A REMOTE SENSING–GIS EVALUATION OF URBAN EXPANSION- A CASE STUDY OF MUSHARI BLOCK, MUZAFFARPUR DISTRICT, BIHAR

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Abstract

Urban sprawl refers to the extent of urbanisation, which is a global phenomenon mainly driven by population growth and large scale migration. Uncontrolled and unplanned urban extents will have excessive control on climate and the local environment and its cause to Land Use Land Cover Change (LULC). In this paper we used temporal data of Landsat 5 TM, Landsat 7 ETM +, Landsat 8 OLI from 1990 to 2020 data of Mushari block of Muzaffarpur district, Bihar. To evaluate expansion of urban area in Mushari block of Muzaffarpur district we create LULC map through supervised classification using Landsat data of different Time series. The main paths for the land use/cover change model were based on five sets of multi temporal land use/cover data derived from remotely sensed images. Using the integrated GIS, several spatial variables were derived, including the proximity to major roads and built-up areas. We found tremendous growth in urban area during period of to 2009 to 2020 after the analyse the result we found urban area increase from 1990 52 hectares to 2020 789 hectares and also decrease in agriculture land from 1990 716 hectares to 2020 13 hectares in present Mushari block of Muzaffarpur district.

Keywords: LULC map, Urban Sprawl, Supervised classification.

1.Introduction

Urban sprawl refers to unplanned development of city. Urban sprawl is characterized by unexpected and irregular growth pattern, driven by multitude of process and leading to ineffective resource utilization (Bhatta, 2010). As the population increase and national economy continue move away from agriculture-based systems, cities grow and spread. The urban sprawl often infringes upon viable agriculture. City growth generally has a negative impact on environmental health of a region. Urbanization as a land use is the physical growth of urban areas as a result of rural migration and even sub-urban concentration into cities (particularly the very large ones) and around the small ones in the village depending on the factors that are driving its growth. Urban population is increasing

at a much faster rate than was expected. The process of urbanization has been characterized not only by population growth but also by industrial expansion, increasing economic and social activities and intensified use of land resources (Karuga, 1993).

Sprawl is defined in terms of "undesirable" land-use patterns—whether scattered development, leapfrog development (a type of scattered development that assumes a monocentric city), strip or ribbon development, or continuous low-density development. Scattered development is perhaps the most common model, but any "non-compact" development pattern qualifies. Scattered development is classic sprawl; it is inefficient from the standpoints of infrastructure and public service provision, personal travel requirements, and the like. Polycentric development, on the other hand, is more efficient than even compact, centralized development when metropolitan areas grow beyond a certain size threshold (Haines, 1986). A polycentric development pattern permits clustering of land uses to reduce trip lengths without producing the degree of congestion extant in a compact, centralized pattern (Gordon et al., 1989). Urbanization as a land use is the physical growth of urban areas as a result of rural migration and even sub Urban concentration into cities (particularly the very large ones) and around the small ones in the village depending on the factors that are driving its growth. Urban population is increasing at a much faster rate than was expected. The process of urbanization has been characterized not only by population growth but also by industrial expansion, increasing economic and social activities and intensified use of land resources (Karuga, 1993). Urban/build area land use has sharply accelerated with an increasing proportion of the population in many countries concentrating in large urban centers that are accessible and with good infrastructure. Security and availability of good services within the centers has also caused movement hence the growth. This movement has created demand for residential houses and thus building haphazardly without coordinated planning. The direct implication of sprawl is change in land use land cover (LULC) of the region a

Land use land cover (LULC) is a global change driver and has notable implications to many of the international policy issues (Vitousek and Field, 1999). Land Use is the human modification of natural environment or wilderness into built environment. It is basically the human activities on the earth's surface. Land

cover on the other hand is simply that which covers the earth surface. Over the years, human activities have modified the environment with significant population increase, migration, and accelerated socio-economic activities. Land use and land cover are two separate terminologies which are often used interchangeably. It is an important component to understand global land status as it shows present as well as past status of the earth surface (Dimyati et al., 1994). Land use land cover analysis plays an important role in the field of environmental science and natural resource management by helping managers to make informed decisions that pertain to sustainable development. Land cover is a secondary measuring parameter of the content of the earth surface as an important factor that affects the condition and functioning of the ecosystem. It is a biophysical state of the earth surface. Land use/cover pattern of a region gives information about the natural and socio-economic factors, human livelihood and development. Like other resources, land resource is also delimiting due to very high demand of agricultural products and increasing population pressure day by day (Yadav et al., 2012). It has mainly exerted intense pressure on existing land uses and the most affected is agricultural land which is diminishing at a very high rate. This is because much of it is being converted into urban/ build-area land use leading to food insecurity (a global problem which has caused governments to spend time and money trying to resolve). Agriculture is the backbone of most economies in developing countries which have good fertile soils and receive adequate rainfall that can support both cash and food crops grown in these areas. Conversion of agricultural land has become a serious problem which is depriving economies foreign exchange income and it has also led to reduced food production. In the last decades Muzaffarpur district has experienced rapid growth in terms of population which has put pressure on its limited land resources and adversely affected land uses in the entire city and more so places that are near urban centers because of demand for housing. In this present study with the help of Remote sensing and GIS technology I observed from the year of 2010 to 2020 rapid growth in urban areas. Remote Sensing (RS) and Geospatial Information Systems (GIS) with their advantages of handling spatial, multispectral and temporal data, their availability and efficiency in data manipulation, have become very handy tools in analyzing, accessing, monitoring of land use/land cover changes and their effects on food

security. Global positioning system (GPS) has also played an important role as a tool for collecting spatial data for the same and in improved farming methods like precision agriculture. Geospatial

techniques have been used extensively in the tropics for generating valuable information on the forest cover, vegetation type and land use change detection (Forman, 1995). In this study we apply GIS, Remote Sensing and GPS tools to analyze the effects of land use land cover changes on agricultural land in Muzaffarpur district, Bihar. The main objective of this study focuses on the effects of the long-term land use land cover changes in Muzaffarpur district. The study employs the use of time-series analysis of Landsat images for the period 1990, 2000, 2010 and 2020.

2. Study Area

The area of the study is Mushari block in Muzaffarpur district of Bihar, "The land of Litchi". Mushari block headquarters is Mushari Radha Nagar town. It belongs to Tirhut division. Mushari block is located on global map between 25° 54' and 26° 23 ' North latitude and 84° 53' and 85° 45' East longitude. The block occupies an area of 184 square kilometers.

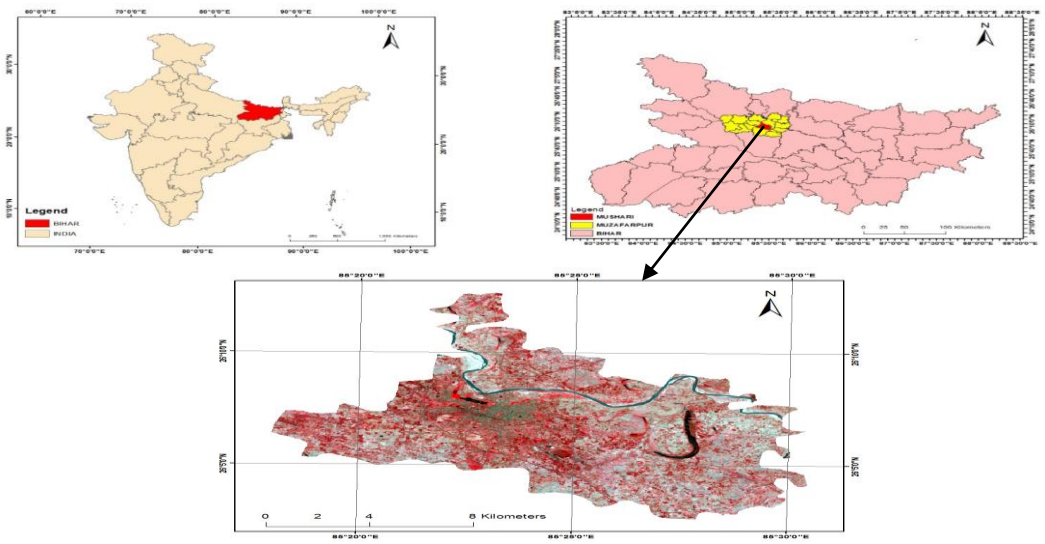

Figure1. Location Map of the study area.

3. Data and Methodology

Change in land use land cover (LULC) pattern were detected using Landsat TM, ETM+ and OLI owing to their good spectral and temporal resolution and moderate temporal resolution (Lillesand et al.,2004; Short 2004). In this study various data set of Landsat were used from 1990 to 2020 and various

software were used to integrate the data and to carry out the analyses. Fig.2 shows the methodology implemented in this study.

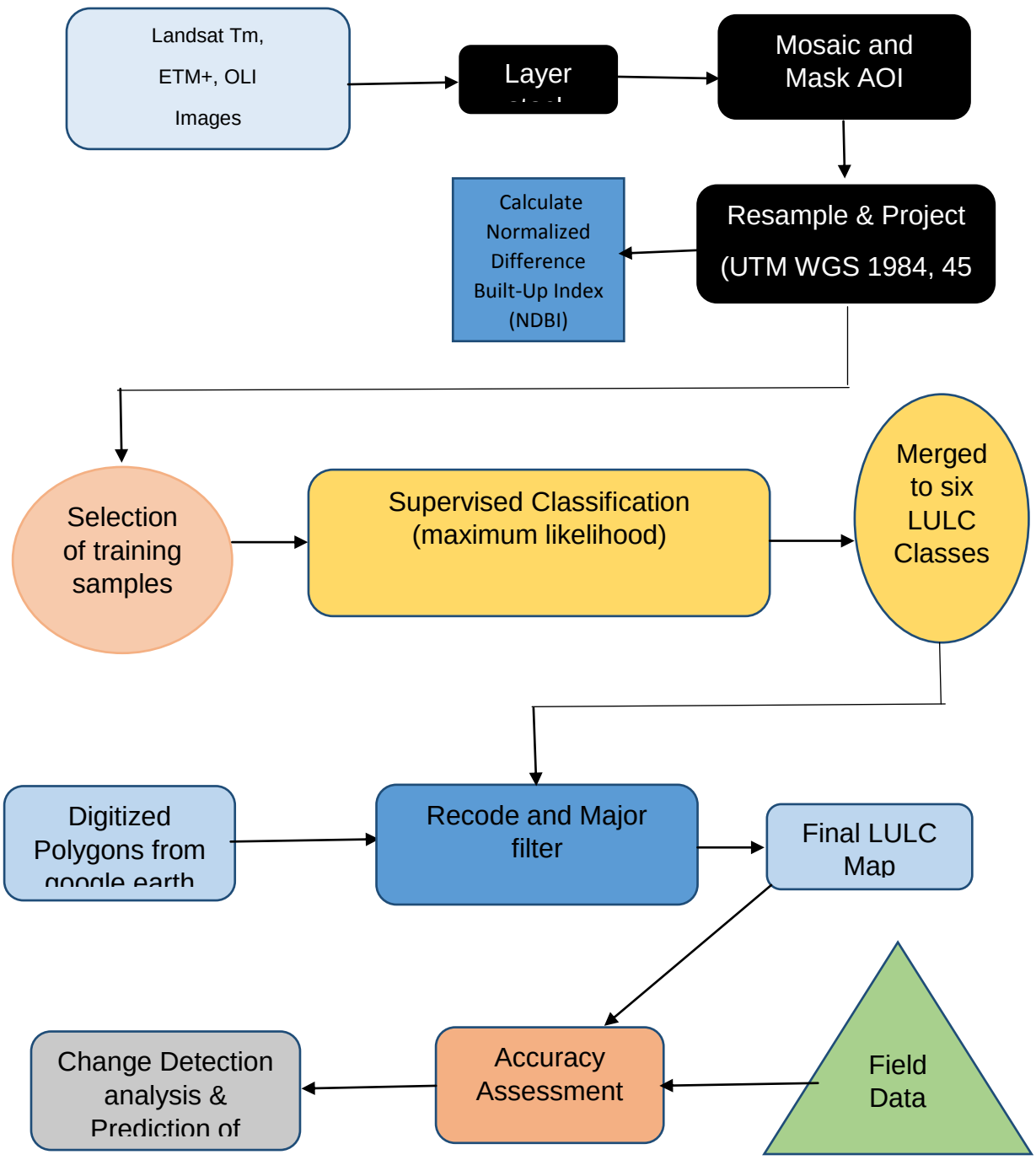

Fig.2. General Methodology.

3.1 Source of Data

In this study I used various Data set, the description of the data is given in Table 1. The Software used in this study include, ArcGIS 10.1 for preparation of thematic map, Database generation, analysis and sub-setting/clipping of images; ERDAS Imagine 2011 for layer stacking, mosaicking, sub-setting, image classification, NDBI calculation, recording of features and accuracy assessments.

DATA TYPE	SOURCE	ROW/PATH	DATE
MULTISEPCTRAL IMAGES	LANDSAT-5 TM	141/42	11-05-1990
	LANDSAT-7 ETM+	141/42	05-05-2000
	LANDSAT-7 ETM+	141/42	23-05-2010
	LANDSAT-8 OLI	141/42	13-05-2020
TOPOGRAPHICAL MAPS SCALE 1:25000	SURVEY OF INDIA		
Google Earth	Historical Google Earth Images.		
SHAPEFILE	IQ GIS WEBSIETE		

Satellite data with low cloud cover (less than 10%) from 1990 to 2020 with gap of five years were selected. The satellite data are given as follow: Epoch 1990 Landsat 5 (TM) Thematic Mapper (Spatial resolution 30 m) from USGS Earth explorer.

Epoch 2000 - 2010 Landsat 7 (ETM+) Enhanced Thematic Mapper (Spatial resolution 30 m) from USGS Earth explorer

Epoch 2020 Landsat 8 (OLI) Operational Land Imager (Spatial resolution 30 m and 15 m Pan.) from USGS Earth explorer.

3.2 Image Processing

Data Collected were processed to make it compatible to other data set and enable its usage in other software. This was achieved through projection and geo-referencing of various data set. Using Erdas Imagine 2015, satellite images were imported to software then layer stacked the different bands and then reproject the data. After that using Muzaffarpur shape file clipped done. ARC GIS 3.1 software is used to prepare different Land Use Land Cover Classification maps for the respective years 1990, 2000, 2010, and 2020. To extract Built-Up area of Mushari block Normalized Difference Built-Up Area (NDBI) is calculated using Erdas Imagine 2015 for the years 1990, 2000, 2010 and 2020.

RESULT AND DISCUSSION

After processing all the data and supervised classification was done sixmain Land use classes were obtained in the study area these classes area Urban Built-Up Area, Agriculture Land, Litchi Plantation field, Bare-land, Water body and waste land. Figure 3. (a, b, c, d,) shows the land use land cover (LULC) for the years 1990, 2000, 2010 and 2020 respectively. Also calculate Normalized Difference Built-Up Index (NDBI) to extract Built-Up area which are shown in Fig. 4. (a, b, c, d).

the AOI (Area of interest), then Supervised classification were done to extract information. Six LULC classes were established through Visual Interpretation of data. Through GPS Co-ordinate well informed knowledge of area and historical Google Earth Images Accuracy Assessment were

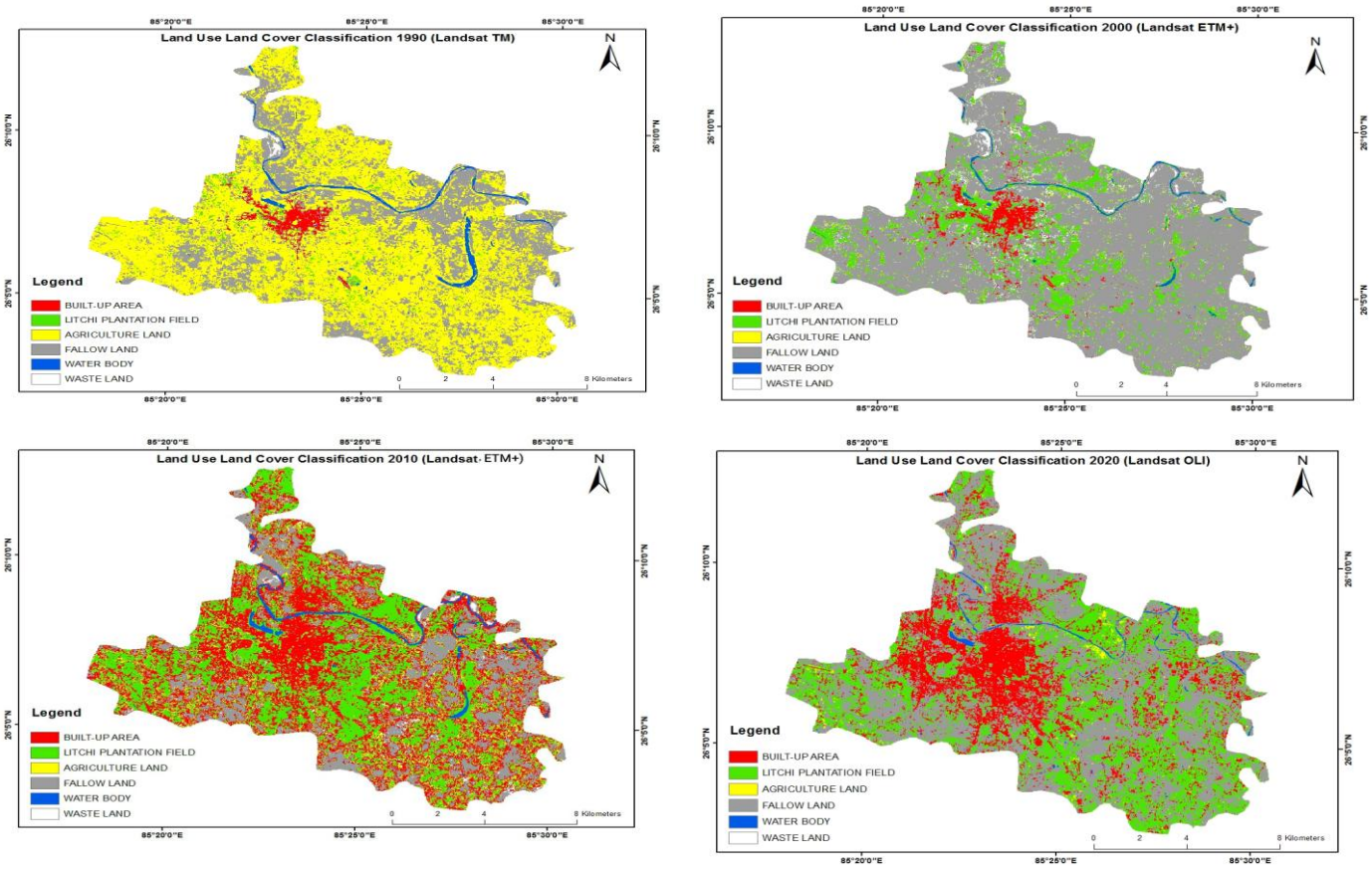

Fig. 3 d LULC map 1990,2000,2010,2020

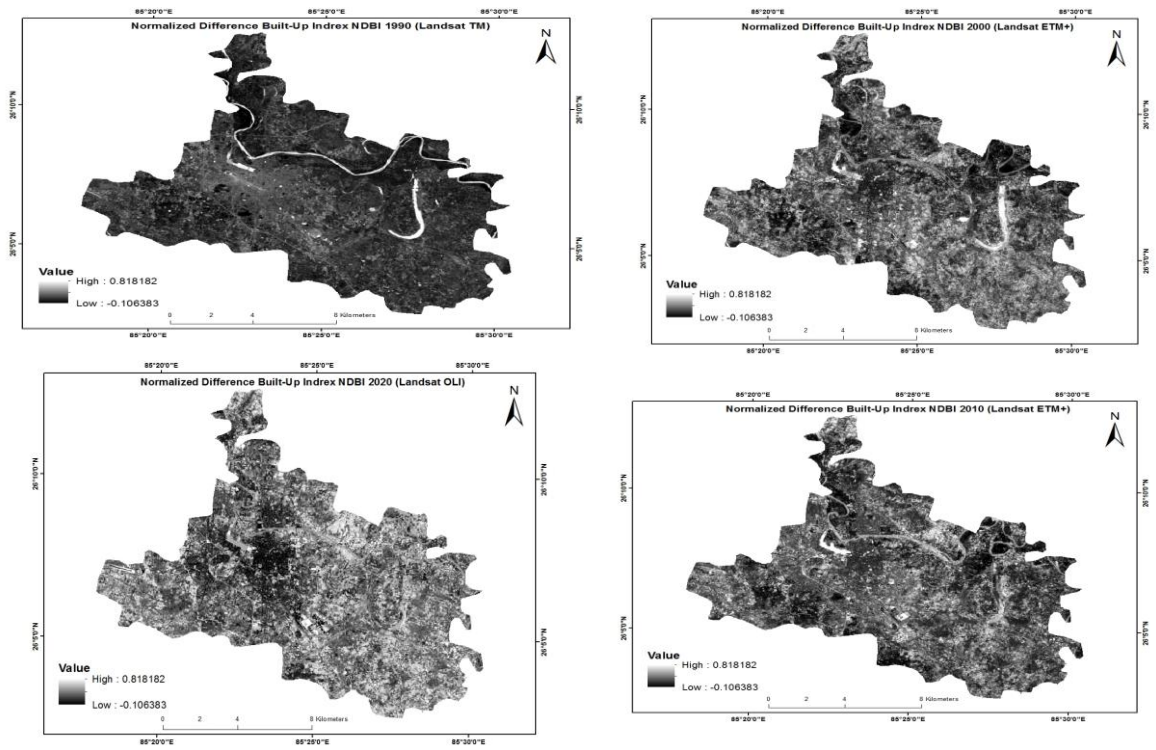

Fig 4 . NDBI Map 1990,2000,2010,2020

Accuracy assessment was performed for the years 1990, 2000, 2010 and 2020 land use land cover change maps (Figures 3a, b, c, d,) using Google maps at different times of the year and knowledge of the local area. The results obtained were within 65%. Table 1 shows the area and percentages of the six land use land cover classes. A graphical representation of the areas occupied by the six land. use and land cover (LULC) classes of Mushari block in Muzaffarpur district during the years 1990, 2000, 2010

land and built area (Figure 5). This shows that agricultural land is being converted into

and 2020 is given in Figure 5. There is a near direct relationship between agricultural residential Table 1 Shows Area (in hectares) Occupied by Six Land Use Land Cover Classes of Mushari block, Muzaffarpur district for the years 1990, 2000, 2010 and 2020 and commercial uses.

Fig.6 Built-Up area (in hectare) of Mushari block, Muzaffarpur district for the years 1990, 2000, 2010 and 2020

5. Conclusion

The purpose of this study was to analyse the effect of urban sprawl on land use land cover change in Muzaffarpur district, Bihar and to determine the main drivers of these using geospatial technology. Satellite data of Landsat series Thematic mapper (TM), Enhanced Thematic mapper (ETM+) and Operational Land Imager (OLI) were used. Images for the session between May-June in the years 1990, 2000, 2010 and 2020 respectively were used. Digital image analysis was carried out through supervised classification using ERDAS Imagine 2015 by defining samples or signature values on the respective images. The classes mapped were urban built-up area, litchi plantation field, agriculture land, bare-land, water-body and waste land. Accuracy assessment was carried out which gave accuracy level within the acceptable limits per the USGS requirements. The results obtained showed that there are increase in built-up area from 1990 52 hectares to 2020, 789 hectares and significantly decrease in agriculture land from 1990 716 hectares to 2020, 13 hectares. if no remedial action will take to improve crop farming. One of the remedial action can be taken is space optimization to accommodate land use land cover (LULC) in an optimal manner.

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