

INTEGRATED APPROACH TO MAP LANDUSE & LANDCOVER CHANGES IN AN URBAN (GREEN) CITY IN NORTHERN INDIA- A CASE STUDY OF CHANDIGARH

L. N. Sharma,

Associate Professor, Department of Applied Sciences, Punjab Engineering College- University of Technology,

Sector-12, Chandigarh-160012, India, 0172-2753259, email:lnsharma@yahoo.com

KEY WORDS: *Land use, Aerial Photographs, GIS- ILWIS, Digital Map, Chandigarh*

ABSTRACT: Chandigarh a green, urban city built in 1966, located at 340 m above MSL, situated in the shadow of the geologically unstable Shivalik hills. The urban boundaries are defined by two rivulets- the Patiala-ki-Rao on the north-west and the Sukhna choe on the south-east. Administrators & planners of this urban city require information on land use / land cover on a single platform on large scale, for monitoring and managing resources and for effective planning. Further, to monitor growth and development activities of its urban environment and to record spatio-temporal changes a digital map having possibility to update dynamic changes has become a necessity. The urbanization in Chandigarh has induced rapid drastic changes in the land use and land cover in the past two decades leading to many changes in the infrastructure and environment. To overcome conventional ground based techniques large scale aerial photographs (1:10,000) with limited ground truth verification were used for preparing Land use / land cover map. A mosaic of 120 aerial photographs was subjected to visual photo interpretation techniques to map different land use and land cover classes covering an area 114 sq km. Interpreted map was digitized & brought under G.I.S (Integrated Land and Water Information System - ILWIS- Netherland) platform. Analytical tools of GIS software were used for analyzing different categories of land use and land cover. Study brought out built up land as the main land cover. Plantation, forest, grassland and crops together constitute and provide green status to the city. Discrepancies in map prepared from 1998 aerial photographs and present trend of the land cover and land use have been observed. It is recommended that an integrated approach needs to be adopted for monitoring spatial and temporal changes using GIS and satellite data. To retain its urban green status, development and trends of land use and land cover, a digital map is necessary to be generated every year using high resolution satellite images to register changes taking place in land use / Land cover. Such a yearly satellite derived digital map will prove to be of immense use to administrators and planners for developmental activities & effective planning.

1. INTRODUCTION

Proper planning, management and monitoring of the natural resource will depend on the availability of information on land use / land cover inventories. Land use /cover allows long term trend in time and space thus help in forming policy. All developmental activities are based on the availability of land resources. Spatio- temporal variations in the urban land use of Mumbai of Mithi river catchment area was carried out using multi sensor satellite data and GIS (Kamini J et al, 2006). Land use mapping of Kandi belt in Jammu region was carried out using digital data of IRS 1C LISS –III (Vijay et al, 2004). Land use –Land cover mapping for Udipi District, Karnataka using IRS 1C and 1D data was carried out (Shetty A et al, 2005). Severe land use changes in the past century were assessed using IRS 1C LISS III images (Raju et. al 2006). Land use / land cover changes near Hazira region, Gujarat have been brought out using IRS 1C LISS III data (Chauhan H.B et al 2005). They have reported decrease in forest and agriculture area where as built up area has increased. With increasing population and national economy continues to move away from agriculture based system, cities are growing and spreading.

Chandigarh is located at an average elevation of 340 m above MSL, situated in the shadow of the ecologically sensitive and geologically unstable Shivalik hills. The urban boundaries of the City are defined by two seasonal rivulets, namely, the Patiala-ki-Rao on the north-western side and the Sukhna choe on the south-eastern side (Fig.1). Chandigarh being no exception, the urban sprawl often infringes upon viable agricultural or productive forest land. This can not be resisted or deflected due to overwhelming momentum of urbanization taking place due to developmental activities such as IT Park and Tri city developmental plan- Chandigarh, Mohali and Panchkula. The change in land use from rural to urban, thus need to be monitored in view of the increasing population. The city was planned for 5 lakhs inhabitants; it has already accommodated more than 9 lakhs. Thus, it has put lot of pressure on the land use and land cover. Analyzing agricultural vs urban land use is important for ensuring that development does not encroach on valuable agricultural land.

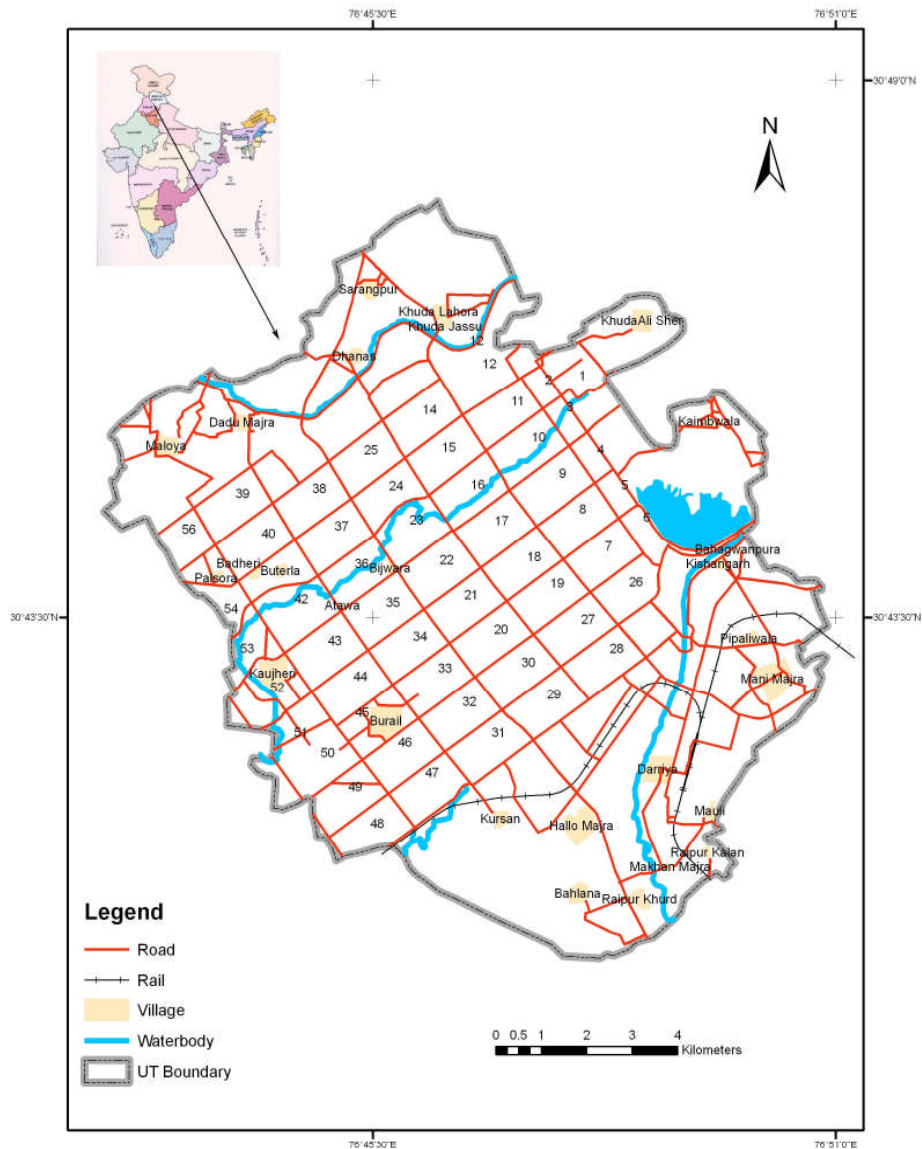


Figure - 1 Location Map of the Study Area

In the present study 1:10,000 scale Aerial Photographs (A.P) were employed to classify types of land use in practical and economical way over large area of Chandigarh. Further various features of land use / land cover were delineated from A.P. Land cover mapping serves as a basic inventory of land resources for all levels of government, environment and private industry. The accurate inventory serves as baseline map for future monitoring and land management. The properties measured with remotes sensing techniques relate to land cover from which the land use can be inferred, particularly with ancillary data or a priori knowledge. In addition to facilitating sustainable management of the land, land cover and land use information may be used for planning, monitoring and evaluation of development, industrial activity or reclamation. The resultant map of the land use /cover existed at the time of the photographs were taken has been brought out very well. This information will be very useful to planners, administrators and government offices for monitoring, managing and effective planning of land as resource in the Chandigarh city. Further, this study will be helpful in identification of urban growth, knowledge of rate and the trends of growth. This information will be very useful for planning of the city and region as a whole as far as development of infrastructure is concerned.

2. METHODOLOGY

The base map of the Chandigarh at a scale of 1:10,000 was traced containing prominent landmarks. Mosaic of aerial photographs at 1:10,000 was prepared. Using elements of photo interpretation land use and land cover map of the Chandigarh was prepared by employing visual interpretation techniques i.e. tone, texture, size, shadow, shape and location on the individual aerial photographs. Lens stereoscope and mirror stereoscope have been used for interpreting, viewing terrain in 3D, enhancing and thus aiding in interpretation. Interpreted details were verified in the field by carrying out extensive ground truth verification / field campaigning. Field photographs were taken of the different categories of the land use and land cover to establish correlation between categories. Having corrected the interpreted details after knowledge acquired through ground truth verification, where ever necessary the final integrated map of Chandigarh showing different classes of land use and land cover was prepared from the aerial photographs existed at that time (Fig 2). For land use / Land cover classification standard categories of agro-climatic zones as adopted under national project was adopted. Interpreted map was scanned and digitized using ILWIS –GIS software.

3. RESULTS AND DISCUSSIONS

The following classes of Land use Land cover categories have been interpreted using aerial photographs. Interpreted details were verified in the field through ground truth collection, as shown in photographs. Aerial photographs being perspective projection, scale does not remain same through out the frame. While interpreting 120 photographs manually by preparing a mosaic minor errors can not be ruled out. While interpreting care was taken not to consider periphery of the photographs but central part of each photograph was considered.

3.1 BUILT UP LAND – URBAN

This category comprises areas of intensive land use where much of the land is covered by structures and buildings. This is the most dominant land use category of the Chandigarh covering almost 50% area. On the aerial photographs dense network of streets shows regular grids, high reflectance and regular pattern. The well demarcated urban sectors are divided by wide roads and have circular transportation system. Sector-wise details have been brought out very well.

3.2 BUILT UP LAND – RURAL

Here buildings & streets show distinct network i.e small in size, congested and less regular pattern. Rural village is always showing a cluster of houses away from urban main land often having less areal extent than urban sectors. The typical texture and congested bright tone on aerial photographs holds true for all the 18 villages falling out side the sector system made it easy to discern this category of land. Apart from prominent villages, colonies (congested residential areas) have been easily identified on the A.P due to pattern and tone.

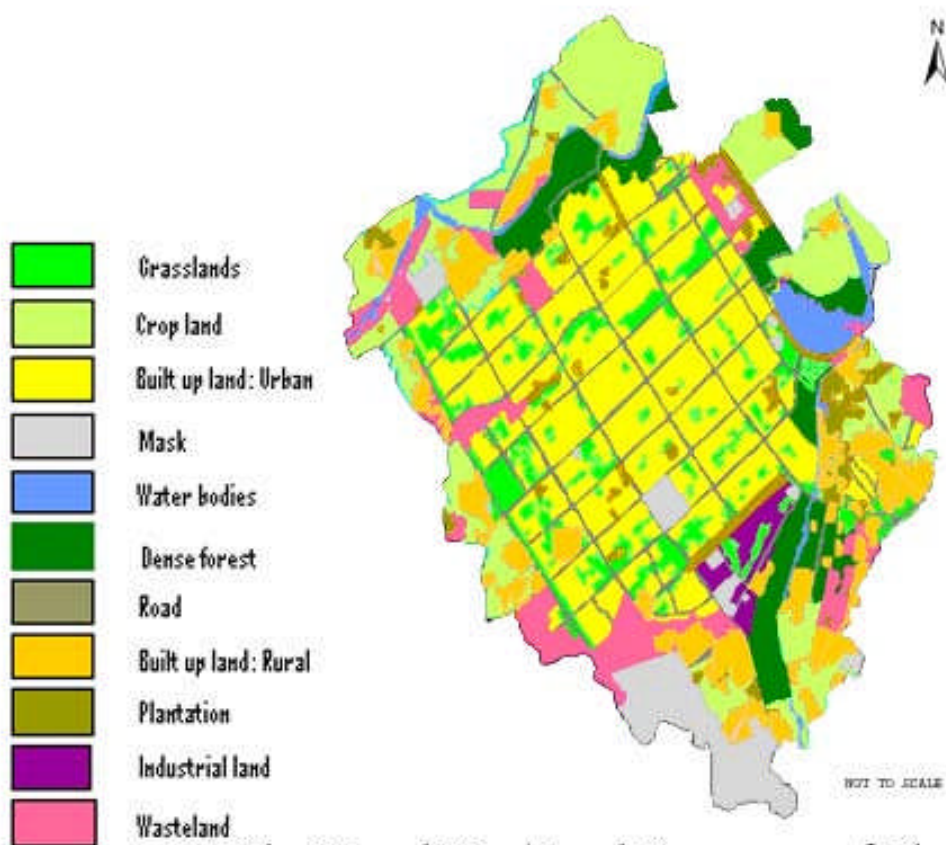


Fig: 2 Land Use / Land Cover map of Chandigarh

3.3 INDUSTRIAL LAND

The building structures of industrial land do not show any symmetry. Prior knowledge helped in identifying this category on the A.P. Industrial land is divided in to Phase-I and Phase-II. The transport area was also easily delineated on the photographs and even trucks parked at the time of the photograph was taken can be easily identified. So is the case of large number of buses can be seen parked in the Inter State Bus Terminal.

3.4 CROP LAND

Land used for agriculture / crops on aerial photographs was readily recognized as it shows rectangular or circular patterns in addition to its tone but are devoid of regular grid. Cultivation pattern was very clearly identified on the aerial photographs. Rectangular dark patches through out periphery of the Chandigarh urban area are identified as crops. Well developed crops are seen on the outer fringes of all the villages.

3.5 PLANTATION

Apart from certain pockets having clusters of plants in the city, all along the roads a thin dark tone is due to plants identified on the aerial photographs. In addition to showing different signatures, plants definitely shows different pattern and location, when compared to forest and crops, thus helped in identify this category.

3.6 DENSE FOREST

A large & wide strip of forest land was found in the west running parallel in between railway line and industrial land. Considerably big patch of dense forest is located south of Sukhna Lake & parallel to Paschim marg is also

easily identified based on the dark tone and location. Typical signatures & pattern of dense forest are very dark on the aerial photographs.

3.7 GRASS LAND

This category of grass includes wide range of grass types i.e lawns, gardens, play grounds and shrubs. Almost all the sectors in city have a gardens and grass land is prominently seen in all the sectors. Rose garden, bougainvillea garden and shrubs found along the Nala flowing in the centre of the Chandigarh cutting across sectors have been classified in this category. Grasses and shrubs show less reflectance in comparison to plants. Further, their pattern and texture definitely helped in delineating them on aerial photographs.

3.8 WATER BODIES:

There are two seasonal rivulets, namely, the Patiala-ki-Rao on the north-western side and the Sukhna choe on the south-eastern side. In addition one artificially man made lake named as Sukhna lake as shown constructed across Sukhna choe and conceived as a major place of relaxation, tourist and sport. The reservoir of the lake is in the shape of a bean seed. The Lake spreads on the foothills of the Shivalik mountain range. Sukhna choe enters Chandigarh from the east near Bhagwanpura. Further, it flows south easterly & runs parallel to railway track and leaves Chandigarh boundary through Raipur Khurd. Dry rivulet beds of both the rivulets namely Patiali Rao and Sukhana Choe could be easily identified on aerial photographs by their shape, location and distinct bright tone. Another water body is seen near Fainda village.

3.9 WASTE LAND

Well known waste lands sites Dadu Majra dumping grounds & land near Indira colony in the east could be easily identified on the aerial photographs. Waste land showed bright tone with no proper symmetry, texture and size. Some more areas waste could be discerned are village Mauli, right side of the railway track, Ram Darbar Colony, Burail jail, sector 47 and sector 37.

3.10 MASKED

Many strategically important buildings i. e Raj Bhawans of Punjab & Haryana, Secretariat, C.S.I.O and Airport areas have been masked on the aerial photographs; thereby no interpretation could be carried out. Such areas are shown as masked on the final map in the absence of details available from the aerial photographs.

3.11 ROADS

All the roads dividing sectors are identified as major roads and could be easily delineated on the aerial photographs by the virtue of straight lines in addition their tone being bright in contrast to the surroundings. This contrast is due to plants grown all along the major roads having dark tone on the aerial photographs. National highway 21 entering from north and passing through the south of the city being wide have also been clearly demarcated. All the roads dividing sectors and national highway are being wide enough have been shown as double lines on the final map. Most of the roads connecting to villages on the outer boundary are thin compared to sector dividing roads and hence they are shown single line.

4. CONCLUSIONS

A large scale (1:10,000) land use / land cover map, hitherto lacking for this green urban city was prepared using aerial photographs. Resultant digitized map in addition to showing what land is being used and the categories of land is covered with. This information on a single platform will be useful for monitoring and managing land resources for planners and administrators. Herculean task of preparing Land use / land cover map using conventional ground based techniques is over come by using aerial photographs with limited ground checks in practical and economical way.

Study also brought out that either many new structures have come up or removed. Thus considerable changes in the land use and land cover from March 1998 to 2006 Dec are noticed.

To retain its green urban city status, it is recommended that an integrated approach is need of the hour to record dynamic spatio-temporal changes taking place in the city. With high resolution satellite data and limited field checks a digital dynamic land use and land cover map should be generated every year to register changes and update this map so as to help administrators and planners of the city.

5. ACKNOWLEDGEMENTS

Thanks are to Director, Department of Science and Technology, Chandigarh for funding this research project. Author wishes to thank Director, Punjab Engineering College, for constant encouragement and support to undertake this assignment.

6. REFERENCES

- Chauhan, H.B and Nayak Shailesh, 2005, Land use / Land cover changes near Hazira region, Gujarat using remote sensing satellite data. *J. Indian Society of Remote Sensing* 33 (3): 413-420
- Kamini J, Jayanthi S.C and Raghavswamy V (2006). Spatio- temporal analysis of Land use in Urban Mumbai- using multi sensor satellite data and GIS techniques *J. Indian Society of Remote Sensing*. 34 (4): 385-396
- Kumar Vijay, Rai S.P and Rathore D.S (2004). Land use mapping of Kandi belt of Jammu region. *J. Indian Society of Remote Sensing* , 32(4): 323-328
- Raju K and Kumar R.A (2006). Land use changes in Udumbanchola taluk, Idukki district- Kerala: An analysis with the application of remote sensing data, *J. Indian Society of Remote Sensing* 34(2): 161-169
- Shetty Amba, Nandagiri L, Thokcham S and Rajesh MVS (2005). Land use – land cover mapping using satellite data for a forested watershed, Udipi Distt., Karnataka, *J. Indian Society of Remote Sensing* 33 (2): 233-238