Assessment of Land Use/Land Cover Changes in Jind District of Haryana in a Period of 1.5 Decade using RS and GIS Approach

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Abstract— The present paper assesses change in land use/land cover in Jind district of Haryana in a period of 1.5 decades(1992-2008) using remote sensing (RS) and Geographic Information System (GIS).For the study, Land use/Land cover (LULC) maps of two different years i.e. 1992-1993 and 2007-08, were prepared using multi-date satellite data. Land use/Land cover maps were prepared by digitization of different features through visual interpretation on satellite imagery using GIS software, after geometric correction of the satellite imageries. The total geographical area of Jind district was 274893 hac and it was categorized in built-up land, agricultural land, wasteland, water bodies, forest and transportation. The satellite data used for year 1992-93 was IRS-IA/IB LISS-I data with 72m resolution, however satellite data for year 2007-08 was IRS-P6 LISS-III data with 23.5m resolution. The agricultural land increased between 1992-93 and 2007-08, whereas fallow land decreased in the prescribed time period. There was an increase in built-up land from 1992-93 to 2007-08. The area under wasteland decreased due to increase in agricultural land and reclamation of salt-affected and waterlogged lands. The paper concludes that with the passage of time built-up increased with increase in human population and also man has reclaimed some wasteland and converted it to agricultural land to increase production for this increasing population.

Index Terms— LISS-I, LISS-III, LULC, GIS, RS .

I. INTRODUCTION

Information on land use/land cover in the form of maps and statistical data is very vital for spatial planning, management and utilization of land for agriculture, forestry, pasture, urban – industrial, environmental studies, economic production etc. Today, with the growing population pressure, low man – land ratio and increasing land degradation, the need for optimum utilization of land assumes much greater relevance [1]. Urbanization is now a common feature of all third world countries. Primate cities and mega cities are emerging in developing countries. In Asia, Africa and Latin America, the unprecedented population growth that characterized much of 20th century has evolved into unparalleled urban growth [2].

A modern nation, as a modern business, must have adequate information on many complex interrelated aspects of its activities in order to make decisions.

Land use is only one such aspect, but knowledge about land use and land cover has become increasingly important as the Nation plans to overcome the problems of haphazard, uncontrolled development, deteriorating environmental quality, loss of prime agricultural lands, loss of prime agricultural lands, destruction of important wetlands, and loss of fish and wildlife habitat. Land use data are needed in analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels. One of the prime prerequisites for better use of land is information on existing land use patterns and changes in land use through time [3].

The usefulness and success of land use and land cover mapping depends on choice of appropriate classification scheme for feature extraction. There are basically two categories for extracting features from satellite images. In one category software needs the user inputs such as number of classes, standard deviation, mean D N value, variance, threshold value etc. to carry out the classification called digital classification. In another category, using the software the interpreter applies his knowledge for extracting features from imagery on the screen, which is commonly known as onscreen visual interpretation [4].

Land use and Land cover (LULC) change is a major issue of global environment change. Scientific research community called for substantive study of land use changes during the 1972. Stockholm conference on the Human Environment, and again 20 years later, at the 1992 United National Conference on Environment and Development (UNCED) [5].Satellite imagery has provided a valuable source of information on topography, land use, vegetation cover and habitat destruction. It has also enabled us to quantify the rate of global and regional habitat destruction which would otherwise be an incredibly difficult task [6] [7].

Land use/Land cover (LULC)

Land use change is not a constant and even process, but it occurs continuously. Land-cover refers to the physical characteristics of earth's surface captured in the distribution of vegetation, water, soil and other physical features of land, including those created solely by human activities e.g. settlements. Land-use refers to the way in which land has been used by humans and their habitat usually with accent on the functional role of land for economic activities [8].

Land use/land cover (LULC) mapping and detection of change using remote sensing and GIS techniques is of great importance to everybody who cares about human sustainable development. The terms "land use" and "land cover" are often confused. Land use "is the total of all arrangements activities and inputs that people undertake in a certain land cover type. In contrast, land cover "is the observed physical and biological cover of the earth's land as vegetation, rocks, water body or man -made features" [9] .

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Application of remotely sensed data made possible to study the changes in land cover in less time, at low cost and with better accuracy [10] in association with Geographical Information System (GIS) that provide suitable platform for data analysis, update and retrieval [11],[12].

II. OBJECTIVES

The study has been carried out with the following aims:-

- Land use/Land cover mapping using 2007-08 digital satellite data.
- Land use/Land cover mapping using 1992-93 digital satellite data.
- Comparing Land use/Land cover maps of 2007-08 and 1992-93.
- Calculating area which changed from one LULC category to another.
- Finding reasons for the change in LULC categories.

III. MATERIALS AND METHODS

A Study area

The Haryana state came into existence on 1st November 1966. It is small state located in the North West part of the country with a geographical area of about 4,42,1000 ha and forms only 1.35 % of the total area of India. Haryana state is located in between 27° 39' N to 30° 55' N latitude and 74° 27' to 77° 36 E longitudes. The state shares a common border with the states of Delhi, Rajasthan, Punjab, Himachal Pradesh and Uttar Pradesh.

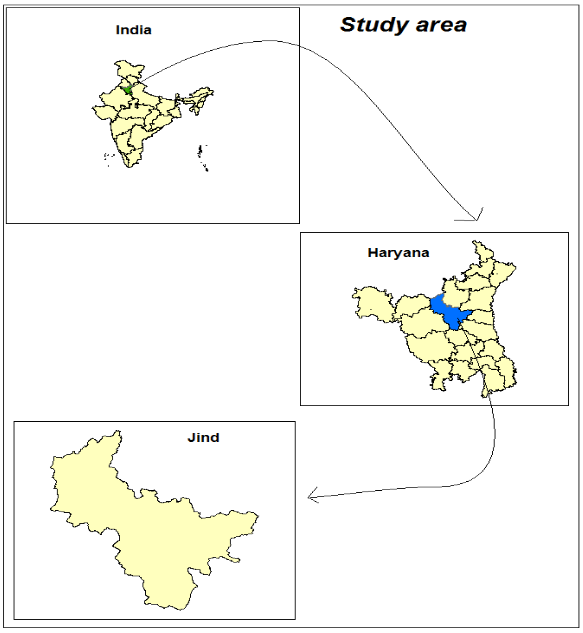

Figure I: Study area Jind District, Haryana

Jind district lies in the North of Haryana between 29°03'00" to 29°51'00" North latitude and 75°53'00" to 76°45' 30" East longitude falling in the Survey of India toposheet No. 53C and 44O. It is bounded by Patiala in the North and Sangrur district of Punjab in the northeast.

It is surrounded by district Kaithal and Karnal of Haryana in east and west respectively. In southwest it has a common boundary with district Hissar, whereas in south and southeast it shares its boundary with Rohtak and Sonipat respectively. Jind district encompasses a geographical area of 274893 hac.

For the administrative convenience, the Jind district, a segment of the Hissar division has been divided into four (04) tehsils i.e. Narwana, Jind , Safidon and Julana. In order to streamline the rural development, these tehsils have been further subdivided into seven blocks namely Narwana, Uchana, Alewa, Jind, Julana, Pilukhera and Safidon.

B.Database

The primary source of data used in the present investigation was satellite data, along with ancillary data.

(a) Satellite Data

The following satellite data were used for visual interpretation to generate various thematic maps in the present study.

For 1992-1993:

IRS 1A/1B LISS I data with path 30 and row 47 for two seasons were selected for the study. This satellite imagery has 72m resolution.

- 3rd Oct.,1992 for Kharif season
- 6th Mar.,1993 for Rabi season

For 2007-2008:

IRS P6 LISS III data with path 95 and row 50 for three seasons were selected for the study. This satellite imagery has 23m resolution.

- 24th Oct.,2007 for Kharif season
- 16th Mar.,2008 for Rabi season
- 27th May, 2008 for summer season

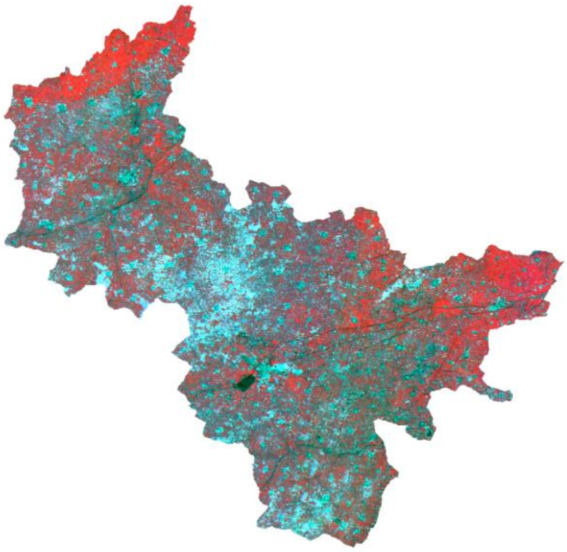

Figure II: Jind District satellite imagery

(b)Ancillary Data

- Statistical Abstract of Haryana state for the year 1992-1993 and 2007-2008.
- Toposheets of Haryana.
- Administrative map (1:50,000 scale).
- Transport network

C. Geometric Correction

Remotely sensed data cannot be used directly for resource information due to the inherent distortion in the image data and so the image data were georeferenced with LCC projection system and WGS 84 datum *i.e.,* map co-ordinates were assigned to the image. Each of the two scenes was geo-referenced separately.

Image enhancement techniques and proper band combination for the identification of the required features are needed to do classification of the image [13].

D. Generation of thematic maps (Land use map)

Visual interpretation of IRS 1A/1B LISS I and IRS P6 LISS III, geocoded, false colour composite images on 1:50 000 scale acquired during Oct., 1992 , Oct.,2007, Mar., 1993,Mar.,2008 and May 2008 was performed for identification of different land use/land cover classes. Multi-date data were taken in order to identify and delineate the boundaries of the cropland in the kharif and rabi seasons. All other LULC categories were also identified on the basis of interpretation keys.

IV. RESULTS

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. 1992-1993 and 2007-2008. The distribution of land use/ land cover classes in the study area in 1992-93(Fig.III) and 2007-08(Fig.IV) is represented in Table I and Table II respectively.

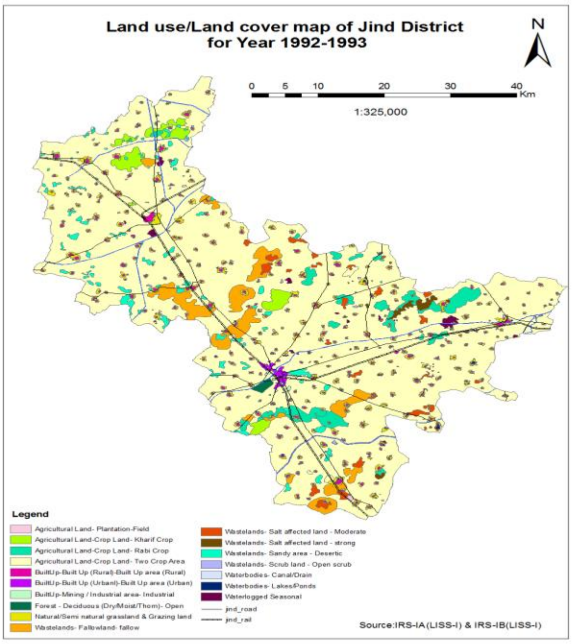

Figure III: LULC Map of JIND District for 1992-1993

A. Agricutural land

The agricultural land comprises of cropland and fallow land. The cropland includes area cropped in rabi season, kharif season and double cropped i.e. rabi and kharif season both cropped. The fallow land includes current fallow and permanent fallow.

The cropland was app. 220553hac (79.85%) in year 1992-1993 and increased to app. 243469hac (88.15%) in year 2007-2008.The fallow land was app. 8241hac (2.98%) in year 1992-1993 and decreased to 811hac (0.29%) in year 2007-2008.

B. Built-up land

The built-up land comprises of settlements and industry. The settlement includes rural area and urban area. The land under rural area was 3680hac (1.33%) in year 1992-1993 and increased to 3808hac (1.38%) in year 2007-2008.The urban area was 726hac (0.26%) in year 1992-1993 and increased to 1378hac (0.50%).There was not much change in industrial area as it was 208hac in year 1992-1993 and 226hac in year 2007-2008.

C. Wasteland

The wasteland includes scrubland, salt-affected land, sandy area, waterlogged area, degraded pasture land and mining dumps.

The scrubland includes open scrub which covers an area of 304hac (0.11%) in year 1992-1993 and increased to 395hac (0.14%) in year 2007-2008. The salt-affected-land includes both strongly affected and moderately affected land which covers a total area of 4244hac (1.54%) in year 1992-1993, of which 1025hac was strongly affected and 1025hac was moderately affected.

The land decreased to 391hac (0.14%) in year 2007-2008.The sandy area is desertic, where sand dunes were semi-stabilized to 15-40m. This covers an area of 4978hac (1.80%) in year 1992-1993 which decreased to 667hac (0.24%) in year 2007-2008.

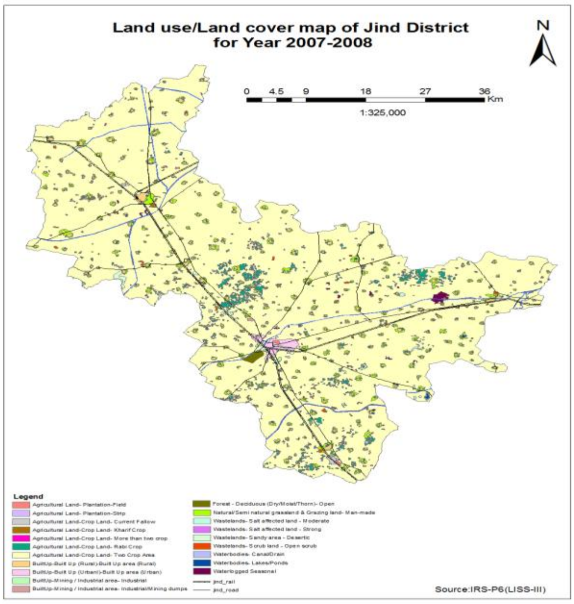

Figure IV: LULC Map of JIND District for 2007-2008

Table I: Land use/Land cover area under different classes for year 1992-93

Land use/land cover class	Area covered(hac)	Percentage(%) of total area
Agriculture	228794.4	82.83
Built-up area	4613.784	1.67
Wasteland	20889.54	7.56
Forest	6538.45	2.36
Transportation	5820.717	2.11
Water bodies	9558.036	3.47
Total	276214.9	100

Table II: Land use/Land cover area under different classes for year 2007-08

Land use/land cover class	Area covered(hac)	Percentage(%) of total area
Agriculture	244507.1	88.52
Built-up area	5412.225	1.96
Wasteland	12788.98	4.63
Forest	1101.901	0.4
Transportation	2820.717	1.02
Water bodies	9570.199	3.47
Total	276201.2	100

The waterlogged land includes seasonal waterlogged areas covering an area of 971hac (0.35%) in year 1992-1993 and it decreased to 704hac (0.26%) in year 2007-2008.The degraded pasture land includes natural/man-made grazing lands around the villages which cover an area of 10392hac (3.76%) in year 1992-1993 which decreased to 10516hac (3.81%) in year 2007-2008.There were no mining dump sites identified in satellite image of 1992-1993 due to high resolution and it covers an area of 116hac in 2007-2008.

D. Forest

The forest cover was around 7000hac (2.53%) in year 1992-1993 and it decreased to only around 11hac in year 2007-2008.

Table III : Change area in LULC between year 1992-2008 (All Area in hactares)

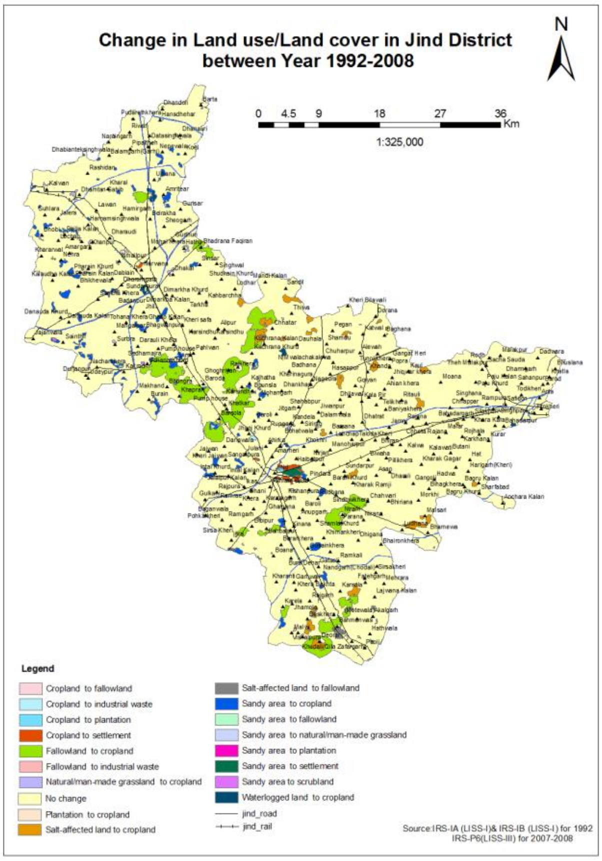

Figure V: LULC Change Map of JIND District for 1992-2008

E. Water bodies

The water bodies include ponds/lakes/reservoirs and canals. The ponds/lakes cover an area of 1385 hac (0.50%) in year 1992-1993 and increased to 1397 hac (0.51%) in year 2007-2008.

V. DISCUSSIONS

The reason for an increase in cropland between 1992-93 to 2007-08 is correlated with decrease in fallow land between the time periods. As more of fallow land is converted to cropland, it automatically explains the reason for an increase in cropland.

2007-08 / 1992-93	Fallow land	Mining dumps	Plantation	Built up	Crop land	Pasture land	Scrub land	Grand total
Cropland	314.01	85.16	677.22	443.09	_	_	_	1519.48
Fallow land	_	26.69	_	_	11055.23	_	_	11081.92
Pasture land	_	_	_	_	392.21	_	_	392.21
Forest	_	_	_	_	6092.99	_	_	6092.99
Plantation	_	_	_	_	28.54	_	_	28.54
Salt-affected	265.73	_	_	_	2804.73	_	_	3070.46
Sandy area	140.90	_	272.42	_	3755.56	3.67	79.13	4251.68
Waterlogged	_	_	_	_	351.92			351.92
Grand total	720.64	111.85	949.63	443.09	24481.11	3.67	79.13	26789.19

The land under rural area was increased as some area of degraded pasture land around the villages was acquired by settlements. The urban area increased with the migration of more people to cities for employment and this resulted in expansion of urban area.

The scrubland increased because of human approach to reclaim fallow land and wasteland, which was otherwise barren and not for any other use. Reclamation of salt affected land resulted in decrease in salt-affected land between 1992-93 to 2007-08. There was also observed a drastic decrease in sandy area, as more of sandy area was taken under cultivation, to get more crop production. Waterlogged land was decreased from 971 hac to 704 hac through land reclamation. Mining dumps were not identified in satellite imagery of 1992-93, but about 116 hac of mining dumps were identified in 2007-08.

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