



Land Use Changes in Haryana Sub-Region of Chandigarh Periphery Controlled Area: A Spatio-Temporal Study

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Abstract

Land use changes are very dynamic in nature and needs to be monitored at regular intervals for sustainable development. The present study analyses land use/land cover changes over a period of 35 years in Haryana sub-region, Chandigarh periphery. The study is primarily based on multi-temporal (1972, 1990 and 2008) Landsat (MSS and TM) satellite imageries of 30m spatial resolution and survey of India toposheets, interim master plan (1990) and field data. Land use analysis for different time periods has been done by using visual interpretation, ground verification, on screen digitization and overlay analysis using Arc GIS 9.1 and Erdas Imagine 8.5 software.

1. INTRODUCTION

Mankind's presence on the earth and his modifications to the landscape has had a profound effect upon the natural environment. These anthropogenic influences on shifting patterns of land use are a primary component of many current environmental concerns as land use and land cover change is gaining recognition as a key driver of environmental change (Riebsame et al, 1994). Changes in land use and land cover are pervasive, increasingly rapid, and can have adverse impacts and implications at local, regional and global scales.

In India, unparalleled population growth coupled with planned and unplanned development activities has resulted in urbanization, but urban areas lack infrastructure facilities. This also has resulted in serious implications for the resources of the region. Urbanization takes place either in radial direction around a well-established city or linearly along the highways. This dispersed development along highways, or around the city and in rural countryside is often referred to as sprawl due to conversion of existing landuse and landcover.

Land use changes are very dynamic in nature and calls for monitoring at regular intervals for sustainable development. The remote sensing data due to synoptic view, repetitive coverage and real time acquisition has proved a vital technology in landuse studies. The digital data in form of satellite imageries, therefore, enable to accurately compute various land cover and land use categories and helps in maintaining the spatial data infrastructure (SDI) which is very necessary for monitoring urban expansion and change detections studies (Burrough, 1986).

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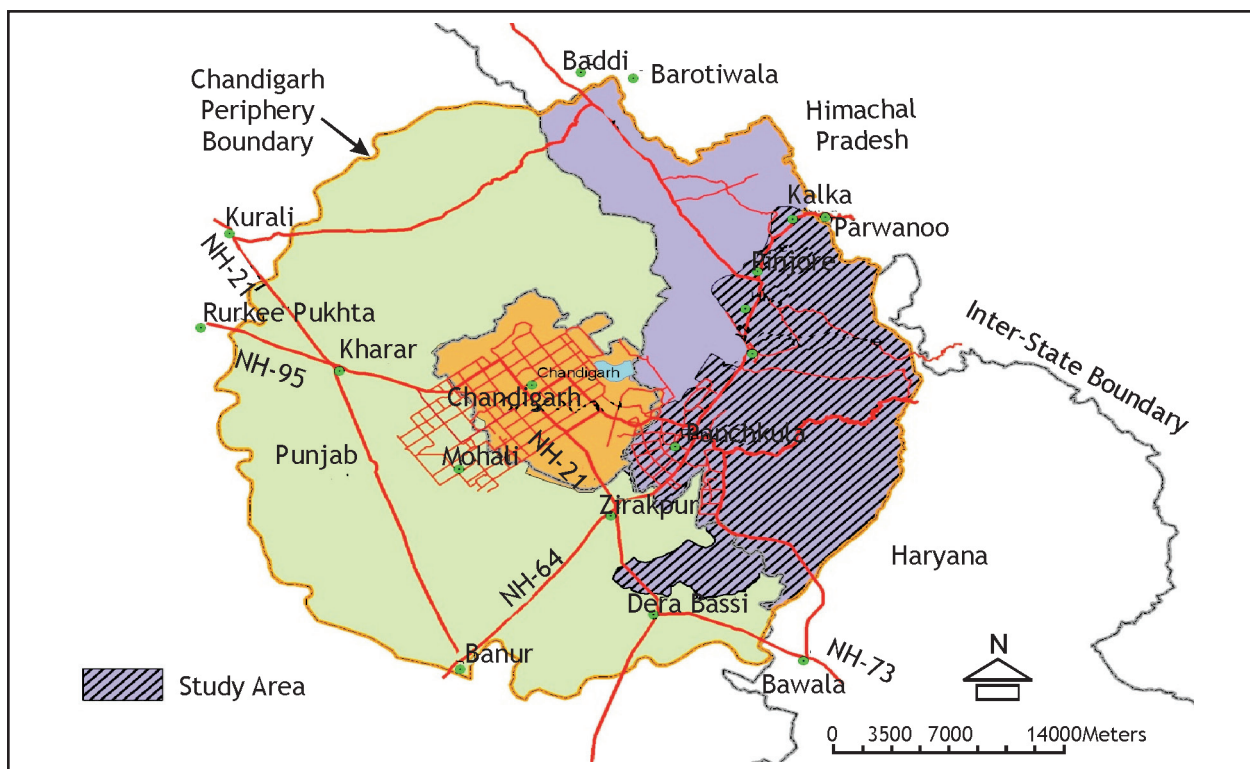
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To better understand the impact of land use change on terrestrial ecosystems, the factors affecting land use needs to be examined. Growing human populations exert increasing pressure on the landscape as demands multiply for resources such as food, water, shelter, and fuel. These socio-economic factors often dictate how land is used regionally. Land use practices generally develop over a long period under different environmental, political, demographic, and social conditions. These conditions often vary yet have a direct impact on land use and land cover (Ojima et al, 1994). Among the factors changing land use are population growth, economy and proximity to resources and basic amenities. Under the influence of growing population in Chandigarh city and its surroundings areas, particularly three towns namely Panchkula Urban Estate, Pinjore and Kalka of Haryana state, the planned land use holds utmost significance for sound environmental planning and resource management. Defying Corbusier's design and dreams Chandigarh could not retain its identity as a fully planned urban island wrapped by a green belt of countryside. There has been a considerable unplanned development particularly in its periphery. The planned development took place in the periphery of Chandigarh before as well as after the reorganization of Punjab (Fig.1).

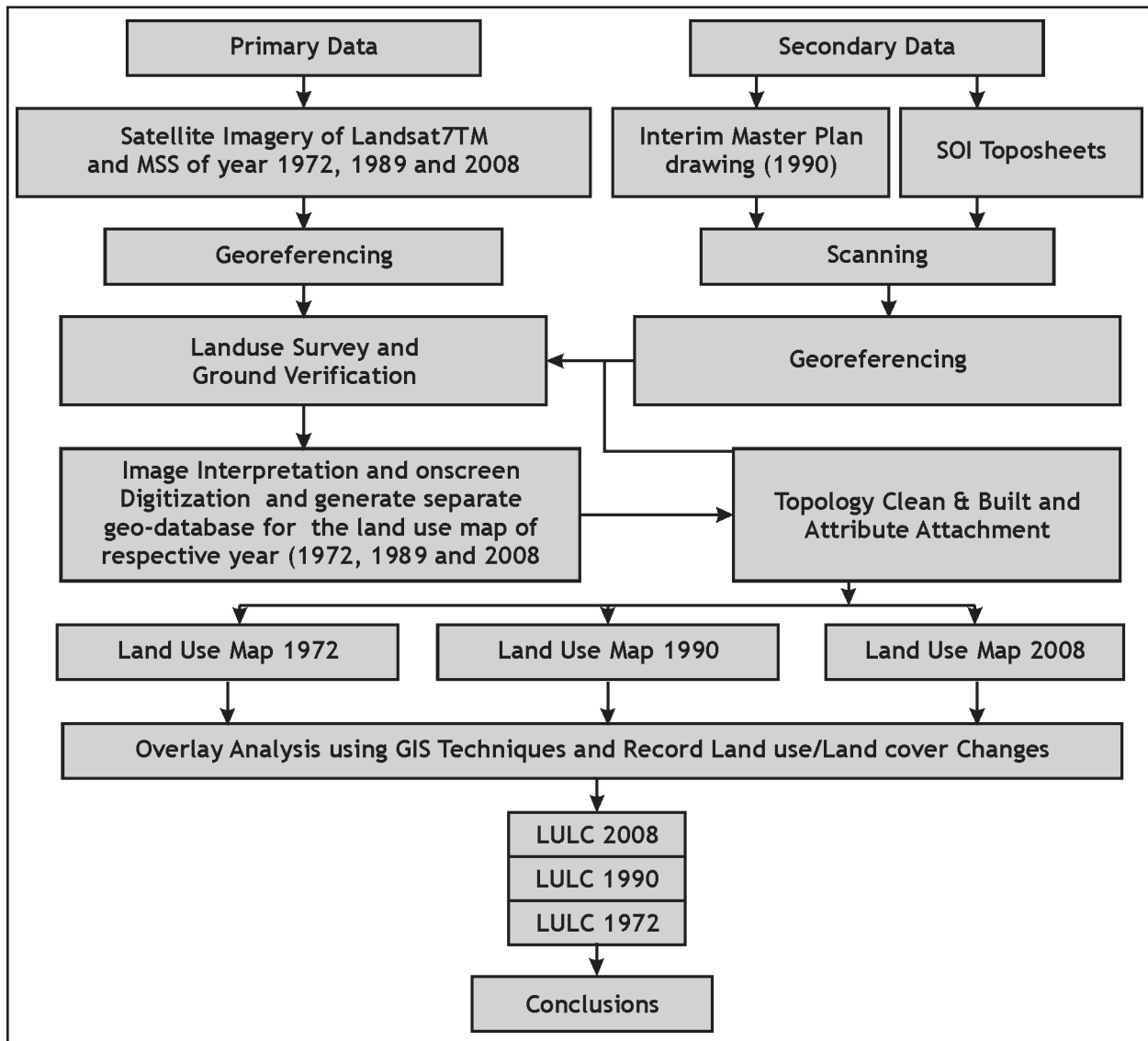
Thus, besides planned, unplanned and haphazard development has been a secularly growing phenomenon. Many new projects are coming in the areas

Fig. 1: Study Area: Enlarge View



Source: 1-Survey of India Toposheet
 II-Chandigarh Inter State Metropolitan Region (CISMeR)-2021 Plan Report

Fig. 2: Methodology



around the Chandigarh (Haryana Region) to meet the demands of the population. Most of the projects are not coming in integration, which are not self-contained and devoid of even civic amenities.

The success of Chandigarh has had its effect on the growth of towns and settlements in the immediate vicinity. Although, the original plan prohibited construction activity within 10 kilometers of the city limits, the state governments of Punjab and Haryana have created satellite townships within this prohibited zone (Takhar, 2002). A large army cantonment has been set up at Chandimandir and the union territory administration has also developed Manimajra, a village just beyond the Capital project area, as a modern residential complex. To the



south of the city, Government of Punjab created Sahibzada Ajit Singh Nagar or SAS Nagar, which is informally known by its old name, Mohali. To the east of the city lies Haryana's newly created town of Panchkula. The Periphery Controlled Area Act, 1952 recommended a wide green belt (initially of 8 km which at later stage increased up to 16 km) around the entire union territory. This Act regulates development, prohibits establishment of any other town or village and forbids commercial and industrial activities in the periphery zone (Sehgal, 2002). The idea was to guarantee that Chandigarh would always be surrounded by countryside. Periphery of Chandigarh was also subdivided with large area on the Punjab side (1,021 sq km) and on Haryana side (295 sq km). Only a small portion was left with the Union Territory of Chandigarh (Fig. 1).

2. STUDY AREA

The study area comprising Haryana sub-region, Chandigarh periphery, controlled area, is spread over an area of about 295 sq km in Panchkula district and includes three towns namely Panchkula Urban Estate, Pinjore and Kalka. The study area is located between $30^{\circ} 32' 42''$ - $30^{\circ} 50' 38''$ N latitude and $76^{\circ} 48' 56''$ - $76^{\circ} 51' 13''$ E longitude. The main objectives of present study are as follows:

- To study the broad land use changes to analyze urban growth with respect to physical expansion during 1972 -2008.
- To study the spatial distribution of land use during the study period.

Present study is based on both traditional (SOI toposheets) and modern (Remote Sensing) data sources. The Survey of India toposheets (53B/13 and 53B/14) at 1:50,000 scale were scanned and geo-referenced with appropriate projection parameters (Projection UTM, Zone-43 and Datum WGS 84). The Landsat TM and MSS satellite imageries scenes acquired in 1972, 1989 and 2008 covering the same area have been downloaded from <http://glcfapp.glcf.umd.edu> web site of Global Land Cover Facilities, Earth Science. Satellite imageries have been geometrically rectified with reference to ground control points (GCP) collected from Survey of India toposheets. Interim Master Plans approved on 15 April 1990 and prepared by Haryana Urban Development Authority (HUDA) have been incorporated in the preparation of landuse map for the year 1990.

Landuse categories relating to agriculture and allied activities, built-up, reserved forests, special areas, vegetal cover, water bodies, mining and slums present in the study area have been generated from remote sensing data. The non-spatial data relating to demographic characteristics have been obtained from Statistical Abstract of Haryana, etc. Geographic Information System (GIS) and Remote Sensing (RS) software such as the Arc GIS 9.1 and ERDAS Imagine 8.5 have been used for image processing, geographical analysis, integration, superimposing/overlying and presentation of the spatial and non-spatial data for examining land cover and land use changes in the study area. The administrative boundaries of state and reserved forest boundary have been taken from toposheets and the boundary of Haryana Sub-region Chandigarh Periphery Controlled Area from



the map given in report titled 'Urban and Architectural Work of Le Corbusier in Chandigarh' prepared in October 2006 by the Department of Tourism, Chandigarh Administration, India.

3. RESULTS AND FINDINGS

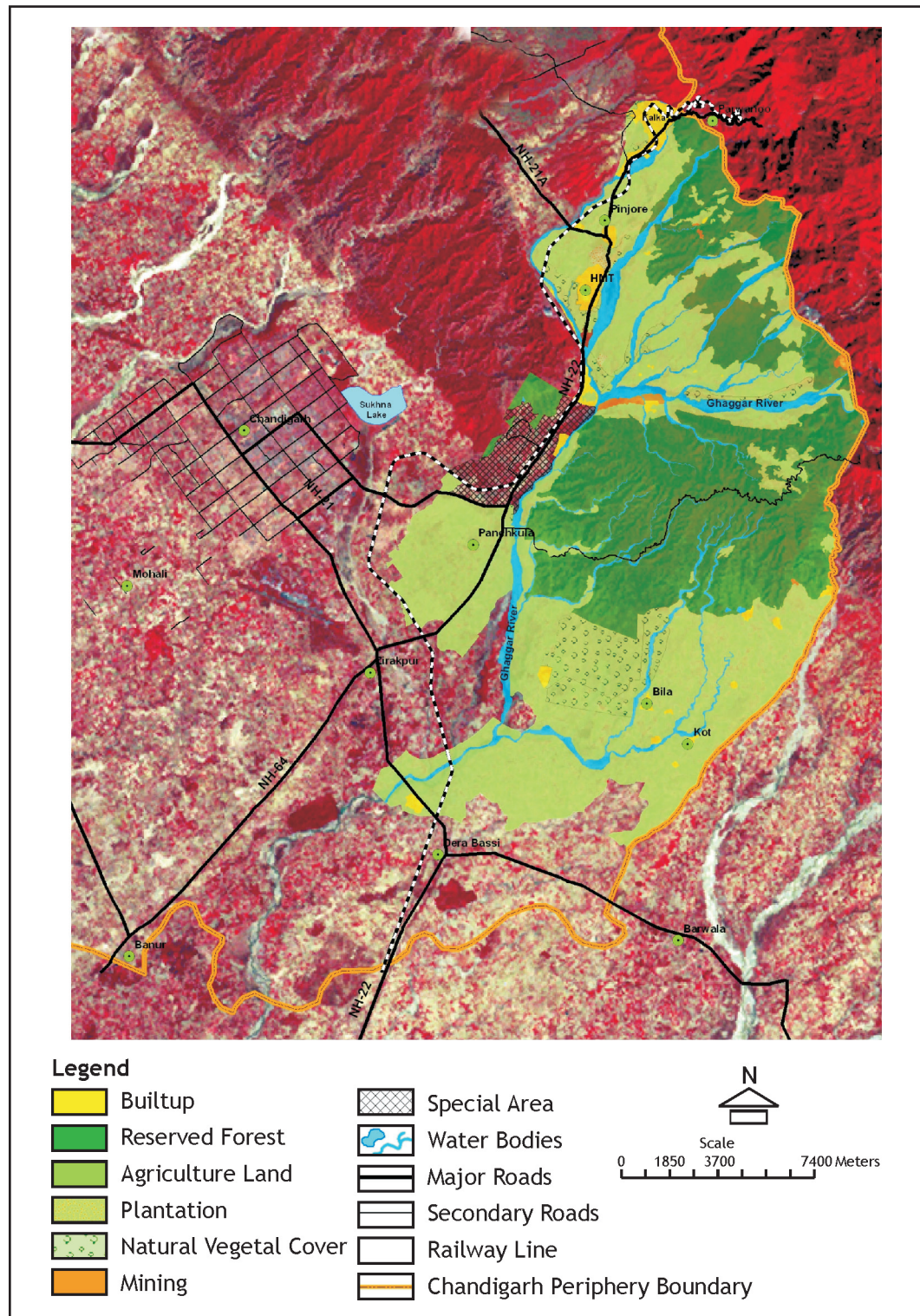
Population of periphery area (Haryana portion) has increased about five times during last three decades. In 1971, population of periphery controlled area (Haryana portion) was 84,143 persons inhabiting 154 villages out of which rural population was 73.92 percent against 26.08 percent of urban population. In 1981, the population of periphery area increased to 124,604 persons with a decadal growth rate of 48 percent whereas the urban population has increased to 30.78 percent over the corresponding previous decade. In 1991, population further increased to 222,346 persons with a growth rate of 78.6 percent. In the last two decades, increase in population of periphery area was almost 3 times which may be considered substantial absolute increase by any planning norms. This huge population increase in the study area is attributed to establishment of various special government projects like HMT, Chandimandir Cantonment, ITBP Complex, Terminal Ballistic Research Laboratory Panchkula, Urban Estate, and nearness to Chandigarh (Capital) periphery area which experienced tremendous socio-economic and physical development of infrastructure. All these factors together also acted as centripetal forces to attract huge number of immigrants from neighboring regions.

Based on the broad land use categories eight land use classes which include agricultural and allied activities, built-up, reserve forest, vegetal cover, special area, water bodies, mining and slums were identified in the study area (Table 2 and Figs. 2, 3 and 4). The study reveals that agricultural land has been declining continuously and is being replaced by the built up area. The area devoted to agricultural purposes was 43 percent in 1972 which declined to 38 percent during next two decades and further declined to 30 percent in 2008. Table 2 shows that area under forests has remained stagnant during the study period. Interestingly, the area under built-up land has sharply increased. Built-up land was hardly 1 percent in 1972 in controlled area. Proportion of built up land has increased to 9 percent in 1990 and further to about 18 percent in 2008. Fig. 3, 4 and 5 reveal that the area under built-up use was earlier devoted to agricultural land.

Increase in built up area has taken place due to new planned residential estate known as Panchkula Urban Estate and increasing urban sprawl due to nearness to capital Chandigarh and good accessibility due to network of roads including NH-22 and Delhi- Chandigarh railway route. The study reveals that change in land use particularly urban expansion has occurred due to huge population pressure in the study area (Table 1). Due to topographical constraints (Ghaggar River) the built-up area has been extended along the Ghaggar River bed and NH-22. Linear urban sprawl has been observed due to the development of HUDA sectors namely 23, 24, 25, 26, 27, 28, 29, 30, 31 and sector 32, Amravati Enclave and Virat Nagar along NH 22 and River Ghaggar.

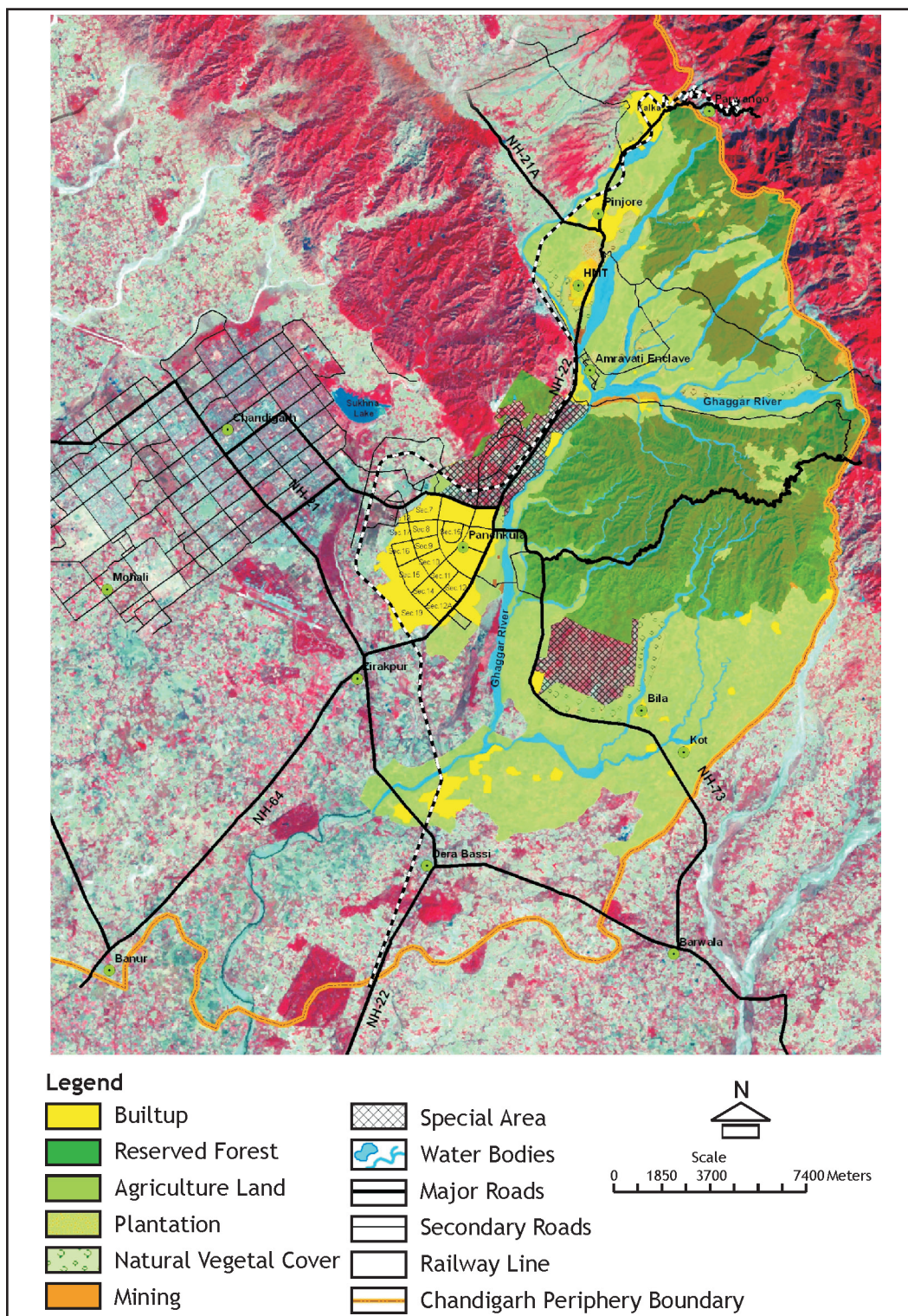


Fig. 3: Haryana Sub-Region, Chandigarh Periphery Landuse / Landcover (1972)



Source: Landsat-MSS Satellite Path158 Row 39 Date 10.10.1972

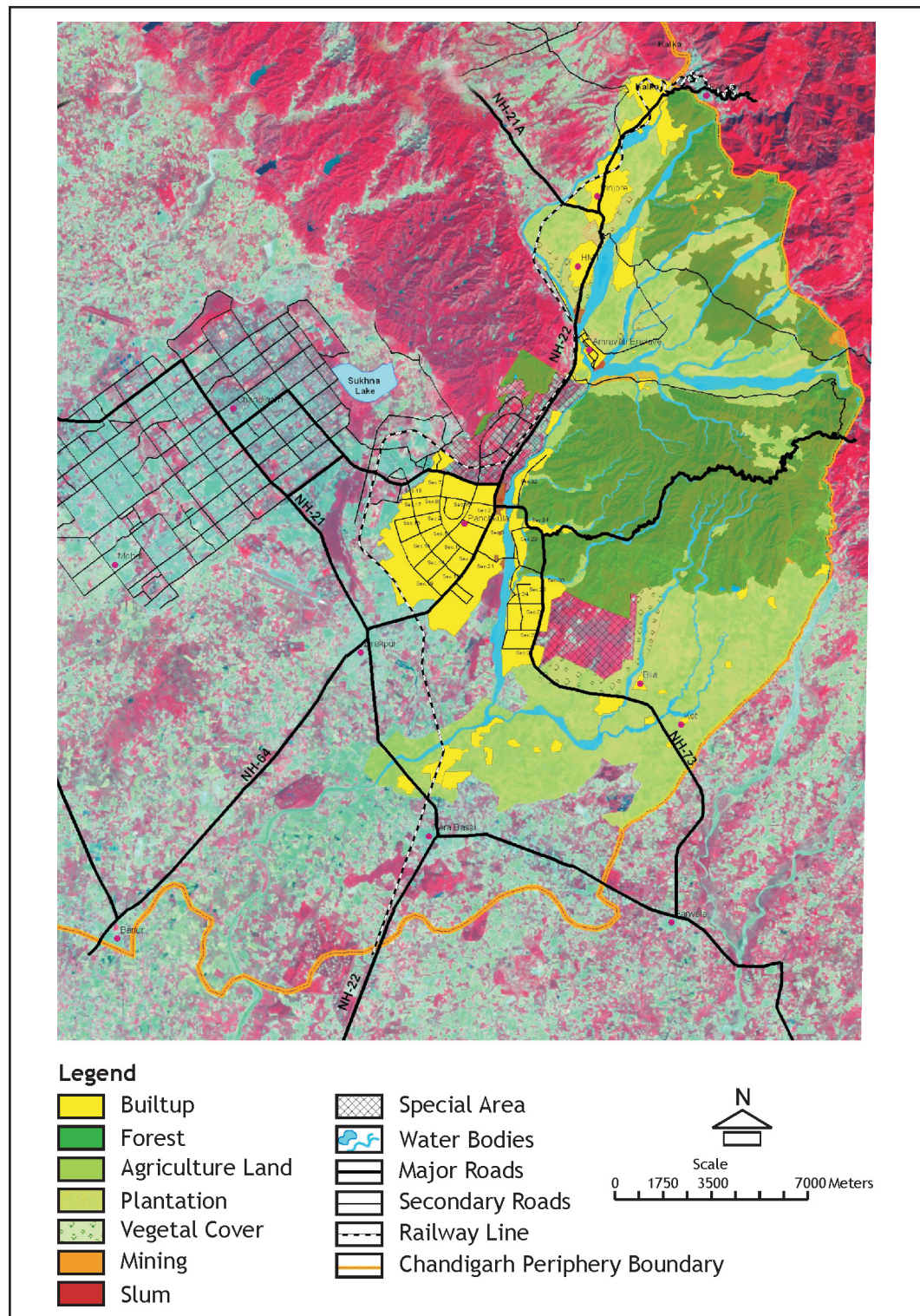
Fig. 4: Haryana Sub-Region, Chandigarh Periphery Landuse / Landcover (1990)



Source: Landsat-7 TM Satellite Path 147 Row 39 Date 25.10.1989

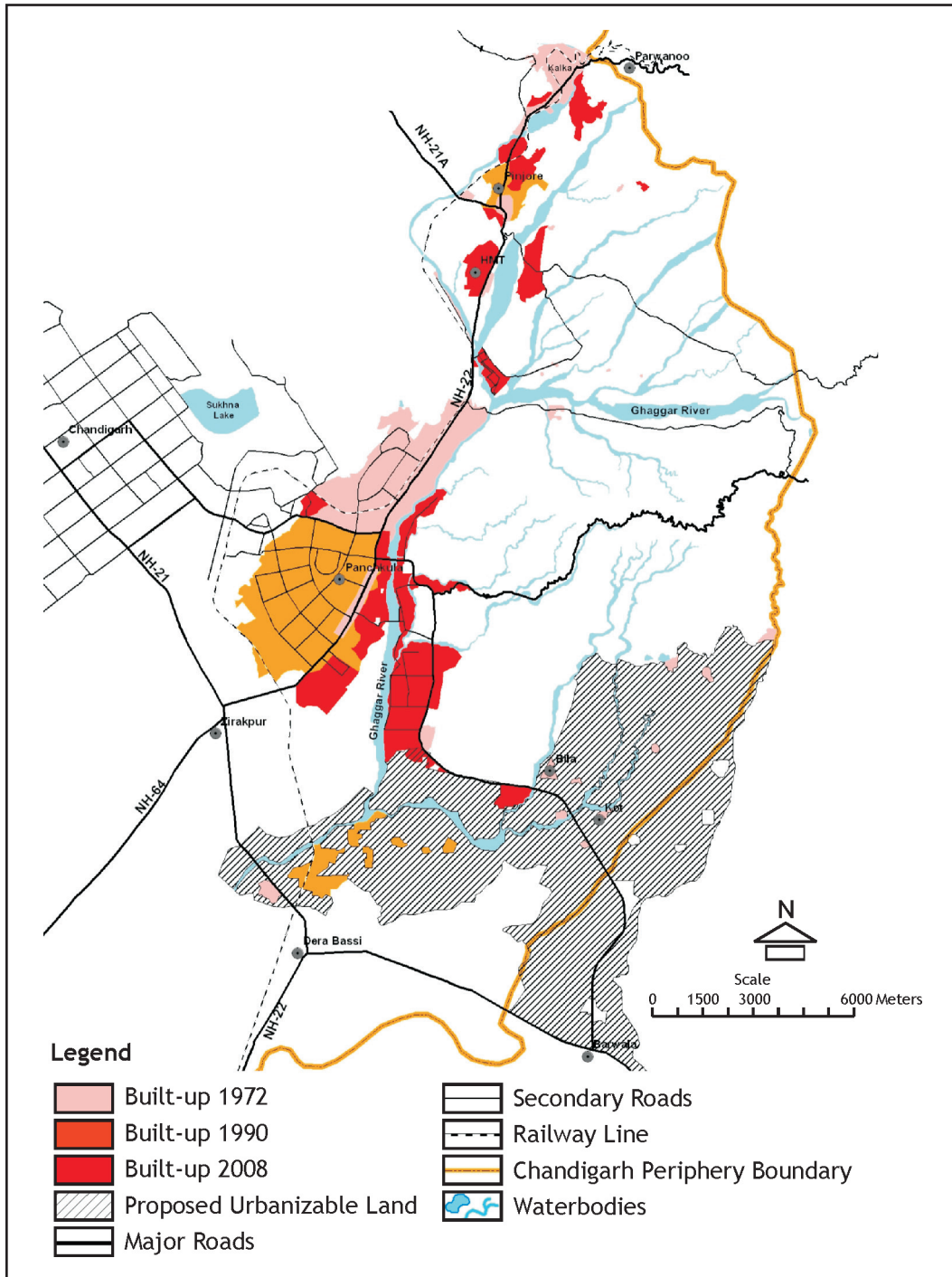


Fig. 5: Haryana Sub-Region, Chandigarh Periphery Landuse / Landcover (2008)



Source: Lansat-7 TM Satellite Path 147 Row 39 Date 13.10.2008

Fig. 6: Haryana Sub-Region, Chandigarh Periphery Growth of Built-up Area (1972-2008)



Source: I-Landsat-MSS Satellite Path 158 Row 39 Date 10.10.1972

II-Landsat-7 TM Satellite Path 147 Row 39 Date 10.10.1989

III-Landsat-7 TM Satellite Path 147 Row 39 Date 13.10.2008


Table 1: Haryana Sub-Region, Chandigarh Periphery Controlled Area: Decadal Population Growth

Census Year	T o t a l Pop.	Population (in %age)		G r o w t h Rate (in %)
		Urban	Rural	
1971	84143	26.98	73.92	-
1981	124604	30.78	69.22	48.08
1991	222346	50.00	50.00	78.60
2001	444692	65.00	35.00	100

Source: *Statistical Abstract of Haryana, 2006*

Spatial distribution of land use brings out that the urban expansion towards north-eastern parts is constrained due to the presence of environmentally sensitive zone i.e. reserved forests and special area (Cantonment Area). The study points out that a large portion of about 43 percent of land in the study area comes under natural resources including streams and reserved and

protected forests. Hence, there are least opportunities of horizontal expansion towards north-east in the study area for urbanizable land for future expansion.

Land devoted to special projects, which include cantonment, terminal ballistic research laboratory, Hindustan Machine Tools and ITBP complex has not witnessed

Table 2: Haryana Sub-Region, Chandigarh Periphery Controlled Area : Per cent Area under Different Landuse Categories over Different Time Periods

Classification	1972	1990	2008	1972	1990	2008
	Area (in Hectares)			Per cent of Total Geographical Area		
1. Agricultural and Related (including crop land, plantation)	12800.00	11330.00	9064.80	43.39	38.41	30.73
2. Built-up (including residential, commercial, industrial, Public & Semi Public and Recreational etc)	257.96	2707.00	5279.70	0.87	9.18	17.90
3. Reserve Forest	10317.01	10317.00	10317.01	34.97	34.97	34.97
4. Vegetal Cover (natural open vegetation)	1930.00	1119.70	857.00	6.54	3.80	2.91
5. Special Area: including Cantonment, Terminal Ballistic Research Laboratory, Hindustan Machine Tools(HMT) and Indo Tibetan Border Police (I.T.B.P)	1857.38	1857.38	1857.38	6.30	6.30	6.30
6. Water bodies (river, streams, nallas)	2228.63	1824.96	1528.23	7.55	6.19	5.18
7. Mining	109.03	309.029	509.03	0.37	1.05	1.73
8. Slums	0.0	34.96	86.85	0.00	0.12	0.29
Total	29500.00	29500.00	29500.00	100	100	100

Source: *LANDSAT Satellite Imageries of Year 1972, 1989 and 2008*



any spatial expansion and change. Therefore, land allocated under this category has remained the same (6.30 percent) during the study period.

Notably, from 1972 to 2008, the natural vegetal cover has been depleted by about 50 percent and might pose a serious threat to ecological balance as the whole study area is environmentally sensitive and rich in biodiversity. The small hills and undulating terrain in northern and eastern parts of the study area falls in catchment of Sukhna Lake. Deforestation of these hills for urban expansion of tri cities of Panchkula, Pinjore and Kalka has also enhanced the sediment load in Sukhna Lake. It is an earthquake prone area and the construction of dam over Kaushlya, a tributary of River Ghaggar calls for further exploration in view of a large chunk of human population inhabiting the region.

4. CONCLUSIONS

Foregoing discussion makes it clear that land uses in the study area have undergone significant transformations during last 35 years. Impact of growing population on the land use change is also discernible as population has experienced about five times increase during the study period. The study reveals that area under agricultural land and built up use has witnessed sharp decrease and increase respectively. This change in land use has largely been between these two categories. It is more evident from the fact that area under agricultural use was about 43 percent during early 1970s which declined to 38 percent during the next two decades and further declined to 30 percent in 2008. In contrast, the built-up land was hardly 1 percent in 1972 in controlled area, which rose to 9 percent in 1990 and further to about 18 percent in 2008. It is observed that such increase in built up area has taken place due to new planned residential estate known as Panchkula Urban Estate and increasing urban sprawl due to nearness of Chandigarh city and good accessibility due to network of roads including NH-22 and Delhi-Chandigarh railway route. The study therefore reveals that changes in land use particularly urban expansion has occurred due to huge population pressure in the study area. The study also reveals that the natural vegetal cover has also been depleted by about 50 percent and might pose a serious threat to ecological balance as the whole study area is environmentally sensitive region and rich in biodiversity. The study illustrates the importance of the Remote Sensing and GIS in land use analyses.

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