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A block level spatio - Temporal analysis of land use / land cover in Sirsa district of Haryana using geo-spatial technology

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Abstract

Land-use/land-cover change is an important field in global environmental change research. Inventory and monitoring of land-use/land-cover changes are indispensable aspects for further understanding of change mechanism and modeling the impact of change on the environment and associated ecosystems at different scales. Remote sensing is a valuable data source from which land-use/land-cover change information can be extracted efficiently. In the past two decades, there has been a growing trend in the development of change detection techniques using remote sensing data. A number of techniques for accomplishing change detection using satellite imagery have been formulated, applied, and evaluated.

The pressures on the natural resources have tremendously increased over years by man's greed for commercialization and livelihood of local people. Devoid of regeneration, population and wide scale tree felling depleted the natural re-sources to a level, which posed a problem for the very sustenance of man. Therefore, it is imperative to understand the consequences of manmade initiatives and to devise proper strategies to counteract these detrimental effects to keep a balance of the environment, ecology, green cover, and human livelihood. Since time immemorial Environment and Development are going together as two wheels of cart. The monitoring of resource and temporal utilization through the multi-temporal IRS-P6 AWiFS satellite data provides detailed information about the land use/land cover changes. This paper explores the temporal composition of the main Land-use/Land-cover (LU/LC) categories, examines the spatial configuration of the categories, and derives the probabilities of transitions in the Sirsa district of Haryana.

The present study aims to investigate the monitoring of resource and temporal utilization using multi-temporal IRS P6 AWiFS satellite data (2005-06 & 2015-16) of Sirsa district and to identify the hot spots of land use changes pertaining to various categories. At the same time, land use and land cover transfer matrixes are used to assess the dynamic change trends for different land cover types.

Sirsa district covers an area of 4268.20 sq. km area. Sirsa district have seven blocks that are Baragudha, Dabawali, Ellenabad, Nathsari Chopta, Odhan, Rania & Sirsa that covers 540.27, 832.66, 572.46, 724.59, 506.38, 543.10 & 548.71 sq. km area respectively. Built-up area, agricultural crops, agricultural plantation, wastelands & waterbody are major LU/LC classes that were observed in both years 2005-06 & 2015-16.

Keywords: AWiFS satellite data, land use/land cover, resource monitoring, temporal utilization, geospatial technology, change analysis

Introduction

Land is the basic, fixed and limited natural resource. Land plays the key role in the determination of man's economic activities as well as social and cultural progress. All agricultural, animal and forestry productions depend on the quality and productivity of the land. Several plans and policies have been formulated and implemented to eradicate the age old land use system in the state by providing the farmers with alternative solutions and amenities. These policies had basic objectives for improving the rural economy and the temporal utilization of natural resource. A policy with a coherent approach for balancing productivity and conservation practices through constant monitoring and identification of problem areas will go a long way in ensuring sustained utilization of natural resources.

The application and integration of multi-sources of information represent a major goal to achieve more satisfactory results in the assessment of many environmental issues. The use of new technologies and science developments such as Remote Sensing, Geographic Information System, field data collection and database development have made it possible to

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approach the study of land use land cover and its impact from a multi-disciplinary perspective. Remote Sensing, currently offers an important tool to the synoptic and timely evaluation of natural resources over large areas. Geographic Information System (GIS) has emerged as a powerful tool for handling spatial and non-spatial geo-referenced data for preparation and visualization of input and output, and for interaction with models. Further, various information layers pertaining to the socio-economic can be analyzed and presented in the form which ultimately assists in evolving judicious management and conservation strategies. The present study aims to analysis the spatial analysis and temporal composition under different LU/LC categories during the period 2005-06 to 2015-16.

Study Area

The Sirsa district lies in the extreme west corner of Haryana State. It is bordered by, the districts of Faridkot and Bhatinda of Punjab state in the north and north-east, Ganganagar and Hanumangarh districts of Rajasthan state in

the west and south, and Fatehabad district of Haryana in the east. Thus, it touches the interstate boundaries on three sides and is connected with its own state only on the eastern side. The district is stretched between 29°14' to 30°N latitudes and 74°29' to 75°18'E longitudes covering an area of 4268.17 Sq. kms. The district comprises of four tehsils namely Dabwali, Sirsa, Rania and Ellenabad and seven blocks i.e. Dabwaii, Baragudha, Ellenabad, Rania, Sirsa, Odhan and Nathusari chopta (Statistical Abstract of Haryana, 1998-99). The location of the district in the state is shown in Figure-1.

Objectives

Therefore, the present study is being undertaken with the following objectives:

1. To evaluate spatio-temporal appraisal of different land use/ land cover categories during 2005-06 to 2015-16.
2. To identify the causes & mechanism of changes between different land use/ land cover categories.

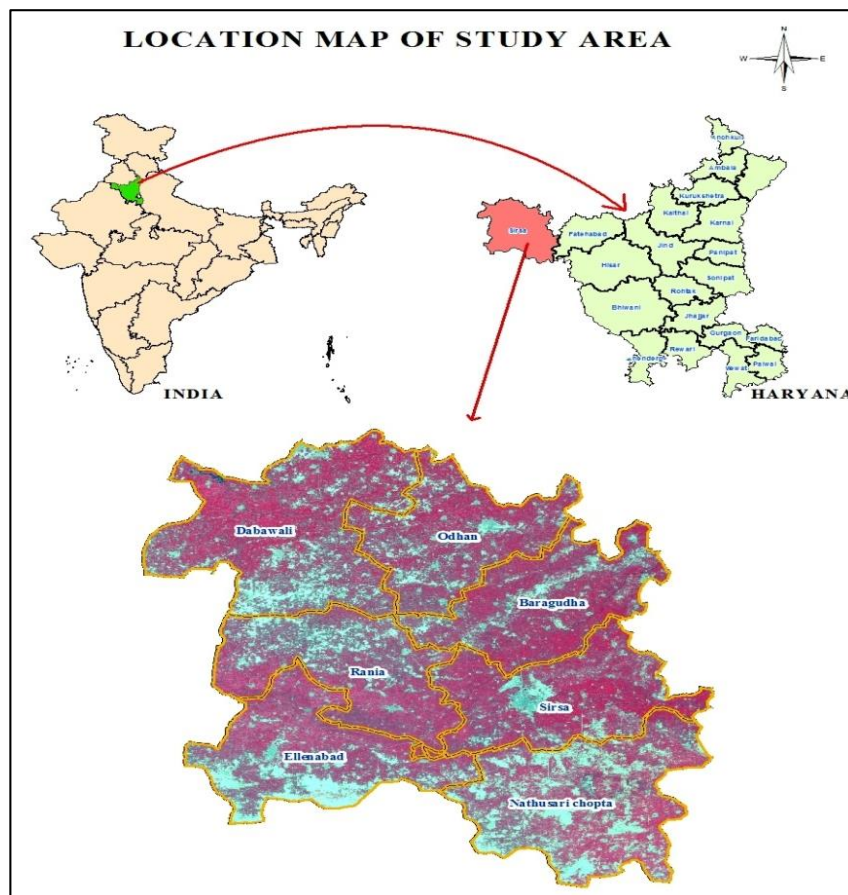


Fig 1

Material & Methodology

Satellite Data

Mainly Indian Remote Sensing Satellite-AWiFS satellite data of both rabi and kharif seasons was used for the present study. This satellite data for both seasons & years (2005 &

2015-16) downloaded from BHUVAN Website and used to prepare thematic layer. The remote sensing satellites, sensors and acquisition dates of the data used during the analysis are given in the Table-1 below.

Table 1: Satellite Data Used during 2005-06 and 2015-16

Sr. No.	Satellite	Sensor	Date of acquisition (2005-06 & 2015-16)
1	IRS-P6 (Resourcesat)	AWiFS	March 2005 & October 2005
2	IRS-P6 (Resourcesat)	AWiFS	March 2016 & November 2015

Software Used

ERDAS IMAGINE 9.3, ARC GIS Desktop 9.3, Microsoft Office 2007.

Scale

The present change mapping was prepared on 1:50,000 scale to monitor land use / land cover change during the year 2005-06 to 2015-16.

Ground Truth

All doubtful areas are checked by field verification. Land use /land cover classification methodology for study area is presented in figure-2 and Table-2.

Results and Discussion

Change analysis of Land use / land Cover of 7 blocks of Sirsa district was carried out using AWiFS satellite data for

the years 2005-06 & 2015-116. All these blocks cover an area of 4268.17 sq. km. These blocks were evaluated based on the changes in the areal extent of their land use/ land cover categories between the years 2005-06 and 2015-116. The category wise description of Sirsa district & each blocks of Sirsa district are given below.

Sirsa district covers an area of 4268.2 sq. km. Based on the interpretation of two season satellite data, the land use/ land cover categories identified in this block were double cropped area, Rabi only, Kharif only, current fallow, strip plantation, horticultural plantation, degraded grazing land, land with open scrub, sandy area, waterlogged seasonal, sat affected area, single/ group building, waterbody and village settlement. The interpreted satellite maps for the years 2005-06 and 2015-16 are shown as Figure-3. The areal extent of these categories during both the years along with change in their area.

Table 2: Land use/Land cover classification scheme

Level-I	Level-II	Level-III	Code
Built up	Rural	Village (Rural)	1
	Urban	City (Urban)	2
Agricultural Land	Cropland	Kharif only	3
		Rabi only	4
		Double cropped	5
	Fallow land	Current Fallow	6
	Plantation	Horticultural Plantation	7
		Agriculture Plantation	8
Wastelands	Scrub lands	Land with open scrub	9
		Land with dense scrub	10
	Mining dump	Brick kiln/stone mining dump	11
	Grazing Land	Degraded Grazing land	12
	Waterlogged	Seasonal waterlogged	13
		Permanent waterlogged	14
	Sandy area	Sandy area	15
	Salt affected	Salt affected area	16
Water body	Pond/River	Pond	17

Details of Change Analysis at Block Level

On the basis of common or union layer was generated on the basis of vector layers of both years 2005-06 & 2015-16. With this common vector layer, changes between all land use/land cover categories during 2005-06 and 2015-16 were calculated and the change map was prepared as shown in Figure-3. The change analysis data shows that 3487.5 sq. km. area of double crop remained unchanged but a reasonable area i.e. 12.37 sq. km. area of double crop changed into degraded grass and grazing land category. 177.59 sq. km. changed in to double crop from rabi only. On the other hand in 2015-16 year data 12.62 sq. km. area of double crop was shifted into kharif only.

Change Analysis of Baragudha Block

The analysis of land use/ land cover data of Baragudha block of Sirsa district revealed that the major changes occurred in agricultural crop categories. The substantial increase of 7.7 sq. km was observed in double crop area, 2.32 sq. km area decrease in rabi only and 3.38 sq. km area decrease in current fellow class and 1.26 sq. km area decrease in kharif only class whereas Total wastelands area in 2005-06 was 16.43 sq. km that was decreased 2.83 sq. km during 2005-06 to 2015-16. Total built up area of this block was 3.7 sq. km in 2005-06 & 5.84 sq. km was observed in 2015-16. Horticultural plantation classes were also observed in 2015-16 that covered 0.12 sq. km area respectively.

Change Analysis of Ellenabad Block

The analysis of land use/ land cover data of Ellenabad block of Sirsa district revealed that the major changes occurred in agricultural crop categories. The substantial increase of 15.46 sq. km was observed in double crop area, 25.86 sq. km area increase in kharif only whereas 29.54 sq. km area decrease in rabi only class and 10.37 sq. km area was decrease in current fellow class during 2005-06 to 2015-16. Total wastelands area in 2005-06 was 13.22 sq. km that was decreased 2.94 sq. km during 2005-06 to 2015-16. Total built up area of this block was 4.44 sq. km in 2005-06 & 7.30 sq. km was observed in 2015-16. Horticultural plantation & agriculture plantation classes were also observed in 2015-16 that covered 0.29 & 0.07 sq. km area respectively.

Change Analysis of Rania Block

The analysis of land use/ land cover data of Rania block of Sirsa district revealed that the major changes occurred in agricultural crop categories. The substantial increase of 39.28 sq. km was observed in double crop area, 9.81 sq. km area increase in kharif only whereas 35.28 sq. km area decrease in rabi only class and 14.00 sq. km area was decrease in current fellow class during 2005-06 to 2015-16. Total wastelands area in 2005-06 was 10.77 sq. km that was decreased 1.10 sq. km during 2005-06 to 2015-16. Total built up area of this block was 4.01 sq. km in 2005-06 &

6.59 sq. km was observed in 2015-16. Horticultural plantation class was also observed in 2015-16 that covered

0.60 sq. km area.

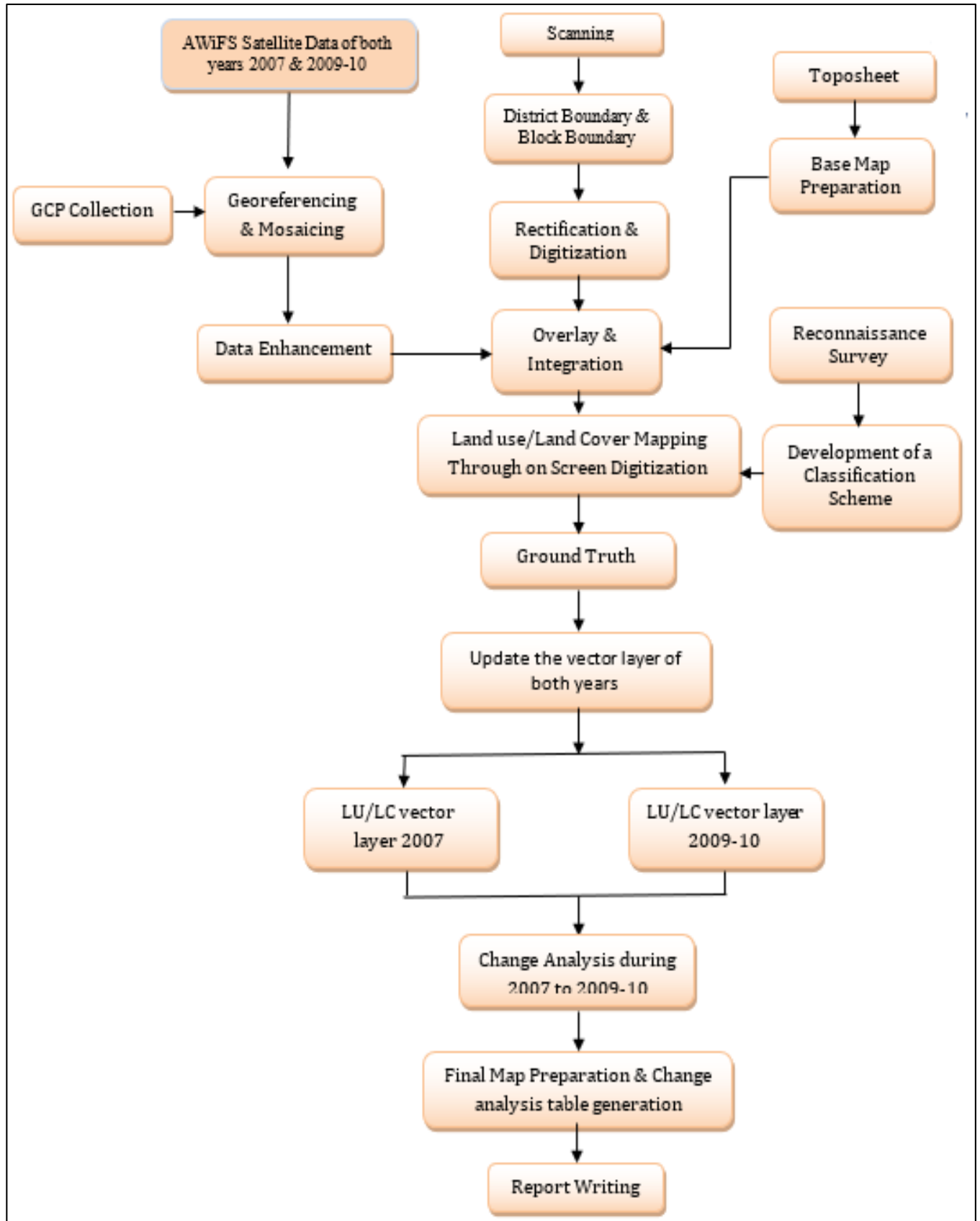


Fig 2: Methodology Flow Chart

Change Analysis of Nathusari Chopta Block

The analysis of land use/ land cover data of Nathusari Chopta block of Sirsa district revealed that the major changes occurred in agricultural crop categories. The

substantial increase of 69.73 sq. km was observed in double crop area, 67.02 sq. km area increase in kharif only whereas 78.97 sq. km area decrease in rabi only class and 56.23 sq. km area was decrease in current fellow class during 2005-06

to 2015-16. Total wastelands area in 2005-06 was 23.53 sq. km that was decreased 1.58 sq. km during 2005-06 to 2015-16. Total built up area of this block was 7.63 sq. km in 2005-06 & 8.49 sq. km was observed in 2015-16. Horticultural plantation & agriculture plantation classes were also observed in 2015-16 that covered 0.07 & 0.06 sq. km area respectively.

Change Analysis of Odhan Block

The analysis of land use/ land cover data of Odhan block of Sirsa district revealed that the major changes occurred in agricultural crop categories. The substantial increase of 15.88 sq. km was observed in double crop area, 1.15 sq. km area increase in kharif only whereas 23 sq. km area decrease in rabi only class and 5.22 sq. km area was increase in current fellow class during 2005-06 to 2015-16. Total wastelands area in 2005-06 was 12.56 sq. km that was decreased 0.71 sq. km during 2005-06 to 2015-16. Total built up area of this block was 6.18 sq. km in 2005-06 & 7.73 sq. km was observed in 2015-16. Horticultural plantation & agriculture plantation classes were also observed in 2015-16 that covered 0.02 & 1.17 sq. km area respectively.

Change Analysis of Sirsa Block

The analysis of land use/ land cover data of Sirsa block of Sirsa district revealed that the major changes occurred in agricultural crop categories. The substantial increase of 12.53 sq. km was observed in double crop area, 4.55 sq. km area increase in kharif only whereas 19.10 sq. km area decrease in rabi only class and 6.33 sq. km area was decrease in current fellow class during 2005-06 to 2015-16. Total wastelands area in 2005-06 was 11.52 sq. km that was

decreased 0.81 sq. km during 2005-06 to 2015-16. Total built up area of this block was 23.23 sq. km in 2005-06 & 33.62 sq. km was observed in 2015-16. Horticultural plantation class was also observed in 2015-16 that covered 0.13 sq. km area.

Change Analysis of Dabawali Block

The analysis of land use/ land cover data of Dabawali block of Sirsa district revealed that the major changes occurred in agricultural crop categories. The substantial increase of 28.42 sq. km was observed in double crop area, 24.53 sq. km area increase in kharif only whereas 41.5 sq. km area decrease in rabi only class and 13.4 sq. km area was decrease in current fellow class during 2005-06 to 2015-16. Total wastelands area in 2005-06 was 18.86 sq. km that was decreased 0.19 sq. km during 2005-06 to 2015-16. Total built up area of this block was 9.69 sq. km in 2005-06 & 12.45 sq. km was observed in 2015-16. Horticultural plantation & agriculture plantation classes were also observed in 2015-16 that covered 0.86 & 1.11 sq. km area respectively.

Conclusions

The present study was conducted to evaluate change analysis of all blocks of Sirsa district by using IRS P6, AWiFS satellite data of both rabi and kharif seasons for the years 2005-06 & 2015-16. Sirsa district cover an area of 4268.20 sq. km. The change analysis is based on the changes observed in land use/ land cover in Sirsa district between 2005-06 and 2015-16. After going through the final land use/land cover data of both years. Sirsa district covers an area of 4268.20 sq. km area.

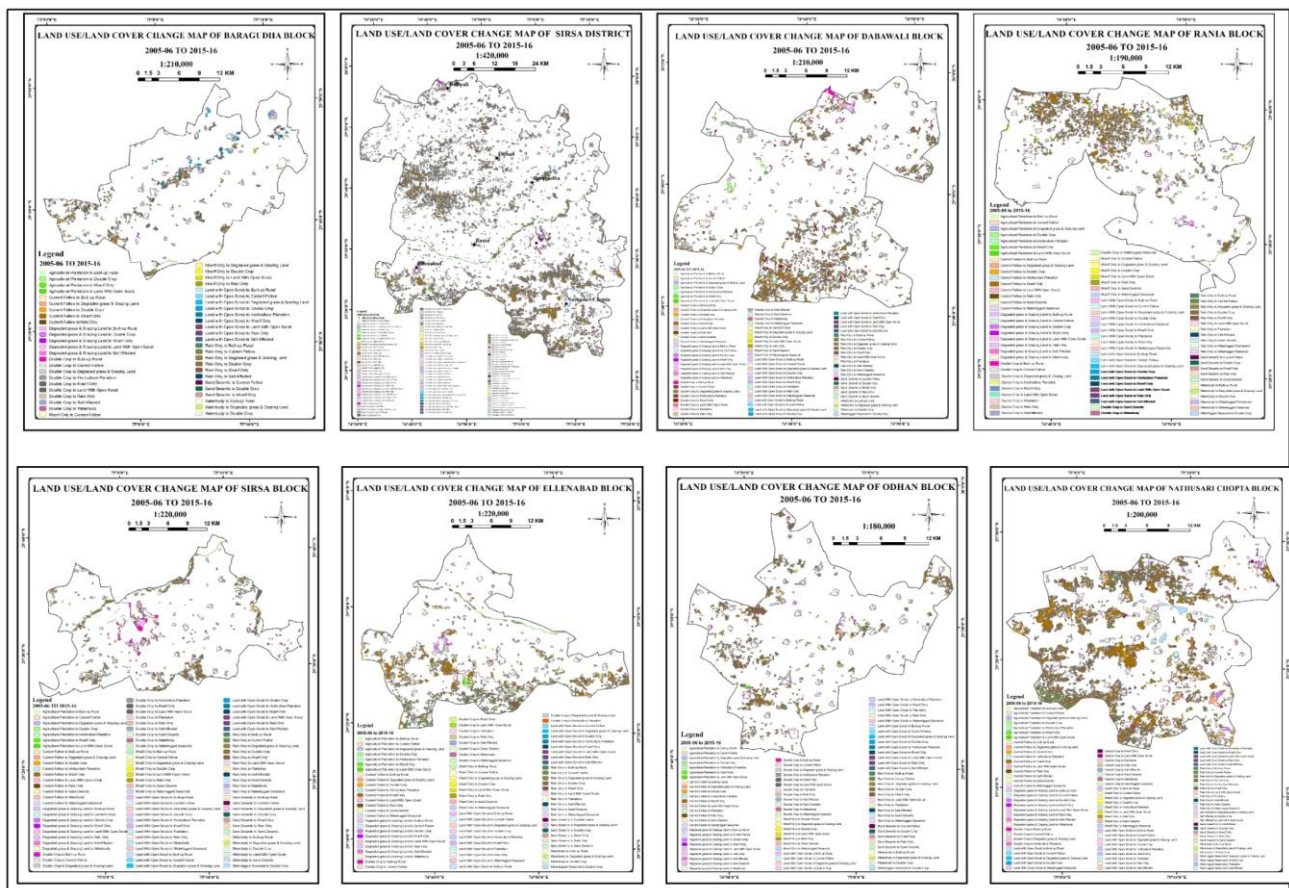


Fig 3
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Sirsa district have seven blocks that are Baragudha, Dabawali, Ellenabad, Nathsari Chopta, Odhan, Rania & Sirsa that covers 540.27, 832.66, 572.46, 724.59, 506.38, 543.10 & 548.71 sq. km area respectively. Built-up area, agricultural crops, agricultural plantation, wastelands & waterbody are major LU/LC classes that were observed in both years 2005-06 & 2015-16. Agricultural crop class covered 4092.80 sq. km area in 2005-06 & 4087.76 sq. km area in 2015-16. This class covers 95.89 percentage area of Sirsa district in 2005-06 & 95.77 percentage area of Sirsa district in 2015-16. Wastelands class was observed 106.10 sq. km in 2005-06 that was 2.48 percentage of total geographical area of the district and 96.67 sq. km area was observed in 2015-16 that was 2.26 percentage of total geographical area of the district. Double crop is the dominant class in both years i.e. 2005-06 and 2015-16 in Sirsa district. The major shifting was observed in rabi only class of 2005-06 whose 238.36 sq. km area was changed into double crop area during 2015-16. The data reveals that total agricultural area was decreased 4.84 sq. km during 2005-06 to 2015-16. This is due to increase in built up area & horticulture plantation classes. Minor changes were also observed in wastelands categories in the district. Block Wise change analysis map is presented in Figure-3.

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