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LAND USE AND LAND COVER CHANGES IN DELHI 1999 AND 2006

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ABSTRACT

In the present scenario, where we do not have planned urbanisation in most parts of India and haphazard growth of urban area is taking place. Due to this land use pattern are changing from green to build-up area which has its own environmental impacts on the health of city. With the help of recent developed technologies like Remote Sensing and Geographical Information System, which give synoptic and continuous temporal coverage of data and facilitate the analysis of that data in better way, we can monitor such type of change and can make better plans for better future. In the present study we compared the satellite images (LANDSAT TM) of two time periods with help of GIS to get the pattern of change in land use in Delhi from 1999 to 2006. Are under agriculture and barren land decreased from 1999 to 2006 and area under forest, water bodies, and build-up has increased during the same period.

KEYWORDS: *Land use, Remote Sensing, GIS, Urban Growth, and Planning.*

INTRODUCTION

Spatially continuous digital databases on land cover and other important biophysical attributes (soils, elevation, topography, etc.) have become increasingly available via websites and data portals. Coupled with advances in computer technology, including processing speed, data capacity, software development (e.g., geographic information systems and statistical programs), and distributed network capabilities, this availability now makes it possible to conduct environmental assessments at multiple scales over relatively large geographic.

Furthermore, the spatial information from surface water bodies, land cover, built up area, forest area, agriculture area and barren land, urbanisation and other high temporal land use practices using satellite remote sensing data can provide a reliable database in timely manner. Timely and accurate information on natural resources is a prerequisite to their optimal utilization and effective management, particularly of remote and inaccessible areas. There is a need to obtain reliable data on vegetation resources at regional and micro-levels, which would help in planning forest management strategies for sustained yield and would benefit the society. Land cover is the overall effect produced by abundance or scarcity or even diversity of the plant life. Hence, it is essential to assess the vegetation cover and understand the reason for the decrease in vegetation

cover in urban area. The recent researches show that the overwhelming population pressure, in 1999-2006 what was the situation of vegetation cover as nature part among the populace and built up area.

DEFINITION OF TERMS

- **Remote sensing:**

Can be defined as any process whereby information is gathered about an object, area or phenomenon without being in contact with it. Given this rather general definition, the term has come to be associated more specifically with the gauging of interactions between earth surface materials and electromagnetic energy.

- **Geographic Information system:**

A computer assisted system for the acquisition, storage, analysis and display of geographic data.

- **Land use:** This is the manner in which human beings employ the land and its resources.
- **Land cover:** Implies the physical or natural state of the Earth's surface.

CAUSES AND CONSEQUENCES:

Changes in land use and land cover date to prehistory and are the direct and indirect consequence of human actions to secure essential resources. This may first have occurred with the burning of areas to enhance the availability of wild game and accelerated dramatically with the birth of agriculture, resulting in the extensive clearing (deforestation) and management of Earth's terrestrial surface that continues today. More recently, industrialization has encouraged the concentration of human populations within urban areas (urbanization) and the depopulation of rural areas, accompanied by the intensification of agriculture in the most productive lands and the abandonment of marginal lands. All of these causes and their consequences are observable simultaneously around the world today.

* Biodiversity loss: When land is transformed from a primary forest to a farm, the loss of forest species within deforested areas is immediate and complete. Even when unaccompanied by apparent changes in land cover, similar effects are observed whenever relatively undisturbed lands are transformed to more intensive uses, including livestock grazing, selective tree harvest and even fire prevention. The habitat suitability of forests and other ecosystems surrounding those under intensive use are also impacted by the fragmenting of existing habitat into smaller pieces (habitat fragmentation), which exposes forest edges to external influences and decreases core habitat area.

* Climate Change: Land use and land cover can increase or decreasing in release of carbon dioxide to the atmosphere by disturbance of terrestrial soils and vegetation, and the major driver of this change is deforestation, especially when followed by agriculture, which causes the further release of soil carbon in response to disturbance by tillage. Changes in land use and land cover are also behind major changes in terrestrial emissions of other greenhouse gases, especially methane (altered surface hydrology: wetland drainage and rice paddies; cattle grazing), and nitrous oxide (agriculture: input of inorganic nitrogen fertilizers; irrigation; cultivation of nitrogen fixing plants; biomass combustion).

* Pollution: Changes in land use and land cover are important drivers of water, soil and air pollution. Perhaps the oldest of these is land clearing for agriculture and the harvest of trees and other biomass. Vegetation removal leaves soils vulnerable to massive increases in soil erosion by wind and water, especially on steep terrain, and when accompanied by fire, also releases pollutants to the atmosphere. This not only degrades soil fertility over time, reducing the suitability of land for future agricultural use, but also releases huge quantities of phosphorus, nitrogen, and sediments to streams and other aquatic ecosystems, causing a variety of negative impacts (increased sedimentation, turbidity, eutrophication and coastal hypoxia). Mining can produce even greater impacts, including pollution by toxic metals exposed in the process.

STUDY AREA

The study area covers the administrative boundary of Delhi. It lies between the latitudinal parallels of 28º 40 N and 28º 67and the longitudinal parallels of 77º 17 E and 77º 22 E .with an area of 1483sq.km, it corresponds to a typical patch of the tropical region completely engrossed with residential commercial and urban centers .Its South-north length is approximately 54 km and East –west distance is 51 km. The climate is classified as continental because of its distance from the sea with temperature range varying from 45 C in summers to 4 C in winters; rains are spread throughout the year (Milap, et al 2010) **[1].**

LITERATURE REVIEW

Land use affects land cover and changes in land cover affect land use. A change in either however is not necessarily the product of the other. Changes in land cover by land use do not necessarily imply degradation of the land. However, many shifting land use patterns driven by a variety of social causes, result in land cover changes that affects biodiversity, water and radiation budgets, trace gas emissions and other processes that come together to affect climate and biosphere (Riebsame, Meyer, and Turner, 1994) **[2].**

According to Meyer, 1999 every parcel of land on the Earth's surface is unique in the cover it possesses. Land use and land cover are distinct yet closely linked characteristics of the Earth's surface. The use to which we put land could be grazing, agriculture, urban development, logging, and mining among many others. While land cover categories could be cropland, forest, wetland, pasture, roads, urban areas among others. The term land cover originally referred to the kind and state of vegetation, such as forest or grass cover but it has broadened in subsequent usage to include other things such as human structures, soil type, biodiversity, surface and ground water.

Macleod and Congation (1998) **[3]** list four aspects of change detection which are important when monitoring natural resources:

1. Detecting the changes that have occurred.

2. Identifying the nature of the change.

3. Measuring the area extent of the change.

4. Assessing the spatial pattern of the change.

The basis of using remote sensing data for change detection is that changes in land cover result in changes in radiance values which can be remotely sensed. Techniques to perform change

detection with satellite imagery have become numerous as a result of increasing versatility in manipulating digital data and increasing computer power.

Mahajan (2006) **[4]** studied Spatial characteristics of vegetation cover based on remote sensing and geographical information system (GIS),In fact the pattern of vegetation distribution on ground is always associated with particular topographic features. The images were acquired in December 1989 and December 1990. This exercise demonstrated the control of elevation (altitude), relief and drainage on the spatial distribution of vegetation cover. The biotic factors are also responsible for the spatial distribution of vegetation. The vegetation of this area is mixed dry deciduous with few moist deciduous elements. The interpretation of satellite images resulted into five vegetation classes and GIS analysis indicates that the very dense forest was mostly confined to interfluves areas at variable relative relief, but particularly at higher elevation i.e. 400 and 800 m ASL. Open forests were found to be associated with settlements and agricultural fields. The sparse vegetation was common on interfluves and along nallas at high elevation. These results were strongly supported by ground surveys at selected locations.

Sakthivel, et al. (2010) **[5]** studied Remote sensing and GIS based forest cover change detection study in Kalrayan hills, Tamil Nadu , focuses on the role of remote sensing and geographic information system (GIS) in assessment of changes in forest cover, between 1931 and 2001, in the Kalrayan hills, Tamil Nadu. The trend of forest cover changes over the time span of 70 years was precisely analysed using high resolution Satellite data. The study revealed that the forest cover was 275.6, 481.7 and 266.5 sq.km in 1931, 1971 and 2001 respectively. It was noticed that forest cover has increased between 1931 and 1971, because of the implementation of various forestation schemes by the forest department and scared grooves. It also revealed that the forest cover loss between 1971 and 2001 could be due to Shifting cultivation and illegal encroachments by villagers; and the forest cover drastically decreased on plateau areas due to human population pressure. The study analyses the forest cover change in the tropical deciduous forest region of the Eastern Ghats of India. It is envisaged that the study would prove the usefulness of Remote Sensing and GIS in forest restoration planning.

OBJECTIVE

Urbanization is characterized by rural to urban land conversion. Urban planners and policy-makers desire scientifically based assessments on the short and long-term effects of these rural to urban land conversion activities.

- To study the land use/ land cover in Delhi in 1999 and 2006.
- To determine the trend and, rate calculating how much land cover change in Delhi in 1999 and 2006.

DATA SOURCE

For the study, LANDSAT satellite images of Delhi State were acquired for TWO years for 1999 and 2006.

TABLE1- DATA SOURCE

S/N	DATA TYPE	Acquired Date	Spatial Resolution	SOURCE
1.	LANDSAT image	1999 Dec	30m ^{TM}	GLCF
2.	LANDSAT image	2006 May	30m ^{TM}	GLCF

METHODOLOGY

Satellite remote sensing and Geographic Information System (GIS) are widely applied in identifying and analyzing Land use and Land cover change over several periods (Weng 2002) **[6].** Satellite remote sensing provides multi-spectral and multi-temporal data that can be used to quantify the type, amount and location of land use change. On the other hand, GIS provides a flexible analysis for displaying, storing and analyzing digital data necessary for change detection. In fact the methodologies used in this study are as follow:

Supervised Classification:

With supervised classification, we identify examples of the Information classes (i.e., land cover type) of interest in the image. These are called "training sites". The image processing software system is then used to develop a statistical characterization of the reflectance for each information class. This stage is often called "signature analysis" and may involve developing a characterization as simple as the mean or the rage of reflectance on each band, or as complex as detailed analyses of the mean, variances and covariance over all bands.

One main methods of data analysis were adopted in this study. Calculation of the Area in hectares of the resulting land use/land cover types for each study year and subsequently comparing the results. This method used for identifying change in the land use types (vegetation cover and built up area). Therefore, they have been combined in this study and the comparison of the land cover (vegetation cover) statistics assisted in identifying the percentage change, trend and rate of change between 1999 and 2006.

Growth Rates:

The percent change from one period to another is calculated from the formula:

$$PR = \frac{(V_{Present} - V_{Past})}{V_{Past}} x100$$

PR = Percent Rate
$V_{Present}$ = Present or Future Value
V_{Past} = Past or Present Value

OUTPUTS AND ANALYSIS

In the present study, land use/ land cover is categorised into five classes which are following: Agriculture, Forest, Water Bodies, Barren land and Build-up area. Table 2 is showing the area under different categories for year 1999 and 2006. Map 1 and 2 are showing the spatial distribution of different categories over the Delhi for 1999 and 2006 respectively.

TABLE 2 LAND USE/LAND COVER AREA IN DELHI 1999-2006					
Classes	2006 in %	1999 in %	2006 in sqkm	1999 in sqkm	Growth rate %
Agriculture	21.40	35.90	317.35	532.39	-40.39
Forest	23.91	17.53	354.59	259.95	36.40
Barren	23.66	24.20	350.88	358.89	-2.23
Water Bodies	1.40	0.97	20.72	14.35	44.40
Buildup Area	29.63	21.40	439.47	317.42	38.45
Total	100.00	100.00	1483.00	1483.00	

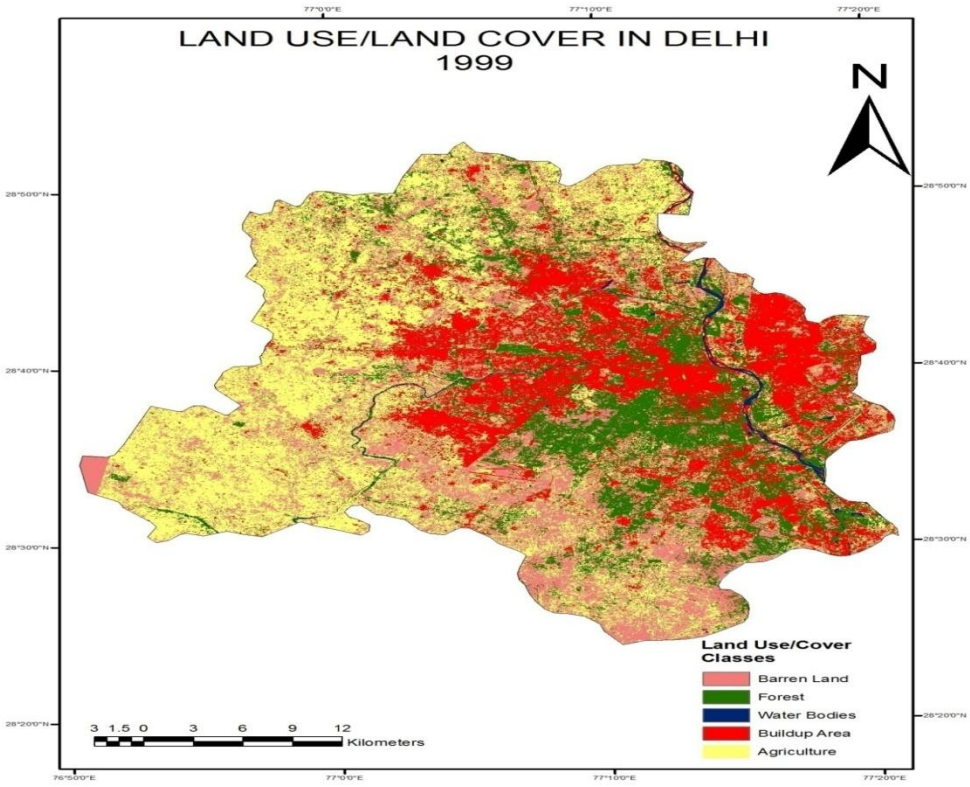
From table 2, there seems to be a negative change i.e. a reduction in agriculture land from 35.8% in 1999 to 21.3% in 2006. This may be related to amount of urbanization in Delhi that changed in the economic base of the city made the state capital and growth rate showing -40.3% changes from 1999 and 2006. Another cause for this change may be the difference of session in which satellite image is acquired. If it is acquired in Rabi season than at that time there are crops in the field. So this area will come under the agriculture part in satellite image. Our 2006 image is belonging to May. In the month of May there is Jayad season in India so in the field there is lesser crop cover. In this case barren field may be categorised as Barren land Category.

Subsequently, built-up land increased by 21.4% in 1999 to 29.63% in 2006 that also growth rate showing 38.4% increase in this category (Table2 and Map 1 &2). Delhi is highly dens populous city. Demands for the housing and other infrastructure are ever increasing. Expansion of build-up area may be at the cost of decreasing agriculture land or shrinking barren land or on the both.

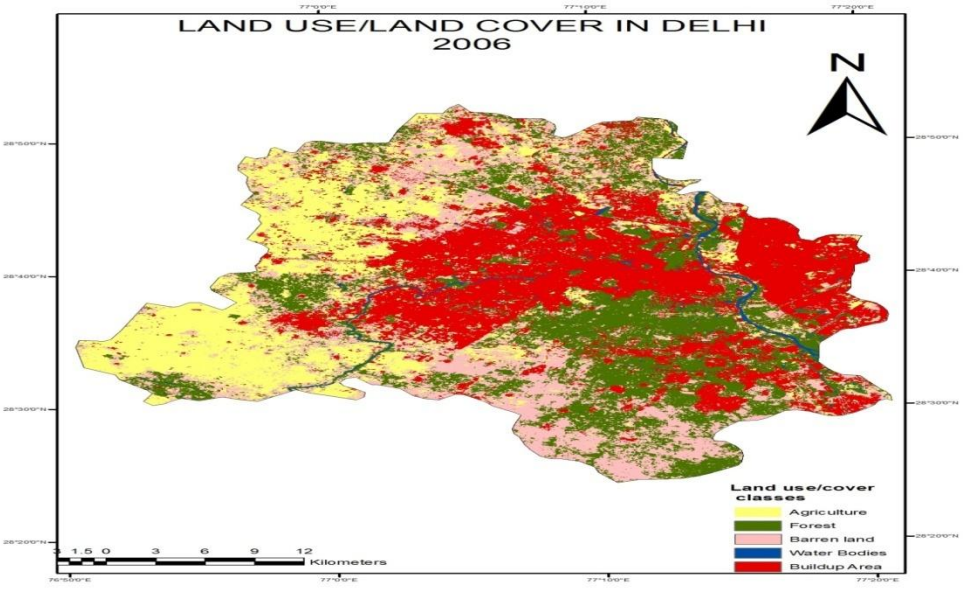
Forest cover was 17.53 % in 1999. It increased with the growth rate of 36.40% from 1999 to 2006 and become 23.91%in 2006. This increase may be due to different season of the images or may be due to some other causes. As we earlier discussed that image of 2006 belongs to month of May and image of 1999 belongs to December, so in the month of May we have little rainfall over Delhi area, due to which barren land may have some recent vegetation cover, which may be categorised as forest cover. This may contribute to the increase in forest cover.

Barren land decreased during this time period. In 1999 it was 24.20% and in 2006 it became 23.66%. It is showing the negative growth rate of -2.23. It may be due to increase in the build-up area or increase in forest area.

Water bodies increased with the growth rate of 44.40% from 1999 to 2006. It is smallest category among the above categories. It increased from 0.97% in 1999 to 1.40 % in 2006. Second image belongs to rainy season in India so there may more water mass in the water bodies.



MAP 1. Land use & Land cover in Delhi 1999.



MAP 2. Land use & Land cover in Delhi 2006.

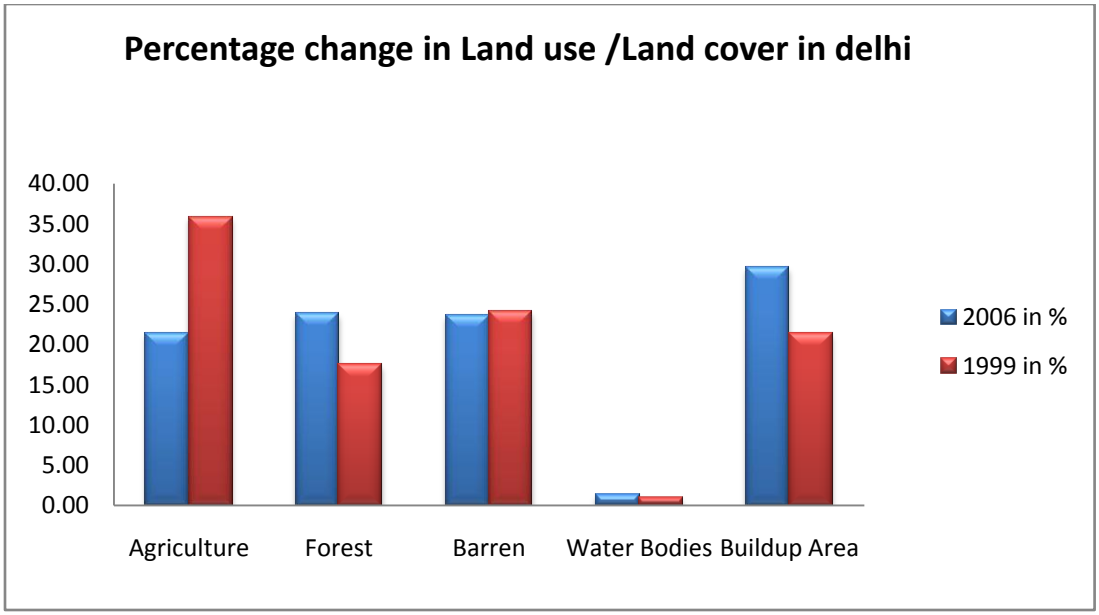


Figure 1-Trend of Land use and Land cover in Delhi 1999-2006.

CONCLUSION

In 1999 agriculture had largest area and water bodies had the minimum area. But in 2006 build-up area acquired the maximum area and water bodies acquired minimum area like the 1999. We can see that there are two categories which shrank in the given time span. Agriculture area and barren land are two categories which decreased from 1999 to 2006. However other three categories i.e. forest, water bodies, and build up area increased. Water bodies with the build-up area is showing highest growth rate.

LIMITATION(S) IN THE STUDY

There was a major limitation as a result of spatial resolution of the images. These both have a spatial resolution of 30 meters. Although there were two limitations during the classification, first, some part of image was cloudy, and second due to acquired season of image.

REFERENCES:

1. Milap PPK, Porwal JMC. Decision tree classification of land use land forest cover in Delhi., India. ELSEVIER, ESWA 5449. No. of P 7, Model 5 G. 2010.

2. Riebsame WE, Meyer WB, Turner BL. Modeling Land-use and Cover as Part of Global Environmental Change. Climate Change. 1994;28:45.

3. Macleod RD, Congalton RG. A Quantitative Comparison of Change Detection Algorithms for Monitoring Eelgrass from Remotely Sensed Data. Photogrammetric Engineering & Remote Sensing. 1998;64(3):207- 216.

4. Mahajan DM. Patial characteristics of vegetation cover based on remote sensing and geographical information system (GIS). International Society for Tropical Ecology, Tropical Ecology, 2006;47(1):71 -79.

5. Sakthivel R, Manivel M, Raj J, Ravichandran N, Pugalanthi V, Anand VD. Remote sensing and GIS based forest cover change detection study in Kalrayan hills, Tamil Nadu. Journal of Environmental Biology, 2010;31(5):737-747 (2010)

6. Wentz EA, Nelson D, Rahman A, Stefanov WL, Roy SS. Expert system classification of urban land use/cover for Delhi, India. Int. J. Remote Sens. 2008;29:4405–4427.