

URBAN SPRAWL AND SPATIO TEMPORAL ANALYSIS OF HISAR CITY IN HARYANA USING REMOTE SENSING & GIS TECNOLOGY

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Abstract— The world is going through the largest speed of urban growth today. During the course of 2008, more than half of the world's population was dwelling in towns. In 2012 this number has crossed the 7 billion mark. Present paper has tried to find out the changes which have taken place in landscape of Hisar City in Haryana from 2003 to 2012. Study has used open source satellite images of IRS-P6 LISS-III from Bhuvan site (NRSC), Google earth images and guide map of Hisar city has been used for ancillary information. Objective of study has been to find out the pattern of sprawl of Hisar city and spatio-temporal changes during the period 2003 to 2012.

Keywords—: Spatio-temporal change, Urban Sprawl, Ancillary, Landscape.

I. INTRODUCTION

Land surface has always been an area of interest for geographers and other scholars interested in spatial analysis. This surface has been recording changes throughout geological times but with recent rapid urban expansion this change has been occurring at a much faster rate. This is more particular in urban landscape. This change needs to be detected, mapped and measured at frequent intervals so that we can have real time information on it. This information will not only be helpful for understanding the dynamics of the change but it is equally essential for further planning and management of land resources.

In most countries spatial control strategies aimed at curbing city growth have pragmatically been replaced by strategies to manage growth, since growth is inevitable anyway (Urban Foundation 1993, p. 4). Mapping urban sprawl helps to identify areas where environmental and natural resources are critically threatened and to suggest likely future directions and patterns of sprawling growth (Simmons, 2007).

During last some decades India has witnessed rapid and uncontrolled urban expansion due to progress in industries,

trade and population increase. The anticipation of services and opportunities in cities fuels this growth. When the population increases due to migration, in the outer part of the city, urban sprawl is taking its toll on the natural resources at an alarming place. Land development has been out of control and the construction on land has kept expanding blindly, especially in the marginal areas of these cities. The rural and urban fringe is most rapidly changing element in the urban landscape mapping; land use/land cover of the rural urban fringe in a timely and accurate manner is thus of great importance for urban land use planning and sustainable management of land resources (Sulochana, 2005).

In the present study, spatio-temporal analysis of land use change and urban sprawl during 2003 to 2012 of Hisar city Haryana was carried out. IRS-P6 Liss-III 2003 and 2012 imagery were used to monitor the land use change and urban sprawl in the study area adopting WGS-84 datum and UTM projection system. The interpretation and analysis of satellite data was carried out by using on-screen interpretation technique. Using vector data of both years (2003 & 2012) a union layer was generated to calculate change detection matrix and change map in the study area.

II. OBJECTIVES

The present study was carried out with the following objectives:

- To prepare land use/land cover map of Hisar city for the years 2003 & 2012.
- To evaluate the spatio-temporal change of study area & urban sprawl map during the period of 2003 to 2012.
- Measure urban sprawl and transformation direction of land use in Hisar city between the periods of 2003 to 2012.

III. STUDY AREA

Hisar is located at 29.17°N 75.72°E. It has an average elevation of 212 meters (695 feet). Hisar city is one of the important and fast growing urban centers of Haryana. The climatic conditions of the study area is very hot summers and

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cold winters. The maximum daily temperature very often touches 48 degrees Celsius during summers. Hisar continued to be the district headquarters of the largest district in the state till its reorganization; some parts of it were transferred to Jind in 1966 when Jind was made a new district. Tehsil Bhiwani and Loharu estate were transferred to the Bhiwani district when Bhiwani was carved out in 1974. Hot winds, locally known as Loo, are strong and frequent from May to July. Hisar lies just 30 km north-east of the Thar Desert. Intermittent dust storms are also common. In the winter some rain is received due to western disturbances. Around 75 to 80 per cent of the annual rainfall is received during SW Monsoon season (June to September) with 50 per cent coefficient of variation (CV). Air temperatures during summer are quite high at Hisar, the maximum value of which touched 48.3°C in May, 1944. However, with the onset of summer monsoon, the temperature ameliorates and falls in the vicinity of 35.0°C. The lowest temperature recorded at Hisar is -3.9°C which occurred in January, 1929. The sub-zero temperatures (frost conditions) are not uncommon during winter season. As of 2001 India census, Hisar had a population of 256,810. Males constitute 55% of the population and females 45%. Hisar has an average literacy rate of 71%, higher than the national average of 59.5%: male literacy is 76%, and female literacy is 64%. In Hisar, 13% of the population is under 6 years of age. The location map of study area is shown in figure-1.

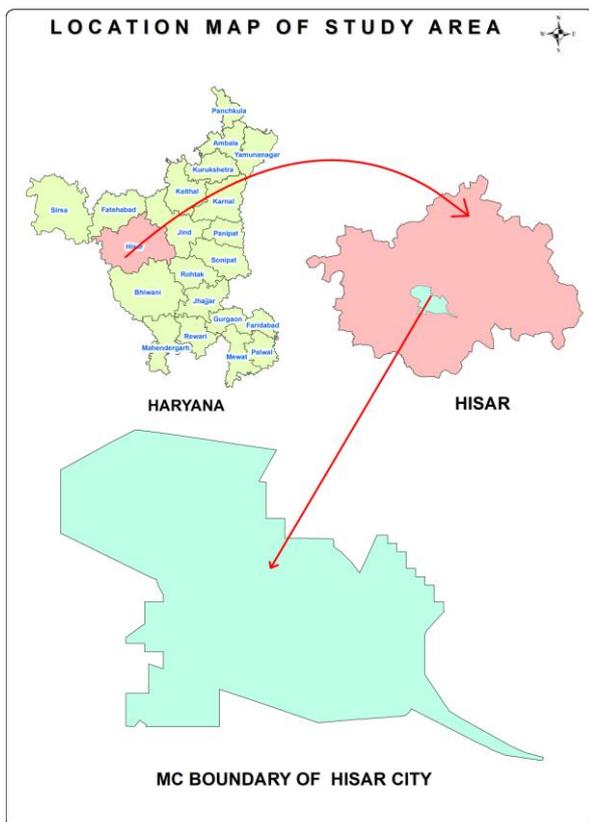


Figure-1

IV. MATERIALS & METHODOLOGY

Satellite Data:

Mainly Indian Remote Sensing Satellite-P6 – LISS-III satellite data was used for the present study. This satellite data for both years (2003 & 2012) was downloaded from Bhuvan and used to prepare thematic layers. The specification of remote sensing satellite data is given in the table-1.

Table-1 Specification of satellite data

Sr. No.	Satellite	Sensor	Spatial Resolution	Date of acquisition
1	IRS-P6	LISS-III	23.5 meters	October 2003
2	IRS-P6	LISS-III	23.5 meters	September 2012

Scale: The present change mapping was prepared on 1:50,000 scale to monitor land use change and urban sprawl during 2003 to 2012.

Spatio- temporal change & urban sprawl methodology for study area is presented in figure-2.

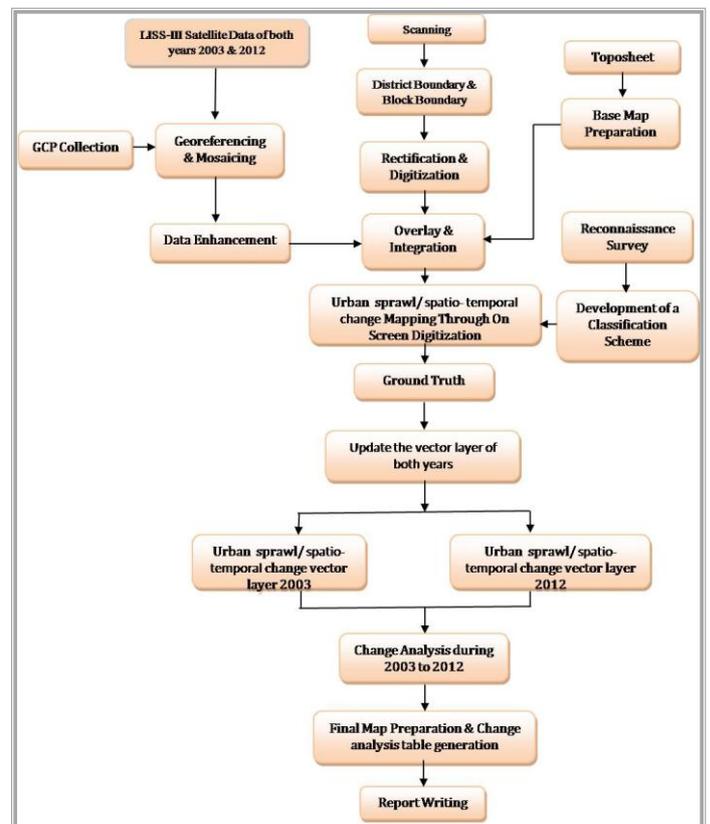


Figure-2

V. RESULT AND DISCUSSION

Urban Sprawl:

In 2003 the total built up area in Hisar city was 39.99 sq. km. In 2012 it increased to 44.27 sq. km, thus recording a growth of built up was 4.6%. During this period however the growth of population has been 17.35 % which indicates a mismatch between population growth and growth of urban sprawl. It indicates speculative construction in urban areas. Sprawl has taken place mainly in a linear patten along with Sirsa road. Second important pattern of sprawl is found in the area lying between NH No.10 and Hisar -Delhi main railway track. Urban sprawl for 2003 and 2012 is shown in figure no. 3 & 4. And a composite map of urban sprawl is shown in figure n. 5.

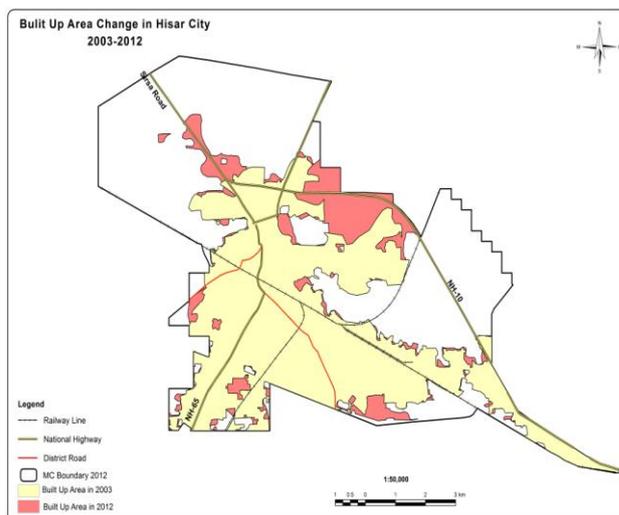


Figure-5

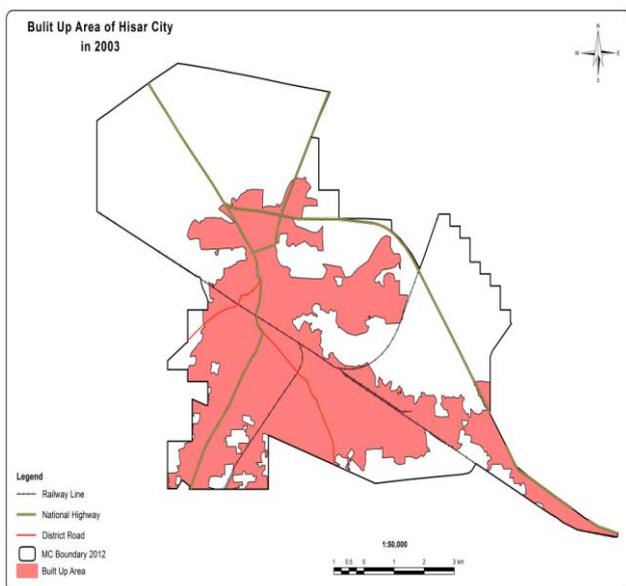


Figure-3

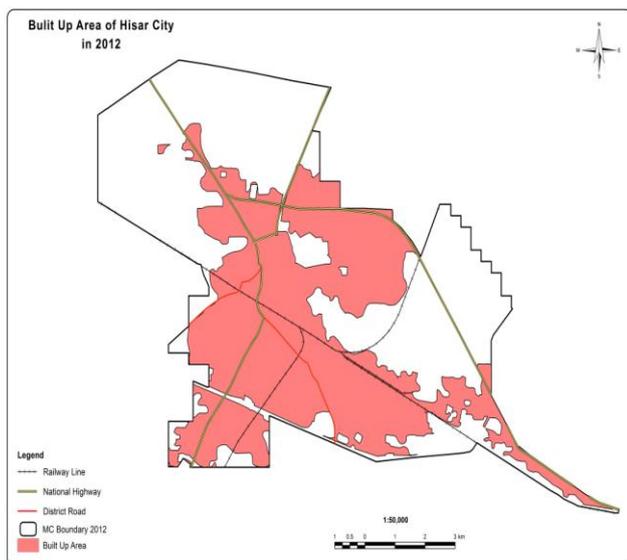


Figure-4

Spatio – Temporal Analysis

As far as change in land use is concerned, the study found that three categories i.e. built up, water bodies and wasteland recorded increase in the area while as other four categories i.e. agriculture land, plantation and grass/grazing land recorded decline in their respective areas.

Major impact has been found in built up area as it has increased by 4.28 sq. km. from 2003 to 2012. Whereas the water body class has also shown an increase of 0.22 sq. km area from 2003 to 2012. Though built up has grown in all directions but major change has taken place in eastern and north-eastern part of the city particularly along with NH No. 10 and Sirsa road.

Major change in land use categories has been reported in grass/grazing land as it has declined from 5.78 sq. km in (2003) to 1.99 sq. km in (2012). The second major land use classes change has been reported in agriculture plantations as it has declined from 2.28 sq. km in (2003) to 0.15 sq. km in (2012). The third land use class is agriculture land which has been declined by 0.45% (2003-2012). The decline in agriculture land, grass/grazing land and agriculture plantation and increase in built up have taken place due to urban sprawl in the study area. The spatio- temporal change between 2003 to 2012 has shown in figure no.6 & 7.

Table-2 Urban sprawl and spatio- temporal analysis of Hisar city

Land use classes	Area in sq. km. (2003)	Area in sq. km. (2012)	Change in area	Area in % 2003	Area in % 2012	Change
Agriculture Land	42.33	41.89	-0.44	45.2	44.8	-0.4
Water-bodies	0.54	0.76	0.22	0.6	0.8	0.2
Built-Up	39.99	44.27	4.28	42.7	47.3	4.6
Grass Land/Grazing Land	5.78	1.99	-3.79	6.2	2.1	-4.1
Plantations	2.28	0.15	-2.13	2.4	0.2	-2.2
Wastelands	2.63	4.50	2.23	2.8	4.8	2.4
Total	93.55	93.55	0.00	100.0	100	0.0

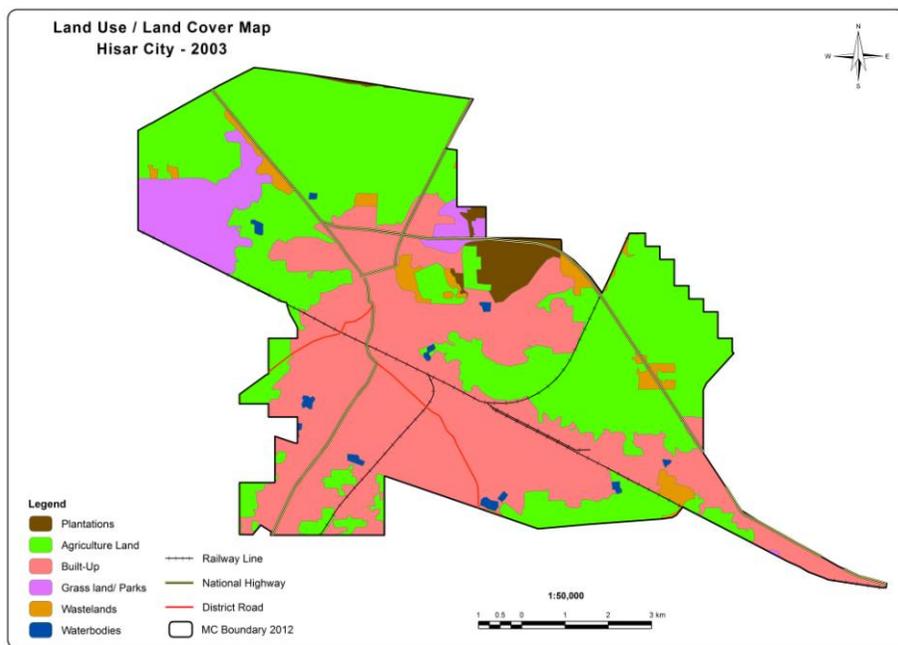


Figure-6

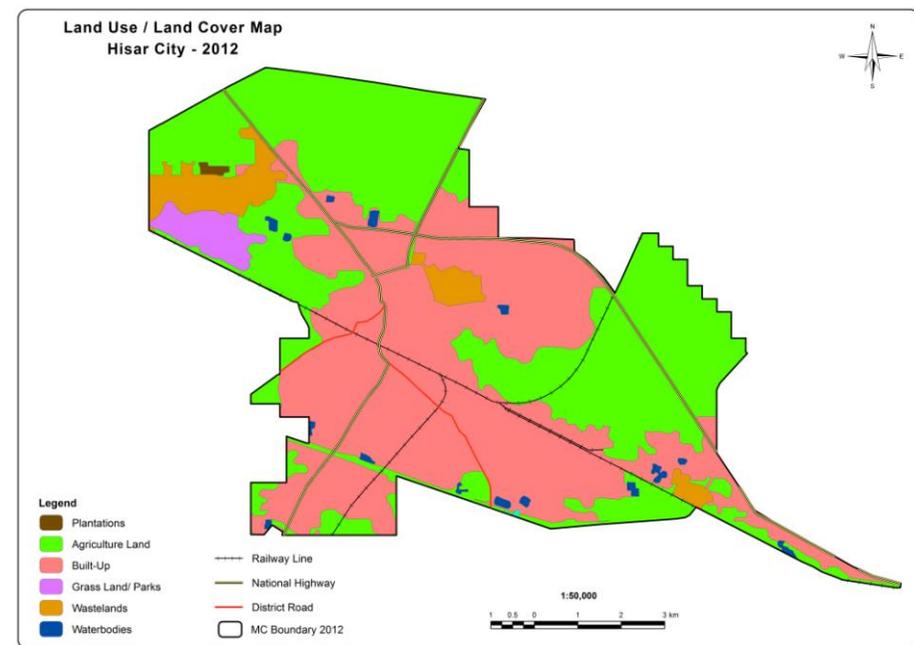


Figure-7

VI. CONCLUSIONS

The present study was conducted to evaluate urban sprawl and land use change by using IRS-P6, LISS-III satellite data of 2003 to 2012. Hisar city cover an area of 93.55 sq. km. After going through the final urban sprawl and land use data of both years the following conclusions were drawn.

1. Study highlights the pattern of urban sprawl of Hisar city from 2003-2012. It is found that transport facilities and industries are the main driving force behind this sprawl in the city.
2. Built-up area, agricultural land, plantation, wastelands & water body are major LU/LC classes that were observed in both years 2003 & 2012.
3. In the present study it was observed that the main urban sprawl has taken place in eastern and north-eastern part of the city particularly along with NH No. 10 and Sirsa road.
4. Built up is encroaching upon agriculture land and grass/grazing land in the city of Hisar which has been a practices in expansion of urban areas globally.
5. Remote sensing and GIS are proving helpful for estimate the direction of urban sprawl and its effects on existing land use/ land cover.

REFERENCES

1. Bhardwaj, P.K., and Kumar, Rajiv. (2009), Technological mapping of land use /land cover transformation along Haridwar-Roorkee transport corridor, proceedings CETAS-2009, pp. 315-319.
2. Bhardwaj, P.K., and Kumar, Vinay., (2012), "Geoinformatics based Mapping and Analysis of land use/land Cover Pattern : A case study of Rohtak City in Haryana" Maharshi Dayanand University Research Journal (ARTS), Vol. 11(1), pp.135-141.
3. C. Simmons, "Ecological footprint analysis: A useful method for exploring the interaction between lifestyles and the built environment," in *Sustainable Urban Development 2: The Environmental Assessment Methods*, M. Deakin, G. Mitchell, P. Nijkamp, and R. Vreeker, Eds. London: Routledge, 2007, pp. 223-235.
4. Sulochana, S. ,(2005), Monitoring urban sprawl of Pune by using Remote Sensing and GIS techniques, Ph D thesis submitted to University of Pune.
5. <http://bhuvannoeda.nrsr.gov.in/download/download/download.php>
6. <http://esaharyana.gov.in/Data/StateStatisticalAbstract/StatisticalAbstract%282011-12%29.pdf>

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