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Spatio-Temporal Land use / Land cover Change Assessments;

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Abstract: ***The present study focuses the rate and pattern of land use/land cover change during 1988 to 2008 of Hisar district using remote sensing and GIS techniques. Land use / land cover mapping of Hisar district were carried out using Landsat TM (1988 & 1998) and IRS-P6 (Resourcesat-I) LISS-III (2008) satellite data. On screen visual interpretation technique of satellite imagery for identification and delineation of land use/land cover classes was employed using on screen digitization technique. The built-up area in the year 1988 was commuted to be 6776.0 ha (1.68%). It was increased 2.55% in 1998 and 4.15% in 2008 of the total geographical area. It was noticed that the agriculture area were also increased. It was 79.47% in 1988, 80.4% in 1998 and 83.7% in 2008 of the total geographical area due to decrease the sandy waste. It is also evident that vegetation has decreased 6.67% in 1988 to 4.30% in 2008. Water bodies and wasteland were also observed negative changes from 1988 to 2008. The study gives a fairly good understanding of land use/land cover changes for a period of two decades, which in turn will be very helpful for local administrative bodies, decision makers and regional planners.***
Key Words: GIS, Remote Sensing and land use/land cover

I. INTRODUCTION

The land use/cover information helps in understanding status of use of resources and in monitoring, modeling and analyzing environmental change (Krishna et al., 2001). The land use/land cover are, as such, dynamic in nature as both, its value and pattern change from one particular point of time to another and from one geographical area to another, with varying efficiencies, abilities, priorities and needs (Bisht and Tiwari,1996). It is directly related with the level of techno-economic advancement of civilization of its inhabitants (Whyte, 1961). The land use/land cover changes are the results of many interacting processes and each of these operates over a range of scales in space and time (Verburg *et al.*, 2003). The problem with land use change is that role players do not always consider the agricultural, cultural, demographic and socio-economic characteristics of an area before the land is actually developed, resulting in unsuitable land use changes (Lockeretz 1988; Werner 1993). Remote sensing and Geographical Information System provide an accurate tool for environmental monitoring (Malaviya et al., 2009). Remotely sensed data can be collected at multiple scales and at multiple times, thereby, offering the opportunity for analysis of previous phenomenon synoptically from local to global scales throughout the time (Reddy, 2004). The given observations are the testimony of the fact that the land use and land cover change has emerged as a central theme in evolving strategies for the management of natural resources and monitoring the environmental change.

II. METHODOLOGY

The present study makes use of both primary and secondary data to fulfill the objectives of the research. Landsat TM satellite data of Hisar district for 1988 and 1998 and IRS- P6 (Resourcesat – I) LISS – III FCC of 2008 has been used in the study area. In other hand village boundaries from Director of Land Records, Population data, Survey of India topo sheet, District Statistical Abstract, published reports has also been used in the study.

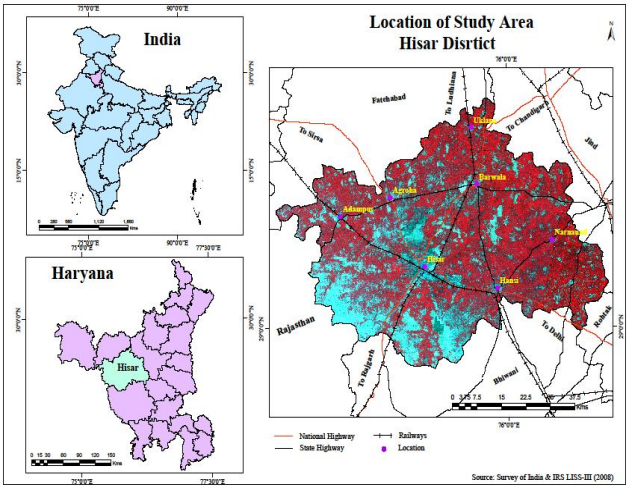
The land use/ land cover mapping for 1988, 1998 and 2008 is based on the utilization of spectral characteristics of various land use/ land cover classes. The methodology for change detection in land use/land cover has been made based on visual interpretation techniques. On screen visual interpretation techniques has been employed for identification and delineation of land use/land cover classes and the change has been delineated in the study area for the years 1988 to 2008. The georeferenced maps have been digitized using Arc GIS software for vactorization. The labels are edited with assigned classification codes. The remote sensing data of the study area have also been verified with the ground reality using the Geographical Positioning System (GPS) instrument. The change in land use categories such as built-up land, agriculture, vegetation, water bodies, wasteland and other changes have been identified and tabulated

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III. THE STUDY AREA

Figure: 1



The Hisar district, a part of the Indo – Gangetic alluvial plain, is situated between 28°53'45" to 29°49'15" North latitudes and 75°13'15" to 76°18'15" East longitudes (Fig.1). It occupies a total area of 3983sq.km. Hisar district comprises of three major physiographic units i.e. Aeolian plain, Older alluvial plain and Chautang flood plain. The district lies in semi-arid region, which is nearly 30 km northeast of the Rajasthan desert. It generally experiences a sub-tropical, continental type of climate. According to 2011 Census, Hisar district recorded a population of 17, 42,815 persons, which made the district 2nd most populous district of the state. The district observed population density of 438 persons per square km. The Population of the district comprised of 931,535 Male and 811,280 female. The district made rapid progress in agricultural production during post Green Revolution period. As a matter of fact the dry climatic conditions of the district necessitated the development of alternative source of water, essential for cultivation of crops.

IV. RESULTS AND DISCUSSION

GIS software has been used to detect the changes in the land use by integrating land use maps of years 1988 and 2008 (Fig. 2, 3 & 4). An analysis of the statistics as shown in Table 4.1, which is based on the interpretation of remote sensing images of 1988, 1998 and 2008 reveals significant changes in the land use/ land cover in the study area. The area under different types of built –up land uses have increased to 17219.7 hectares in 2008 from 2882.5 hectares in 1988. These changes include an increase in residential area 3352.6 hectares from 1988 to 2008. Further, the land use/ land cover changes also include an increase in area under villages, which has increase 4337.3 hectares from 1988 to 2008. Besides, institutional, transportation and other land use (found some of the land uses under Cantonment during the field verification), categories also observed marginal increase in their respective area. It is observed that the residential area of the Hisar city have recorded an unprecedented increase during the given period, which may be attributed to the population growth and the increasing infrastructural facilities and services in the

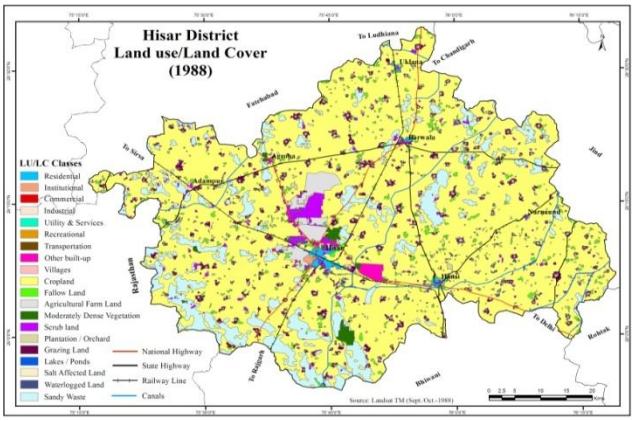


Figure: 2

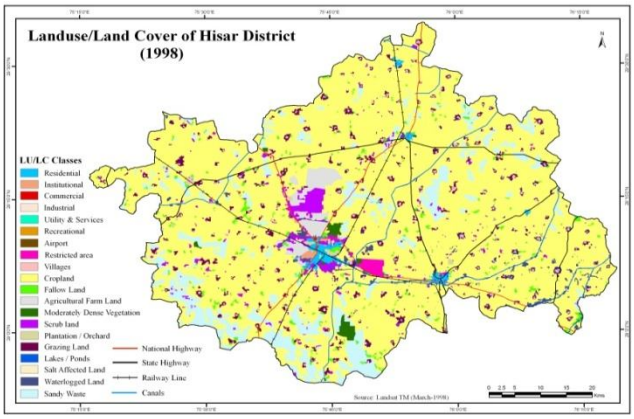


Figure: 3

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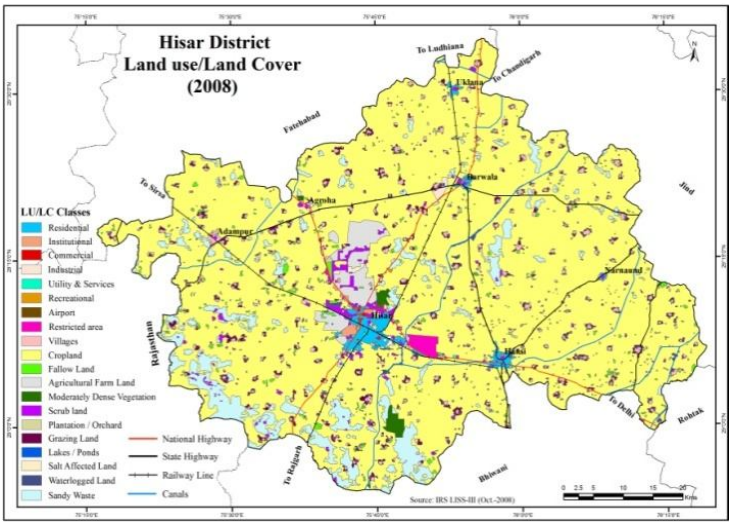


Figure: 3

City leading to population pull into the city. The other land uses observing increasing trends include commercial and industrial sectors and the villages. Land use/land cover mapping of Hisar district was carried out using multi-temporal satellite data. The thematic land use/land cover maps for 1988, 1998 and 2008were prepared using on screen digitization and visual classification approach. The results are shown in Table 4.1 The non – built up land use/ land cover classes such as the crop land, and agricultural farmland also shows increasing trends during the given period, with the cropped land recording an overall increase of 2, 21, 18.8 hectares and the agricultural farm land expanding by 1,480.8 hectares in area. A combination of factors such as increase in enhanced agricultural production with the use of fertilizers and pesticides led to the increase in area of these land use classes. The vegetation cover, on the other hand shows decreasing trends, which has been resulted due to the increasing deforestation and poor rainfall regimes. The water bodies, in particular traditional ponds in and around villages, also depleted during the same period.
The accelerated population growth in the recent decades is seen as a major factor for the urban expansion and increase in built – up area. Besides, various developmental initiatives also led to the increase in the area of other built – up land use classes such as institutional, commercial & industrial, transportation and recreational.

Table 4.1: Land Use / Land Cover Change Detection for the year 1988 to 2008

	Land use/land cover Classes		Area in Hectares				
Sr .No.	Major Class	Sub Class	1988	1998	2008	Change (1988-2008)	Per cent Change (1988 to 2008)
1	Built-up land	1.1 Residential	1865.4	3387.3	5218.0	+3352.6	+179.7
		1.2 Institutional	349.9	586.2	876.9	+527.0	+150.6
		1.3 Commercial	68.1	139.8	248.2	+180.1	+264.5
		1.4 Industrial	160.5	417.4	1198.2	+1037.7	+646.5
		1.5 Utility & Services	63.3	103.9	168.6	+105.2	+166.2
		1.6 Recreational	21.0	26.2	136.4	+115.4	+549.5
		1.7 Transportation	45.6	45.6	45.6	0.0	0.0
		1.8 Other Built-up	1319.7	1355.3	1449.9	+130.2	+9.9
		1.9 Villages	2882.5	4092.1	7219.7	+4337.3	+150.5
2	Agricultural land	2.1 Cropland	299204.4	307243.5	321323.3	+22118.8	+7.4
		2.2 Fallow land	10787.4	6551.5	4118.2	-6669.2	-61.8
		2.4 Agricultural farm	6543.1	6752.5	8023.9	+1480.8	+22.6

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		land					
3	Vegetation	3.1 Moderately dense vegetation	2214.1	1956.1	1586.5	-627.6	-28.3
		3.2 Scrub land	8587.4	7978.9	5231.0	-3356.4	-39.1
		3.3 Plantation / Orchard	1931.5	1237.7	781.3	-1150.2	-59.5
		3.4 Grazing land	13838.9	11678.3	9548.8	-4290.0	-31.0
4	Water bodies	4.1 Lakes/ Ponds	1391.6	1639.7	1274.8	-116.8	-8.4
		4.2 Canal					
5	Wastelands	5.1 Salt affected land	991.8	459.0	604.9	-386.9	-39.0
		5.2 Waterlogged land	1519.9	4200.7	1148.1	-371.9	-24.5
		5.3 Sandy waste	44513.9	38448.3	28097.6	-16416.3	-36.9
	Total Geographical Area of the district			398300.0	398300.0	398300.0	

Source: Based on the interpretation of Landsat TM 1988, 1998 and IRS- P6 (2008) images.
Note: decrease carries negative sign while increase carries positive sign.

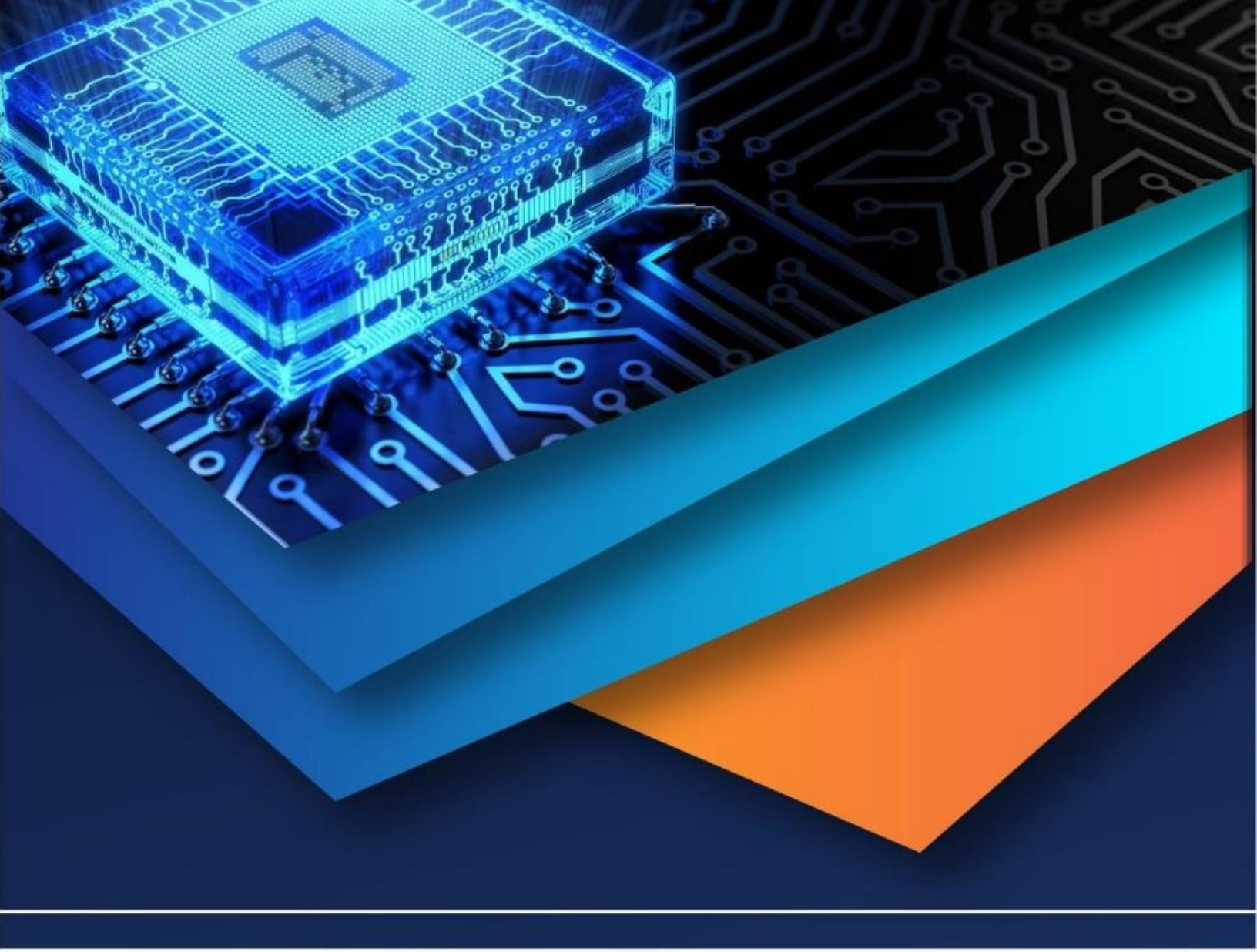
V. CONCLUSION

The land use/ land cover change during 1988 – 2008 helps in understanding the forms and processes of change in the district. It may be seen from Table 4.1 that most of the land uses falling under built – up category exhibits increasing trends during the 20 years periods between 1988 and 2008. The maximum increase in areal extent was recorded under both urban and rural residential land use. The information pertaining land use/land cover and possibilities
for their optimal use is, therefore, essential for the selection, planning and implementation of land use schemes so as to meet the increasing demands for basic human needs and welfare of the people.

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