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A STUDY OF TREND IN URBANIZATION AND LAND USE/ LAND COVER CHANGE PATTERN IN AMBALA CITY AND AMBALA CANTONMENT, HARYANA, INDIA

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Abstract

As the process of urbanization accelerates, a simultaneous change occurs in land use/ land cover pattern of that area. Land-use change has emerged as a global trend which has its roots at local level. As a consequence of increase in population and decrease in forest cover, there is definitely an increase in the change of land use area. Not only India, but the world has entered in the era of urbanization and thus the change in land use has also become imperative. To determine the change in land use/ land cover of Ambala City and Ambala Cantonment, Haryana, India, Landsat TM and ETM^+ images were used. Due to its location near the state capital Chandigarh, there is a fast growth in urban population of these two cities, which has consequently affected the environment and changed land use pattern in the study area. The study revealed the decreased vegetation cover and increased built up space in the study area.

Keywords: Urbanization, Land use, Land cover.

Introduction

Urbanization is a process which exhibits itself in the demographic, social, economic, technological and environmental aspects of
life through temporal, spatial and sectoral changes in a given society. Urbanization is a progressive concentration of traditional rural economies into modern industrial one (Davis, 1965). The uncontrolled growth of population in several parts of the world has led to many changes such as change in land use, land cover, agriculture and industrial activities. The surface utilization of all developed and vacant land on a particular point at a given time and space is called land use (Mandal, 1982). While planning natural resource management, the change in land use and land cover of an area has become an important factor. The manner, in which we use our land, definitely leaves some visible or invisible impact on all the natural resources.

Present paper deals with the urbanization and change in land use/ land cover in the twin cities of Ambala. These cities are located near the state capital of Haryana i. e. Chandigarh. The impact of land use change exerts its effect on natural resources, such as air, water and soil.

Major natural factors include climate, topography and soil structure, whereas socio-economic factors include economic ability, awareness among farmers, management practices and the development of infrastructure. Unsustainable development coupled with unplanned and unsystematic urbanization has led to environmental pollution. Pollution, once considered a regional problem, has transformed into a global phenomenon now. In the new era of globalization and economic liberalization, it becomes imperative to plan
and manage cities. It needs a logical approach and far sightedness to see the future problems while making planning in present. While analyzing global change, the study of land use/ land cover (LULC) change plays an important role. On one side rapid urbanization has brought opportunities in terms of new urban development but suffered losses to arable land, forest land and water bodies on the other side. Although remotely sensed images have been used to study urban growth pattern the world over, very few studies have employed these methods to examine the growth of Indian cities, particularly Ambala City and Ambala Cantonment in Haryana. To study the continuously changing process of urbanization, remote sensing is very helpful. During last decade, there has been great attention towards urbanization and land use, as there is a strong effect of anthropogenic activities and the ecosystem as almost half of the world population is living in the cities (Stow and Chen, 2002). With increase in urban population, there is an increased demand of natural resources and hence the increased exploitation, scarcity and contamination.

While studying spatial and temporal dynamics urban growth and land use change, remote sensing plays very significant role (Herold et al., 2003). Geographical information system (GIS) and remote sensing (RS) are well established information technologies that demonstrated a great potential to understand the landscape dynamics- detect, identify, map and monitor differences in land use and land cover patterns over time. Available data on LULC changes can provide critical input to decision making of environment management and planning the future. Therefore in the present paper, total impervious area (TIA) has been calculated using the Landsat images to know the present status of the Ambala City and Ambala Cantonment. The present study was undertaken with the objective of analysis of LULC changes in the Ambala City and Ambala Cantonment between 1990 to 2015 with a view to detect the land consumption rate and the change that has taken place particularly in the built-up land using both GIS and RS data. This will also help in monitoring the dynamics of land

use resulting out of changing demand of increasing population.

Location of the study area

The study area i.e. Ambala City and Ambala Cantonment lies in the state of Haryana as depicted in Figure 1. Ambala City is the headquarter of district Ambala. It is located between 30° 21' to 30° 23' north latitude and 76° 40' to 76° 46' east longitude. The average height from mean sea level is 277 meters. It is one of the important cities of Haryana and is located at a distance of about 205 kilometers from National Capital, New Delhi and 45 kilometers from the State Capital, Chandigarh. It is here at Ambala City that Grand Trunk Road bifurcates distinctly towards Punjab and Himachal Pradesh. In terms of linkages, Ambala City is gateway to Punjab, Haryana and Himachal Pradesh. There are two railway stations in the town. The town is famous for its big cloth market.

Ambala Cantonment is located between 30° 19' to 30° 23' north latitude and 76° 46' to 76° 51' east longitude. Its average height above mean sea level is 277 meters. It lies on the south-east of Ambala City. It is an important railway junction where Delhi-Kalka and Saharanpur, Ludhiana railway lines intersect. This cantonment was established in 1843. The town has progressed well as a consequence of industrial units having been established in it. The place has assumed importance as centre for the manufacture of scientific and surgical instruments and as an important railway junction. Ambala-Amritsar road, the Grand Trunk road (National Highway-1), passes through this town. Its distance from National Capital, New Delhi and State Capital, Chandigarh are 200 kilometers and 50 kilometers respectively. Ambala Cantonment is an important rail junction of northern India. The connectivity and proximity of both these towns to Delhi and other big markets of India have proved to be a boon to agriculture, trade and commerce. It has a large Indian Army and Indian Air Force presence within the confines of its cantonment area.

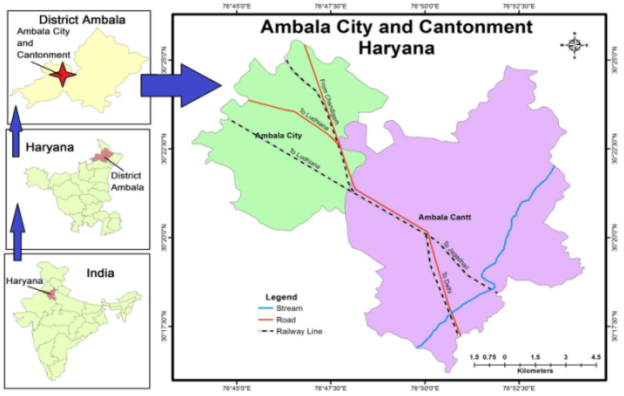

Figure 1. Location map of the study area

DEMOGRAPHIC STATUS

Ambala City is governed by Municipal Corporation which comes under Ambala metropolitan region. According to International Journal of Remote Sensing & Geoscience (IJRSG) census 2011, total population of Ambala City is 1, 95,153. In which the male population is 1, 02,607 while the number of females is 92,546. Ambala Cantonment is an urban agglomeration comprising municipal town of Ambala Sadar and Ambala Cantonment. It is evident from the Figure 1.2 that from 1901 to 2011, the towns have been showing moderate growth of population. However, considering the industrial policy of the state for encouraging rapid industrialization of the area it has been assumed that it will grow at higher rate. The overall scenario of district Ambala is showing a rise in urban growth rate while a decline in the rural growth rate (Table 1.).

Table 1. Urban and rural population growth rate in 1991-2001 and 2001-2011

Year	District Ambala		
	Total	Rural	Urban
1991-2001	25.78	28.48	24.92
2001-2011	11.23	(-)4.53	40.26

(Source: Statistical Abstract, Haryana, 2012- 2013)

Figure. 2 exhibits that there is a trend of constant increase in the population of study area from 1901 to 2011. This indicates an increasing pressure on the natural resources of the study area.

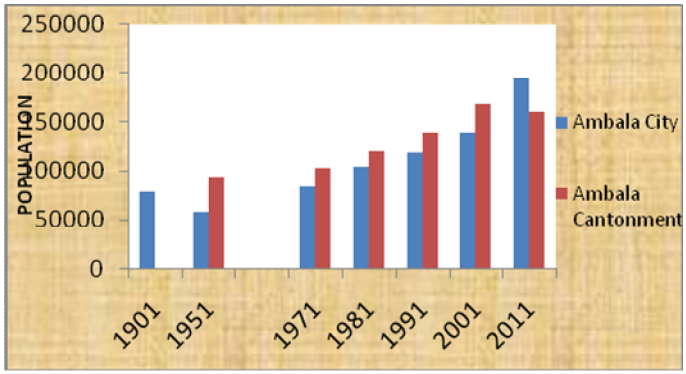

Figure. 2 Trend in population of Ambala City and Ambala Cantonment from year 1901- 2011

SPATIAL CHANGES IN THE LAND USE AND LAND COVER PATTERN

A change in land use pattern has been observed in Ambala City and Ambala Cantonment over a period of time resulting from increased urbanization leading to increased demand of more land. These two cities have undergone various changes over a period of time. The city has witnessed the remarkable expansion, growth and developmental activities such as building, road construction, deforestation and many other anthropogenic activities. A lot of commercial activity has come up in the form of the industrial area and shopping complexes and that also without proper planning of space and

other infrastructural concepts. Also, more population means more of transportation and traffic, which has triggered changes

in land use pattern for locomotion. This pressure has driven a change in land use pattern over the time. Urban sprawl has been quantified by considering the impervious area as the key feature of urban sprawl, which can be obtained through remotely acquired data. Growth patterns of the study area have been analyzed for the period 1990, 2000 and 2015 using remotely sensed data and GIS.

Methodology

Urban dynamics was analyzed using temporal remote sensing data for the period 1990-2015. Landsat TM and Landsat ETM data along with the demographic information from census data has been used in detection of the change in land use and land cover over the period of time in the study area.

General procedure for data processing

Land cover was studied using remote sensing techniques. LANDSAT TM (Thematic Mapper) and ETM+ images have been employed to classify the study area. The TM data are the most frequently used data for environmental assessment and monitoring. Remote sensing data (Landsat series) for Ambala City and Ambala Cantonment acquired for different time period were downloaded from United State Geological Survey (USGS) and Glovis (http://www.glovis.usgs.gov). Survey of India (SOI) topo-sheets of 1:50,000 scale were used to generate base layers of city boundary. Powerful tools such as Arc GIS 9.0 and ERDAS Imagine 9.2 were employed for extracting land use and land cover layer. Fig. 1 shows the flow chart of methodology used for land use/land cover change analysis of the study area. Three images acquired on April 3, 1990, 15 October 2000 and October 1, 2015 were selected from data available for this study.

Data processing

To serve as a base map, pre processing of Survey of India Toposheets at 1:50000 scale has been done which involved the scanning and digitization. To establish the relationship between an image coordinate system and a map coordinate system, we need to align or georeference the raster data. The images were geometrically rectified and registered to the same projection namely, Transverse Mercator WGS 84 to lay them over each other. After georeferencing the base map, remote sensing image is registered with base map using the same technique.

Image classification

The initial LANDSAT (1990) and final (2015) imageries were subjected to a classification zones. Visual image interpretation was utilized to classify the rectified images to different land use categories. In order to classify the images, four classes were delineated in the images namely agriculture, settlements, forests, water bodies and stream/ barren land and others. The overall testing accuracy for year 1990 was 90%, for year 2000 it was 88% and for year 2015 it was 91%. Land use/land cover maps of Ambala City and Ambala Cantonment for the year 1990, 2000 and 2015 is shown in Figure 3, Figure 4 and Figure 5 respectively.

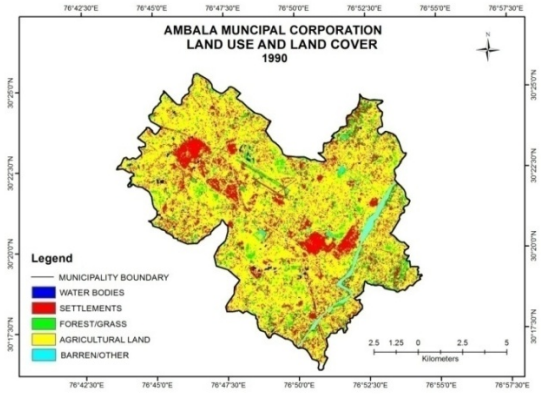

Figure 3. Land use/ Land cover map (1990)

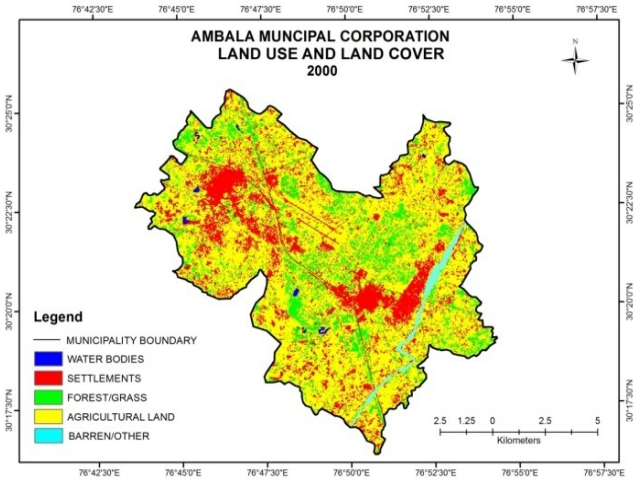

Figure 4. Land use/ Land cover map (2000)

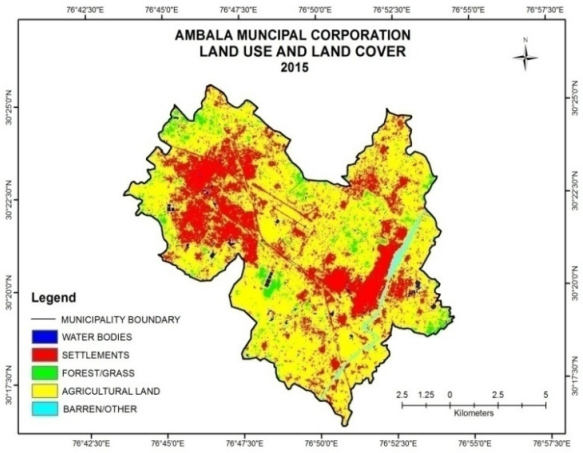

Figure 5. Land use/ Land cover map (2015)

Land Use/ Land Cover change

Table 2. Land use statistics of Ambala City and Ambala Cantonment from 1990-2015

Ambala City and Ambala Cantonment							
	1990		2000		2015		%age variation (1990-2015)
	Ha	%	Ha	%	Ha	%	
Agriculture	9845.5	65.7	9459.9	63.1	9954.5	66.4	-0.6
Settlements	2988.4	19.9	3144.2	20.9	3987.9	26.6	-6.6
Forest	1769.4	11.8	2135.4	14.2	690.24	4.6	7.2
Water	93.06	0.6	73.5	0.4	174.06	1.1	-0.5
Stream/ Barren	271.53	1.8	175.4	1.1	181.6	1.2	0.6
Total	14976.89	100	14988.4	100	14988.3	100	

pattern in Ambala City and Ambala Cantonment

Land use statistics and transition matrices are important information to analyze the changes of land use. The change analysis is based on the statistics extracted from the land use/land cover maps of Ambala City and Ambala Cantonment by using GIS. Land use statistics of Ambala City and Ambala Cantonment from 1990-2015 in given in Table 1.3.The built up area or settlement area has a noticeable increase, it has been observed that the haphazard growth of population in the study area, particularly in Ambala City has driven change in land use pattern over a period of time in the study area (Fig. 1.6). Urban development is quiet high in the study area, as the area under the built up has increased from 19.95% (2988.4 ha) of total area in 1990 to 26.60 % (3987.9 ha) in 2015. On the other hand forest data has shown decreasing trend from 1990 to 2015 i.e.11.81 % (2135.4 ha) of total area in 1990 to 4.60 % (690.24 ha) in 2015. While study observed the decrease in the vegetation area from 28.90% (3295.08 ha) to 27.46% (3131.55 ha) due to acquisition of land for various purposes. Analysis showed that area under agriculture was 65.73%, 63.11%, and 66.41% in 1990, 2000 and 2015 respectively which signifies that not much fluctuation has occurred in the area under agriculture over the years. On the other hand, in terms of forest area, a significant decreasing trend from 1990 to 2015 (Table 2) is visible, which is due to expansion and fast development in the study area. Forest is decreasing and simultaneously, residential area/urban population and industrial area are increasing. Trend of land use /land cover change in the study area, from 1990-2010 is shown in Figure 7. Results have made the scenario clear which shows an increase in urbanization in the study area. Change in land use pattern has exerted a great impact on the land of the study area. Aggregation and sprawl of built-up land has occurred on the cost of fragmentation of various other classes particularly forest area. There has been growth of peripheral zones, urban outgrowths and urban agglomeration in the study area. So proper planning will be required to cope up with the increase in demand for the systematically planned Ambala Cantonment and haphazardly grown Ambala City.

Results have aided in visualizing and quantifying the impact of increased urban population and its consequent effects in the study area. Aggregation and sprawl of built-up land has occurred on the cost of the forest area. The well defined boundary of urban area of Ambala Municipal council has grown far beyond the boundaries of the Municipal council and the two cities Ambala City and Ambala Cantonment have almost merged into each other.

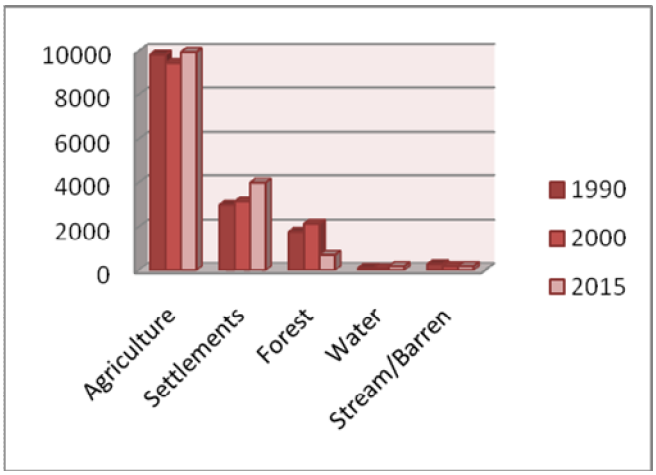

Figure 6. Land cover of the study area in 1990, 2000, 2015

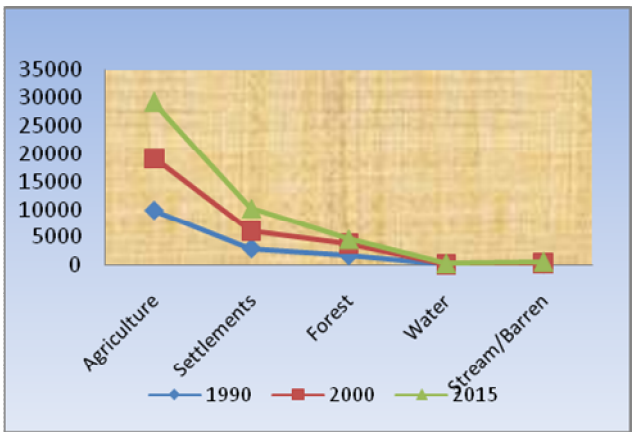

Figure 7. Trend of land use/land cover change pattern

Conclusion

In the present study, a clear correlation between the change in land use/ land cover and urbanization of the study area can be observed. Due to lack of proper planning there is no sustainable development in the study area. Remotely sensed

images exhibits the urban growth pattern in Ambala City and Ambala Cantonment to examine the land use/ land cover

changes in the study area. The pressure of increased commercialization has driven a change in land use pattern over a period of time in the study area especially the forest land which is the most affected. It is evident from the data that it has been decreasing over the past decades and also urban growth leading to an increase in the built up area has played a critical role in the changing relationships between subsurface recharge at different depths and rainfall runoff. Since water logging and subsurface contamination is rampant and requires urgent management. The degradation of water quality of the study area during the study period coincides with the major urban development in the vicinity of the city.

Some of the main problems have been highlighted, alongside areas for potential resolution and in doing so it has provided some insights for future possibilities for the sustainable development in the study area.

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