

LAND USE/LAND COVER MAPPING & CHANGE ANALYSIS OF NATHUSARI CHOPTA BLOCK OF SIRSA DISTRICT, HARYANA - USING GEOSPATIAL 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 present study, Nathusari chopta block of Sirsa district was carried out. IRS-P6 AWiFS satellite data for three seasons i.e. Kharif, Rabi and Zaid for the year 2007 and 2009-10 was used for interpretation of the LU/LC 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 on 1:50,000 scale for 2007 and 2009-10 respectively. A common or union layer was generated on the basis of vector layers of both years 2007 & 2009-10. Using this common vector layer, changes between all land use/land cover categories during 2007 and 2009-10 were calculated.

Introduction

India is bestowed with the bounty of natural resources including minerals, soils, water and forests. The urban population pressure has led to spatial and hazardous growth of urban centres into peripheral Agriculture lands. Such changes in land use/land cover have resulted in a serious environmental degradation, namely soil erosion by water and wind, salinization and/or alkalization, waterlogging, etc. For ensuring food security, fertile land needs to be prevented from degradation and degraded land may to be brought under cultivation after reclamation. In fact, India needs to produce about 100 million tones of additional food grains by 2020.

- Land cover refers to the attributes of a part of the Earth's land surface, including biota, soil, topography, water, and human structures.

- Land use refers to the purposes for which humans exploit the land cover.

Remote sensing data, Geographical Information System (GIS) and Global Positioning System (GPS) techniques have capability to provide reliable information for spatial modeling. The synoptic large area repetitive coverage provided by satellite sensors can provide appropriate data base for LU/LC mapping.

The present study aims to analysis the change under different LU/LC categories during the period 2007 to 2009-10.

Study area

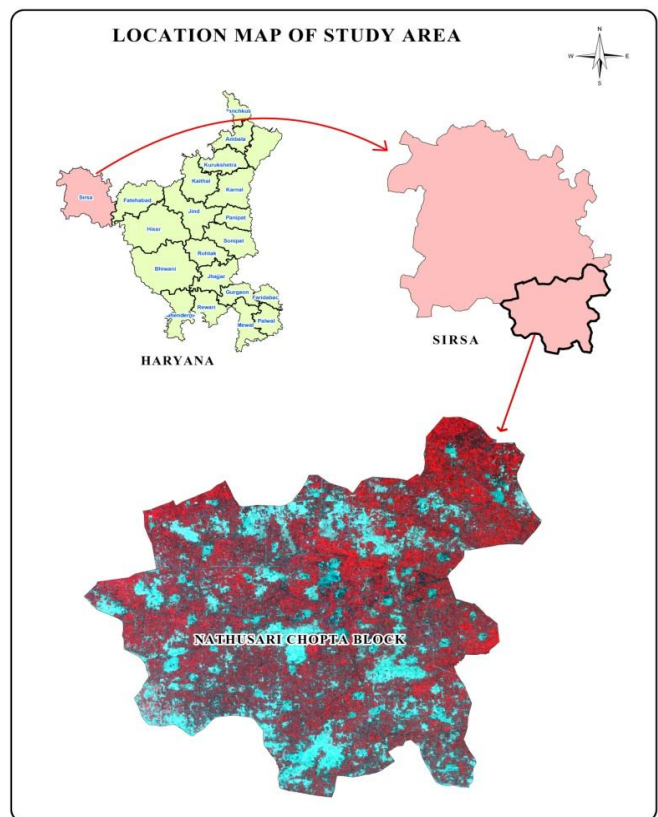


Figure- 1 Location Map of study area

The Nathusari Chopta block of Sirsa district situated between 29°13'21" to 29°31'28" N latitude and 74°54'13" to 75°18'40 E longitude. The total geographical area of the Nathusari Chopta block is 724.59 sq. km. It is located on the border of Rajasthan. It is surrounded by Fatehabad district in the east, Sirsa block in the north, Ellenabad in the west & Hanumangarh district of Rajasthan state in south. The summer months are very hot with maximum temperature ranging from 41 °C to 46 °C in May and June. June is the period of highest incidence of dust storm. Sometimes, the temperature rises up to 48 °C. The study is dominated by dry lands with presence of sandy plains, shifting sand dunes, stabilized sand dunes, dissected upland tracts. Location map of study area is displayed in figure-1.

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 (2007& 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.

Software Used:

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

Table-1. Specification of satellite data used during 2007 and 2009-10

Sr. No.	Satellite	Sensor	Date of acquisition (2007-08)
1	IRS-P6	AWiFS	March 2007 & October 2007
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 2007to 2009-10.

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

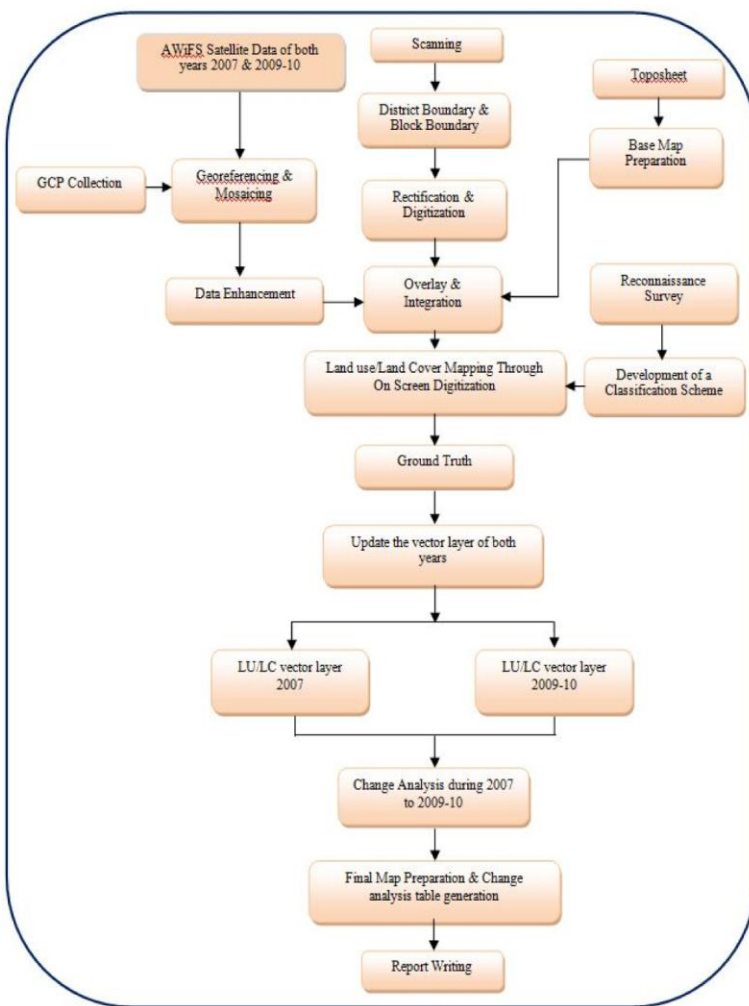


Figure-2 Methodology flow chart

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
Agriculture Land	Cropland	Kharif only	4
		Rabi only	5
		Double cropped	6
	Fallow land	Current Fallow	8
Plantation	Agriculture Plantation	Strip Plantation	9
		Horticulture 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

Ground truth: Doubtful areas are checked by field verification.

Results & discussion

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, horticulture plantation, degraded grazing land, land with open scrub, sandy area, waterlogged seasonal, salt affected area, single/ group building, water body and settlement. The interpreted satellite maps for the years 2007 and 2009-10 are shown as Figure-3 & 4 respectively. The areal extent of these categories during both the years along with change in their area is given in Table-3. The brief description of various classes is as follows:

Built Up Land: Built-up land is comprised of areas of intensive use with much of the land covered by structures. 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 Nathusari Chopta block was 7.54 sq. km. in 2007. During the year 2009-10, it was found that there is increase of 2.78 sq. km in the settlement area of these villages i.e. 10.32 sq. km. Built up urban of Nathusari Chopta block was 0.09 sq. km founded in 2007 and in 2009-10, it was increased to 1.18 sq. km.

Agriculture land: Agriculture 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- Double crop is the dominant category in Nathusari Chopta block. The area under this class during 2007 was 518.69 sq. km. whereas it became 555.58 sq. km. in 2009-

10. The increment of 36.89 sq. km. is also justified from the decrement of rabi only & strip plantation classes 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 85.19 sq. km in 2007 and 8.85 sq. km in 2009-10. The decrement of 76.4 sq. km. in this category 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 5.58 sq. km in 2007 and 74.84 sq. km in 2009-10 i.e. An increment of 69.26 sq. km. area due to decrement in 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 83.76 sq. km. of this class was found during 2007 whereas this class was decreased to 30.38 sq. km. in 2009-10. This class decreased 53.38 sq. km during 2007 to 2009-10.

Plantation: Plantations are the cultivated trees or plants grown in Agriculture fields.

Agriculture plantation- Agriculture plantation covered an area of 0.21 sq. km in 2007 and this class covered .06 sq. km area in 2009-10. Mostly, this class was changed into horticulture plantation. Horticulture plantation covered 0.07 sq. km. area.

Strip plantation - Strip plantation is mainly done on both sides of roads/ kachcha ways. Strip plantation covered an area of 4.84 sq. km area in 2009-10 and this class was not mapped in 2007. This class increased due to decrement double crop class.

Wastelands: This class is 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 2007 was 11.90 sq. km and it decreased by 4.49 sq. km. during 2007 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. This class occupied an area of 1.49 sq. km. in 2007 and 0.61sq. km. in 2009-10 i.e. decrement of 0.88 sq. km. during this period.

Sandy area- A small area of 1.47 sq. km was found during 2007 in the Nathusari Chopta block. In 2009-10, 0.11 sq. km area was covered by this class.

Seasonally waterlogged- Seasonally waterlogged areas are those where the water logging condition prevails usually during the monsoon period. 5.37 sq. km area of this class was

found during 2007 whereas this class covered 22.93 sq. km area in 2009-10.

Salt affected area- Lands affected by salinity/alkalinity have excess soluble salts (saline) or high exchangeable sodium. This class was observed in 2007 and covered 3.30 sq.km area. In 2009-10, this class covered 6.33 sq. km area. Salt affected patches are distributed near village Nathusari that was shown in figure-4.

Water Body: This class includes ponds and lakes present in the study area. Ponds were observed in this block covering an area of 1.08 sq. km in 2009-10.

Table-3. Areal extent and change in area of land use/ land cover categories of Nathusari Chopta Block.

Land use/Land cover Categories		Area in Sq. km. (2007)	Area in Sq. km. (2009-10)	Change
Built Up Land	Rural	7.54	10.32	2.78
	Urban	0.09	1.18	1.09
	Single Group Building	0	0.00	0.00
Agriculture Crops	Double Crop	518.69	555.58	36.89
	Rabi Only	85.19	8.85	-76.34
	Kharif Only	5.58	74.84	69.26
	Current Fallow	83.76	30.38	-53.38
Plantations	Horticulture Plantation	0.00	0.07	0.07
	Agriculture Plantation	0.21	0.06	-0.15
	Strip Plantation	0.00	4.84	4.84
Wastelands	Land with Open Scrub	1.49	0.61	-0.88
	Degraded Grazing land	11.90	7.41	-4.49
	Salt Affected Area	3.30	6.33	3.03
	Waterlogged Seasonal	5.37	22.93	17.56
Sand Desertic		1.47	0.11	-1.36
Water body	Water body	0.00	1.08	1.08
Total		724.59	724.59	0.00

Change Analysis

A common or union layer was generated on the basis of vector layers of both years 2007 & 2009-10. Using this common vector layer, changes between all land use/ land cover categories during 2007 and 2009-10 were calculated as shown in Table-4 and the change map was prepared as shown in Figure-5. The change analysis data shows that 476.44 sq. km. area of double crop remained unchanged but a reasonable area i.e. 4.51 sq. km. area of double crop changed into strip plantation category. 0.71 sq. km. area changed into built up rural & 1.10 sq. km area of double crop changed into built up urban in 2009-10. 51.22 sq. km. changed in to double crop

from rabi only. On the other hand in 2009-10 year data 9.10 sq. km. area of double crop was shifted into kharif only.

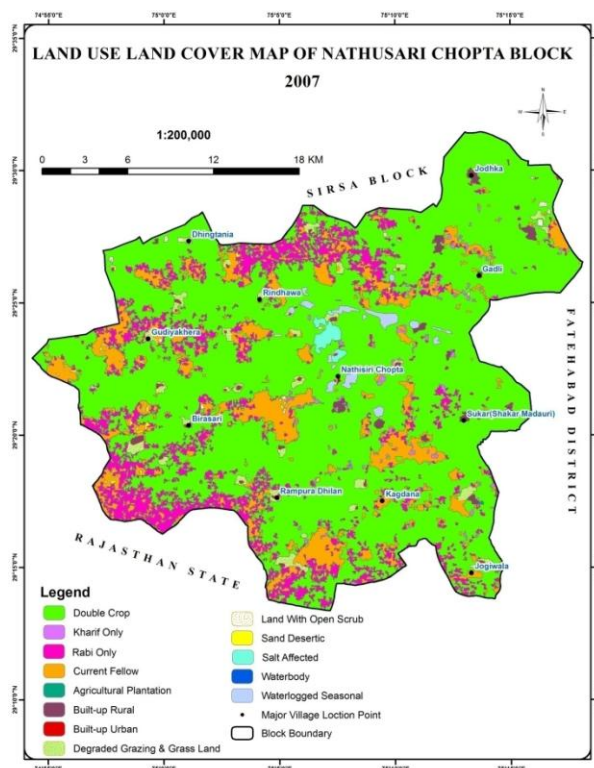


Figure-3

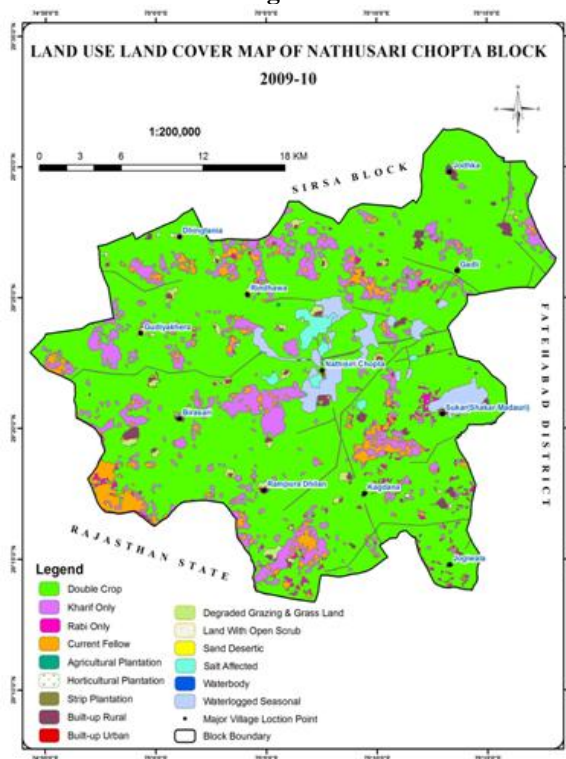


Figure-4

Table-4. Category wise change analysis of land use/ land cover classes during 2007 and 2009-10 (Area in sq. km.)

2009-10 \ 2007	Agriculture Plantation	Built-up Rural	Built-up Urban	Current Fallow	Degraded grazing Land	Double Crop	Horticulture Plantation	Kharif Only	Land With Open Scrub	Rabi Only	Salt Affected	Sand Desertic	Strip Plan-tation	Water body	Waterlogged Seasonal	Grand Total
Agriculture Plantation	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.21
Built-up Rural	0.00	7.28	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.03	0.19	7.54
Built-up Urban	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.09
Current Fallow	0.00	0.94	0.00	18.16	0.00	19.12	0.00	44.05	0.11	1.11	0.00	0.05	0.06	0.01	0.14	83.76
Degraded Grazing Land	0.00	1.26	0.00	0.00	6.99	3.23	0.00	0.29	0.00	0.02	0.05	0.00	0.02	0.02	0.00	11.90
Double Crop	0.00	0.71	1.10	0.84	0.00	476.44	0.03	9.10	0.00	2.94	2.64	0.01	4.51	1.00	19.37	518.69
Kharif Only	0.00	0.00	0.00	0.33	0.29	2.59	0.02	2.05	0.06	0.13	0.01	0.00	0.01	0.01	0.08	5.58
Land With Open Scrub	0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.21	0.35	0.01	0.02	0.06	0.00	0.00	0.04	1.49
Rabi Only	0.00	0.10	0.00	10.59	0.00	51.22	0.02	18.15	0.00	4.63	0.07	0.00	0.07	0.00	0.33	85.19
Salt Affected	0.00	0.00	0.00	0.00	0.08	0.22	0.00	0.00	0.06	0.00	2.79	0.00	0.00	0.00	0.13	3.30
Sand Desertic	0.00	0.00	0.00	0.45	0.00	0.10	0.00	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47
Waterlogged Seasonal	0.06	0.02	0.00	0.00	0.05	1.71	0.00	0.00	0.00	0.00	0.74	0.00	0.14	0.00	2.64	5.37
Grand Total	0.06	10.32	1.18	30.38	7.41	555.57	0.07	74.84	0.61	8.85	6.33	0.11	4.84	1.08	22.93	724.59

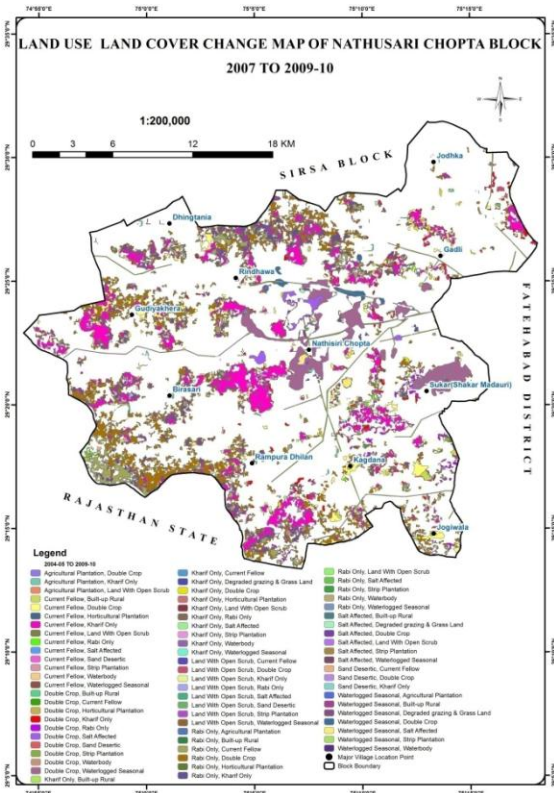


Figure-5

Conclusions

The present study was conducted to evaluate change analysis of Nathusari chopta block of Sirsa district by using IRS P6-AWiFS satellite data of both rabi and kharif seasons for the years 2007 & 2009-10. The change analysis is based on the changes observed in land use/ land cover in study area between 2007 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. **Red colour** used to denote no change and **green colour** for changes in existing class that is shown in table-4.

- Built-up area, Agriculture crops, Agriculture plantation, wastelands & waterbody are major LU/LC classes that were observed in both years 2007 & 2009-10.
- Agriculture crop class covered 693.22 sq. km area in 2007 & 669.65 sq. km area in 2009-10. This class covers 95.67 percentage area of block in 2007 & 92.42 percentage area of total area of block in 2009-10.
- Built-up area was observed 7.54 sq. km in 2007 that was 1.05 percentages of total geographical area of the block and 10.32 sq. km area was observed in 2009-10 that was 1.81 percentage of total geographical area of the block.
- Wastelands class was observed 23.53 sq. km in 2007 that was 3.25 percentages of total geographical area of the block and 37.39 sq. km area was observed in 2009-10 that was 5.16 percentage of total geographical area of the block.

➤ The analysis of landuse/ land cover data of Nathusari Chopta block of Sirsa district revealed that the major changes occurred in Agriculture crop categories. The substantial increase of 36.89 sq. km was observed in double crop area, 69.26 sq. km area increase in kharif only whereas 76.37 sq. km area decrease in rabi only class and 53.38 sq. km area was decrease in current fallow class during 2007 to 2009-10. Total wastelands area in 2007 was 23.53 sq. km that was increased 13.86 sq. km during 2007 to 2009-10. Seasonal waterlogged & salt affected are only classes that were increased. Total built up area of this block was 7.63 sq. km in 2007 & 11.50 sq. km was observed in 2009-10. Horticulture plantation & strip plantation classes were also observed in 2009-10 that covered 0.07 & 4.84 sq. km area respectively.

References

- [1.] Anderson, J. R., Hardy E.T., Roach J.T. and Witmer R.E. (1976). A land use and land cover classification system using remote sensing data. U.S.G.S. Prof. Paper No. 466. pp 1-26.
- [2.] Anil. N.C; (2011) Land Use/Land Cover and change detection from parts of South West Go-davari District, A.P- using Remote Sensing and GIS techniques.
- [3.] Hooda, R. S; Arya, V. S; Arya, Sandeep; Khatri, S.S; Singh, Hardev; Kumar, Sandeep; Kumar, Dushyant; Sharma, Prem Parkash; Sharma, Hee-na; Wastelands Atlas of Haryana (2012): Haryana Space Applications Centre (HARSAC), Dept. of Science and Technology, Govt. of Haryana.
- [4.] <http://bhuvannoeda.nrsc.gov.in/download/download/download.php>
- [5.] <http://support.esri.com/en/+>
- [6.] Kerr, J. with Ganesh Pangare, Vasudha Lokur Pangare, and P.J. George (2000). An Evaluation of Dry Land Watershed Development Projects in India, Environment and Production Technology Division, International Food Policy Research Institute 2033, K Street, N.W Washington, D.C. 20006 U.S.A. EPTD Discussion paper no. 68. pp-1-3
- [7.] Land Record Department, Haryana (2007-2011).
- [8.] Lillesand, T. M. and Kiefer, R. W., 1987. Remote Sensing & Image Interpretation.
- [9.] Minakshi K., Sharma, P.K., Kaur, Amandeep, & Shalley, Vanita. (2005), Satellite based study of Landtransformation in Ludhiana District Punjab Journal of the Indian Society of Remote Sensing 31(1). pp-63-68.
- [10.] Statistical Abstract of Haryana (2007-2008). Economic and statistical advisor, planning department Government of Haryana.
- [11.] Suhas, P. Wani and Y.S. Ramakrishna, (2005). Sustainable Management of Rainwater

through Integrated Watershed Approach for Improved Rural Livelihoods, pp: 39-60.

- [12.] V.Jothiprakash, S.Mohan, K.Elango: "Influence of percolation ponds-A recharging structure in a small watershed" (1997) Paper in National Conference on Ground Water Sources at JNTU Hy-derabad. pp- 280-289.
- [13.] V.M. Choudhry, Saikat Paul, T.Srinivas Kumar, S.Sudhakar, S.Adiga, P.P.Nageswara Rao (2001). Remote Sensing & GIS Approach for Watershed Monitoring and Evaluation:-A case study in Orissa state, India. pp-1-6
- [14.] William, E.R., B.M. William, and B.L. Turner II, (1994) "Modeling land use and land cover as part of global environmental change, Climatic Change, Vol. 28, pp.45-64.
- [15.] Yadav, P.K; (2009) Land use Land cover map-ping, change detection and conflict analysis of Nagzira-Navegaon Corridor, Central India

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