Land Use and Land Cover Mapping and Change Detection in Jind District of Haryana Using Multi-Temporal Satellite Data

Ravindra Prawasi, M.P. Sharma, T. P. Babu, Om Pal, Saroj, Kirti Yadav, R.S.Hooda

Abstract— **Land use and land cover generally infers to some type of development with impacts such as loss of agricultural land, open space, and ecologically sensitive habitats. Present paper entitled "Land Use and Land Cover Mapping and Change Detection in Jind District of Haryana Using Multi-Temporal Satellite Data" adequately demonstrates the utility of Remote Sensing and GIS to detect and record the Land use and Land cover of the area and its changes through time. In the present paper satellite data (LISS–III) was used for different season for the year 2005-06 to 2011- 2012 to detect the changes of Jind district. Satellite data are found to be useful in mapping and quantifying the changes of land use and land cover of the study area. This study shows that built-up area has increased during the period of 2005-06 and 2011- 2012. The research on such issues can help urban developers/planners and policy makers to make informed decisions and take action to restore natural resources before they are lost forever. Ultimately the power to balance the urban ecosystems rests with regional awareness, policies, administration practices, management issues and operational problems. This publication on urban systems is aimed at helping scientists, policy makers, engineers, urban planners and ultimately the common man to envisage how towns and cities grow over a period of time based on investigations in the regions around the highway and cities. The present paper is an attempt to analyze the changes that have taken place in land use pattern in Jind district from 2005-06 to 2011-12. The study reveals that marginal changes have occurred in all land use categories except proportion of area under agriculture area which has drastically declined from 93.42 percent in 2005-06 to 92.63 percent in 2011-12. There was observed an increase in built-up area from 2005-06 to 2011-12.**

Keywords — Remote sensing, GIS, Land use/land cover, Resourcesat-2, LISS-III, change detection.

I. INTRODUCTION

The land use/land cover of planned and unplanned residential area is very important for decision making of sustainable land use planning at both national and regional levels. Identification of land cover establishes the baseline form which monitoring activities can provides the ground cover information for baseline thematic maps.

Information of land use and land cover is an important element in forming policies regarding economies, demographics and environmental issues at national, regional and local levels. The relation between man and land determines all the productive and economies activities. Land is not only a resource but also resources base in itself. Land use and land cover (LU/LC) changes are affected by human intervention and natural Phenomena such as agricultural demand and trade, population growth and consumption Patterns, urbanization and economic development, science and technology, and other factors. As a consequence, information about Land use / land cover is essential for any kind of natural resource management and action planning.

Timely and precise information about LU/LC change detection of earth's surface is extremely important for understanding relationships and interactions between human and natural phenomena for better management of decision making. Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes. The advancement in the concept of vegetation mapping has greatly increased research on land use and land cover change thus providing an accurate evaluation of the spread and health of the world's forest, grassland, and agricultural resources has become an important priority.

II. STUDY AREA

The district lies in the North of Haryana between 29.03' and 29.51' North latitude & 75.53' and 76.47' East longitude. On its East and North-East lie the districts of Panipat, Karnal and Kaithal respectively. Its boundary line on the North forms the inter-state Haryana- Punjab border with Patiala and Sangrur districts of Punjab. In the West and South-West it has a common boundary with districts Hisar & Fatehabad and in its South and South-East lies the district of Rohtak and Sonipat respectively. Total geographical area of the district is 2702 sq.km. The district has tropical steppe, semi-arid and hot monsoon type of climate. The normal annual rainfall of the district is 515 mm, which is unevenly distributed over the area in 26 days. The Jind district is sub-divided into seven communities development blocks viz., the Narwana, Uchana , Alewa, Jind, Julana, Pillukhera and Safidon.

III. MATERIALS AND METHOD

Indian Remote Sensing Satellite Resourcesat-2 (IRS-P6) LISS-III data of October-2011, March-2012 and June-2012 to Kharif, Rabi and Zaid seasons respectively were used to prepare land use/land cover map for the three seasons data. The sensor provides 23.5 m spatial resolution in Green, Red, Near Infra Red (NIR) and Short Wave Infra

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Red (SWIR) bands with 24 days revisit capability which is ideal for this type of study at a district level. Land use/land cover (LU/LC) cycle-1data for the two districts for the year 2005-06 was taken from NRSC, Hyderabad for comparison and change detection analysis.

3.1 ANCILLARY DATA

In the preparation of land use / land cover map the ancillary data in the form of topographic maps, and other published relevant material were used as reference data. Survey of India digital topographic maps on 1: 50,000 scale were also used for identification of base features and for planning ground data collection. Legacy data on land use/land cover; wastelands generated for 2008-09 were also used as a reference during delineation of various wasteland classes. ERDAS Imagine 9.3 software was used in importing, image rectification and Geo-referencing, Arc GIS 10.0was used for digitization, preparation of land use/land covers layer and creation of database and MS Office was used for database preparation.

3.2 METHODOLOGY

The methodology followed was on-screen visual interpretation using interpretation keys like tone, texture, shape, size, pattern and association, etc. Methodology flow chart provided in Fig. 1 indicate different steps followed in the updation of land use/ land cover map of 2005 -06 using three seasons (Kharif / Rabi /Zaid) satellite data of 2011-12 leading to preparation of Land use/Land Cover (LU/LC) map 2011-12 and also the Land use/Land Cover (LU/LC) change detection map generation.

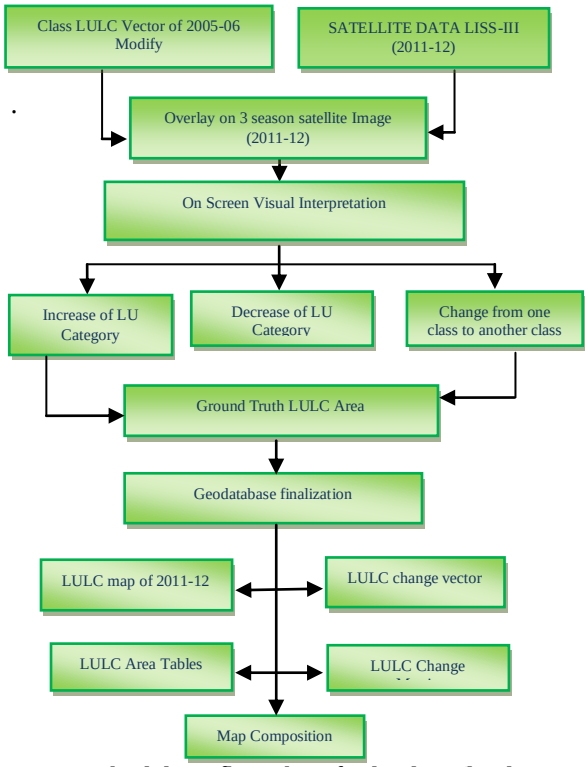

Fig. 1 - Methodology flow chart for land use/land covers and change detection.

3.3 LAND USE/LAND COVER (LU/LC) CHANGE ANALYSIS

Land use/ Land cover change analysis was done by computing the Relative Deviation (RD) of different land use categories from the year 2005-06to 2011-12.

$$\%RD = \frac{A\ (2011\text{-}12) - B\ (2005\text{-}06)}{B\ (2005\text{-}06)} \times 100$$

Where: A (2011-12) is the area under a specified land use class for the year 2011-12

B (2005-06) is the area under the same land use class for the year 2005-06.

IV. RESULT AND DISCUSSION

Figures 2, 3 and 4 provides an overview of the major land use / land cover features of the Jind district for 2005-06 and 2011-12. The area available in each of class has been calculated by using geometry and basic statistics tools of GIS software environment and that has been graphically represented (Figure 5A & 5B). Tabulations and area calculations provide a comprehensive data set in terms of the overall landscape and the types & amount of change, which have occurred (Table1). Table 1 shows the estimated land / and land cover transitions based on the comparison of the image interpretation results for the 2005-06 and 2011-12 images.

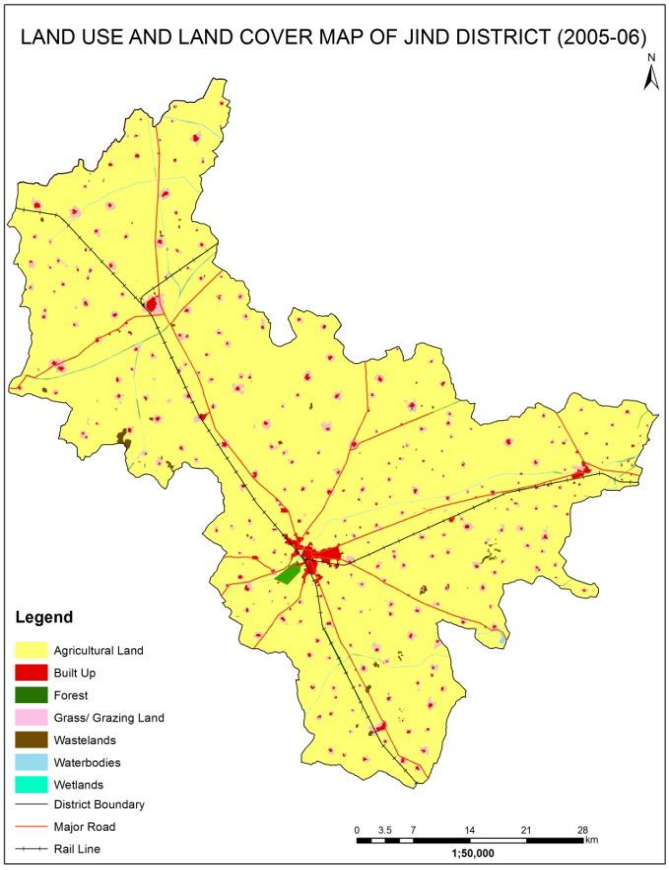

Fig. 2 Land use/land cover map of Jind district during 2005-06.

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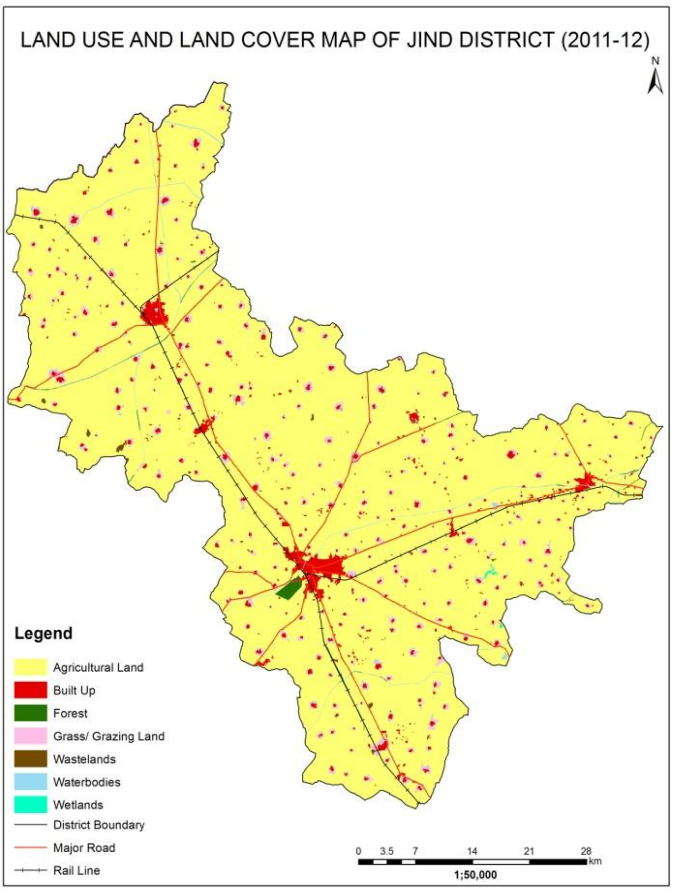

Fig. 3 Land use/land cover map of Jind district during 2011-12.

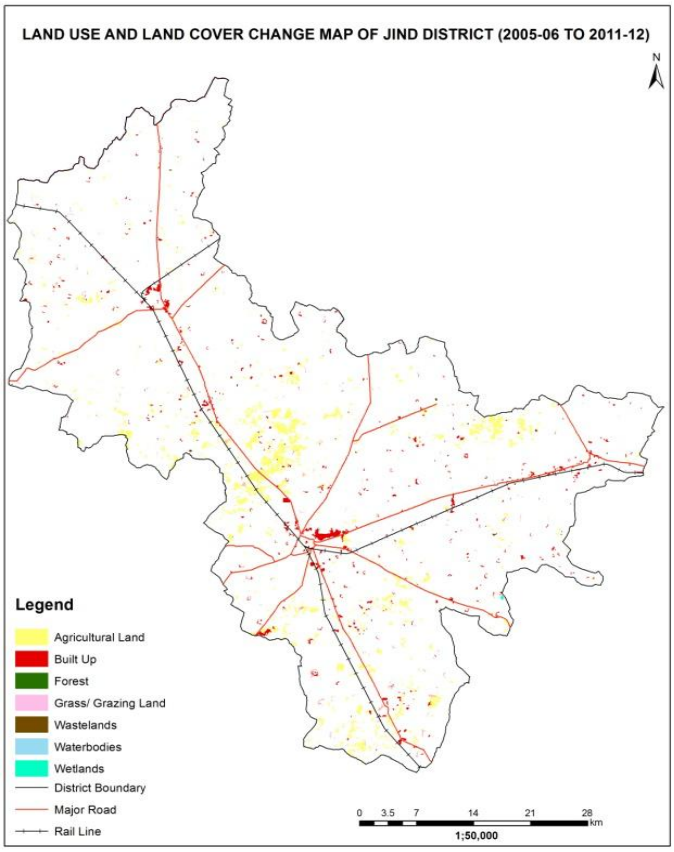

Fig. 4 Land use/land cover change in Jind district from 2005-06 to 2011-12

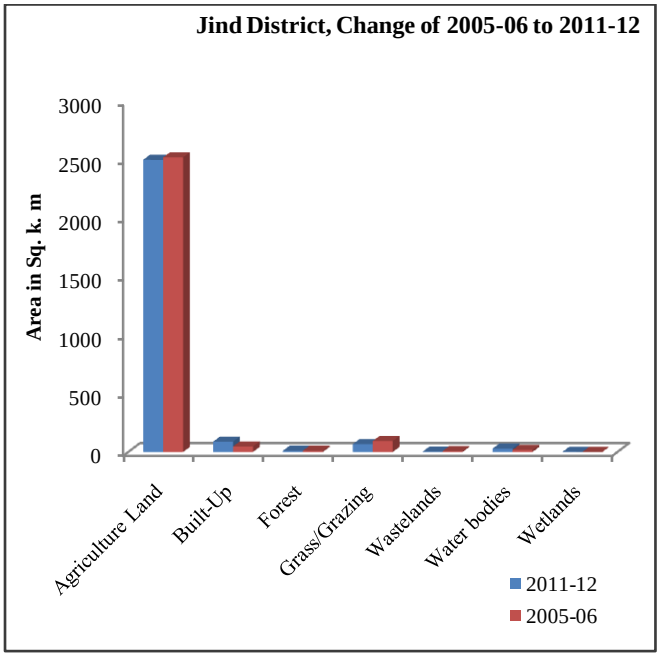

Fig. 5(A) Land use/land cover change in Jind districts from 2005-06 to 2011-12.

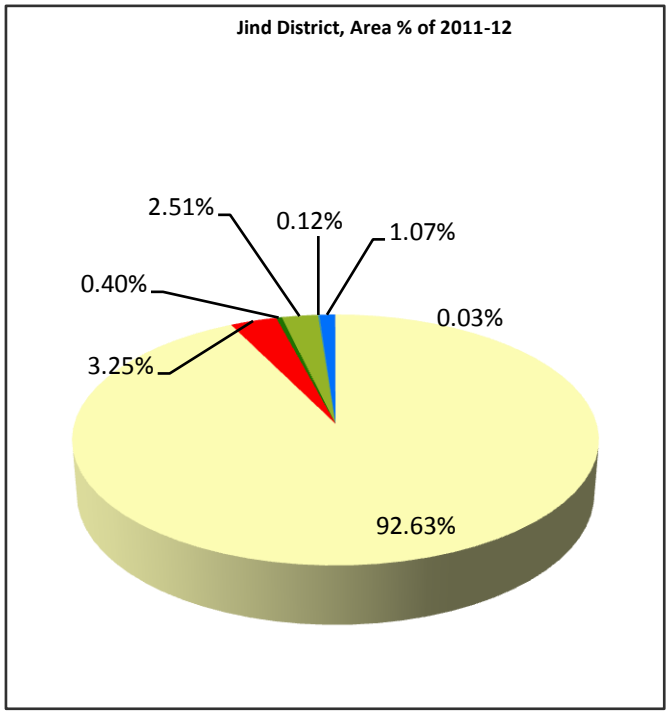

Fig. 5 (B) Land use/land cover area % in Jind district in 2011-12.

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S.No.	Categories	2011-12	%	2005-06	%	Change	% diff.
1	Agricultural Land	2502.88	92.63	2524.11	93.42	-21.23	-0.79
2	Built Up	87.76	3.25	47.05	1.74	40.71	1.51
3	Forest	10.74	0.40	10.98	0.41	-0.24	-0.01
4	Grass/Grazing	67.69	2.51	94.15	3.48	-26.46	-0.98
5	Wastelands	3.19	0.12	7.79	0.29	-4.61	-0.17
6	Water bodies	28.97	1.07	17.92	0.66	11.05	0.41
7	Wetlands	0.77	0.03	0.00	0.00	0.77	0.03
	Total	**2702.00**	**100.00**	**2702.00**	**100.00**	**0.00**	**0.00**

Table No. 1 Statistics of land use/land cover (LU/LC) change in Jind district during 2005-06 to 2011-12 (Area in sq.km)

4.1 BUILT UP : In Jind district the built up area was 47.05 sq.km (1.74%) in year 2005-06 and increased to 87.76 sq.km (3.25%) in year 2011-12. Mainly agricultural area, grazing land and wasteland categories have been converted into built-up area during this period.

4.2 AGRICULTURAL AREA : In Jind district the agricultural area was 2524.11sq.km (93.42%) in year 2005-06 and decreased to 2502.88sq.km (92.63%) in year 2011-12 it has reduced mainly due to increase in built up area.

4.3 WATER BODIES : The water bodies include ponds/lakes/reservoirs and canals. These cover an area of 17.92 sq.km (0.66%) in year 2005-06 and increased to 28.97 sq.km (1.07%) in year 2011-12.

4.4 WASTELAND -The Wasteland area was 7.79 sq.km (0.29%) in year 2005-06 which decreased to 3.19 sq.km (0.12%) in year 2011-12 in jind district which has been converted to agricultural area, built up and water bodies.

4.5 FOREST : The forest cover was around 10.98 sq.km (0.41%) in year 2005-06 and it decreased to 10.74 sq.km (0.40%) in year 2011-12 in Jind district.

4.6 WETLAND : The wetland area has increased from 0.00sq.km (0.00%) in year 2005-06 to 0.77sq.km (0.03%) in the year 2011-12 because of water logging in some of the agricultural areas.

4.7 GRAZING LAND : The grazing land was around 94.15sq.km (3.48%) in year 2005-06 and it decreased to 67.69 sq.km (2.51%) in year 2011-12 as some area was converted to built up, agricultural area or water bodies.

V. CONCLUSION

Satellite remote sensing techniques allow generating reliable and seasonal information of land use / land cover and help to monitor their changes periodically. However, use of legacy spatial database and ancillary data help improving the results derived from satellite data interpretation. The present study focused on demarcating boundaries of different land use/land cover units on the basis of analysis of satellite imagery for the year 2005-06 and 2011-12. Today, remotely sensed satellite images provide synoptic coverage and overview of the whole region. The Built up area has increased by 1.51 % from 1.74 % in 2005-06 to 3.25 % in 2011-12. Mainly Agriculture area, Grazing land and Wasteland categories have been converted to built up area during this period. The Grazing land has reduced by 0.98 % from 3.48 % in 2005-06 to 2.51 % in 2011-12, as some area was converted to Built-up, agriculture area or water bodies. Mainly Agriculture area, Grazing land and Wasteland categories have been converted to built up area during this period. The Agriculture area has reduced by 2524.11sq.km (92.42%) in year 2005-06 and decreased to 2502.88sq.km (92.63%) in year 2011-12. It has reduced mainly due to increase in built up area. The built up area was 47.05 sq.km (1.74%) in year 2005-06 and increased to 87.76 sq.km (3.25%) in year 2011-12. Mainly agricultural area, grazing land and wasteland categories have been converted into built-up area during this period. The methodology protocol adapted for identification and delineation of each class using standard image interpretation techniques and interpretation keys have played a decisive role in generating the area estimates. Therefore, these estimates may differ in some cases from those generated by other methods / agencies and thus such differences need to be considered while using, analyzing and interpreting the data. Nevertheless, these estimates would serve as a baseline/benchmark database on LU/LC for Haryana, for the agricultural year 2011-12.

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