
Land use and Land cover change detection through Remote Sensing & GIS Technology: Case study of Pathankot and Dhar Kalan Tehsils, Punjab

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ABSTRACT

Digital change detection is the process helps in determining the changes associated with land use and land cover properties .Landuse/landcover change detection in the form of maps and statistical data is very vital for spatial planning, management and utilization of land. Remote Sensing and Geographic Information System (GIS) have been used in order to study landuse / land cover changes. The aim of this study is to detect land use changes between 1991 to 2006 using satellite images of IRS-IA,D, LISS-II,LISS-III,ETM+,TM Landsat (1991-2006) and digital SOI topographic maps. The study has produced a land use/ land cover map of Pathankot and Dhar Kalan tehsil at three (1991,2002,2006) point of time in order to detect the changes that have taken place particularly in the built-up land and forest areas.

The objective of study is to prepare land use/land cover map for different time periods, analyse the land use changes and evaluate the socio – economic implications of predicted change. Landuse changes have been detected by image processing method in EDRAS imagine9.3, ArcGIS9.3. Monitoring of landuse/landcover changes help to plan development activities such as major schemes and for community requirements. Fifteen year time period of 1991 -2006 shows some major land use changes. During this period of fifteen years 104.02 sqkm areas has undergone positive changes into Cropped Land and Builtup areas from Forest and Fallow land. There is a remarkable increase (69.23sq/km) in the area of Crop Land.

Keywords: Landuse, Landcover, Change Detection

1. Introduction

Land is the most important natural resource which embodies soil, water and associated flora and fauna involving the total ecosystem. The growing population and human activities are increasing the pressure on the limited land and soil resources for food, energy and several other needs. Comprehensive information on the spatial distribution of the land use/land cover categories and the pattern of their change is a prerequisite for planning, utilization and management of the land resources of the country. Landcover inventories are assuming increasing importance in various resource sectors like agricultural planning, settlement and cadastral surveys, environmental studies and operational planning based on agro climatic zones. As the population increases particularly in the urban areas by attracting job opportunities and city spreads outward

from its limit, encroachment on the surrounding available land starts. Due to increasing number of population, agricultural land starts converting into built up area and forest areas starts converting into agricultural land, built up etc.

The land use/land cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, 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 activities. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population.

Therefore, attempt has been made in this study to map out the status of land use land cover of Pathankot and Dhar Kalan tehsils, district Gurdaspur of Punjab with a view to detecting changes that has taken place in their status particularly in the built-up land and Forest area.

2. Study Area

The present study has been conducted in Pathankot and Dhar Kalan Tehsils of Gurdaspur District of Punjab lying between 75°19'9" - 75°56'6" East to 32°30'44" - 32°4'50" North. Dhar Kalan Tehsil lies within the sub mountainous belt of Kashmir Himalaya and Pathankot tehsil observes gradual transition into Punjab Plain. It covers 950 sq/km area. Jammu & Kashmir lies in the North and it is bounded by Himachal Pradesh in the North-east. It shares international border with Pakistan in the West Figure.1 represents study area of Pathankot and Dhar Kalan tehsils.

Pathankot, a city and a municipal committee in Gurdaspur district was a part of the Nurpur Princely state ruled by the Pathania Rajputs prior to 1849 A.D. Due to its ideal location, Pathankot serves as a travel hub for the three northerly states and is a hub for the defence forces - Indian Army and Indian Air Force. Pathankot is the fifth largest city in the state of Punjab in terms of population. It is the last city in Punjab on the national highway that connects Jammu and Kashmir with the rest of India.

3. Methodology

Methodology is a sequence of activities that starts with the decision making, problem recognition and ends with recommendation. The quality of decision making depends on sequence on which the activities are undertaken.

The main goal of this study is to extract land use/land cover changes using multi-temporal satellite data. Digital image-processing software Erdas imagine 9.3, ArcGIS 9.3 and Arc Info were used for the processing, analysis and integration of spatial data to reach the objectives of the study. Erdas Imagine was used to generate the false colour composite, by combining near infrared, red and green which are bands 3, 2, 1 together for satellite images

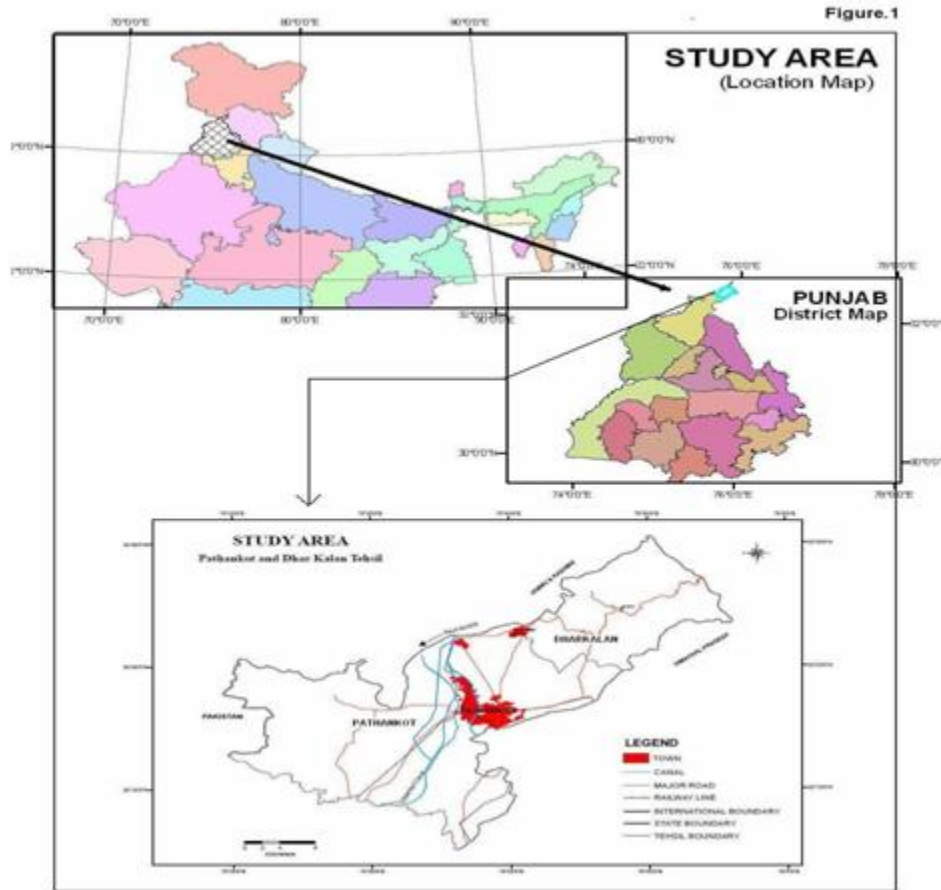


Figure 1: Study area map

This was done for vegetation recognition, because chlorophyll in plants reflects very well to near infrared than the visible. Calculation of the Area in sq/kms of the resulting land use/land cover types has been done for each study year and subsequently comparing the results.

1. Visual Interpretation of 1991 FCC (Hard Copy) image was carried out to prepare Land Use/Land Cover map of study area.
2. On screen Visual Interpretation of 2002 image was carried out to prepare Land Use/Land Cover map of study area.
3. Visual Interpretation of 2006 image was carried out to prepare Land Use/Land Cover map of study area.
4. After digitization, Overlay Analysis was performed to detect changes.

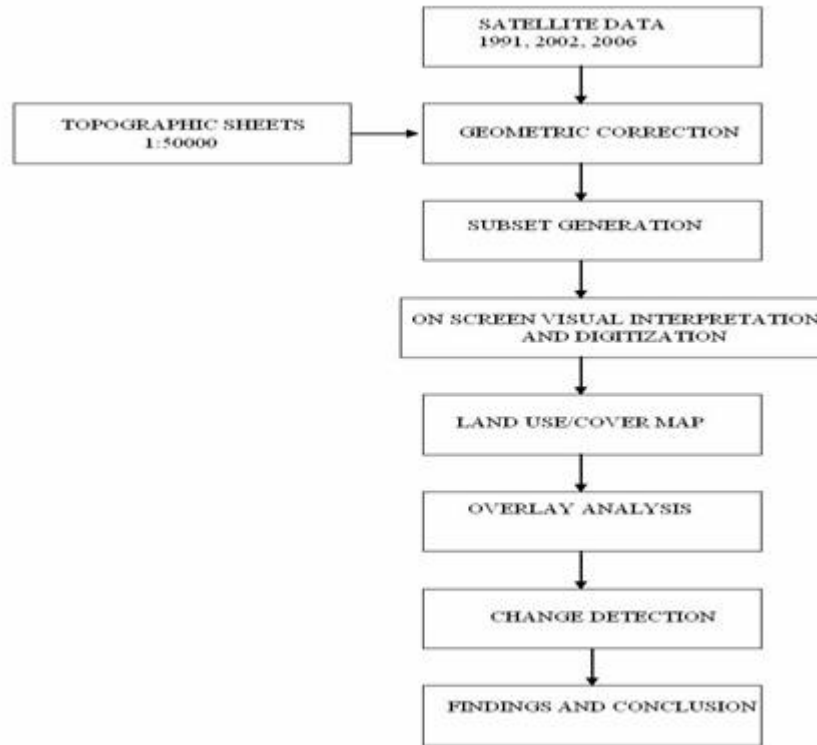


Figure 2: Methodology of research

4. Result and Discussion

Land Use/Cover over the study area has been analyzed for the time periods of 1991-2006. The results are presented in form of maps, charts and statistical tables. Table.1&Figure.2 shows landuse/land cover analysis of study areas. The major proportion in land use is the agricultural land. Other land use/land covers are dense forest, open forest, built up (urban), built up (rural) and water bodies. On account of increasing population the area is facing land use changes.

Landuse/Landcover Analysis of 1991-2006

Table 1: Land Use/Land Cover Changes (1991-2006)

Sr. No.	Landuse Category	Area in Sq\Km			Percentage (%)		
		1991	2002	2006	1991	2002	2006
1	Built Up (Urban)	7.64	23.49	23.58	0.80	2.47	2.90
2	Built Up (Rural)	14.89	27.59	29.54	1.56	2.90	3.10
3	Dense Forest	136.27	96.07	88.40	14.33	10.10	9.29
4	Open Forest	92.16	65.12	61.42	9.69	6.84	6.46
5	CropLand	557.99	623.67	627.22	58.68	65.59	65.97

6	Plantation	12.66	13.06	12.60	1.33	1.37	1.32
7	Fallow Land	17.14	2.33	2.16	1.80	0.24	0.22
8	Marshy Land	0.44	0.72	0.44	0.04	0.07	0.04
9	Water Logged	0.79	0.75	0.66	0.08	0.07	0.06
10	WaterChannel Area	22.09	11.98	9.58	2.32	1.26	1.00
11	River Bed	74.40	56.70	62.00	7.82	5.96	6.52
12	Canal	5.34	5.65	5.77	0.56	0.59	0.60
13	Choe	7.94	9.93	9.21	0.83	1.04	0.96
14	Drain	0.25	0.52	0.52	0.02	0.05	0.05
15	Pond	0.67	0.15	0.23	0.07	0.01	0.02

Landuse \Landcover Classification

Pathankot & Dharkalan Tehsil
(Gurudaspur District, Punjab)

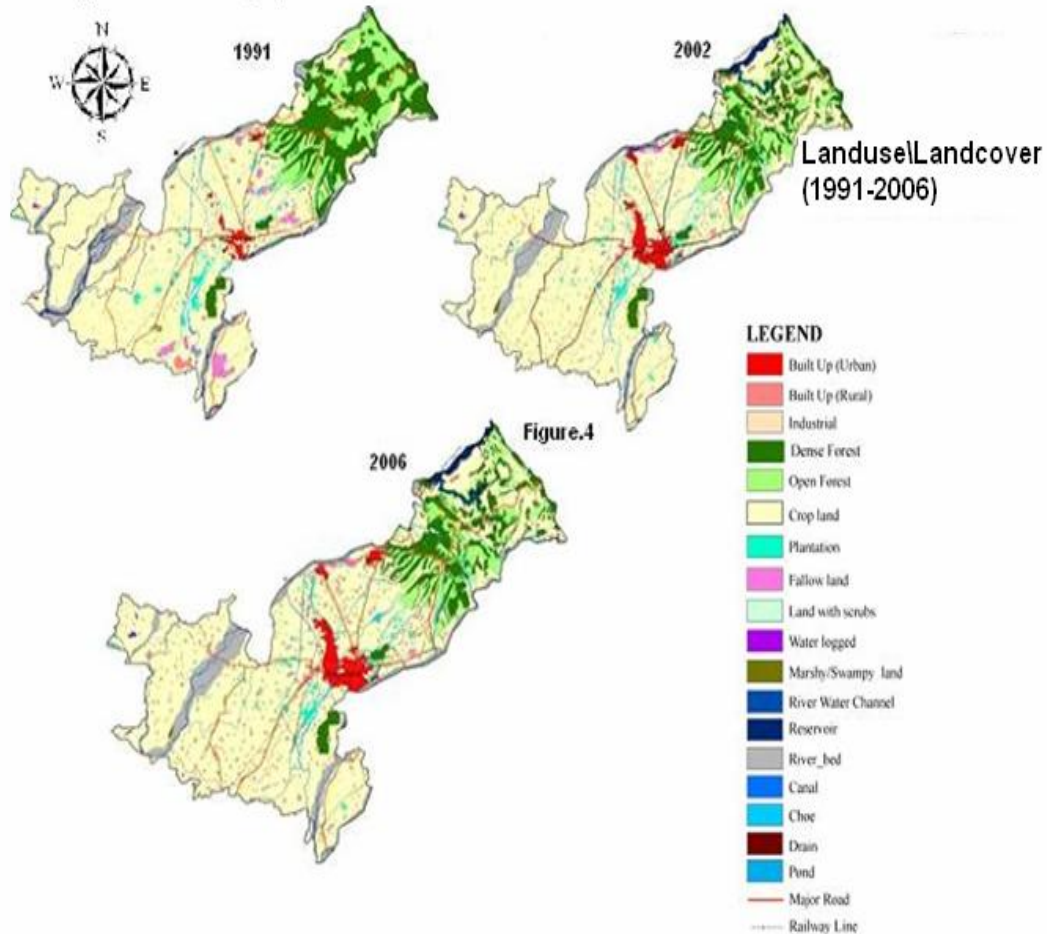


Figure 3: Landuse/ Landcover details of study area

5. Analysis of Landuse/Landcover Changes

The analysis of Land use/land cover of Pathankot and Dhar Kalan tehsils of Gurudaspur districts for different time periods, indicate substantial changes. The major proportion in land use is the agricultural land. Major changes have taken place particularly in the built-up land and forest areas. Dense forest has decreased by 47.87 sq/km in the time period of 1991-2006. Open forest is also decreased by 30.74sq/km during this period. While urban and rural Built up areas have increased 19.94 and 14.65 sq/km respectively. Table. 2 and Figure. 2 portray changes in Landuses.Land use changes reveal the differences in uses of land for different land use categories in different year's periods. Forest land and Agricultural land is a major source of utilization for other purposes.

The developments scenario of 1991 -2006 time periods shows the area under Dense Forest has decreased by 35.13 % during 15 years fulfilling requirements of the growing population. Open Forest has also decreased by 33.4%. The same problem of reduction under are of plantation is occurring that is reduced from0.4sq/km in 1991 to 0.06sq/km used for different purposes. The area under Built Up (Urban) has increased from 15.85 in 1991 to 19.94 sq/km in 2006 by fulfilling the growing needs of the city population. Built Up (Rural) area also increased from 12.7 in 1991 to 14.65 sq/km in 2006.

Apparent interpretation of Table.2 shows that loss in Forest area has been compensated by gains in crop land. As a matter of fact all landuse categories have undergone complex metamorphosis which has been mapped in Figure.2. Change in Builtup area is mostly brought at the cost of crop land. Crop land is also transferred to plantations and water bodies (canal etc.). Similarly, Open Forest land has been converted into cropland and Dense forest to Open forest. Fallow land has also moved into cropland, builtup area and industry as well.

Table 2: Analysis of Land Use/cover Changes

Sr.No.	Land Use Type	Area in Sq/Km			PercentChange (%)	
		Change 1991-2002	Change 2002-2006	Change 1991-2006	Landuse Change	Net Change
1	Dense Forest	-40.2	-7.67	-47.87	-35.13	-51.13
2	Open Forest	-26.77	-3.98	-30.74	33.36	-32.99
3	Crop Land	65.68	3.55	69.23	1.79	66.55
4	Built Up (Rural)	12.7	1.95	14.65	1.94	14.08
5	BuiltUp (Urban)	15.85	4.09	19.94	1.34	19.17
6	Plantation	0.4	-0.46	-0.06	-0.47	-0.04
7	Fallow Land	-14.81	0.17	-14.64	-85.41	-15.69

Inter -Landuse \Landcover Changes
Pathankot & Dhar Kalan Tehsil
(Gurdaspur District, Punjab)

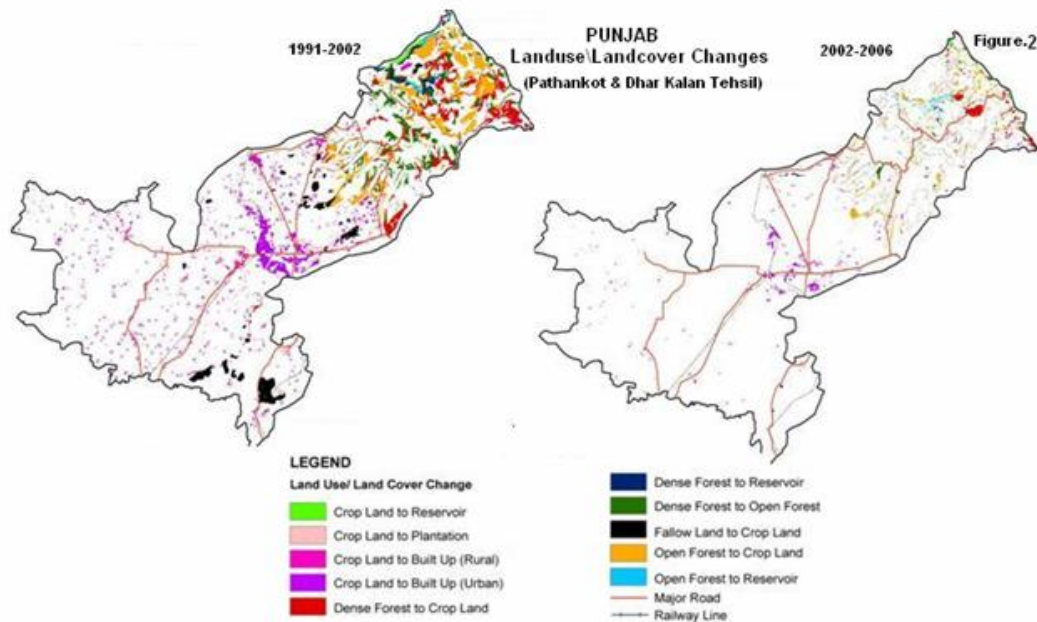


Figure 4: Inter land use/ land cover changes of study area

6. Conclusion

The land use study is of fundamental significance, as the land resources play a strategic role in the determination of man's economic, social and cultural progress. In fact the land use of a region is always characterized by the spatial variations and is profoundly influenced by physio-socio-economic factors. The study of changes in land-use is important in the field of geography. From the above discussion it is apparent that the problem of degradation of forest cover in Pathankot and Dhar kalan tehsil needs a disaggregated analysis. Converting of Forest areas into Crop land is not beneficial for mankind and natural environment. Proportion of agricultural land is also used for industrial and residential. So there is need for proper planning of the haphazard growth of built up otherwise, unplanned built up could create problem. Industry should be established on unproductive land as remote sensing provides information of different categories of land. Growing population demands more land for crop production and settlement at an ever increasing rate. Now Remote Sensing and GIS offers quick and cheaper methods of generating spatial data for optimal landuse planning.

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