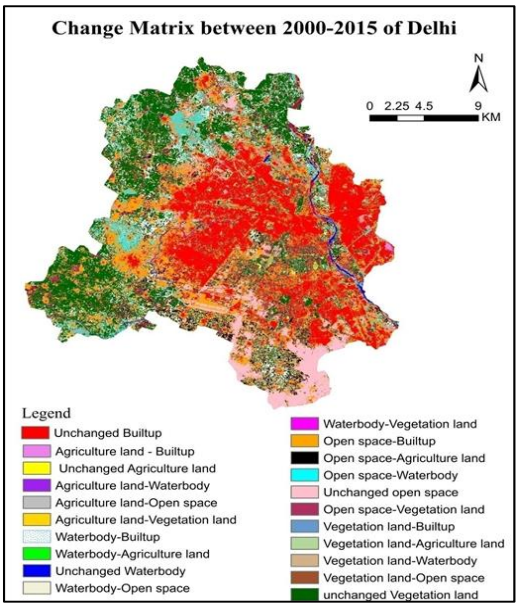

Fig. 7: Change matrix between 2000-2015 of Delhi

V. CONCLUSION

An attempt was made in this study to develop a spatial data of LULC of Delhi metropolitan city. A comprehensive LULC map was developed for four distinct years for a period of 25 years to study the urbanization in Delhi and evaluate the Change Detection of the study area and showing the result into change matrix. The classification finally gives the land use, land cover image of the area on which analysis. Five land classes namely built up, Agriculture land, Open space, Vegetation, Water body identified in the study area.

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