

# Land Use and Land Cover Change Detection of Bandhavgarh National Park, M.P., India Using Sentinel-2 Satellite Data

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**Abstract:** Land use relates to the human activity or economic function associated with a specific piece of Land. Land use is an expression of human uses of the landscape, e.g. for residential, commercial, or agricultural purposes and has no spectral basis for its unique identification. A proper use of land is therefore very important to manage the space as well as the utilities in the Bandhavgarh National Park (BNP). The land use and land cover map clearly shows that the major changes in forest land and agriculture land area in given map. Here in this study a try has been made to evaluate the changes in the land use land cover pattern of the Bandhavgarh National Park. Land Use and Land Cover (LULC) changes in Bandhavgarh National Park 2007 to 2017 were analyzed using temporal remote sensing data with geographic information system (GIS). LISS-III imageries at a resolution 23.5m and Sentinel-2A imageries at a resolution of 10m have been used to prepare the LULC maps of the Bandhavgarh National Park for mentioned years. Erdas Imagine software used for extracting ground information from the satellite imageries. It has been observed that changes in the land use pattern with increase of scrub forest by 231.33 km<sup>2</sup>, open forest 119.09 km<sup>2</sup> and agriculture land 55.45 km<sup>2</sup> and dense forest decreased by 384.27 km<sup>2</sup>.

**IndexTerms - LULC, Change Detection, Sentinel-2A, LISS-III, GIS.**

## I. INTRODUCTION

The terms land use and land cover is often used interchangeably, but each term has its own unique meaning. Land cover refers to the surface cover on the ground like vegetation, urban infrastructure, water, bare soil etc. Identification of land cover establishes the baseline information for activities like thematic mapping and change detection analysis. Land use refers to the purpose the land serves, for example, recreation, wildlife habitat or agriculture.

When used together with the phrase Land Use / Land Cover generally refers to the categorization or classification of human activities and natural elements on the landscape within a specific time frame based on established scientific and statistical methods of analysis of appropriate source materials. Land cover is the physical material at the surface of the earth. Land use is the description of how people utilize the land for the socio-economic activities

Land Use / Land Cover generally refers to the categorization or classification of human activities and natural elements on the landscape within a specific time frame based on established scientific and statistical methods of analysis of appropriate source materials. It has various methods of classifications. Various types of LULC elements is there like Urban or Built-up Land, Agricultural Land, Forest Land and many more. LULC maps has there wide applications like Natural resource management, Baseline mapping for GIS input, Legal boundaries for tax and property evaluation and many more. LULC mapping is not possible without the help of other geospatial datasets.

Land use/land cover changes have direct impacts on the hydrological cycle and stream water quality and furthermore, there are also indirect impacts on climate and the related impacts of the altered climate on the hydrology of an area (Weng, 2001). Therefore, LULC changes have been treated as one of the most crucial and sensitive factors for global environmental change. Urbanization is the major force that is driving LULC changes. Although urbanization due to urban sprawl provides social and economic benefits to the community, the detrimental consequences of the urbanization to the urban environment are widespread, especially in most emerging countries. Increased impervious surface in the urbanized. The LULC maps are derived from LISS-III imageries and Sentinel-2A imageries (2007-2017) using unsupervised classification method. The main objective of this study to prepare land use / land cover change detection map between 2007-2017 using unsupervised classification technique.

## II. STUDY AREA

Bandhavgarh National Park is a unique natural heritage area in Madhya Pradesh. Bamboo clumps are an intrinsic feature of BNP, as is the hilly terrain with its steep ridges, sal forests and grassy pastures. This wildlife haven is linked through patchy corridor forests with Kanha and both together constitute one of the world's most important tiger-breeding habitats.

The BNP is located in the north eastern border of Madhya Pradesh at the central part of India. It dwells around the Umaria-Shahdol district surrounded by the Satpura mountain range. The latitude and longitude are lies between 23° 27' 00" to 23° 59' 50" North latitude and 80° 43' 15" to 81° 15' 45" East longitude, falls under the Survey of India toposheet 64E/1, 64E/2, 64E/3, 64A/13 and 64A/14. The park is elevated at an altitude between 410 m and 810 m. The buffer zone has three administrative zones- Manpur, Dhamokhar and Panpatha. The reserve falls in the districts Umaria, Katni and Shahdol of Madhya Pradesh.

The mountains of BNP Tala range are being composed of sandstone and the soil is sandy to sandy loam. The whole park is filled with more than 20 luminous streams out of which some of the most important streams are Johilla, janadh, charanganga, Damnar, Banbei, Ambanala and Andhiyari Jhiria. These streams then merge into the son river, an important southern tributary to

the river Ganges. Along with that many caves and lakes can also be found at the vicinity of BNP especially around the area of the fort which is the most majestic and ancient part of BNP.

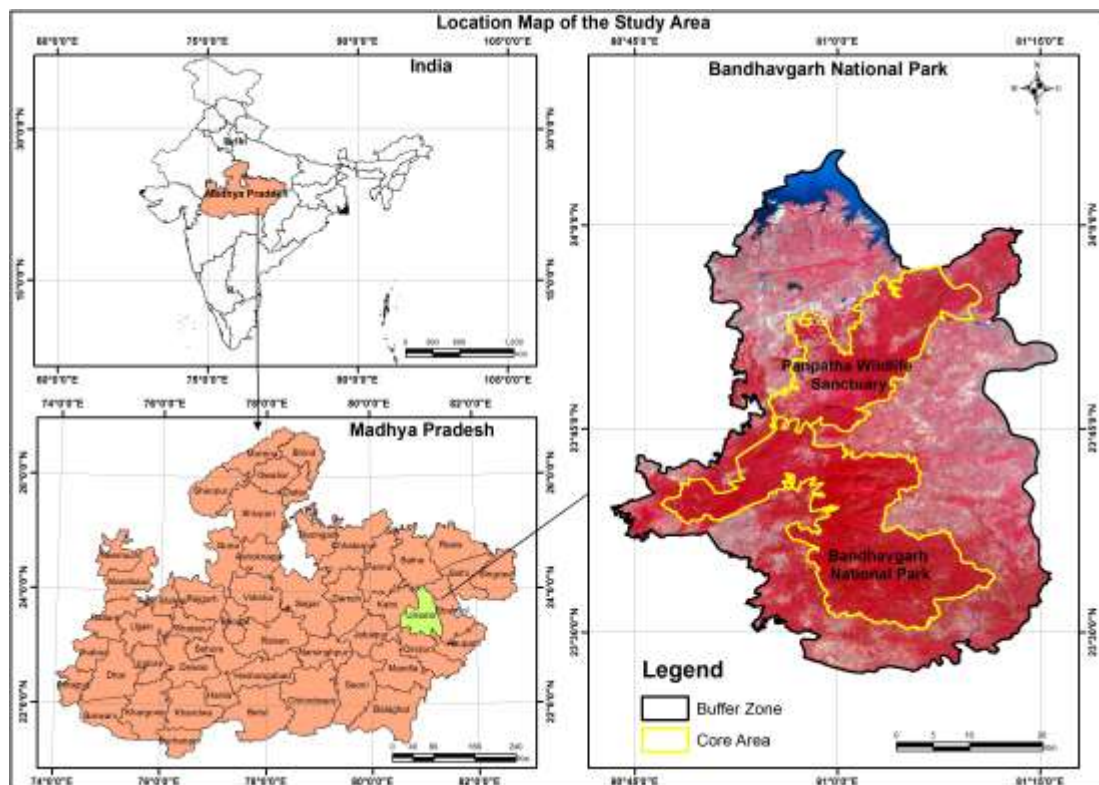


Figure 1: Location Map of Bandhavgarh National Park

### III. RESEARCH METHODOLOGY

The LULC classification maps were derived from LISS-III image and Sentinel-2A image (2007 to 2017). The data processing framework of research on LULC changes is given below. The figure 3 shows the LULC area of 2007-2017 and the figure 4 show the LULC changes.

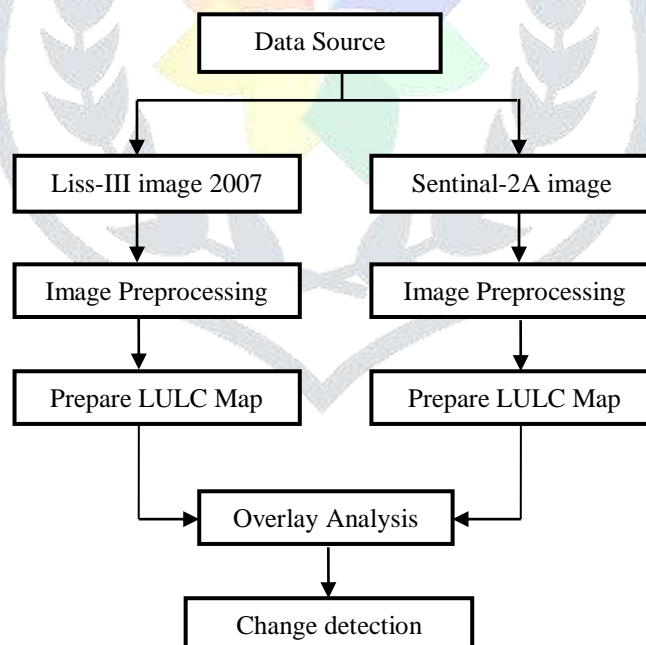


Figure 2: Flow chart of methodology for land use/land cover change detection.

### IV. RESULTS AND DISCUSSION

In the present study land use/land cover of BNP area was mapped for the years 2007 and 2017. In order to monitor the changes in land use/land cover, proper care was taken in the selection of cloud free temporal data.

The major land use/land cover categories identified in the study area are river & water bodies, Agricultural Land, Fallow land, Built Up, Dense Forest, Open Forest, Scrub Forest, and Wastelands. The details of the various land use classes and the observed changes are presented in Table 1.

Table 1: Area Statistics of Land use/Land cover distribution in Bandhabgarh National park 2007, 2017

Class Name	2007		2017		Change Detection	
	Area (km <sup>2</sup> )	Area in %	Area (km <sup>2</sup> )	Area in %	Changes in (km <sup>2</sup> )	Changes in %
Agricultural Land	611.82	27.33	667.26	29.81	55.45	9.06
Fallow land	71.33	3.19	32.36	1.45	-38.97	-54.64
Built Up	12.41	0.55	13.35	0.60	0.94	7.59
Dense Forest	702.49	31.38	318.22	14.21	-384.27	-54.7
Open Forest	591.87	26.44	710.97	31.76	119.09	20.12
Scrub Forest	48.13	2.15	279.45	12.48	231.33	480.68
Wastelands	57.75	2.58	66.88	2.99	9.14	15.82
Water bodies	142.87	6.38	150.17	6.71	7.29	5.1
Total	2238.66	100.00	2238.66	100.00		

Out of the total geographical area of 2238.66 km<sup>2</sup>, dense forest constitutes 702.49 km<sup>2</sup> in 2007-08, which is 318.22 km<sup>2</sup> in 2017. Major cause of this unprecedented decrease in area under dense forest is transformation into scrub forest and open forest (table1). The main reason for this land transformation is massive growth of population and urbanization. It has been also observed that there has been a considerable change in the land use pattern with an decrease of 54.64 % in the area under fallow land which may be transformed into agriculture land. Even though there has been slight change in the area under built-up land and water body. The area under wasteland land has increased by 15.82 % in 2017.

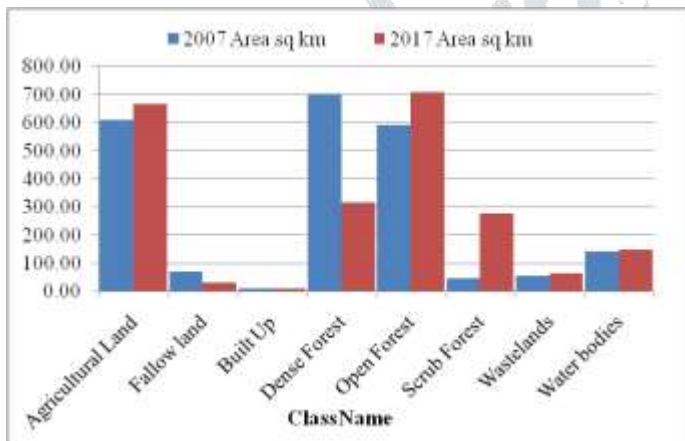


Figure 3: Land use/Land cover distribution in 2007-2017

Figure 4: Land use and land cover Changes

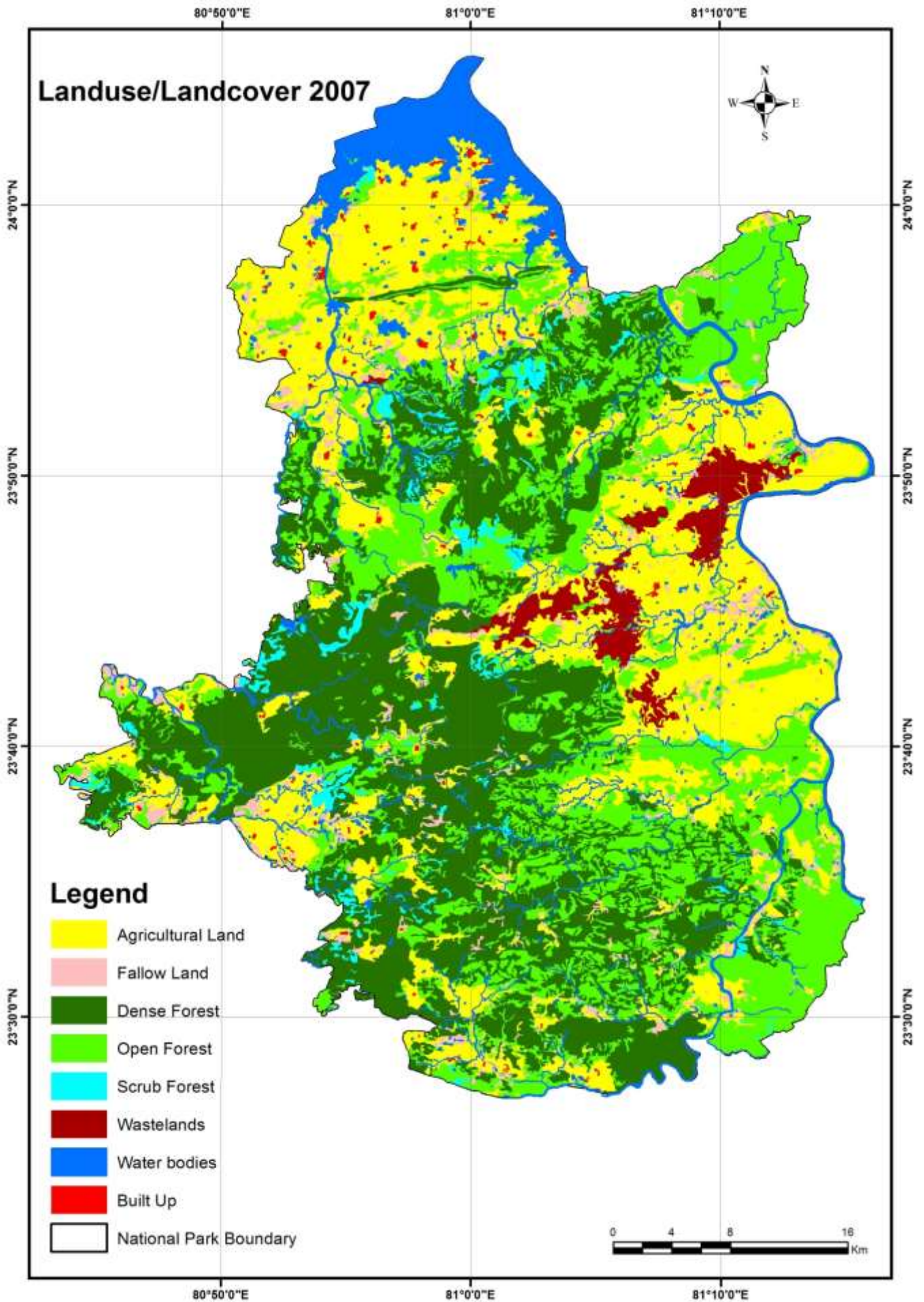


Figure 5: LULC Map of Bandhavgarh National Park 2007

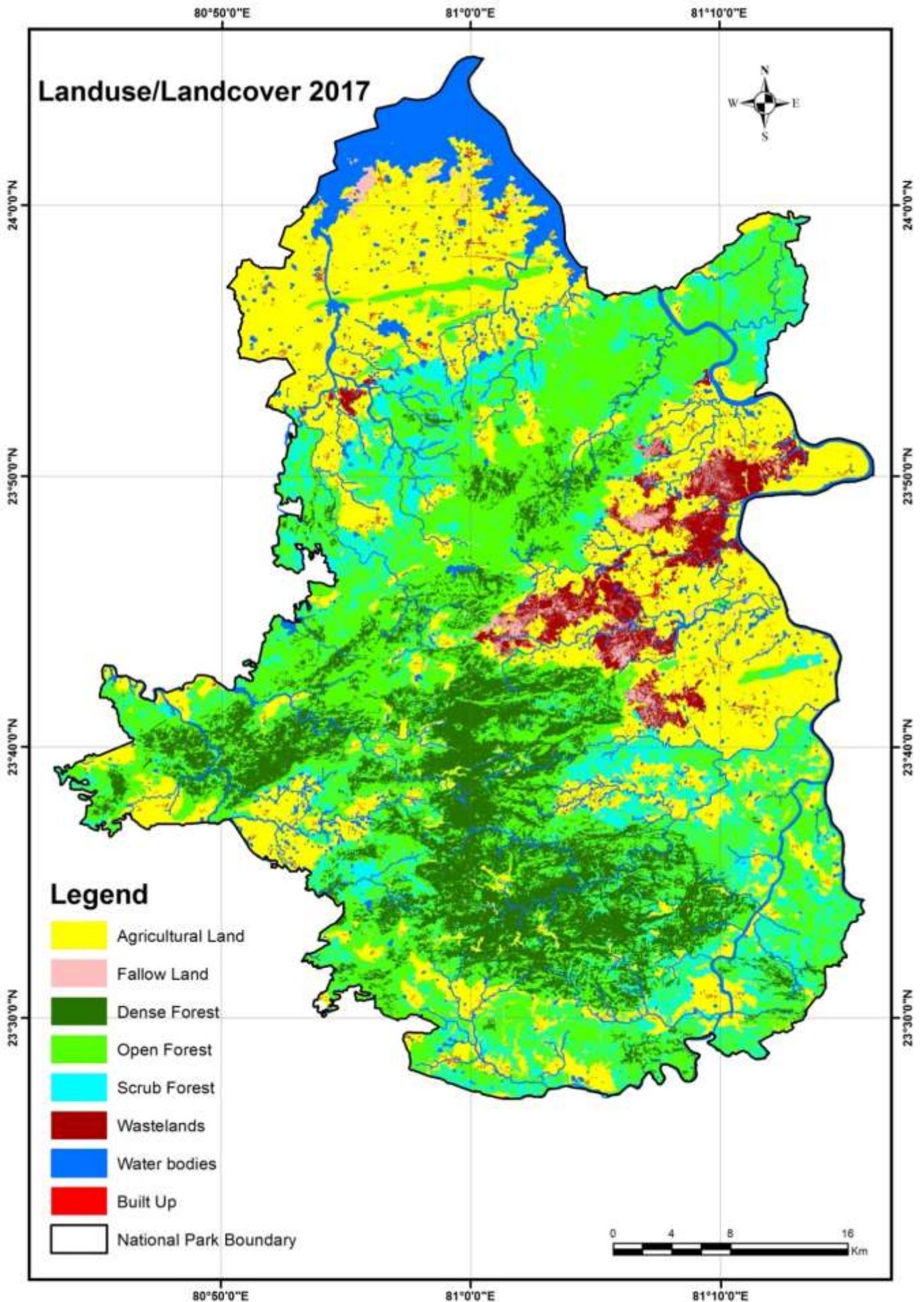


Figure 6: LULC Map of Bandhavgarh National Park 2017

V. CONCLUSIONS

Present study shows that how to classify land use and land cover from satellite imagery, we have calculated land use/land cover area using unsupervised classification, the land use/ land cover map clearly shows that area of Forest is higher than others. The

superior performance of neural network in terms of good classification accuracy has been reported earlier. The present study also supports their results by achieving accuracy even in case of Land use land cover mapping.

This paper presents a case study to investigate the LULC change especially on forest of the BNP. The LULC maps were derived from LISS-III imageries and Sentinel-2A imageries (2007 to 2017) using support unsupervised classification. Results indicated that the selected study area have forest in three categories dense forest, open forest, scrub forest. It has been observed that changes in the land use pattern dense forest decreased by 318.22 km<sup>2</sup> with the difference of 384.27 km<sup>2</sup> in 2017 and this dense forest area converted in to scrub forest, open forest and agriculture land Scrub forest increase by 231.33 km<sup>2</sup>, open forest 119.09 km<sup>2</sup> and agriculture land 55.45 km<sup>2</sup>.

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