International Journal of Applied Research 2017; 3(10): 347-354

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2017; 3(10): 347-354
www.allresearchjournal.com
Received: 16-08-2017
Accepted: 21-09-2017

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Temporal utilization of land resources and their mapping in Rania block of Sirsa district using remote sensing & GIS techniques

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Abstract
Land/Use refers to man's activities on earth, which are directly related to land, whereas Land/Cover denotes the natural features and artificial constructions covering the land surface. Land/use practices of a region are influenced by a number of parameters namely physical and chemical environments, socio-economic factors and needs of the masses. Land is the basic, fixed and limited natural resource. 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 (LULC) categories, examines the spatial configuration of the categories, and derives the probabilities of transitions in the Rania block of Sirsa district, Haryana.
The present study aims to investigate the monitoring of resource and temporal utilization using multi-temporal IRS P6 AWiFS satellite data (2005-06 to 2015-16) of Rania block 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.
Double crop class covered 481.74 sq. km area in 2005-06 & 494.27 sq. km area in 2015-16. Double crop is the dominant class in both years i.e. 2005-06 and 2015-16 in Rania block.

Keywords: AWiFS satellite data, Resource monitoring, temporal utilization, Land use/ land cover, Geospatial technology.

1. Introduction
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.
Land cover and land use changes are very dynamic in nature and have to be monitored at regular intervals for sustainable environment development. It can be done easily and precisely by using remote sensing data. Remote Sensing data is very useful because of its synoptic view, repetitive coverage and real time data acquisition. In other words, the multi date and multispectral remote sensing satellite data provides different levels of spatial information which are used in change detection studies (Burrough, 1986).
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 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 Rania block situated between 29°26'17" to 29°42'2.1" N latitude and 74°34'29" to 74°56'28 E longitude. The total geographical area of the Raniya block is 543.1 sq. km. it's situated at the end of Haryana state. It is surrounded by Ellenabad block in south and Dabwali block in the north. Climate of Rania block is arid and hot which is mainly dry with very hot summer and cold winter except during monsoon season when moist air entered. The summer starts from mid March to last week of the June followed by the south- west monsoon which lasts till September. The transition period from September to October forms the post-monsoon season. The winter season starts late in November and remains up to first week of March. The normal annual rainfall is 308 mm. The south west monsoon sets in from last week of June and withdraws in end of September, contributed about 80% of annual rainfall. July and Rest 20% rainfall is received during winter in the wake of western disturbances. During winter i.e. January and February, the temperature goes down sometimes below 2°C. Physiographically it falls under Ghaggar river sub-basin which flows from east to west. The block is formed by aeolian and alluvium plain which has been further divided into many sub geomorphic divisions viz. recent flood plain, nearly level old flood plain, aeolian plain (sand dunes), old flood plain with occasional sand dunes. Location map of study area is displayed in figure-1.

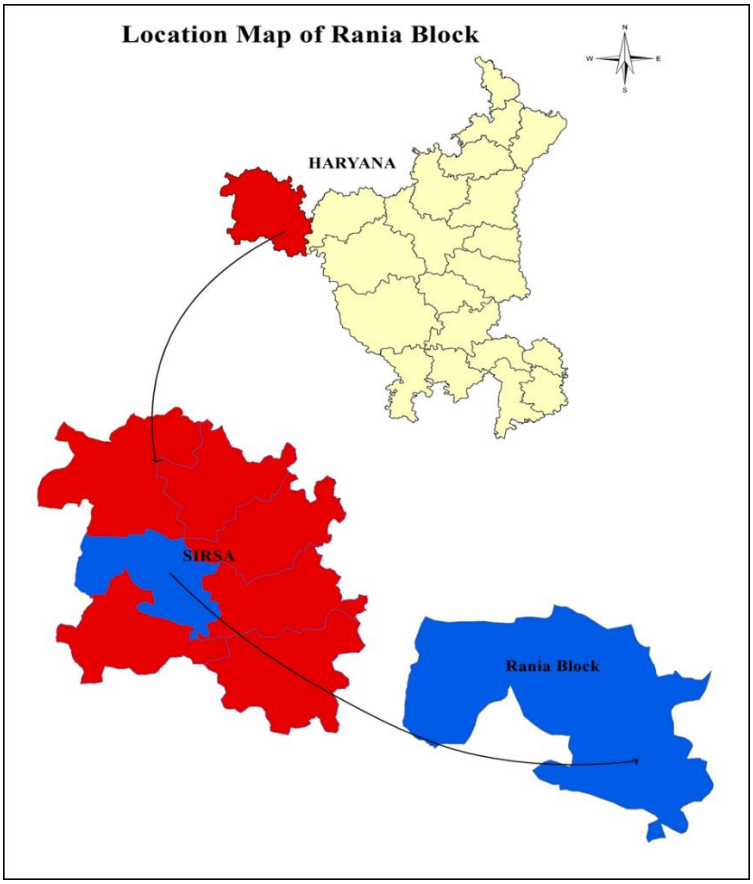

Fig 1: Location map of Rania block

Materials & Methodology

Satellite Data

Mainly Indian Remote Sensing Satellite P6 – 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) 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 used during 2005-06 and 2015-16

Sr. No.	*Satellite*	*Sensor*	*Date of acquisition*
1	IRS-P6	AWiFS	March 2005 & October 2005
2	IRS-P6	AWiFS	September 2016 & March 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.

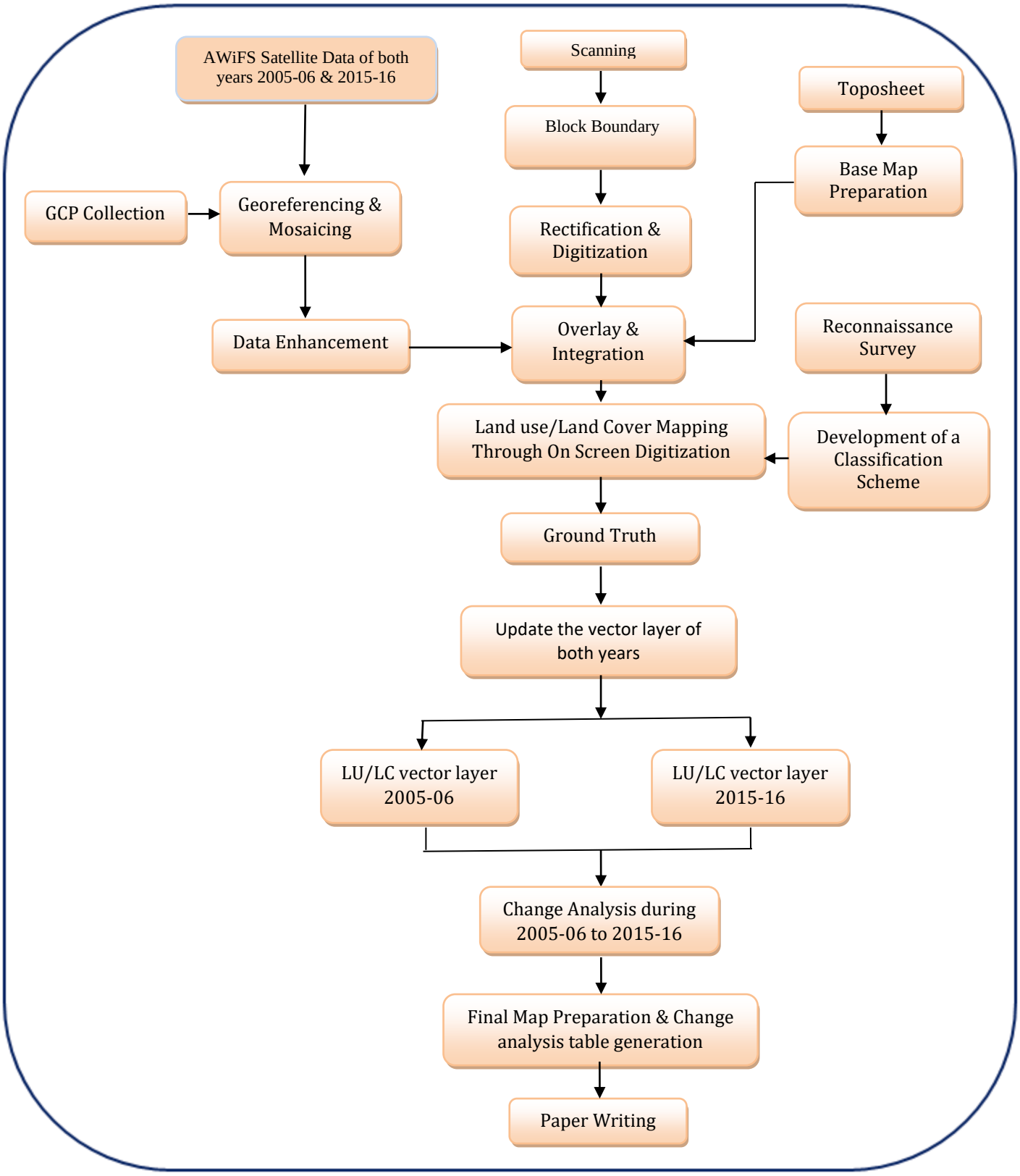

Fig 2: Land use /land cover classification methodology for study area

Results & Discussion

Rania block covers an area of 543.10 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, 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 & 4. The areal extent of these categories during both the years alongwith change in their area is given in Table-3.

Table 2: Codification of classification system

Level-I	Level-II	Level-III	Code
Built up	Rural	Village (Rural)	1
		Single/Group Building	2
	Urban	City (Urban)	3
Agricultural Land	Cropland	Kharif only	4
		Rabi only	5
		Double cropped	6
	Fallow land	Current Fallow	8
Plantation	Agricultural Plantation	Strip Plantation	9
		Horticultural Plantation	10
	Block Plantation	Block Plantation	11
		Bund plantation	12
Wastelands	Scrub lands	Land with open scrub	13
		Land with dense scrub	14
	Mining dump	Brick kiln/stone mining dump	15
	Grazing Land	Degraded Grazing land	16
	Waterlogged	Seasonal waterlogged	17
		Permanent waterlogged	18
	Sandy area	Sandy area	19
	Salt affected	Salt affected area	20
Water body	Pond/River	Pond	21

The brief description of various classes is as follows

Built Up Land

Built-up Land is comprised of areas of concentrated use amid greatly of the land covered by houses. It is further divided into village, urban built up, single/group building.

Built up Rural & Urban – Out of the total built up rural land or settlement area of Rania block was 3.40 sq. km. in 2005-06. During the year 2015-16, it was found that there is increase of 1.59 sq. km in the settlement area of these villages i.e. 8.39 sq. km. Built up urban of Rania block was 0.61 sq. km founded in 2005-06 and in 2015-16, it was increased to 1.60 sq. km.

Agricultural land

Agricultural land may be defined broadly as land used primarily for production of food grains and fodder. This category is further divided into double crop, rabi only, kharif only and current fallow sub-classes.

Double crop- This sub-category involves an area that is cropped in both rabi and kharif seasons throughout the year. Double crop is the dominant category in Rania block. The area under this class during 2005-06 was 456.89 sq. km. whereas it became 496.17 sq. km. in 2015-16. The increment of 39.28 sq. km. is also justified from the decrease of rabi only class in this block.

Rabi only - The area utilized only in rabi season and residue fallow in kharif season is classify as rabi only. This class enclosed an area of 38.71 sq. km in 2005-06 and 3.41 sq. km in 2015-16. The decrease of 35.28 sq. km. in this class may be because of the shifting of this area in kharif only & double crop categories.

Kharif only - Plantations are the cultured trees or plant developed in crop lands. These categories It covered an area of 6.16 sq. km in 2005-06 and 15.97 sq. km in 2015-16 i.e. a increase of 9.81 sq. km due to decreased the class rabi only.

Current Fallow - Land which is kept fallow in both rabi and kharif seasons due to one or the other reasons falls under this category. An area of 25.25 sq. km. of this class was found during 2005-06 whereas this class was decreased to 11.25 sq. km. in 2015-16. This class decreased 14.00 sq. km during 2005-06 to 2015-16.

Plantation

Plantations are the cultivated trees or plants grown in agricultural fields. This category includes Agricultural plantation, Strip plantation and Horticultural plantation classes also.

Agricultural *plantation*- Agricultural plantation is done around the crop field. Agricultural plantation covered an area of 0.60 sq. km in 2005-06 and this class was not mapped in 2015-16.

Wastelands

The term wastelands defines to degraded lands that were at present no utilized, and are failing for lack of suitable soil & water management. Wastelands develop naturally or due to influence of environment, chemical and physical properties of the soil or management constraints. These are further divided into Degraded Grazing Land, scrub land and sandy area.

Degraded Grazing Land- These lands re the Panchayat land, uneven in shape and size, and are found adjacent to settlement fringes. These lands have degraded due to lack of proper soil conservation and drainage measures. The areal extent of this class during 2005-06 was 8.41 sq. km and it decreased by 8.32 sq. km. during 2005-06 to 2015-16 due to increment in settlement area of the villages.

Land with Open scrub- These lands generally occupy topographically high locations and possess sparse vegetation. These are subjected to excessive aridity with scrubs dominating the landscape. These may either occur naturally or be the result of human activities. This class occupied an area of 1.46 sq. km. in 2005-06 and 1.25 sq. km in 2015-16 i.e. decreased of 0.21 sq. km. during this period.

Sandy area- A small area of 0.90 sq. km was found during 2005-06 in the Rania block. Most of the sandy wastelands have been leveled and put under cultivation.

Seasonally waterlogged- Seasonally waterlogged areas are those where the water logging condition prevails usually during the monsoon period. These lands are mostly located in plain areas associated with the drainage congestion. 0.10 sq. km area of this class was found during 2015-16.

Water Body

This class involves ponds and lakes currently in the study area. Ponds were observed in this block covering an area of 0.72 sq. km in 2005-06 & 0.04 sq. km area in 2015-16.

Table 3: Spatial area and temporal change of land use & land cover classes of Rania Block

Land use & Land cover Categories		Area in Sq. km. (2005-06)	Area in Sq. km. (2015-16)	Change
Built Up Land	Rural	3.40	4.99	1.59
	Urban	0.61	1.60	1.01
Agricultural Crops	Double Crop	456.89	496.17	39.28
	Rabi Only	38.71	3.41	-35.28
	Kharif Only	6.16	15.97	9.81
	Current Fellow	25.25	11.25	-14.00
Plantations	Agricultural Plantation	0.60	0.00	-0.60
Wastelands	Land with Open Scrub	1.46	1.25	-0.21
	Degraded Grazing & Grass land	8.41	8.32	-0.09
	Sand Desertic	0.90	0.00	-0.90
	Waterlogged Seasonal	0.00	0.10	0.10
Waterbody	Waterbody	0.72	0.04	-0.68
Total		543.10	543.10	0.00

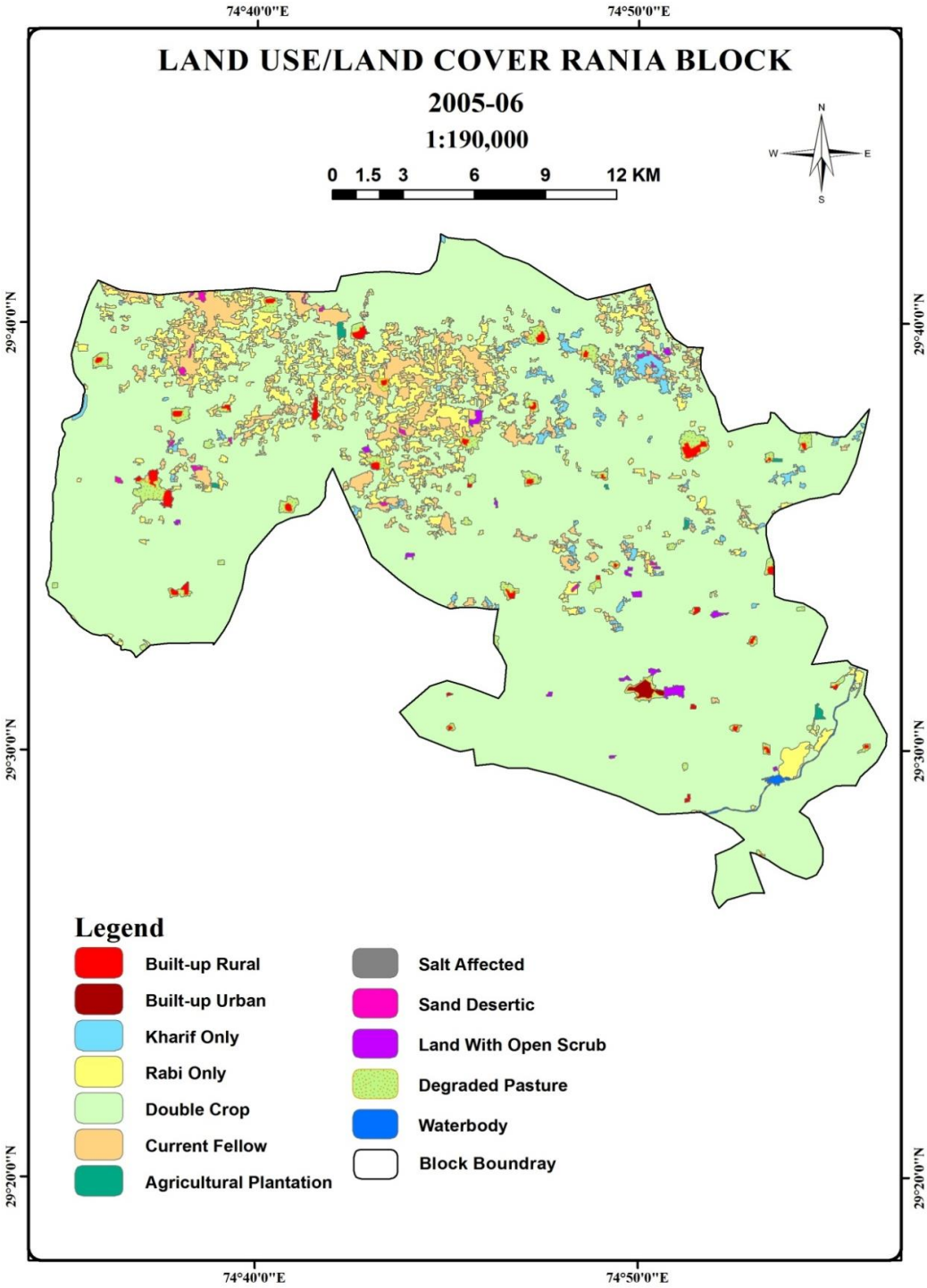

Fig 3: The interpreted satellite maps for the years 2005-06

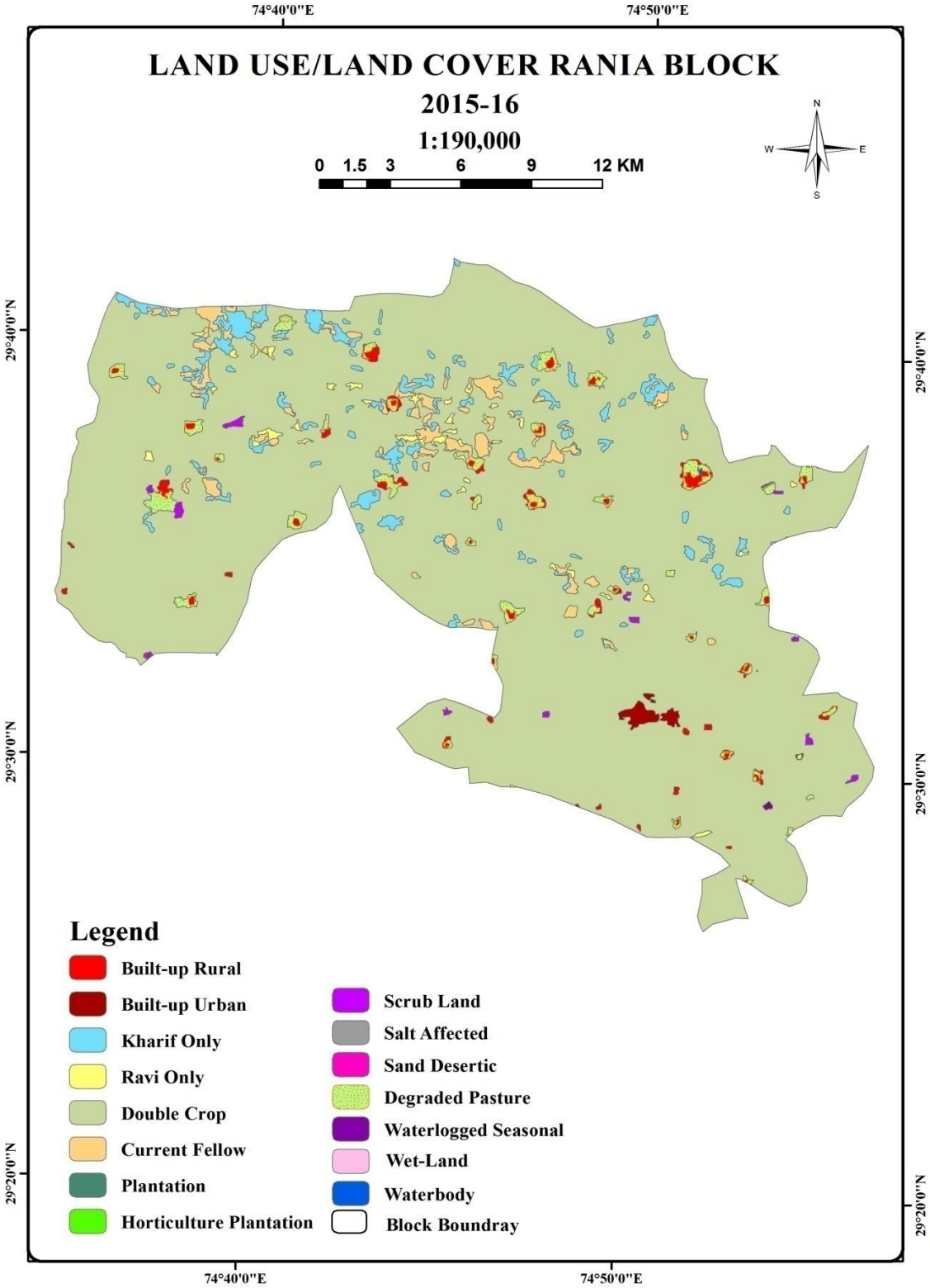

Fig 4: The interpreted satellite maps for the years 2015-16.

Change Analysis

A 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 as shown in Table-20 and the change map was prepared as shown in Figure-5. The change analysis data shows that 448.91 sq. km. area of double crop remained unchanged but a reasonable area i.e. 0.27 sq. km. area of double crop changed into agriculture plantation category. 0.86 sq. km. area changed into grazing land & 0.59 sq, km area changed into scrub land from double crop into 2015-16. 32.11 sq. km. changed in to double crop from rabi only. On the other hand in 2015-16 year data 3.32 sq. km. area of double crop was shifted into kharif only.

Table 4: Category wise change analysis of land use/ land cover classes during 2005-06 and 2015-16 of Rania Block (Area in sq. km.)

2005-06 / 2015-16	Built-up Rural	Built-up Urban	Current Fellow	Degraded Pasture	Double Crop	Kharif Only	Ravi Only	Scrub Land	Water body	Waterlogged Seasonal	Wet-Land	Grand Total
Agricultural Plantation			0.00	0.01	0.27	0.18		0.13				0.60
Built-up Rural	3.41											3.40
Built-up Urban		0.61										0.61
Current Fellow	0.16		7.07	0.08	9.07	7.90	0.94	0.03				25.25
Degraded grass & Grazing Land	1.03	0.28	0.00	5.93	0.86	0.04	0.00	0.23	0.03			8.41
Double Crop	1.52	0.35	0.78	1.49	448.91	2.85	0.70	0.29		0.01		456.89
Kharif Only			0.87		3.32	1.81	0.16					6.16
Land With Open Scrub		0.37	0.28		0.59	0.05	0.00	0.18				1.46
Rabi Only	0.14		1.87	0.10	32.11	2.81	1.62	0.04		0.02	0.00	38.71
Sand Desertic			0.38		0.19	0.33	0.00					0.90
Waterbody					0.64					0.07	0.00	0.72
Grand Total	6.26	1.61	11.25	7.61	495.96	15.97	3.42	0.9	0.03	0.1	0	543.10

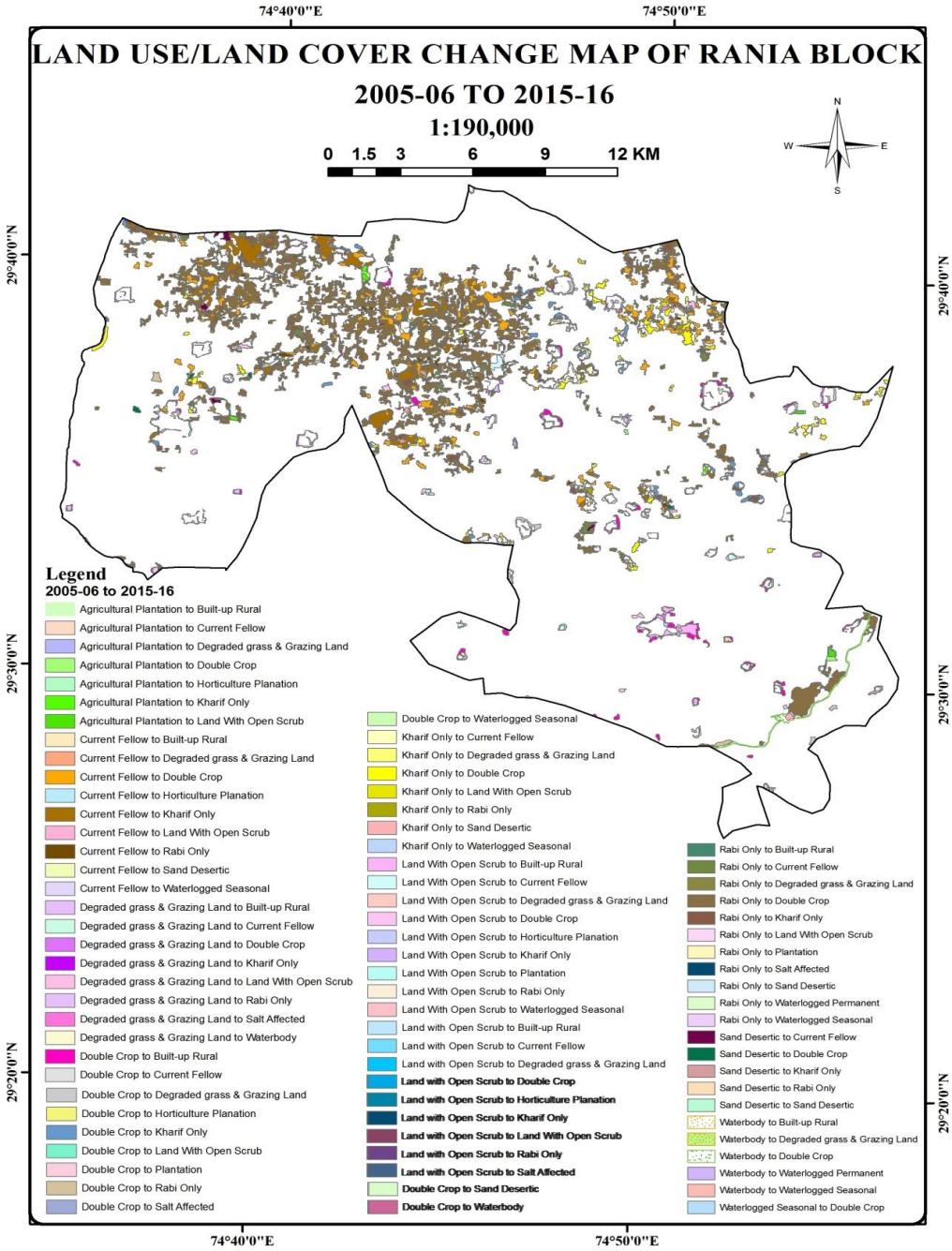

Fig 5: Changes between all land use/land cover categories during 2005-06 and 2015-16 were calculated

Conclusions

The present study was conducted to evaluate change analysis of Rania block of Sirsa district by using IRS P6, AWiFS satellite data of both rabi and kharif seasons for the years 2005-06 & 2015-16. Rania block cover an area of 543.10 sq. km. The change analysis is based on the changes observed in land use/ land cover in study area between 2005-06 and 2015-16. After going through the final land use/land cover data of both years and the changes occurred during these years, following conclusions were drawn.

1) 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.
2) Total wastelands area in 2005-06 was 10.77 sq. km that was decreased 1.10 sq. km during 2005-06 to 2015-16.
3) Total built up area of this block was 4.01 sq. km in 2005-06 & 6.59 sq. km was observed in 2015-16.
4) Horticultural plantation class was also observed in 2015-16 that covered 0.60 sq. km area.

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