

**'GROWTH AND ENVIRONMENT
IN THE CHALLENGING TIMES:
THE STRATAGIES AHEAD'**



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ANALYZING URBAN SPRAWL OF CHANDIGARH USING GEO-SPATIAL TECHNIQUE

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Abstract:

Urban sprawl describes the level of urbanization, a global trend arising mainly from population growth and large scale migration in nature, urban sprawl talks worryingly about natural resources. The present research work describes the urban sprawl of Chandigarh over the period of 2001 to 2017 extract the information related to urban sprawl and its temporal variability. Remotely sensed satellite images collected from Google earth explorer for the statistical classification approaches and got the accurate result. Chandigarh is one of the India's fast growing town, the town has seen incredible growth in the built-up sector. In 2001 the total built-up area was just 53.88sq.km; in 2017 the built-up area reached 62.79sq.km. Many roads and few railway lines link the city with its surroundings. The research may be used to estimate a possible urban sprawl. It will be useful for urban planning institutions in developing countries where data are not routinely available.

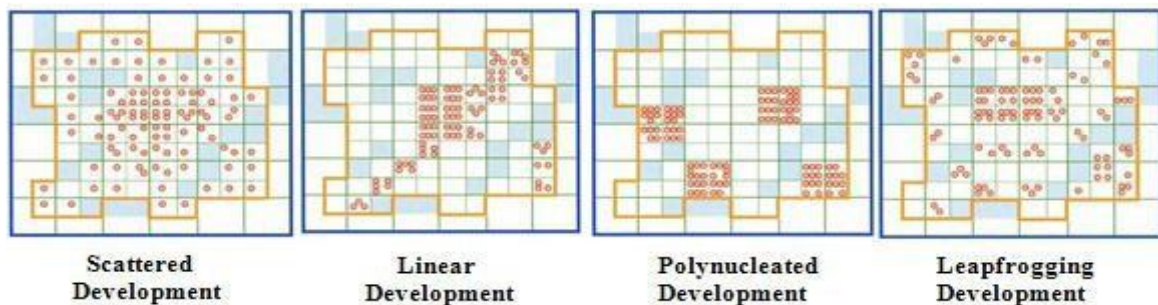
Keywords: Urban Sprawl, Georeferencing, Temporal variations, Image classification, Built-up area expansion.

1. Introduction:

Urban sprawl is a defined term and considered as spreading of the urban development on undeveloped land near the city (www.merriam-webster.com/dictionary/urban%20sprawl). As Chandigarh is the planned and administrative urban area, so the expansion of the urban area as outgrowth is the natural process. Areas emerged in urban sprawls becoming the socio-economic support system areas for Chandigarh as the other metropolitan areas like Delhi, Calcutta, Chennai, and Bangalore. Mostly metropolitan cities or major urban area usually gave work to the commuters or migrants but failed to give the home habitat. Therefore, sprawls come in the origin along with the process of urbanization. The phenomenon of urban sprawl is getting increase with the start of 21st century along most of the parent cities. This rise the question of urban development, that ***how can we plan the periphery of the city with existing outer growth?*** The planning is the essential part of managing urban or rural landscape so, it become important to monitor the urban sprawl of Chandigarh. Now, the question comes into existence about the monitoring of urban sprawl. GIS and remote sensing provide a strong base to the monitoring of urban sprawl because it fulfill the need of looking over 3 main indicators of urban sprawl measuring and monitoring suggested by **Sidentop and Fina, 2008**. The indicators are -

- i) **Surface characteristics** to look over the land use and land cover of the urban sprawl in Chandigarh.

- ii) **Landscape pattern** to analyze the physical pattern of sprawl development. **Stan, 2013** has been described 5 type of pattern in urban sprawl area. **Galster et al., 2001** described 4 major type of pattern in urban sprawl areas. These are shown in the following figure –



Picture 1 Pattern of urban sprawl

Source: **Feng, 2009**

- iii) **Density** to analyze the population congestion.

This study tries to find out the use of geospatial technique for the mentoring of urban sprawl of Chandigarh.

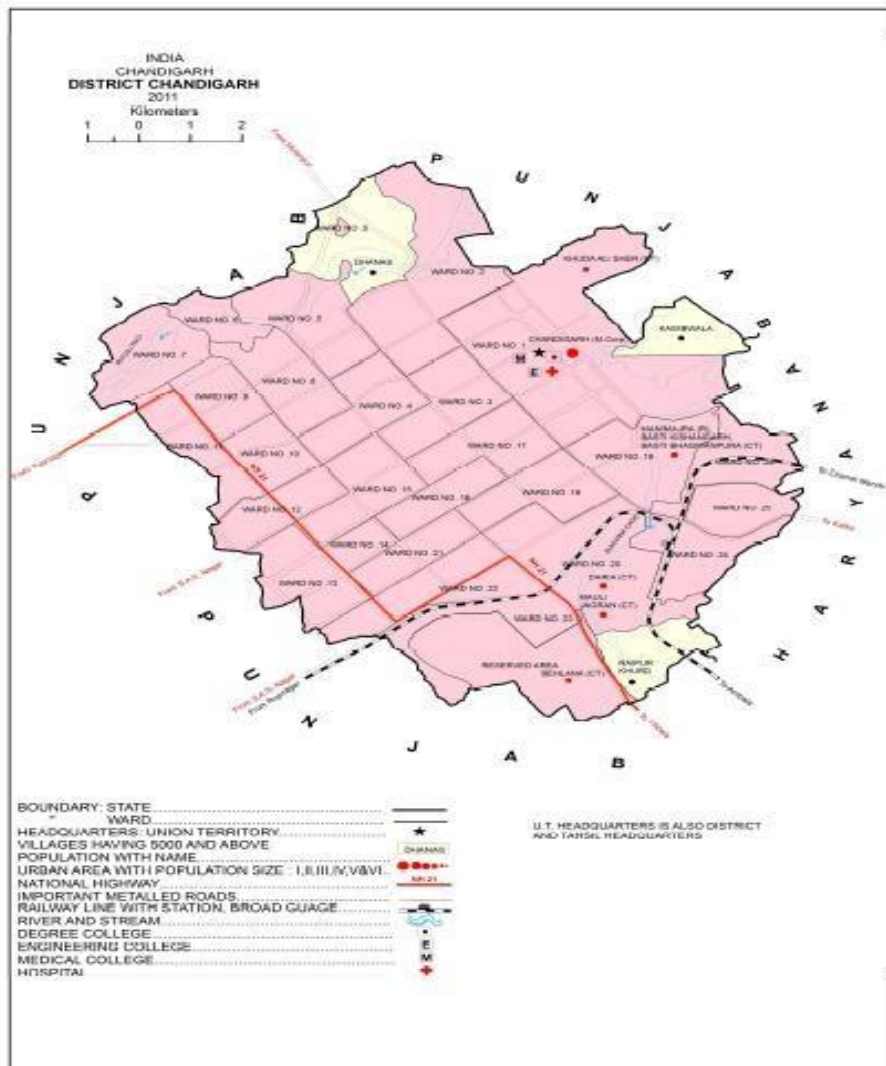
2. Objective:

The prime objective of the study is to monitor the sprawl of Chandigarh union territory from 2001 to 2017 by using geo spatial technique.

3. Study area:

Chandigarh is the area of focus in the present study. Administratively it is one out of seven union territories in India and the common capital of Haryana and Punjab. As a common capital of Punjab and Haryana, Chandigarh gives administrative support to both the states. The 1966 originated territory, lies between 30°44'14" north latitude 76°47'14" east longitude. The UT is 114 sq. Km. in area and considered as urban because of 109.53 sq. Km. urban area. Chandigarh is located in the foot hills of Shivalik and surrounded by Haryana and Punjab. Physiographically Chandigarh is divided into 2 categories - one is Chandigarh Shivaliks, which is the upper part of the Chandigarh and second is Chandigarh Plains, which is further the middle and lower part of the Chandigarh. Chandigarh plain is the productive part of the Chandigarh UT. It consists 4 villages (Sarangpur, Dhanas, Raipur Khurd, and Raipur Kalan & Makhan Majra) and 6 towns (Chandigarh (M Corp. and OG); Manimajra, Basti Kishangarh, and Basti Bhagwanpura; Daria, Maulijagran, and Behlana). Chandigarh city is the biggest urban center of the UT consists 95.6 % of total area and 98.2 % of total population. Chandigarh also surrounded by dry beds of Sukhnachoe, Attawachoe and Patialirao. Chandigarh has the grid plan proposed by Le Corbusier in 1950s. Chandigarh is the political and economic hub for the Haryana and Punjab. There are many government offices of the Punjab and Haryana in the Chandigarh. Chandigarh is also the headquarter of reputed national daily named - The Tribune. The UT is also well known for its educational institutes. Some fabled educational institutions are – Punjab University Chandigarh, Post Graduate Institute of Medical Education and Research (PGIMER), Dayanand Anglo Vedic College and Punjab Engineering collage. There are almost 107 government schools in Chandigarh. The Industrial area of the Chandigarh is the spine of Haryana and Punjab. Rajiv Gandhi IT Park is world known for outsourcing industry and ranked 4th in India. (**District census Handbook, 2011, p. 13-15**)

So there are many reasons in Chandigarh which make it an important urban area and further provide cause of mentoring urban sprawl for future planning.



Map 1 Study area

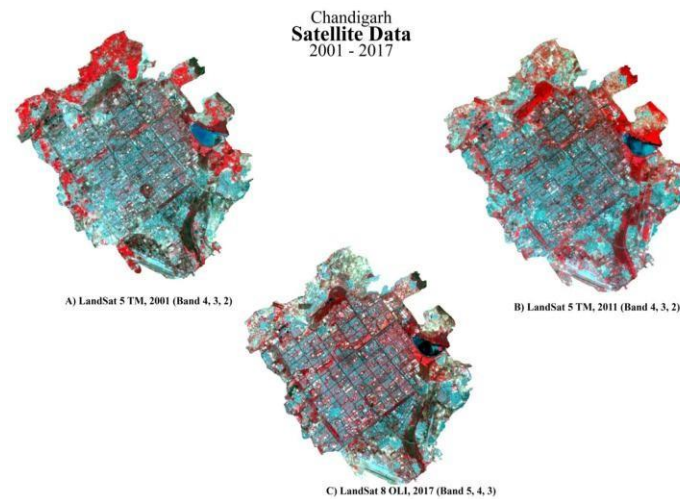
Source: District census Handbook, 2011

4. **Database:** The present study is based on the data taken from secondary sources. Most of the part of the study is based on the satellite imageries and census data.

Table 1 Data sources

year	satellite	Characteristics				Source
		sensor	band	Spatial resolution (m)	Wavelength (mm)	
2001	Landsat 5	Thematic Mapper	2 (Green), 3 (Red) and 4 (Near Infra-red)	30	0.52-0.60, 0.63-0.69 and 0.76-0.90	USGS
2011	Landsat 5	Thematic Mapper	2 (Green), 3 (Red) and 4 (Near Infra-red)	30	0.52-0.60, 0.63-0.69 and 0.76-0.90	USGS
2017	Landsat 8	Operational Land Imager	3 (Green), 4 (Red) and 5 (Near Infra-red)	30	0.533-0.590, 0.636-0.673 and 0.851-0.879	USGS

The demographic data of year 2001 and 2011 has been extracted from the webpage of Census of India



Picture 2 Satellite data of Chandigarh (2001-2017)

5. Methodology:

Methodology for the present study has been based on geo-spatial technique. All the geo-spatial processes have done in ArcGIS 10. The Methodology for the present study includes following processes -

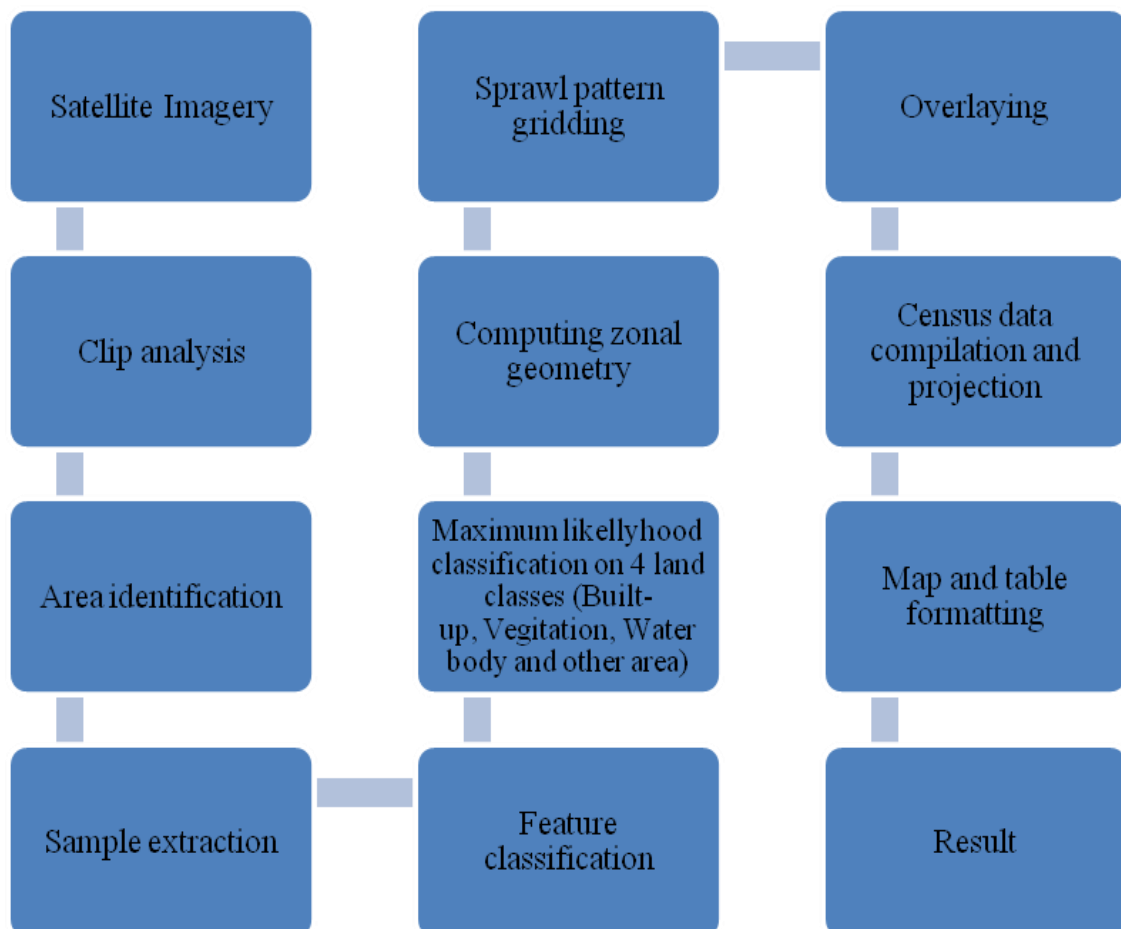


Figure 1 Methodology for image processing and data analysis

6. Result and discussion:

Chandigarh as a union territory has a huge urban and built-up area. The UT composed off several commercial and noncommercial buildings along with housing settlement. Chandigarh also covered with vegetation and surrounded by agricultural land. So it becomes hard to monitor that type of landscape without look over the ground in true state. The present study tries to find out the way to monitor the urban sprawl of Chandigarh from 2001 to 2017 through simple geo-spatial techniques.

As earlier mentioned in the methodology the urban sprawl can be monitor by 3 types of indicators. Which are:-

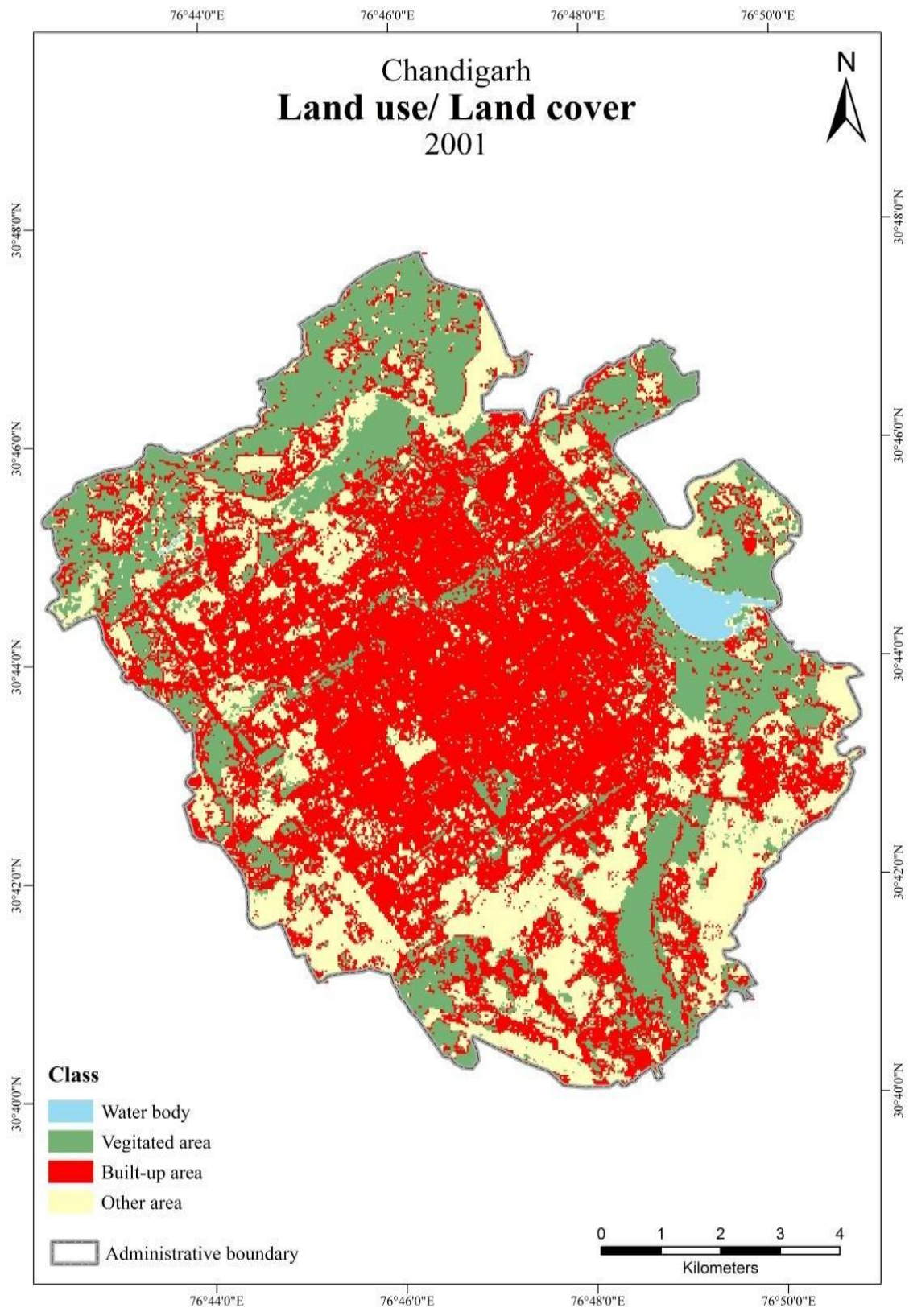
1. Surface characteristics: - the surface of the Chandigarh has been found covered by four major types of land classes. The first is **built-up** area. The built-up area can be distinguished in the satellite imagery of Chandigarh in the major proportionate. The maximum likelihood land use and land cover classification of the Chandigarh revealed that there is almost 55.18% (62.798 sq. Km.) area lies under the buildup class, which has been increased from 53.880 sq. Km. in 2001 (See Table 2 and Map 2, 3 and 4). The outgrowth of the UT has been discovered as the main reason of the increased built-up area in the UT.

The surrounding area of the Chandigarh municipality has rural settlements along with agricultural land and open area. In the present study this type of land use has been taken under **other land area**. The other land area has been found in second highest proportionate. This land class had 26.89 % (30.603sq. Km.) area in 2001, which further increased to 37.42 % (42.588 sq. Km.) in 2011 and decreased to 28.61 % (32.553sq. Km.) in 2017 (See Table 2 and Map 2, 3 and 4). This fluctuation has been led by decrease in **vegetated area**. However this exercise doesn't include the change detection but it can be clearly intercept by looking over Map 2, 3 and 4. The vegetated area has found declined drastically in the study area from the share of 24.67 % (2001) to 17.121 % (2017) (See Table 2 and Map 5). The clustering of the outgrowths also significantly took over the fact that the vegetated and other area has been converting into the built-up area outside the municipality (See Map 6). The land classification analysis of the study area has been found **water body or open water resources** in the least proportionate. Sukhna Lake in the Chandigarh has found as the main water body in the study area. There have been minimum fluctuations noticed throughout the time (See Table 2).

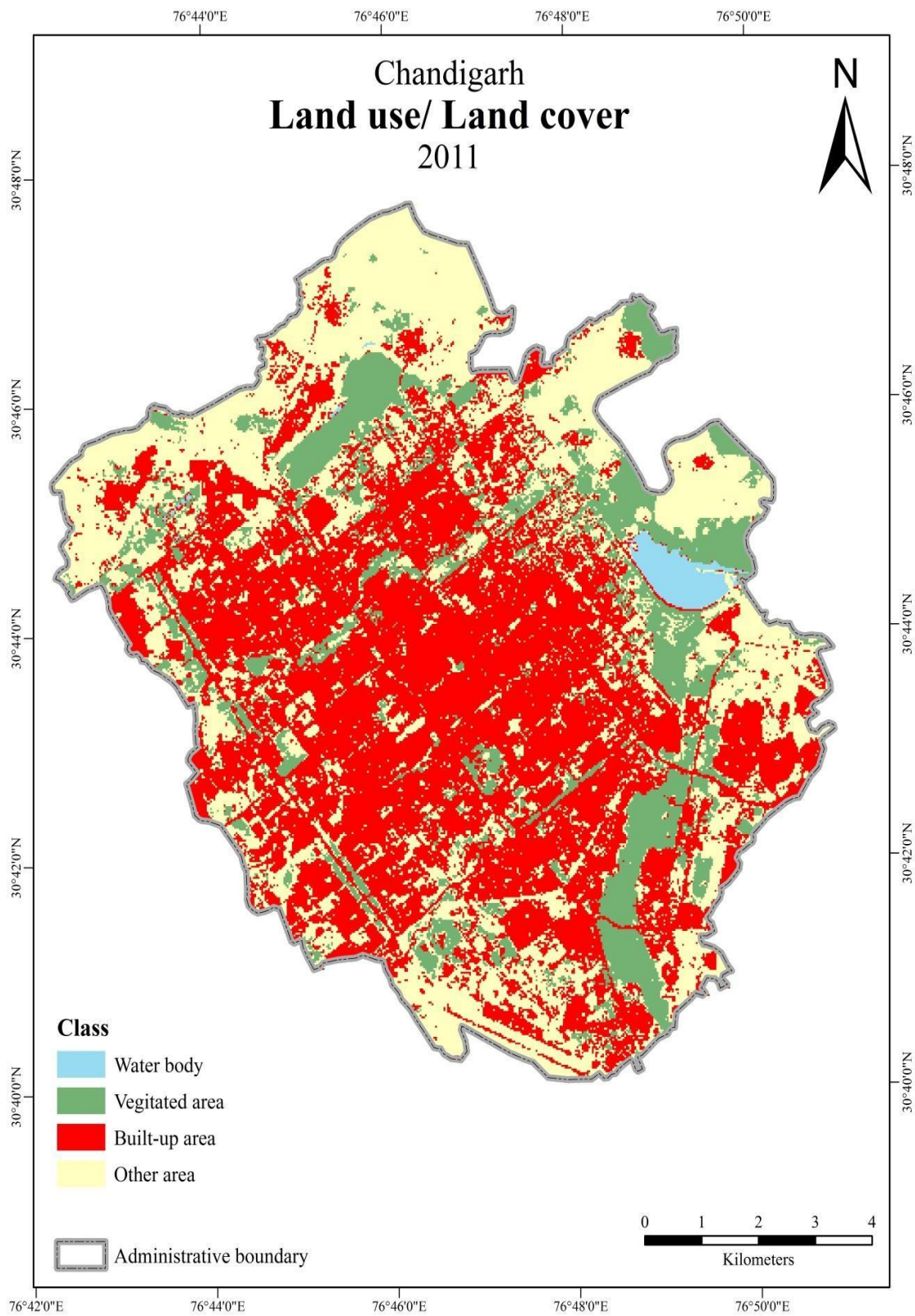
Table 2 Land use and Land cover classification of Chandigarh (2001-2017)

LULC class	2001		2011		2017	
	Share of area (%)	Area in sq.km.	Share of area (%)	Area in sq.km.	Share of area (%)	Area in sq.km.
Water body	1.09	1.244	1.11	1.259	1.17	1.326
Vegetation cover	24.67	28.072	14.67	16.693	15.05	17.121
Built-up area	47.35	53.880	46.80	53.258	55.18	62.798
Other area	26.89	30.603	37.42	42.588	28.61	32.553

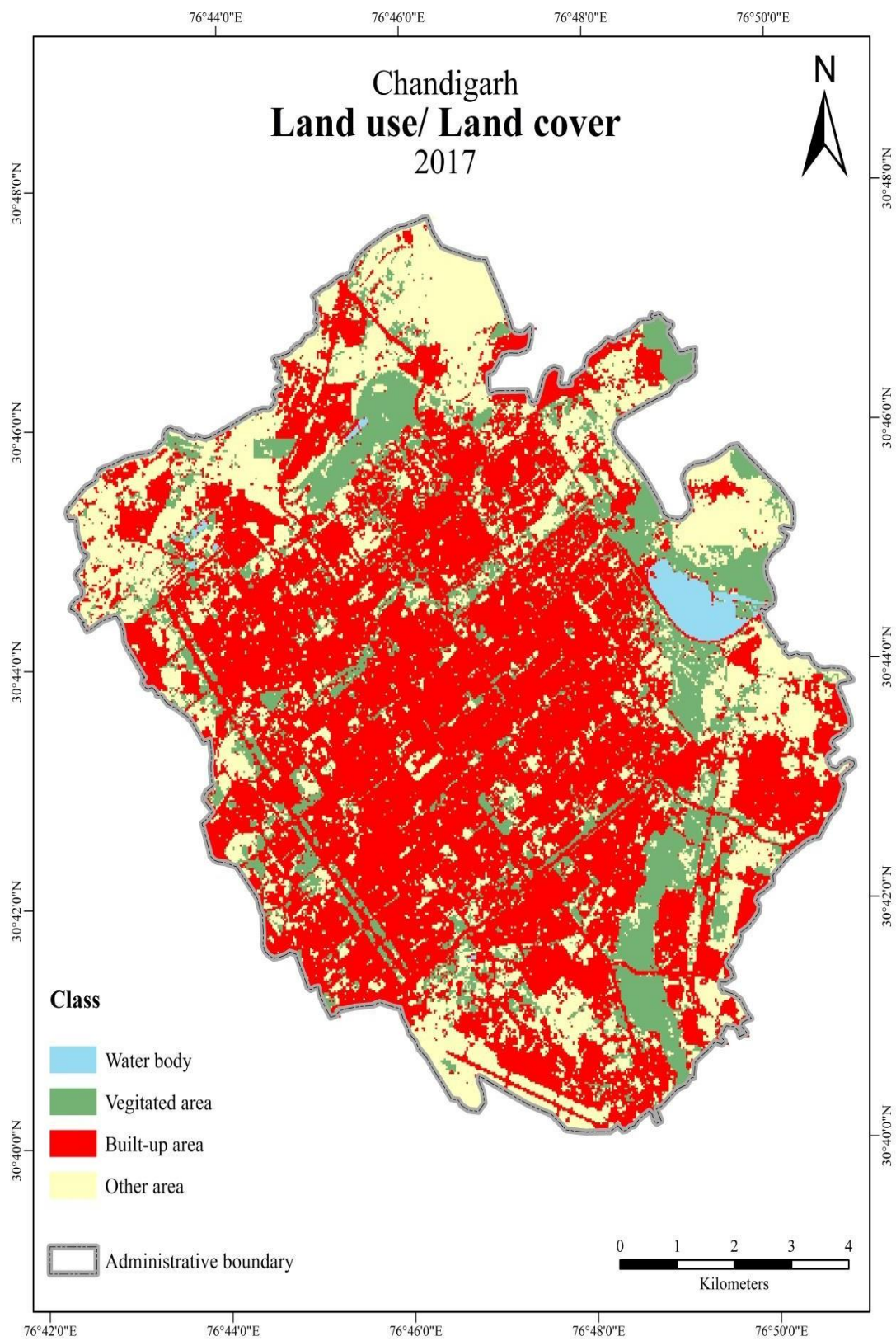
Source: Computed by Author



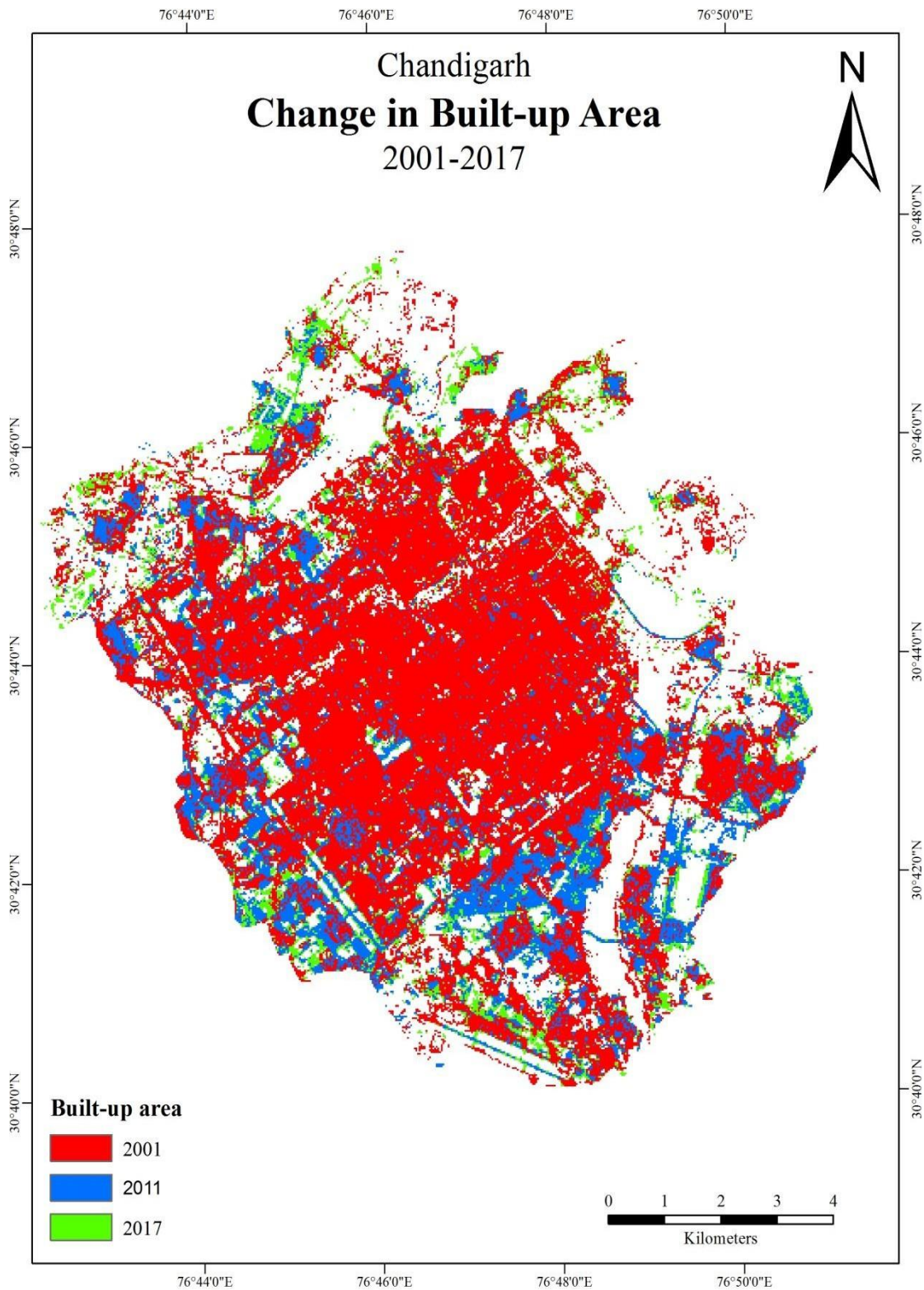
Map 2 Land use and Land cover of Chandigarh (2001)



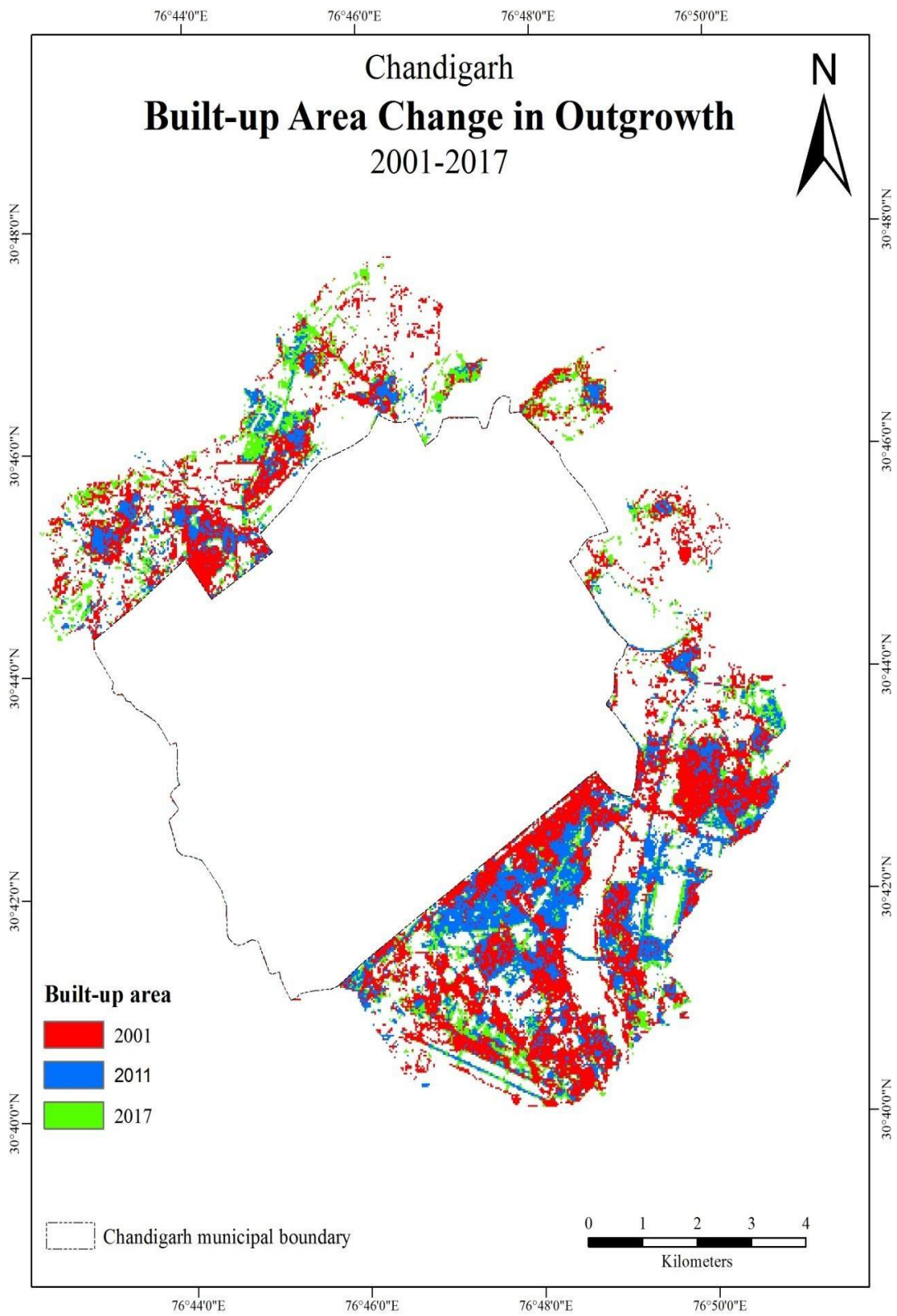
Map 3 Land use and land cover of the Chandigarh (2011)



Map 4 Land use and Land cover of Chandigarh (2017)

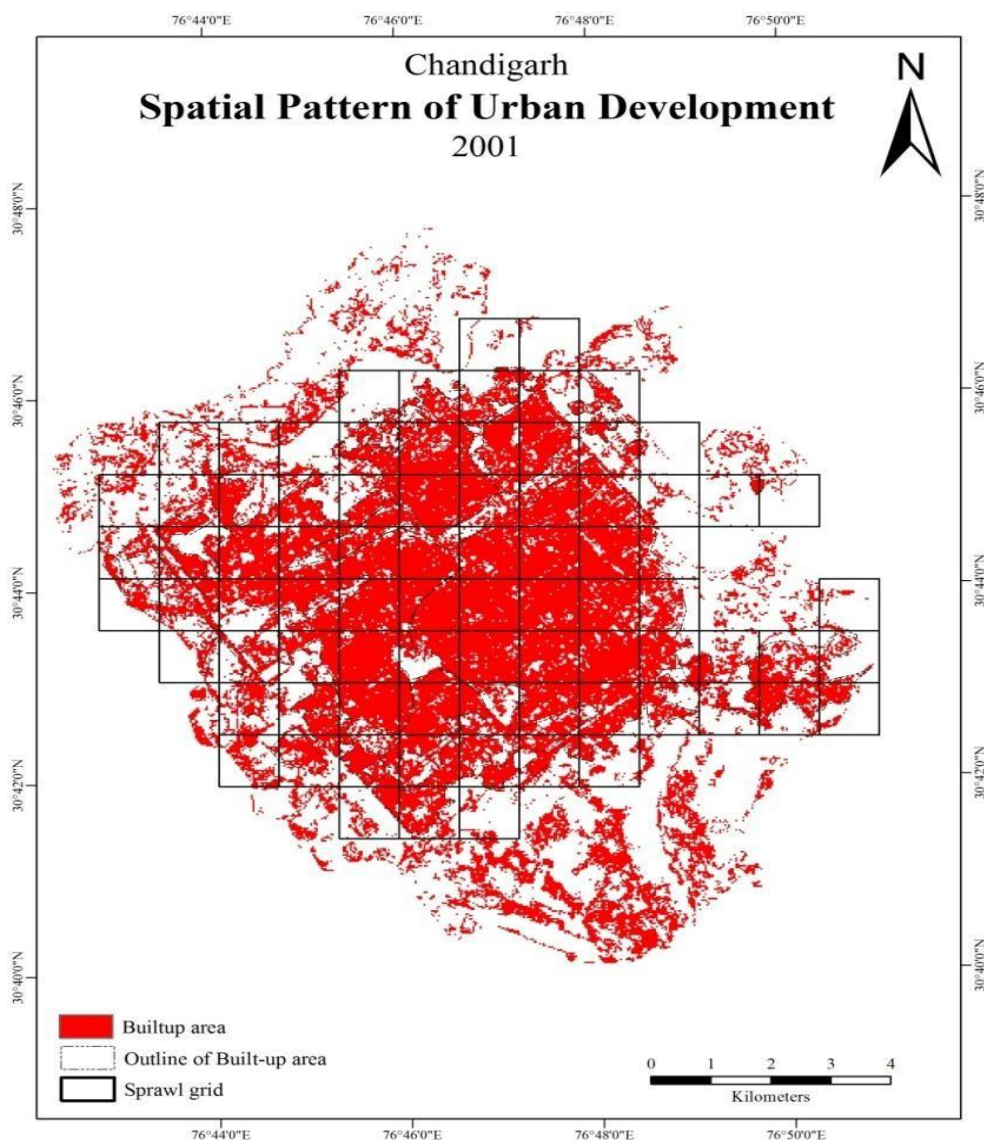


Map 5 Built-up area change in Chandigarh (2001-2017)

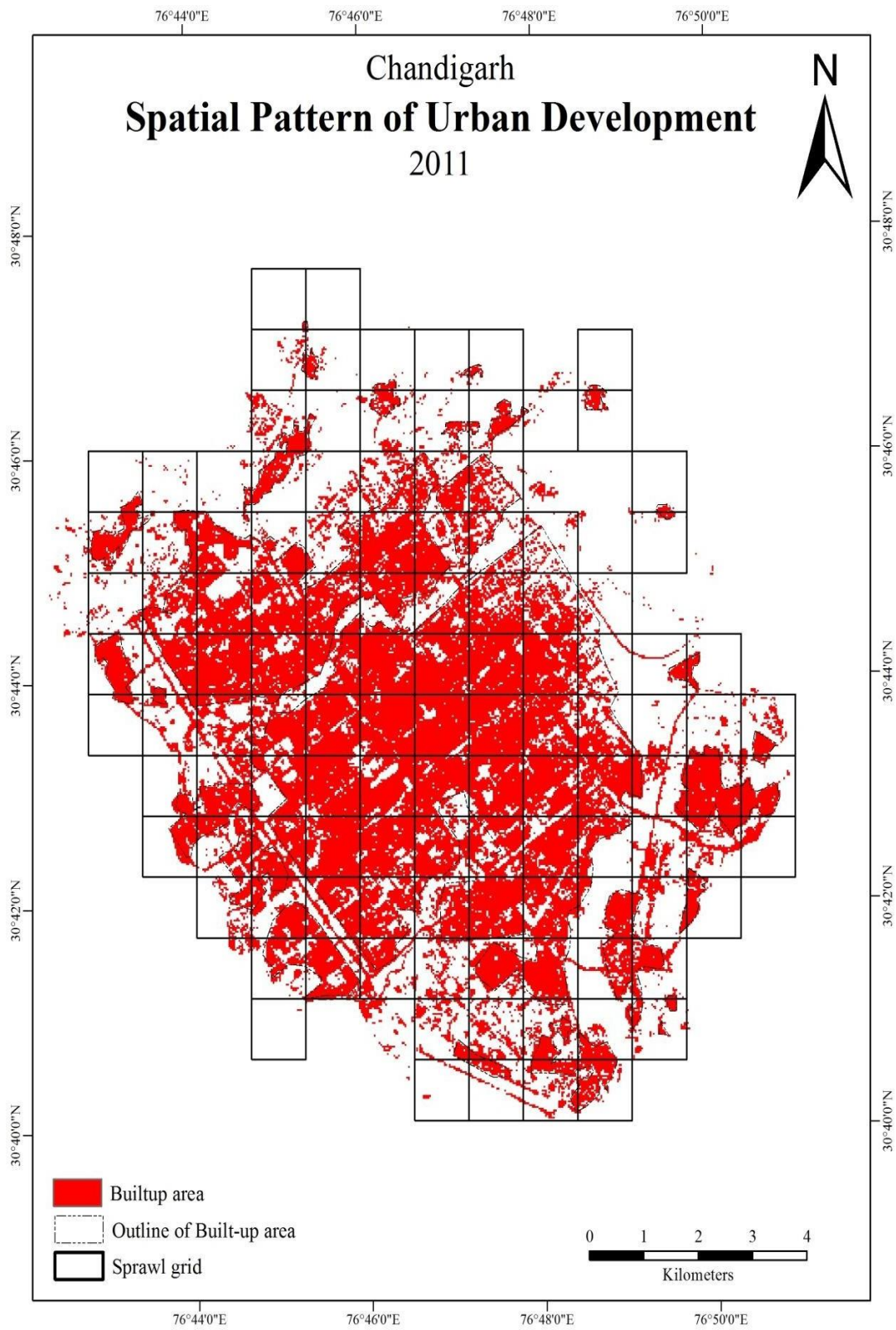


Map 6 Outgrowth change in the Chandigarh (2001-2017)

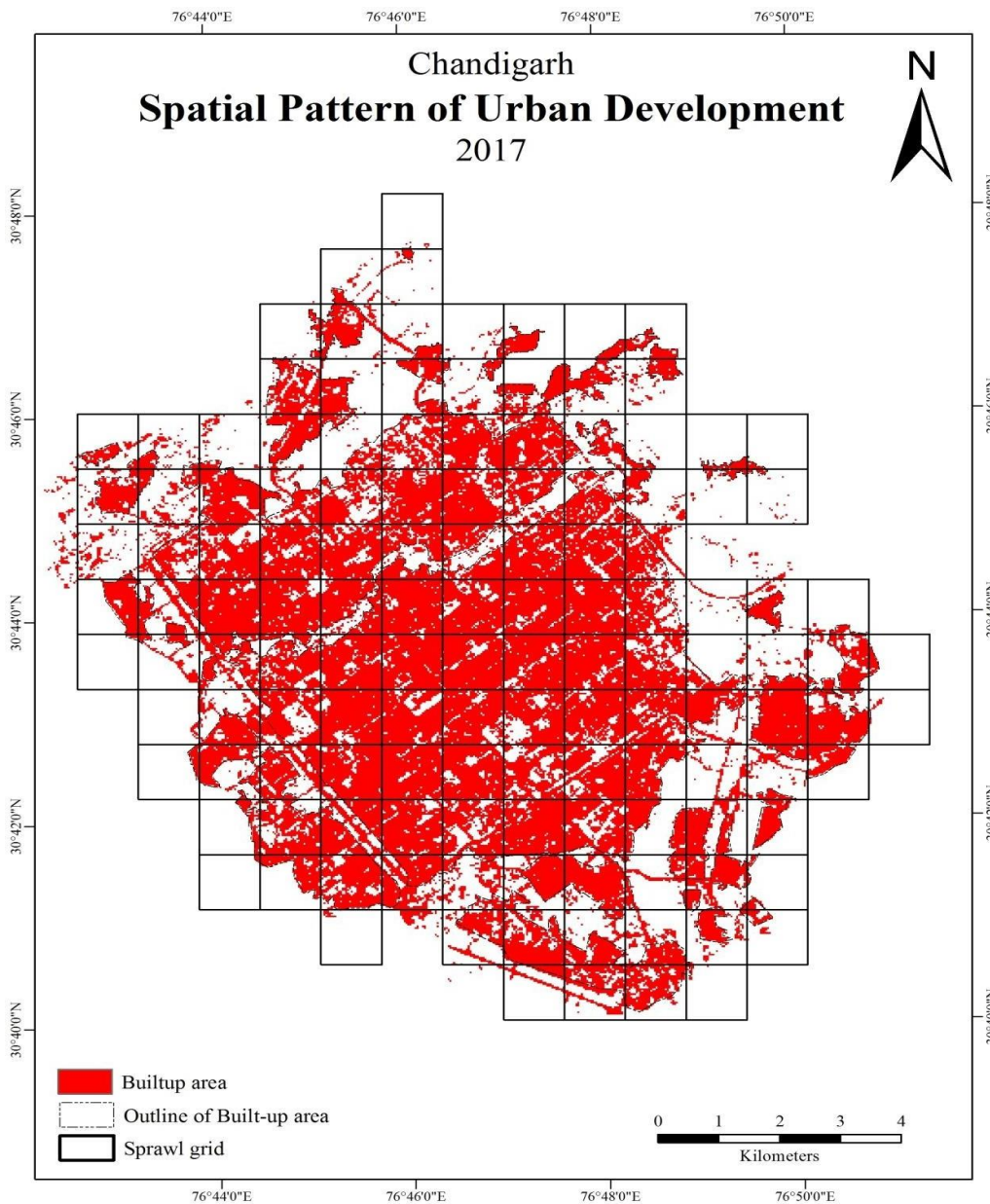
2. **Landscape pattern:** - The landscape pattern is another indicator to monitor the urban sprawl of Chandigarh. In the present study tries to explore the physical pattern of the study area throughout the time. There are basically 4 types of physical patterns, which define the sprawl development. The study has been discovered **Scattered and Leapfrogging sprawl development** in the analysis. In 2001, the study area has been found the scattered outgrowth sprawl development (See Map 7), which further led to leapfrogging sprawl development in the outgrowth of the Chandigarh municipality while 2011 and 2017 (See Map 8 and 9). The leapfrogging sprawl development came into occurrence due to the increasing economic value in outgrowth in terms of several economic indicators like earning and commodity and land sale values, etc.



Map 7 Pattern of sprawl development in 2001



Map 8 Pattern of sprawl development 2011



Map 9 Pattern of sprawl development 2017

3. **Density:** - Density is an indicator to ensure the monitoring of sprawl. The present study also looks over the urban density of the study area based on secondary data. During 2001, there was only one Town and 23 villages in Chandigarh UT. That time the urban area has counted in 79.34 sq. Km. with the density of 10191 people per square kilometer. The area had been increased in 2011 to 109.53 sq. Km due to the increase in census towns from 1 to 6 with declined density of 9371 person per square kilometer (See Table 3). The main cause of density decline in the study area from 2001 to 2011 has been found that the increase of urban area in more proportionate than the population. In 2017, the urban area has been found static with 6 towns and 109.53 square kilometer and due to which the projected population has been found increased along with density.

Table 3 Urban area and density of Chandigarh (2001-2017)

Year	No. of Towns	Area (in Sq.)	Population	Density (Person/ sq.Km.)
2001	1	79.34	808515	10191
2011	6	109.53	1026459	9371
2017*	6	109.53	1220460*	11142*

Source: Census of India. 2001 and 2011

*- Projected by author through linear projection

The density analysis of the study area reveals that the congestion in the urban area is increasing due to increase in the population density. People are moving toward nuclei in outgrowths from surrounding states.

7. Conclusion

Urban sprawl and sprawl development is the integrated part of an urban area. Chandigarh as an UT and urban area has a huge significance of the sprawl. Chandigarh isexpending outward and providing a strong socio-economic platform to the in-migrated people and the population living its surrounding. On the way of expansion, the landscape of the Chandigarh has been developed for housing societies and industries. This further led to the decline of vegetated area and other area throughout the time. The declined vegetated area would lead to the harmful ecology near future. The increasing urban density also leading toward congested urban landscape. So it becomes necessary to monitor the sprawl development in the Chandigarh for future planning.

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