An Analysis of Land use/land Cover Change Detection Using Geospatial Technology-A Case Study of Rewari District, Haryana, India

Beniwal Ashok, M.P Sharma,Vinod Kumar

Abstract ***Land resources are finite and therefore their conservation, development and management plays the determining role in their sustaining use. The land resources shall be treated as single, renewable and intergenerational entity and they have to be viewed as prime national resources for all societal, economical and political considerations. Preparation of land use/Land cover maps for development plan aims at optimal, eco-friendly, viable & integrated land use planning. As a pre-requisite of any planning and implementation of land resources development action plan with continuous and periodic assessment of status of land use/Land cover both at regional and national level. The objective of study is to generate change analysis of land use/land cover pattern of the years 2005-2006 and 2011-2012 of the study area. This analysis was carried out through geospatial technology using IRS-Resourcesat-2 (LISS-III) data. The study shows that increase in area under built up land category is the expense of agricultural and wasteland land use classes. The study concluded that area under urban infrastructure is increasing at fast pace and which is eating up fertile agriculture land of area.***

Keywords: ***Remote sensing and GIS, Resourcesat-2, LISS-III, land use/land cover.***

I. INTRODUCTION

Land is the most significant of all natural resources of the globe, as larger proportion Of inhabitants depends on exploitation of this resource. It largely contributes to well being of human society. Today, we are forced with the crucial problem of incessantly growing pressure of population on limited land resources, coupled with wide spread poverty, malnutrition and low economic level. Now it seems imperative to undertake functional objective to study of these resources i.e. use & misuse of land, its actual potential and proper exploitation and conservation for well being of human society. The need of the hour is optimum utilization of land resources, which must be preceded by a thorough and careful functional survey of past and present position and its scientific interpretation. (Harmsen, 2002)[1]. Although conventional land use data available in the form of thematic maps, records and statistical figure are inadequate and do not provide an up to date information on changing land use pattern and processes.

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As a consequence, timely and precise information about (LU/LC) changes of the area are extremely important for understanding relationship and interaction between human and natural resources for better planning. 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. Geo-spatial technology is a very effective tool for monitoring land use changes. Anderson et al (1971,76)[2] attempted to develop a classification system for land use with remote sensing techniques that will satisfy the needs of majority users and certain guidelines of criteria for evaluation first were established. Panigrahi et al (2004) [3]conducted a study in Bhatinda district for mapping the cropping pattern, crop rotation and monitoring long term changes in cropping pattern using satellite based remote sensing. Meenakshi et al (2005) [4] conducted study of land transformation using satellite data in Ludhiana district from 1970 to 2001. Ray et al (2005) [5] used GIS & remote sensing techniques to study crop diversification based on soil and water requirement of different crops in Punjab state. Sharma, et al. (2013)[6] using GIS techniques for land use/land cover change detection in National Capital Region (NCR) Delhi: A case study of Gurgaon District.

OBJECTIVES:

- To find out and analysis the land use change and its direction in the study area
- To prepare Geospatial data base for sustainable land planning.
- To evaluate changing land use pattern

II. STUDY AREA

Rewari district of Haryana state lies between 27^{o} 46’ to 28^{o} 28’ North latitudes and 76^{o} 15’ to 76^{o} 51’ East longitudes. Total geographical area of the district is 1594 sq.km. as shows in fig.1. The district is divided into five-development blocks viz. Bawal, Jatusana, Khol, Nahar and Rewari. The climate of the district can be classifieds tropical steppe, semi-arid and hot which is mainly dry with very hot summer and cold winter. The normal monsoon rainfall and annual rainfall of the district is 489 mm and 553 mm respectively.

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Fig: 1 Location Map of Study Area

III. Materials and methodology

a. Primary Data:

The basic primary data in this study was Resourcesat-1&2 (IRS-P6) LISS-III data of Kharif, Rabi and Zaid seasons to analyze the changes in land use/land cover. The spatial resolution of LISS-III is 23.5 m in Green, Red, NIR and SWIR bands with 24 days revisit time (Table-1&2).

b. 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. The base maps of study area were prepared using SOI digital topographical maps on 1:50000 scale. Besides other supporting data like land use/land cover theme maps generated for 2008-2009 were also used as a reference during delineation of various wasteland classes. Some of the latest project reports and statistical data published by various state and central government departments also constitute the data base for this study. LU/LC Cycle-1 data (2005-2006) and wastelands data of year 2008-2009 of NRSC, Hyderabad were also used in the study.

Sr. No.	Satellite	Sensor	Date of acquisition
1.	IRS-P6	LISS-III	Oct. 2005
2.	IRS-P6	LISS-III	March.2006
3.	IRS-P6	LISS-III	June.2006
4.	IRS-P6	LISS-III	Oct. 2011
5.	IRS-P6	LISS-III	March. 2012
6.	IRS-P6	LISS-III	June. 2012

Table: 1. Satellite Data Used

Satellite & Sensor	IRS-P6, LISS-III
Spatial Resolution	23.5m
Spectral Resolution	B2 0.52-.59 µm (Green)
	B3 0.62-.68 µm(Red)
	B4 0.77-.86 µm(NIR)
	B5 1.55-1.70 µm (SWIR)
Radiometric Resolution	10 bit
Temporal Resolution	24 days
Swath Width	140 km

Table: 2. Satellite sensor Specifications

c. Methodology:

First, based on image interpretation aspects & elements i.e. colour & tone, shape, size, texture, association etc, khrif, rabi and zaid crop season data were on screen visually interpreted with the help of ARC GIS 9.3 software . Then, identification & delineation of khrif, rabi and zaid season crop lands from corresponding satellite imageries of both years (2005, 06 - 2011, 012). The common areas falling under rabi , khrif & zaid crops is delineated as double cropped area. The area excluding the crops grown during karif/ rabi / zaid season and under double crop is treated as fallow lands. The other classes of land use/ land cover were also delineated from three season data of both years. Then, all doubtful areas were identified and listed for ground truth verification. After collection of ground truth, the necessary correction and modifications of land use/ land cover boundaries and category was done. Before, finalization of maps a recheck and crosscheck was done wherever possible to ensure higher accuracy and reliability of information. Lastly, The Land use/Land Cover (LU/LC) maps of both years (2005-06 & 2011-2012) and change detection maps were prepared as shown Figs: 1, 2&3.

d. Change Detection Analysis

Land use/ land cover change analysis was done by computing different land use/cover categories from the year 2005-2006 to 2011-2012.Relative Deviation (RD %) was computed as under :

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

Where: A is the area under a specified land use/cover class for the year 2011-2012. B is the area under the same land use/cover class for the year 2005-2006.

IV. RESULT & DISCUSSION

Various types of land use/ land cover categories found in study area of both years (2005-2006 and 2011-2012) and major change detection is described in following section as

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given in fig.2,3 and table 3.

a. Built up Land:

These are human settlements comprising of residential areas, transport/ communication lines, industrial commercial complexes, utilities and services etc. Collectively, cities, towns and village habitation are included under this category. The built up land category occupies 3.82% of TGA in 2005-2006 that have increased to 8.86% in 2011-2012. The study area situated in NCR and the pace of urban development is very high. Therefore, the ever expansion of built up lands in rural & urban areas are at the cost of natural green cover and fertile agricultural land.

b. Agricultural land:

Agriculture is main economic base of the area which was nearly 89.63 percent of its total geographical area under agriculture use in year 2005-2006. But the during the year 2011-2012 the share of agricultural land is declined drastically to 83.37 percent of TGA. This has happened due to that agricultural land is being acquired by government speedily for urban, industrial and commercial development purpose and to reduce the pressure upon over crowded National Capital Delhi. Simultaneously a lot of uncontrolled, haphazard and unplanned urban development is also taking place along the transport network.

c. Grass/Grazing land:

These lands occur around villages on panchyat common lands and most of them are degraded conditions. These lands were spared over 2.32 percent of TGA in 2005-2006 and reduced to 1.91 percent of TGA in year 2011-2012. This reduction caused by increase in built up land and forest plantation.

d. Wastelands:

Wastelands are described as, degraded lands and are resulted from inherent/ imposed disabilities. The total area under category was 3.43 percent of TGA in 2005-2006 but it has been reduce to 3.35 percent of TGA during 2011-2012. This deviation is occurred due to wastelands were taken up for forest plantation and for urban development.

e. Water Bodies

This class comprises area of surface water impounded in form of ponds, tanks and reservoir. These are associated with urban and rural built up areas. The area under this category was 0.29 percent of TGA in 2005-2006 and increased to 0.41 percent in year of 2011-2012.

f. Wetland:

The wetland in the district comprised 0.00 % of the total geographical area during 2005-2006, was increased to 0.03% in the year of 2011-2012. A net increase of relative deviation was 0.00% of the total wetland area in the district.

g. Forest:

The natural forest and forest plantation covered under this category. The forest cover spread over 0.51% in year 2005-2006 which has increased to 2.04% in the year 2011-2012 in the area. The reason for increase area under forest is forest plantation carried by government on wastelands particularly hilly undulating scrub lands.

Sr. No.	Categories	2005-06	2011-12	(%) of geographical area of 2005-06	(%) of geographical area of 2011-12	Change From 2005-06 to 2011-12	RD %From 2005-06 to 2011-12
1	**Built Up**	60.82	141.3	3.82	8.86	80.47	132.32
2	**Agricultural Land**	1428.74	1328.9	89.63	83.37	- 99.84	-6.99
3	**Forest**	8.10	32.65	0.51	2.04	24.56	303.09
4	**Wastelands**	54.66	53.45	3.43	3.35	-1.21	-17.72
5	**Grass/Grazing**	37.01	30.45	2.32	1.91	-6.57	-2.21
6	**Water bodies**	4.67	6.65	0.29	0.41	1.98	42.40
7	**Wetland**	0.00	0.61	0.00	0.03	0.61	0.00
						TGA =	**1594 Sq.km**

Table 3 Statistics of land use/land cover (LU/ LC) change in Rewari district during 2005-06 to 2011-12. (Area in Sq.km)

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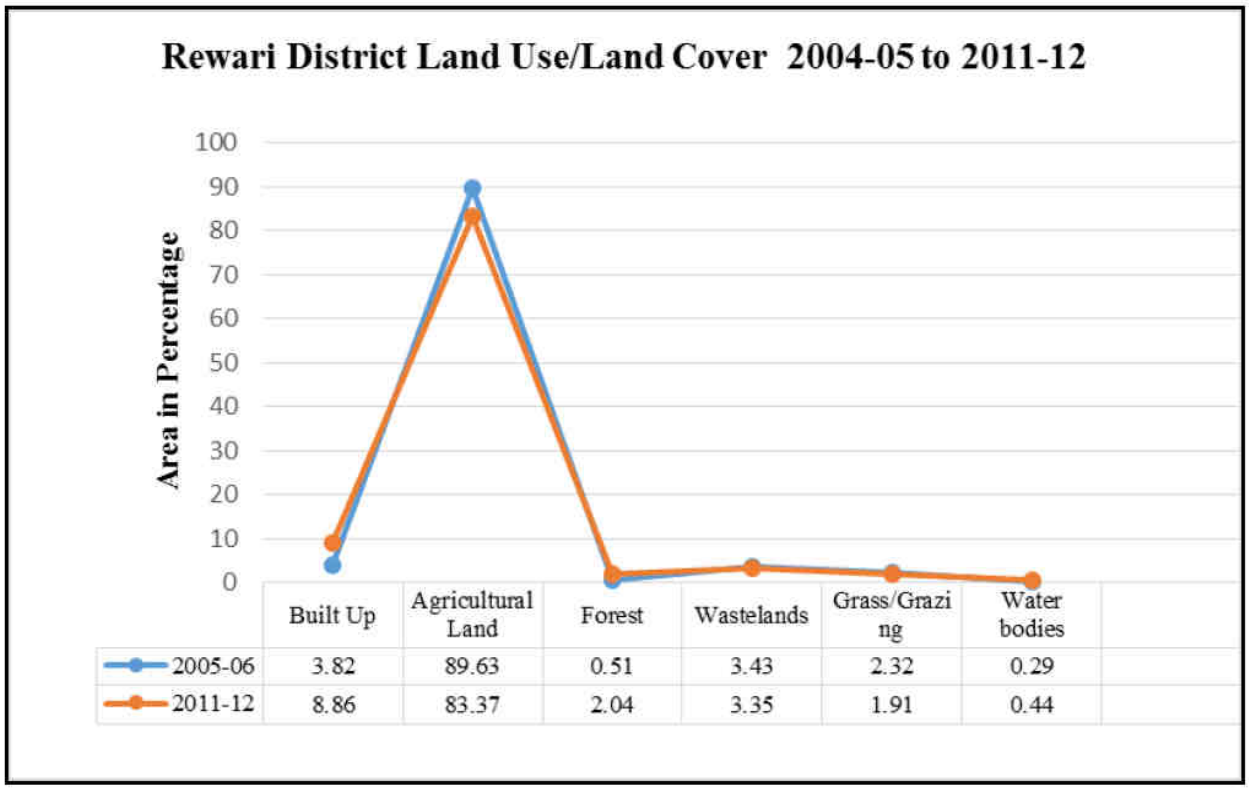

Fig. 2: Change in land use/land cover in Rewari District (2005-2006 to 2011-2012)

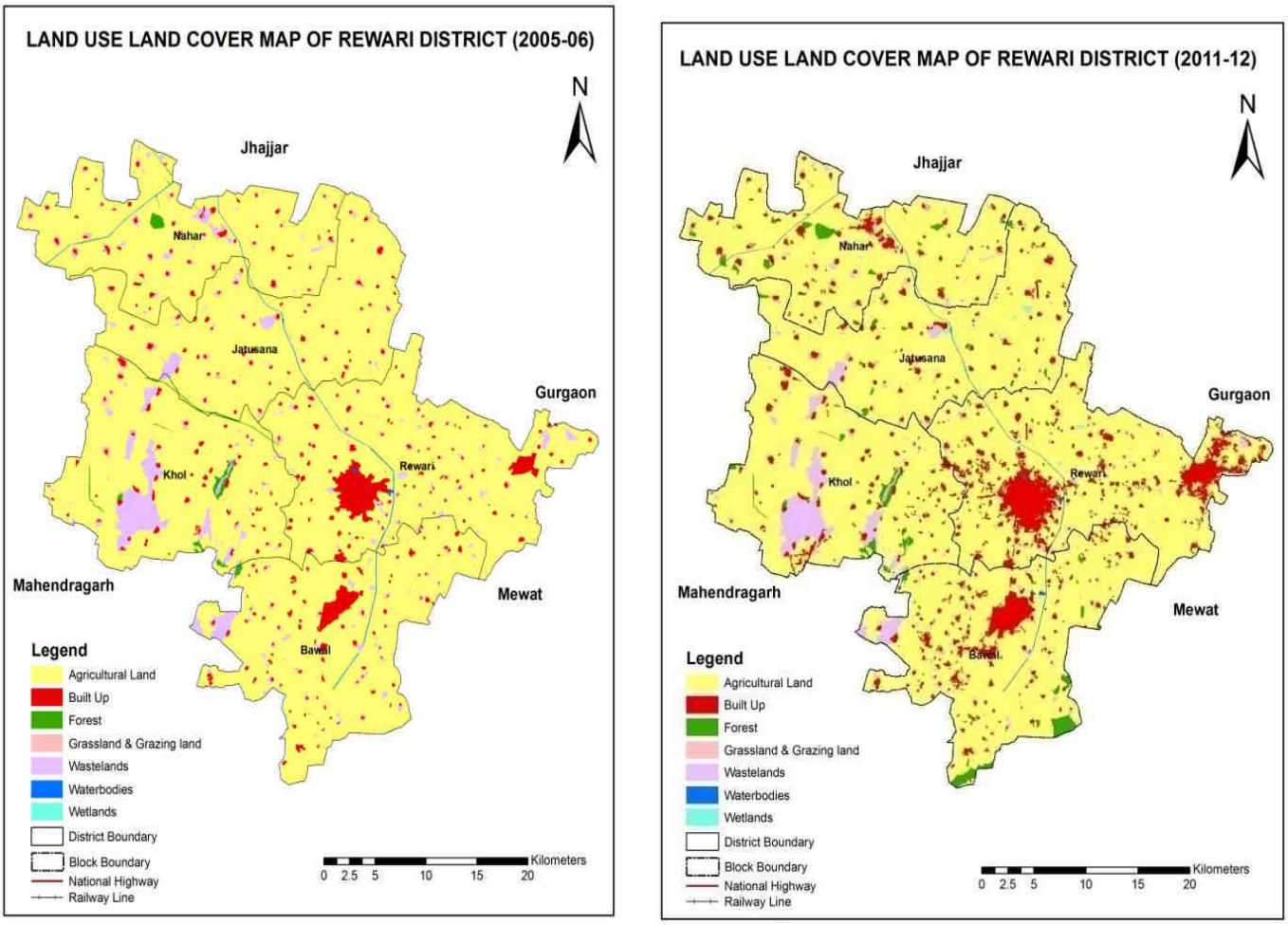

Fig. 3: LULC maps of Rewari district (2005-2006) and (2011-2012)

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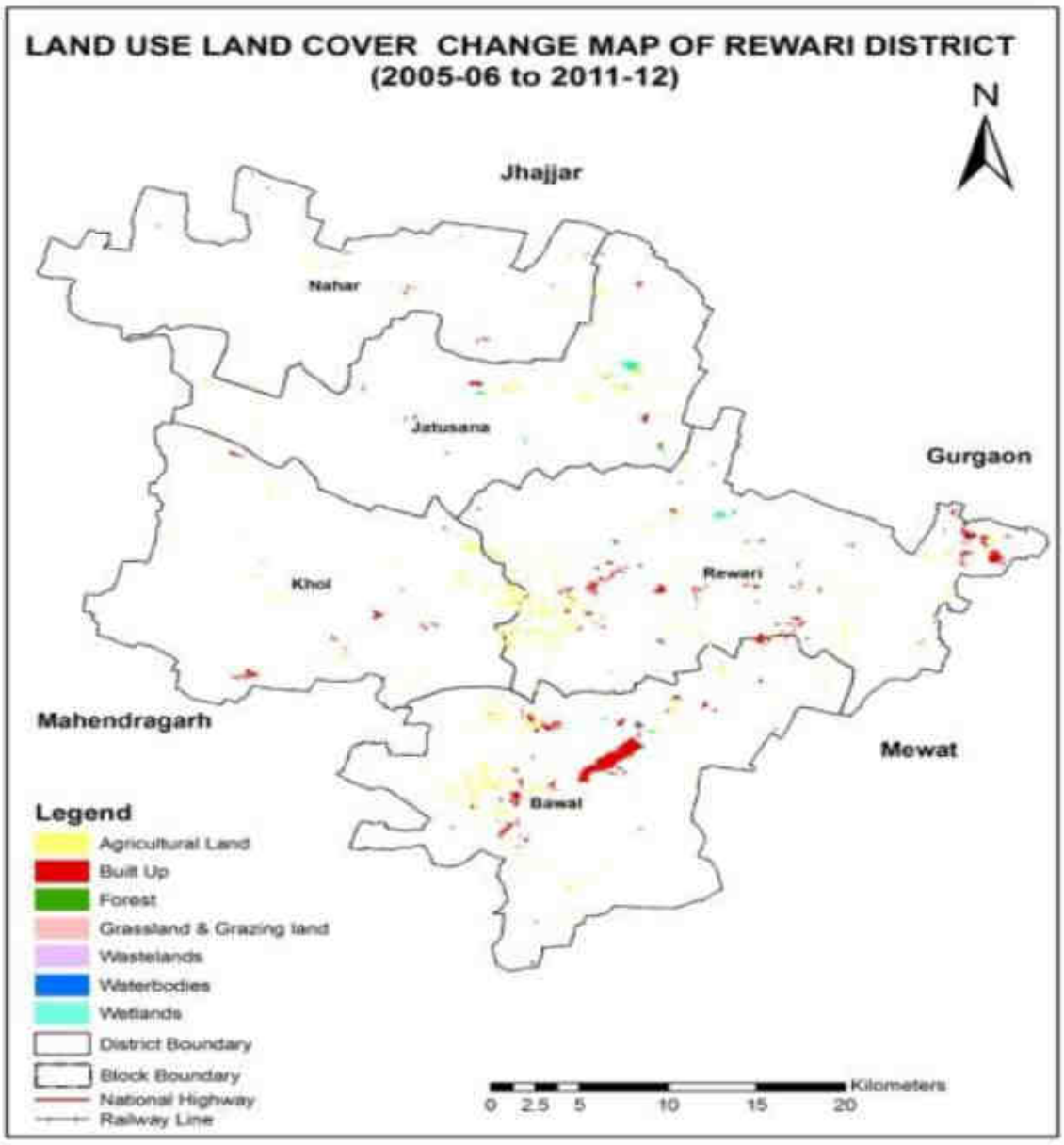

Fig. 4: LULC Change Detection Map of Rewari district (2005-2006 to 2011-2012)

V. CONCLUSIONS

There is need of scientific land use planning in the district due to high urban growth because the area is located in National Capital Region. The present study concluded that the area is one of most intensively cultivated part of Haryana state and the agricultural land is being used for both planned and unplanned urban and industrial development rapidly. There has been a dynamic change in the land use/land cover in Rewari district from 2005-2006 to 2011-2012 as shown fig; 4.The change in land use is quite steep towards urban industrial development from agricultural land. These changes may likely to alter the structure, function and complexity of the local ecology. The urban area increased due to heavy pressure of migration and industrialization. The changing land use pattern does not fulfill the requirement of sustainable land use planning and have envirmental, economic and social harmful consequences. There is a need of hour is to have accurate data base for land use planning and development and the eospatial technology provide accurate, timely data base for land use mapping, monitoring and sustainable land use planning.

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