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Study on the Pattern of Land Use /Land Cover Change in Sonipat District of NCR, A Block Level Case Study of Sonipat District

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ABSTRACT

Land surface has always been an area of interest for geographers and researchers working on spatial analysis. Land use land cover change has become a central component in current strategies for managing natural resources of a region. Urban expansion has brought serious losses of agriculture land, vegetation and water bodies. National Capital Region (NCR) is one of the fastest growing area in India witnessing fast landuse change in time. Remote Sensing (RS) and Geographic Information System (GIS) technology are providing new tools for monitoring these fast landuse changes. The present study using IRS-Resourcesat-2 (LISS-III) data demonstrates the scope, methodology and outcomes of land use/land cover change mapping of Sonipat district in Haryana which comes under NCR. The data was interpretated using hybrid approach for the mapping of various land use/land cover categories on 1:50,000 scale for the years 2005-06 and 2011-12. The land use/land cover classes in the study area are divided into six categories. The Agriculture land has decreased between 2005-06 and 2011-12.There was an increase in built up land.The area under wasteland decreased due to increase in agriculture and built up area. The paper concludes that with the passage of time built-up increased with increase in human population.

KEYWORDS: GIS, Land use/land cover, Resourcesat-2, LISS-III change detection, NCR.

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1. INTRODUCTION

Land use/land cover (LU/LC) changes are affected by human intervention and natural phenomena such as agriculture, population growth, consumption, patterns, urbanization, economic development etc. As a consequence, timely and precise information about (LU/LC) change detection of the area of intrest is extremely important for understanding relationships and interactions between human and natural resources for better decision making. Information on land use/land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. Remote Sensing (RS) and Geographic Information System (GIS) technology has are now the new tools for monitoring land use changes.

The Urban planners formulated 1962 the concept of National Capital Region (NCR) in the first Master Plan of Delhi in 1962. The main objective of creation of NCR was to decongest Delhi by diffusing the population pressure towards ring towns. Thereafter, the NCR came into existence in 1985, when some surrounding districts of neighboring states became part of it. This plan has to achieve its objectives through an inter-related policy framework in context to socio-economic development and environmental parameters such as the population re-distribution, settlement patterns, regional land use / land cover patterns, economic activities, infrastructural facilities etc. So, the NCR comprises by the National Capital Territory (NCT) and the delineated area of the surrounding states of Haryana, Uttar Pradesh, and Rajasthan. The land use / land cover patterns are changing fast in the (NCR) over the period. Sonipat town falling in the Haryana which is a part of NCR has gained national recognition in the last few years due to fast growing service sector. Therefore, it has witnessed fast land use / land cover changes in recent times. This is one of the important factors for selecting Sonipat for this case study to have an appreciation of changing land use patterns in NCR. This present study has been under taken with an objective to generate spatial database on land use/land cover for the years 2005-06 and 2011-12 and to identify the pattern of (LU/LC).

2. STUDY AREA

Sonipat district is situated in the eastern a part of Haryana bording north of Delhi. The study area falls between 28°48'15"N to 29°17'10"N latitude and 76°28'40"E to77°12'45"E longitude. Total geographical area (TGA) of the district is 2,260 km^2. Sonipat district comprises of seven blocks: Ganaur, Sonipat, Rai, Kharkhoda, Gohana, Kathura and Mundlana. The climate of Sonipat is dry with a hot

summer and a cold winter. The annual rainfall varies considerably from year to year. In fact, the monsoon period accounts for 75% of the annual rainfall in the district. Soils of this district is fine loam of rich colour. However, some areas have sandy soil.

3. MATERIALS AND METHOD

Indian Remote Sensing Satellite Resourcesat-2(IRS-P6) LISS-III data of October-20, March-31 and June11&28 for Kharif, Rabi and Zaid seasons respectively prepare were used to analyze the changes in land use/land cover map of the Sonipat district for the three seasons data. The sensor provides 23.5 m spatial resolution in Green, Red, NIR and SWIR bands with 24 days revisit time.

I. 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 (SOI) 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. LULC Cycle-1 data (2005-06) and wastelands data of year 2008-09 were taken from NRSC, Hyderabad.

II. Software Used

- ***ERDAS IMAGINE 9.3:*** In this study ERDAS was applied in importing, image rectification and Geo-referencing.
- ***Arc GIS 9.3:*** for digitization, preparation of land use/land covers layer and for composition and generation of maps
- ***Microsoft Office*****:** for database preparation.

III. Methodology

The methodology followed was on-screen visual interpretation using interpretation keys like tone, shape, texture, size, pattern and association etc.

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.

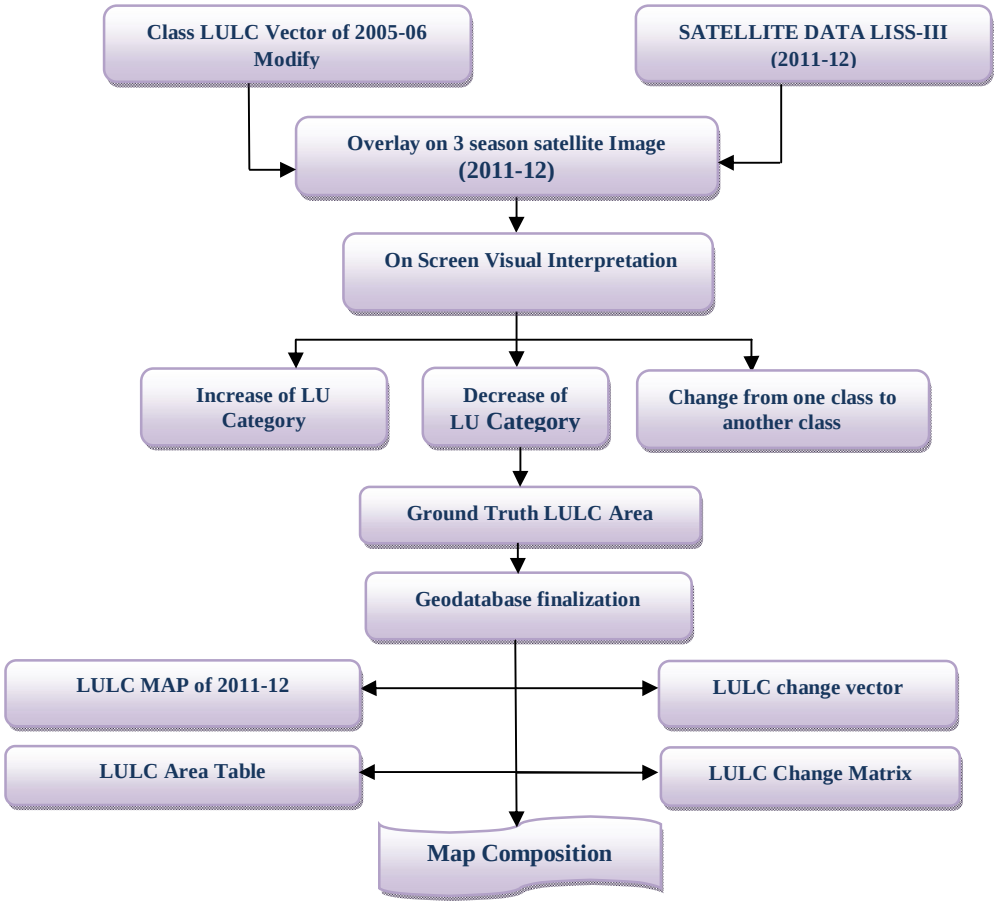

Fig. 1- Methodology flow chart for land use/land cover and change detection.

IV. *Land use/Land Cover (LU/LC) change analysis*

Land use/ land cover change analysis was done by computing different land use categories from the year, 2005-06 to 2011-12.

Relative Deviation (RD %) was computed as under :

$$\%RD = \frac{A - B}{B} \times 100$$

Where: A is the area under a specified land use class for the year 2011-12.
B is the area under the same land use class for the year 2005-06.

4. RESULT AND DISCUSSION

Following results have been concluded on the basis of the land use/land cover maps prepared for the two different years using multi-date satellite data i.e. 2005-06 and 2011-12. The distribution of land use/ land cover classes in the study area in 2005-06 and 2011-12 (Fig.2) is represented in Table 1.

The agriculture land was 193572.28 ha (88.4% of TGA) in year 2005-06 and decreased to 184980.75 ha (84.47% of TGA) in year 2011-2012. The Built-up area was 8558.40 (3.91% of TGA) in year 2005-06 and increased to 18495.39 ha (8.45% of TGA). The forest cover was around 1363.28ha (0.62% of TGA) in year 2005-06 and around 1367.079 ha in year 2011-12. The Wasteland which covers an area of 13291.68 ha (6.07% of TGA) in year 2005-06 and decreased to 10242.81ha (4.68 % of TGA) in year 2011-12. The water bodies cover an area of 2076.04 ha (0.95%) in year 2005-06 and increased to 3765.00 ha (1.72% of TGA) in year 2011-12.

Table 1 Statistics of land use/land cover change in Sonipat district during 2005-06 to 2011-12.

Sr. No.	**Categories (Sonipat District)**	**Area (ha.)in 2005-06**	**Area (ha.)in 2011-12**	**(%) of geographical area of 2005-06**	**(%) of geographical area of 2011-12**	**RD % From 2005-06 to 2011-12**
1	Built-Up	8558.40	18495.39	3.91	8.45	116.11
2	Agricultural	193572.28	184980.75	88.40	84.47	-4.44
3	Water bodies	2076.04	3765.00	0.95	1.72	81.35
4	Wasteland	13333.64	10242.81	6.09	4.68	-23.18
5	Forest	1363.28	1367.079	0.62	0.62	0.28
6	Wetland	77.75	131.88	0.04	0.06	69.62

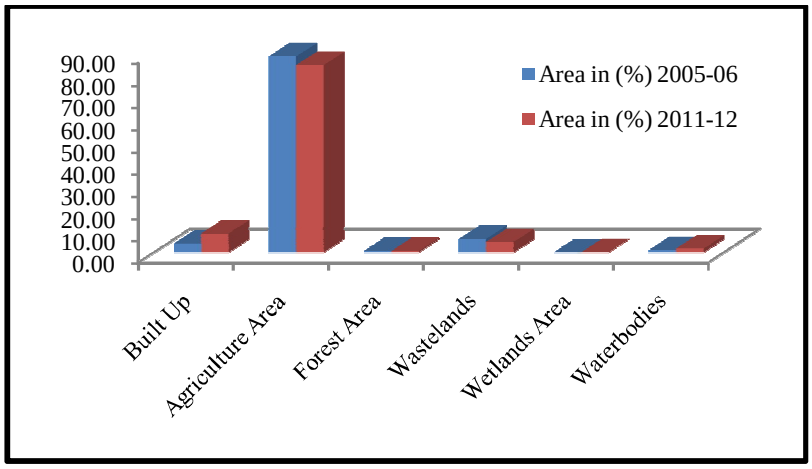

Fig 2: Change in land use/land cover under different categories in Sonipat District during 2005-06 to 2011-12.

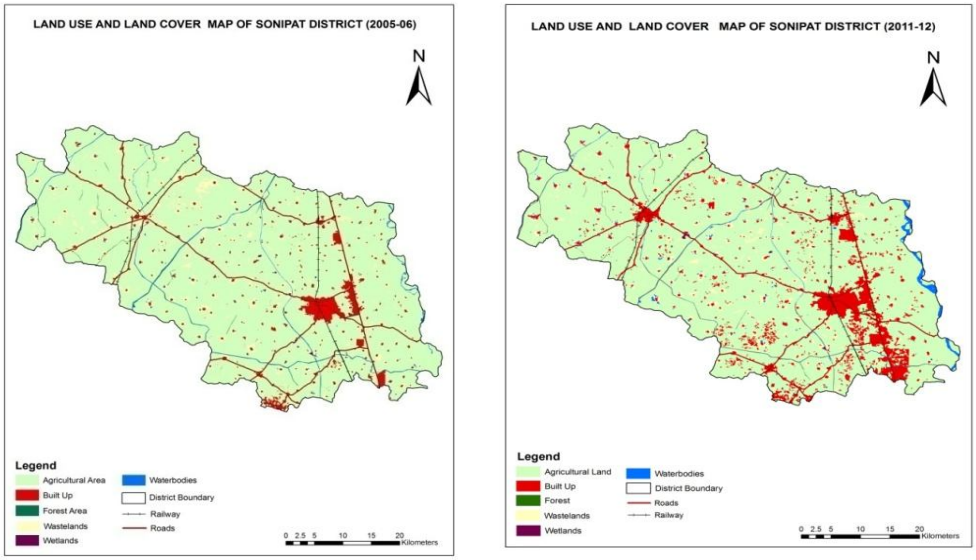

Fig -3: Land use/land cover Map of Sonipat district during 2005-06 to 2011-12.

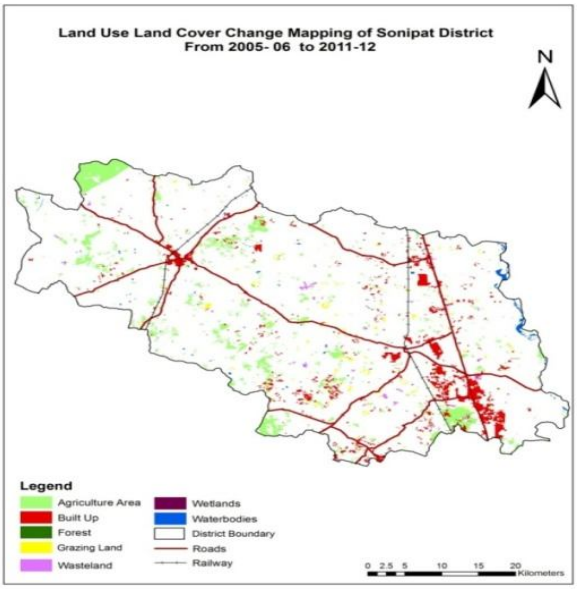

Fig- 4 Land use/land cover change Map of Sonipat district during 2005-06 to 2011-12

Table 2 Statistics of land use/land cover change in Gohana Block during 2005-06 to 2011-12.

Sr. No.	**Categories (Ganaur block)**	**Area (ha.)in 2005-06**	**Area (ha.)in 2011-12**	**(%) of geographical area of 2005-**	**(%) of geographical area of 2011-**	**RD % From 2005-06 to 2011-12**
1	Built-up	1385.32	2874.11	0.62	1.29	107.47
2	Agricultural	217637.19	215945.46	97.90	97.14	-0.78
3	Forest	131.34	131.34	0.06	0.70	0.00
4	Wastelands	1793.19	1545.59	0.81	0.01	-13.81
5	Wetland	18.77	15.69	0.01	0.01	-16.38
6	Waterbodies	1348.39	1802.01	0.61	0.81	33.64

Table 3 Statistics of land use/land cover change in Sonipat Block during 2005-0 to 2011-12.

Sr. No.	Categories (Gohana block)	Area (ha.)in 2005-06	Area (ha.)in 2011-12	(%) of geographical area of 2005-06	(%) of geographical area of 2011-12	RD % From 2005-06 to 2011-12
1	Built-up	621.05	1901.73	0.36	1.09	206.21
2	Agricultural	168448.39	168303.53	96.48	96.39	-0.09
3	Forest	380.74	342.41	0.22	0.20	-10.07
4	Wastelands	3674.71	2314.58	2.10	1.33	-37.01
5	Wetland	23.64	73.06	0.01	0.04	13.07
6	Waterbodies	1454.60	1667.82	0.83	0.96	14.66

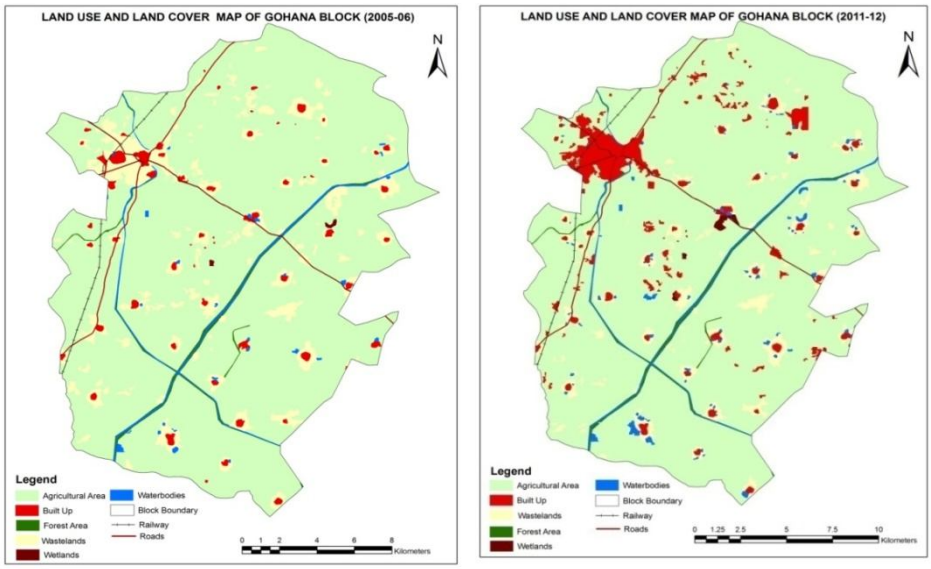

Fig -5: Land use/land covers Map of Ganaur Block during 2005-06 and 2011-12.

Table 4 Statistics of land use/land cover change in Kharkhoda Block during 2005-06 to 2011-12.

Sr. No.	Categories (Sonipat block)	Area (ha.)in 2005-06	Area (ha.)in 2011-12	(%) of geographical area of 2005-06	(%) of geographical area of 2011-12	RD % From 2005-06 to 2011-12
1	Built-up	4078.82	5916.63	4.04	5.85	45.06
2	Agricultural	93759.33	90952.00	92.77	89.99	-2.99
3	Forest	151.09	151.09	0.15	0.15	0.00
4	Wastelands	1840.48	2310.97	1.82	0.03	25.56
5	Wetland	25.89	26.83	0.03	0.03	3.65
6	Waterbodies	1215.72	1713.81	1.20	1.70	40.97

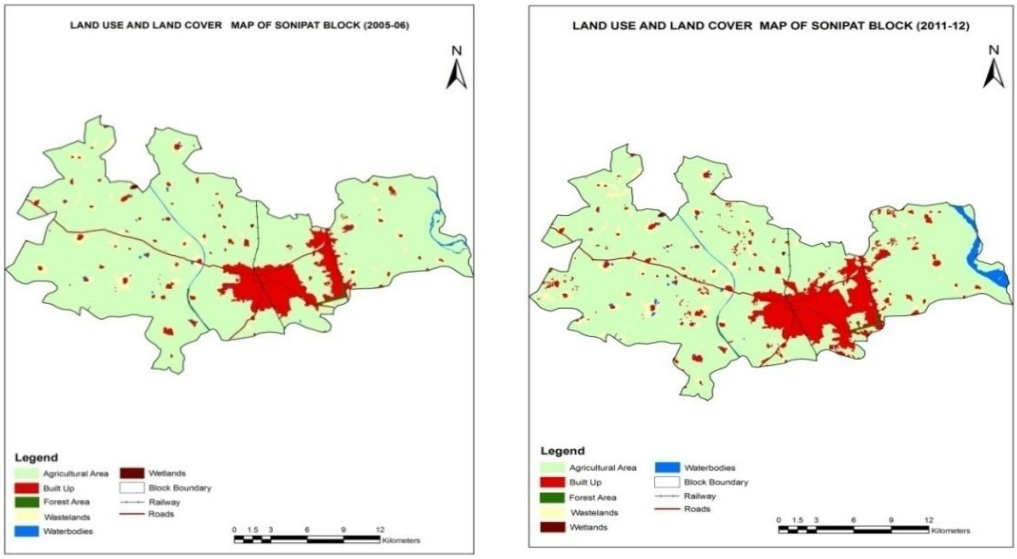

Fig -6: Land use/land cover Map of Gohana Block during 2005-06 and 2011-12.

Table 5 Statistics of land use/land cover change in Gohana Block during 2005-06 to 2011-12.

Sr. No.	Categories (Kharkhoda block)	Area (ha.)in 2005-06	Area (ha.)in 2011-12	(%) of geographical area of 2005-06	(%) of geographical area of 2011-12	From 2005-06 to 2011-12
1	Built-up	815.25	2530.81	0.67	2.09	210.43
2	Agricultural	117214.04	115475.15	96.95	95.51	-1.48
3	Forest	337.24	333.32	0.28	0.28	-1.16
4	Wastelands	1460.07	1378.07	1.21	1.14	-5.62
5	Wetland	4.45	8.21	0.00	0.01	84.75
6	Waterbodies	1075.39	1180.89	0.89	0.98	9.81

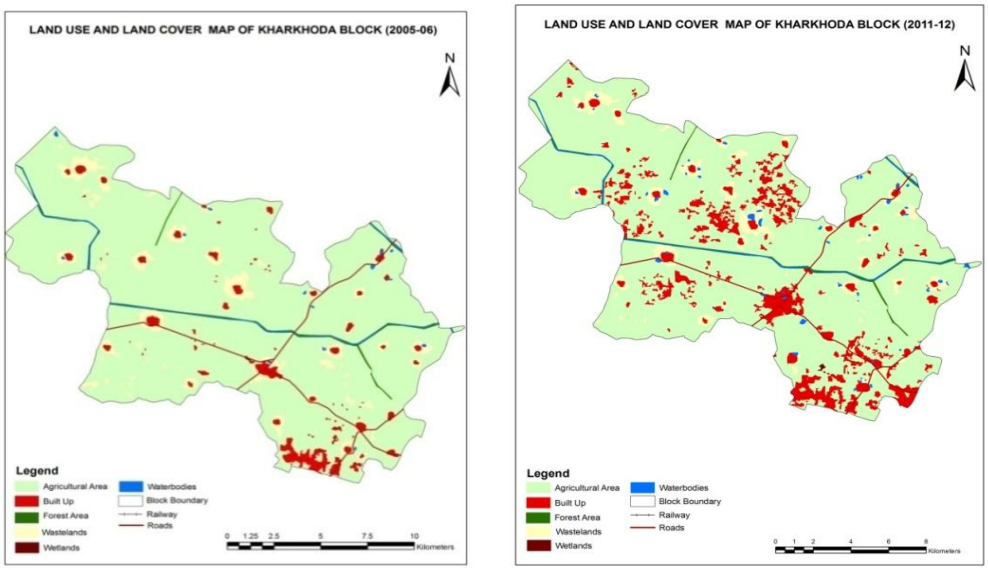

Fig -7: Land use/land cover Map of Sonipat Block during 2005-06 and 2011-12.

Table 6 Statistics of land use/land cover change in Kathurah Block during 2005-06 to 2011-12.

Sr. No.	Categories (Kathuarh block)	Area (ha.)in 2005-06	Area (ha.)in 2011-12	(%) of geographical area of 2005-06	(%) of geographical area of 2011-12	RD % From 2005-06 to 2011-12
1	Built-up	321.68	861.58	0.21	0.55	167.84
2	Agricultural	153148.46	153917.50	97.64	98.13	0.50
3	Forest	410.65	271.11	0.26	0.17	-33.98
4	Wastelands	2424.53	1127.23	1.55	0.72	-53.51
5	Wetland	552.69	680.61	0.35	0.43	23.14
6	Water bodies	321.68	861.58	0.21	0.55	167.84

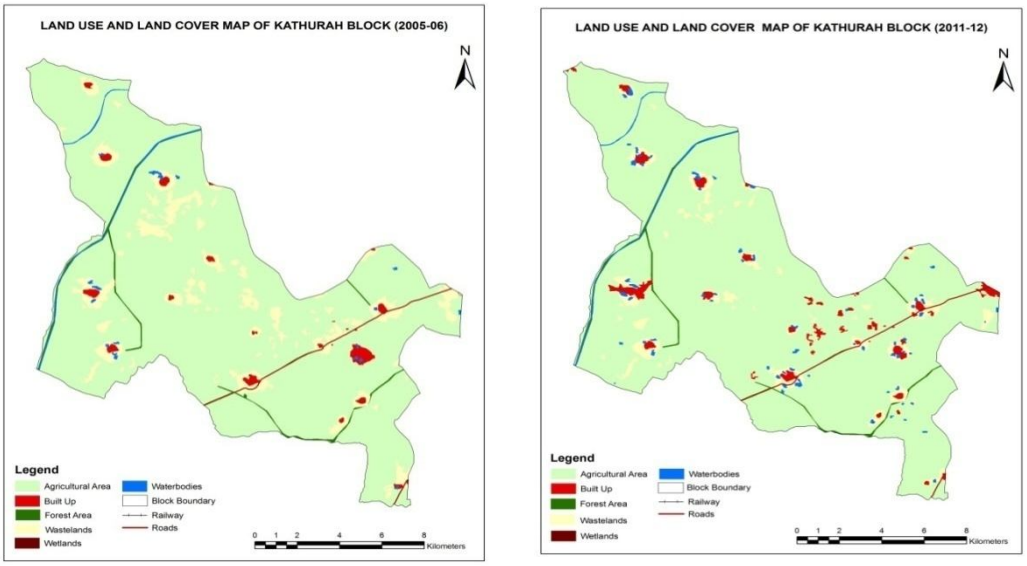

Fig -8: Land use/land cover Map of Kharkhoda Block during 2005-06 and 2011-12.

Table 7 Statistics of land use/land cover change in Mudlana Block during 2005-06 to 2011-12.

Sr. No.	Categories (Mudlana Block)	Area (ha.)in 2005-06	Area (ha.)in 2011-12	(%) of geographical area of 2005-06	(%) of geographical area of 2011-12	RD % From 2005-06 to 2011-12
1	Built-up	354.80	718.44	0.10	0.21	102.49
2	Agricultural	344226.64	344460.47	99.07	99.14	0.07
3	Forest	159.94	149.45	0.05	0.04	-6.56
4	Wastelands	2201.91	1469.77	0.63	0.42	-33.25
5	Wetland	498.59	643.76	0.14	0.19	29.12
6	Waterbodies	354.80	718.44	0.10	0.21	102.49

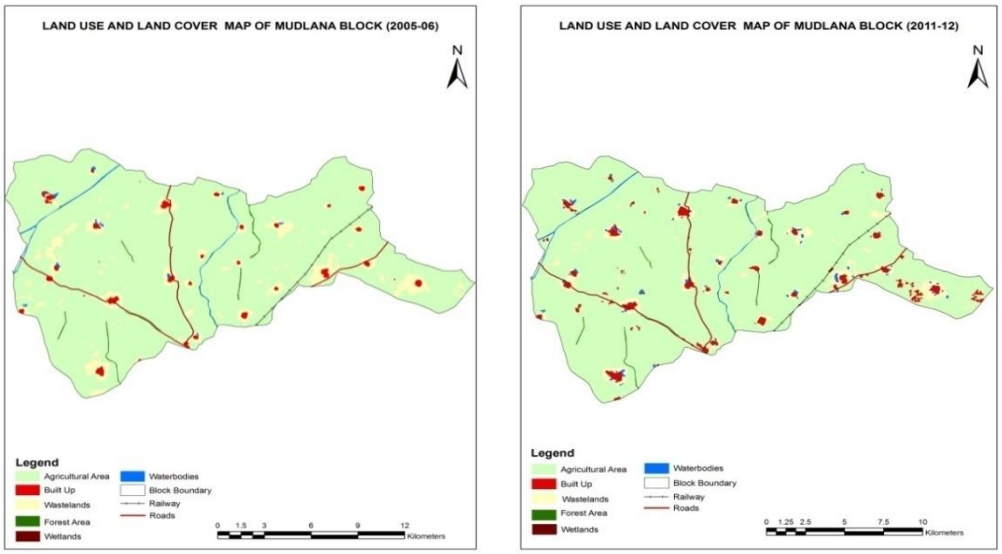

Fig -9: Land use/land cover Map of Kathurah Block during 2005-06 and 2011-12.

Table 8 Statistics of land use/land cover change in Rai Block during 2005-06 to 2011-12.

Sr. No.	Categories (Rai block)	Area (ha.)in 2005-06	Area (ha.)in 2011-12	(%) of geographical area of 2005-06	(%) of geographical area of 2011-12	RD % From 2005-06 to 2011-12
1	Built-up	1399.16	4906.06	1.27	4.44	250.64
2	Agricultural	106139.29	102565.27	96.14	92.90	-3.37
3	Forest	363.02	370.34	0.33	0.34	2.01
4	Wastelands	1234.33	1116.51	1.12	0.02	-9.55
5	Wetland	23.78	23.78	0.02	0.02	0.00
6	Waterbodies	1242.66	1420.28	1.13	1.29	14.29

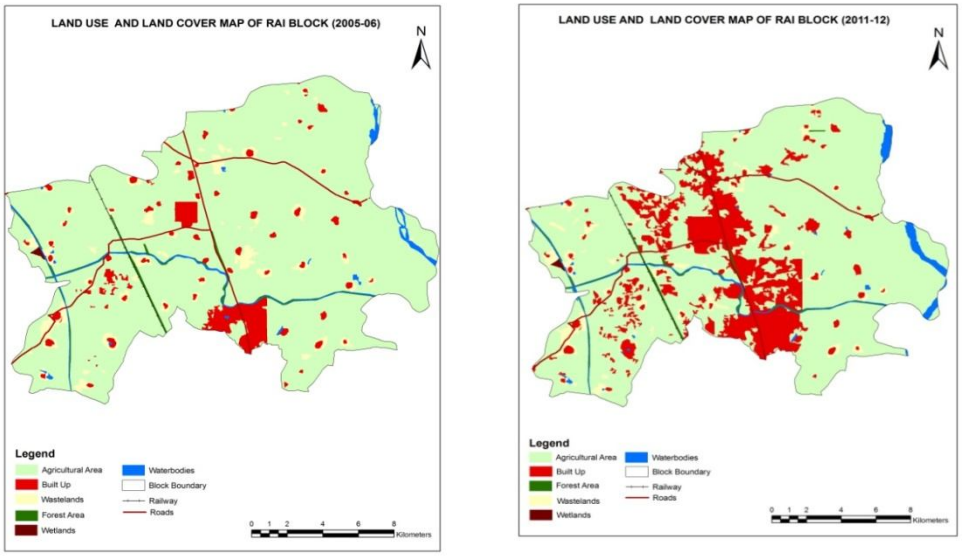

Fig -10: Land use/land cover Map of Mudlana Block during 2005-06 and 2011-12.

5. CONCLUSION

The study demonstrated that the application of GIS help in studying the changes in land use pattern of an area. The existing land use/land cover has been dynamic in nature from 2005-06 to 2011-12 in Sonipat district. The study area has been divided into six major categories such as built-Up, agricultural land, forest, wastelands, water bodies and wetland. Different types of human activities have resulted in vast changes in the land use and land cover of the study area. The water bodies have been depleting at faster rate which is a matter of great concern. These changes are likely to alter the structure, function and the complexity of the local ecology with critical implication for the maintenance of the biodiversity, genetic species and landscape. The land under rural area has increased as some area of degraded pasture land around the villages was acquired by settlements. The urban area increased due to migration of people to cities for employment income generation. The reason for an decrease in cropland between 2005-06 to 2011-12 is correlated with decrease in fallow land between the time periods. The wasteland has decreased for crop production and some part of it has been converted in to built up area.

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