



Monitoring & spatio - temporal analysis of land use/ land cover using multi temporal AWiFS satellite IMAGES: a case study of rania block of sirsa district, haryana.

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Abstract

Today, the population of the world is more than 7 billion and more than 60 percentages of it is working in primary sector. This ever increasing population has altered and modified most of earth's land surfaces. Remote sensing data with auxiliary techniques provide dependable, updated and precise information for LULC mapping and future planning. The monitoring and mapping of LULC changes through the multi-temporal digital (satellite) data provides detailed information. In order to monitor the pattern, distribution and trend of urban land use/ land cover change, it is necessary to integrate polarization, spatial, spectral and multi-temporal remotely sensed data to assess the spatial pattern and dynamics changes of urban areas in both the spatial and the temporal dimensions. This research paper aims to monitor the land use and land cover classes for the years 2006-07 and 2009-10 and their temporal analysis for Rania block of Sirsa district. Agriculture land, wastelands, built-up, plantation and water body are main classes observed in study area at first level classification. At second level double crop, rabi only, kharif only, current fallow, sand desertic, waterlogged seasonal and degraded pasture & grazing land are observed in both years.

Key word: Remote sensing; Multi-temporal; Classification; Degraded pasture

Introduction:

The land use pattern of any terrain is a reflection of the complex physical process acting upon the surface of the Earth. These processes include impact of climatic, geologic and topographic conditions on the distribution

of natural resources. Remote sensing has emerged as one of the frontier technologies in recent times because of its repetitive and synoptic coverage capabilities which are helpful in assessing land use/land cover changes in a time series domain. Information on existing land use/land cover (LU/LC), its spatial distribution and changes is essential prerequisite for planning. Environmental change detection and monitoring can be done using multi data image to evaluate difference in LU/LC. It might be due to the human activities or by change in environmental conditions. GIS is an effective tool to solve geo-scientific problems creating geo-database of natural resources and to integrate various thematic data layers to study inter relationships of different layers. GIS and remote sensing techniques are being effectively used in recent times as advanced tools gather information about the earth's resources more accurately, efficiently and quickly than conventional methods. Multi layer overlay and raster analysis is also generated from GIS, which is helpful in assessing land cover changes.

In the present study, spatio-temporal analysis of land use / land cover during 2006-07 & 2009-10) of Rania block of Sirsa district was carried out. IRS-P6 AWiFS satellite data of two seasons i.e. Kharif & Rabi for both years (2006-07 & 2009-10) were used to monitor the land use / land cover categories 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 (2006-07 & 2009-10) a union layer was generated to

calculate change detection matrix and change map in the study area.

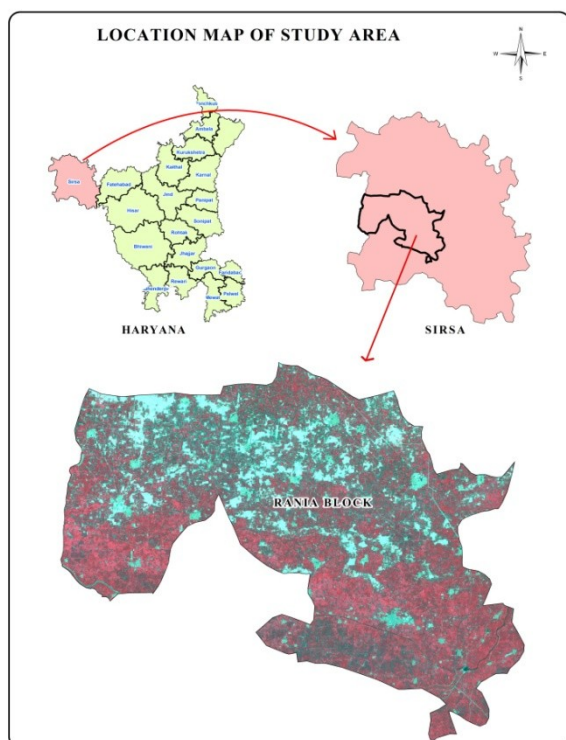
Objectives:

The present study was carried out with the following objectives:

- To prepare land use/land cover map of Rania block of Sirsa district for the year 2006-07 & 2009-10.
- To generate the database of Rania block in GIS format.
- To evaluate the land use/ land cover change in area & change map during the period of 2006-07 to 2009-10.
- How are natural landscapes changes?
- What are the causes & mechanism of changes?

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. The average

rainfall in the district as a whole is 186.3 mm. Over 60% of the annual rainfall is received during the months of July to September. Temperature begins to rise from March and May and June are the hottest months. The mean daily maximum temperature varies from 41°C to 46°C and mean daily minimum temperature is about 27°C, maximum temperature may go up to 48°C. The terrain of study area may be broadly classified from north to south into three major types i.e. Haryana Plain, Alluvial bed of Ghaggar or Nali.

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 (2006-07 & 2009-10) 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 2006-07 and 2009-10

Sr. No.	Satellite	Sensor	Date of acquisition
1	IRS-P6	AWiFS	October 2006 & March 2006-07
2	IRS-P6	AWiFS	September 2009 & March 2010

Scale: The present change mapping was prepared on 1:50,000 scale to monitor land use / land cover change during the year 2006-07 to 2009-10.

Land use /land cover classification methodology for study area is presented in figure-2.

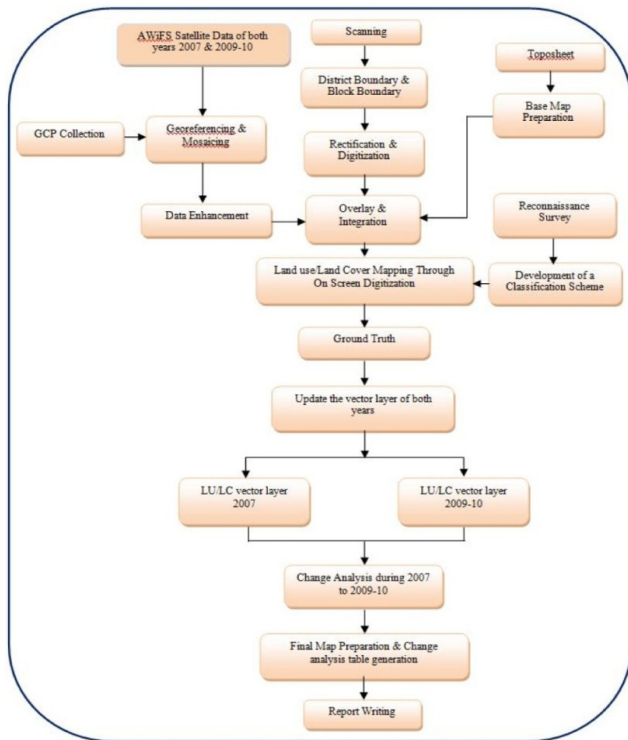


Figure-2

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 2006-07 and 2009-10 are shown as figure-3 & 4 respectively. The areal extent of these categories during both the years alongwith change in their area is given in table-2. The brief description of various classes is as follows:

Built Up Land: Built-up land is comprised an area of intensive use with much of the land covered by structures.

Built up Rural & Urban – Out of the total built up rural land or settlement area of Rania block was 3.40 sq. km. in 2006-07. During the year 2009-10, it was found that there is increase of 2.71 sq. km in the settlement area

of these villages i.e. 6.11 sq. km. Built up urban of Rania block was 0.61 sq. km founded in 2006-07 and in 2009-10, it was increased to 1.20 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-class includes an area which is cultivated during both rabi and kharif seasons in a year. Double crop is the dominant category in Rania block. The area under this class during 2006-07 was 456.89 sq. km. whereas it became 490.26 sq. km. in 2009-10. The increment of 33.37 sq. km. is also justified from the decrease of rabi only class in this block.

Rabi only - The area cultivated only during rabi season and remains fallow during kharif season is classified as rabi only. This class covered an area of 38.71 sq. km in 2006-07 and 4.28 sq. km in 2009-10. The decrease of 34.43 sq. km. in this category may be due to the shifting of this area in kharif only & double crop categories.

Kharif only - The area which is cultivated only during kharif season and remains fallow during rabi season is called kharif only. It covered an area of 6.16 sq. km in 2006-07 and 18.68 sq. km in 2019-10 i.e. a increase of 12.52 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 25.24 sq. km. of this class was found during 2006-07 whereas this class was decreased to 10.62 sq. km. in 2009-10. This class decreased 14.62 sq. km during 2006-07 to 2009-10.

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 2006-07 and this class was not mapped in 2009-10.

Strip plantation - Strip plantation is mainly done on both sides of roads/ kachcha ways. Strip plantation covered an area of 2.12 sq. km area in 2009-10 and this class was not mapped in 2006-07. This class increased due to decreased rabi only class.

Wastelands: The term wastelands refer to degraded lands that are currently underutilized, and are deteriorating for lack of appropriate soil & water management or on account of natural causes. 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 are the Panchayat lands, irregular in shape, and are found close to settlement fringes. These lands have degraded due to lack of proper soil conservation and drainage measures. The areal extent of this class during 2006-07 was 8.41 sq. km and it decreased by 2.28 sq. km. during 2006-07 to 2011-12 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 2006-07 and 0.39 sq. km in 2009-10 i.e. decreased of 1.07 sq. km. during this period.

Sandy area- A small area of 0.90 sq. km was found during 2006-07 in the Rania block. In 2009-10, 0.04 sq. km area was covered by this class. 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. 0.12 sq. km area of this class was found during 2009-10.

Land use/Land cover Categories		Area in Sq. km. (2006-07)	Area in Sq. km. (2009-10)	Change
Built Up Land	Rural	3.40	6.11	2.71
	Urban	0.61	1.20	0.59
	Single Group Building	0	0.46	0.46
Agricultural Crops	Double Crop	456.89	490.26	33.37
	Rabi Only	38.71	4.28	-34.43
	Kharif Only	6.16	18.68	12.52
	Current Fallow	25.24	10.62	-14.62
Plantations	Horticultural Plantation	0.00	0.00	0.00
	Agricultural Plantation	0.60	0.00	-0.60
	Strip Plantation	0.00	2.12	2.12
Wastelands	Land with Open Scrub	1.46	0.39	-1.07
	Degraded Grazing & Grass land	8.41	6.13	-2.28
	Waterlogged Seasonal	0.00	0.12	0.12
	Sand Desertic	0.90	0.04	-0.86
Waterbody	Waterbody	0.72	2.69	1.97
Total		543.10	543.10	0.00

Table-2 Areal extent and change in area of land use/ land cover categories of Rania block

Change Analysis:

A common or union layer was generated on the basis of vector layers of both years 2006-07 & 2009-10. With this common vector layer, changes between all land use/ land cover categories during 2006-07 and 2009-10 were calculated as shown in Table-3 and the change map was prepared as shown in figure-5. The change analysis data shows that 445.57 sq. km. area of double crop remained unchanged but a reasonable area i.e. 2.01 sq. km. area of double crop changed into strip plantation category. 1.09 sq. km. area changed into built up rural & 0.59 sq. km area changed into built up urban from double crop into 2009-10. 31.39 sq. km. changed in to double crop from rabi only. On the other hand in 2009-10 year data 3.55 sq. km. area of double crop was shifted into kharif only.



Table-3. Category wise change analysis of land use/ land cover classes during 2006-07 and 2009-10 of Rania Block
(Area in sq. km.)

2009-10 2006-07	Built-up Rural	Built-up Urban	Current Fallow	Degraded grass & Grazing Land	Double Crop	Kharif Only	Land With Open Scrub	Rabi Only	Sand Desertic	Single Group Building	Strip Plantation	Water body	Waterlogged Seasonal	Grand Total
Agricultural Plantation	0.00	0.00	0.00	0.01	0.26	0.18	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.60
Built-up Rural	3.37	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	3.40
Built-up Urban	0.00	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61
Current Fallow	0.11	0.00	6.60	0.00	8.21	9.10	0.03	1.09	0.04	0.05	0.01	0.00	0.00	25.25
Degraded grass & Grazing Land	1.30	0.00	0.00	6.12	0.85	0.04	0.00	0.01	0.00	0.00	0.03	0.05	0.00	8.41
Double Crop	1.09	0.59	0.67	0.00	445.57	3.55	0.00	1.01	0.00	0.14	2.01	2.24	0.02	456.89
Kharif Only	0.00	0.00	0.74	0.00	3.00	2.19	0.00	0.20	0.00	0.00	0.02	0.00	0.00	6.16
Land With Open Scrub	0.10	0.00	0.24	0.00	0.56	0.12	0.17	0.00	0.00	0.26	0.01	0.00	0.00	1.46
Rabi Only	0.15	0.00	1.86	0.00	31.39	3.18	0.04	1.97	0.00	0.00	0.03	0.07	0.02	38.71
Sand Desertic	0.00	0.00	0.48	0.00	0.10	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
Waterbody	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.08	0.72
Grand Total	6.11	1.20	10.63	6.13	490.27	18.68	0.39	4.28	0.04	0.46	2.12	2.69	0.12	543.10

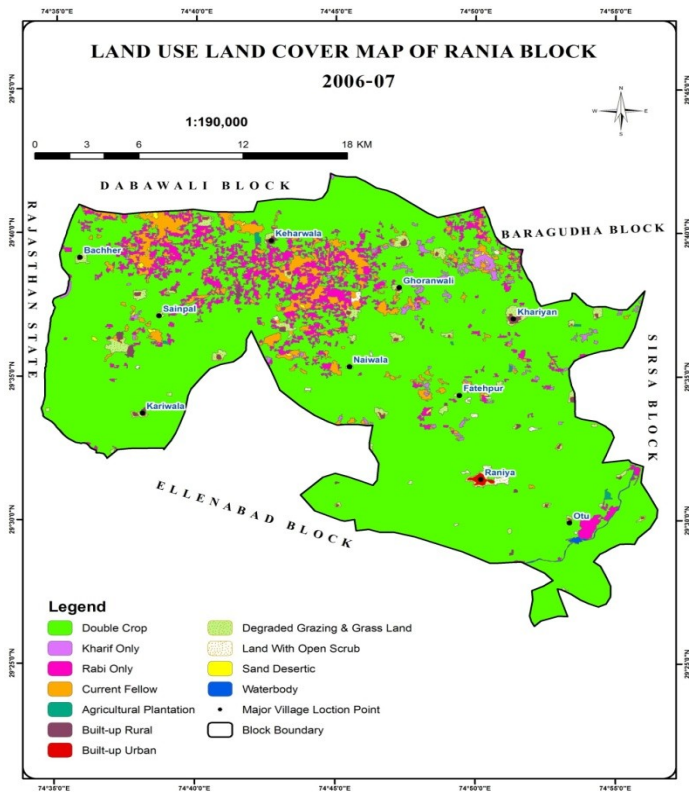


Figure-3

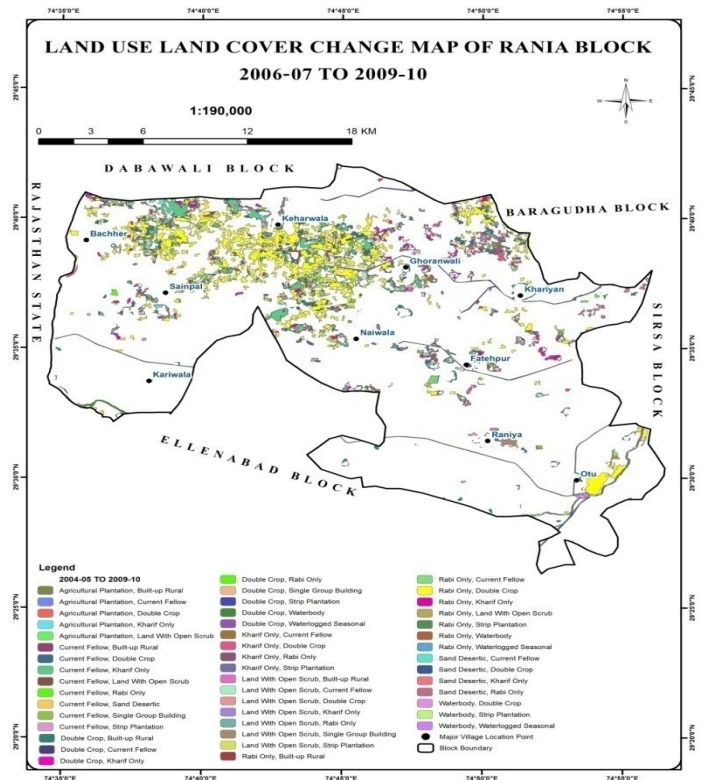


Figure-5

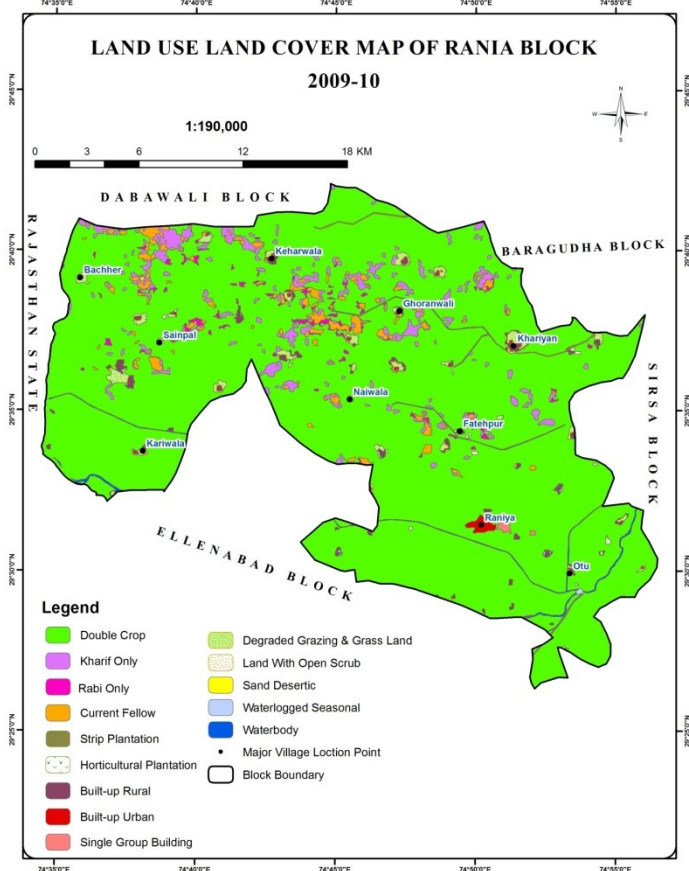


Figure-4

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 2006-07 & 2009-10. 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 2006-07 and 2009-10. After going through the final land use/land cover data of both years and the changes occurred during these years, following conclusions were drawn.

- ❖ Built-up area, agricultural crops, plantation, wastelands & waterbody are major LU/LC classes that were observed in both years 2006-07 & 2009-10.



- ❖ Agricultural crop class covered 527 sq. km area in 2006-07 & 523.84 sq. km area in 2009-10. This class covers 97.03 percentage area of study area in 2006-07 & 96.45 percentage area of study area in 2009-10.
- ❖ Built-up area was observed 4.01 sq. km in 2006-07 that was 0.74 percentages of total geographical area of study area and 7.77 sq. km area was observed in 2009-10 that was 1.43 percentage of total geographical area of study area.
- ❖ Wastelands class was observed 10.77 sq. km in 2006-07 that was 1.98 percentages of total geographical area of the Rania block and 6.68 sq. km area was observed in 2009-10 that was 1.22 percentage of total geographical area of the Rania block.
- ❖ Double crop is the dominant class in both years i.e. 2006-07 and 2009-10 in study area. The major shifting was observed in rabi only class of 2006-07 whose 31.39 sq. km area was changed into double crop area during 2009-10. 445.57 sq. km. area of double crop is remains unchanged.
- ❖ The data reveals that total agricultural area was decreased 3.16 sq. km during 2006-07 to 2009-10. This is due to increase in built up area & strip plantation classes. Minor changes were also observed in wastelands categories in the study area.

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