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Application of Geo-Spatial Technologies for detecting Landcover/Landuse Changes in Nashik

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Abstract

The Land Cover/Land use (LC/LU) changes are real important to have proper provision and use of natural resources and their management. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on LC/LU and possibilities for their optimal function is essential for the selection, preparation and implementation of land use schemes meet the increasing needs for basic human needs and welfare. Urbanization contributes many advantages in terms of economics, but if uncontrolled, would create negative consequences to the physical, social and natural environment. Rapid growth of urban sprawl with increasing population results in the loss of productive agricultural land, loss of surface water bodies, green open spaces, besides causing air pollution, health hazards and contamination of water. The present study highlights a coordinated significance of Remote Sensing and GIS techniques in detecting land use changes that have been experienced in last twenty years in nashik and its surrounding areas. Remote sensing applications with the availability of high resolution data from the state of the art satellites like LANDASAT accompanied with the image processing technique is an effective Geographical Information System (GIS) tool for identifying the urban growth pattern from the spatial and temporal data. Nashik in India is growing at a very fast rate. The central part or the core has gone through unusual changes in terms of social and physical transformations. The measurement and monitoring of these land use changes are crucial to understand land use cover dynamics over different spatial and temporal time scales for effective land management. On the above background, the precise aim of this present study is to find out landcover/landuse of Nashik Taluka. The spatial patterns of landcover/landuse over different time periods, can be systematically mapped, monitored and accurately assessed from satellite data along with conventional ground data. Landsat images of two different periods were analyzed to evaluate urban growth rate as well as LC/LU changes. Superwised and unsupewised classification and manual digitization techniques used in this study.

Keywords: *Urban Sprawl, Urban Planning, Remote Sensing and GIS, Multi-temporal Satellite Imageries, LC/LU, Overlay Analysis.*

Introduction

Land use/cover change has become a central and important component in current strategies for managing natural resources and monitoring environmental changes. Land use is a product of interactions between a society's cultural background, state and its physical needs on the one hand and the natural potential of land on the other (Rawata et.al. 2016). LC/LU changing aspects are important elements for monitoring, assessing, defending and arrangement for earth resources. The current rapid high level urbanization at world level is relatively a recent phenomenon. One among six people in this world lives in India: After China India is the second largest populated country and is projected to cross China's population with 1.5 billion people by 2040. India has more people than all of Africa and also more than South America and North America put together.

In India the proportion of people living in cities and urban area is almost doubled to 27.78% in year 2001, which was low when compared to figures of nations developed. However, the 28.53 crore urban population living in 27 metros, 396 cities and 4738 towns is more than the total population of developing and developed countries. This kind of uncontrolled, haphazard, low density settlements leads to Urban sprawl (Vinothkumar, 2005).

The PCMC (Pimpri - Chinchawad Municipal Corporation) 94.4 % was recorded highest growth of population according to 2001, census in Maharashtra, which is the part of Pune Metropolitan region. This is mainly due to the rapid growth in the Information Technology sectoral region. Between 1991 and 2001, the growth has doubled to 62.17 % in Comparison; Pune district has a growth rate of 38.58 %, while the state is experiencing the growth rate of 22.5%. Therefore it is necessary to add the past and present growth trends of these rapidly growing cities, for effective urban management (S. Shekhar, 2005).

A Geo-spatial technique is a decision support system that can facilitate urban planning. The use of this Geo-spatial technique has become quite prevailing within the field of LC/LC. Geo-spatial technique reveals spatial patterns of horizontal growth by measuring new growth areas from town centers and roads. For healthy and happy living provision of adequate amenities, facilities and public utility services are essential as they enhance efficiency and economic utilization and time.

The prime objective of the present study is to find out LC/LU changes in area of study.

Study area:

The study area is located in the State of Maharashtra, in the northwest direction of Maharashtra state. The study area lies between 19° 53' to 20° 08' North latitude and 73° 38' to 73° 55' East longitude. The city has become the Centre of attraction because of its surroundings and cool and pleasant atmosphere. The river Godavari flows through the study area. Nashik is one of the places in India where the Kumbh Mela is held once in 12 years and also the wine capital of India.

Methodology

Digital change detection techniques by using multi-temporal satellite imagery helps in understanding landscape dynamics. The present study illustrates the Spatio-temporal dynamics of land use/cover of Nashik Tehsil of district Nashik, Maharashtra, India. Landsat satellite imageries of two different time periods, i.e., Landsat Thematic Mapper (TM) imageries of 1989 and 2009 were acquired by Global Land Cover Facility Site (GLCF) and USGS earth explorer site and quantified the changes in the Nashik Tehsil from 1989 to 2009 over a period of 20 years. Unsupervised classification methodology has been employed in System for Automated Geoscientific Analyses (SAGA GIS) Software. The images of the study area were categorized into five different classes namely Forest, agriculture, barren land, built-up and water bodies.

In unsupervised classification, the algorithm analyzes all the bands of the image and pick out the clusters of pixels having similar values without the user intervention. The clusters are then assigned to their classes at the user's discretion. Therefore, this method generally applied to the regions, where we don't have any knowledge and information about land cover type.

Land cover/land use change detection and analysis

For performing LC/LU change, analysis in SAGA GIS software following steps was applied cluster analysis for unsupervised classification process. The resultant image with clustered classes was obtained in twenty five classes under unsupervised classification scheme. The verification for each class was met out by checking and assigning each class with minimum and maximum values. The various subclasses under the main classification i.e. Level-I classes were merged under five main heads and each was assigned a different color through changing maximum and minimum values in lookup table for cluster raster layers of 1989 and 2009. We came out with Landuse patterns for both 1989 and 2009 as the outcome with visible marked differences.

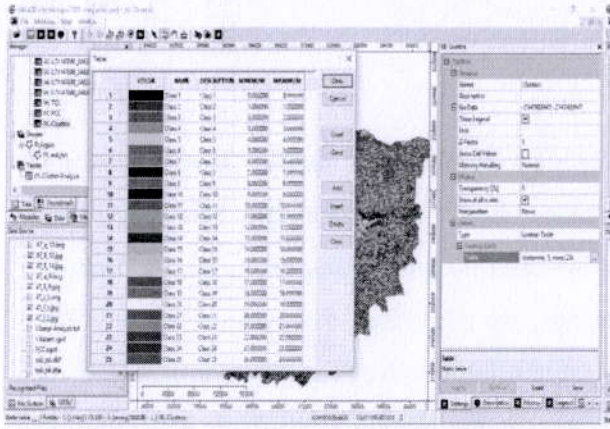


Fig. 1 Clustered twenty five classes

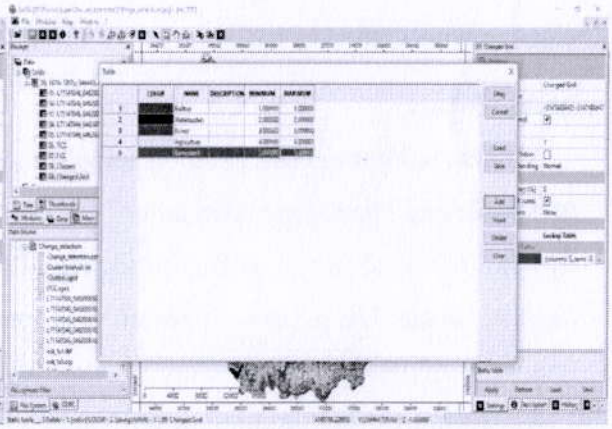


Fig. 2 Clustered classes merged into five

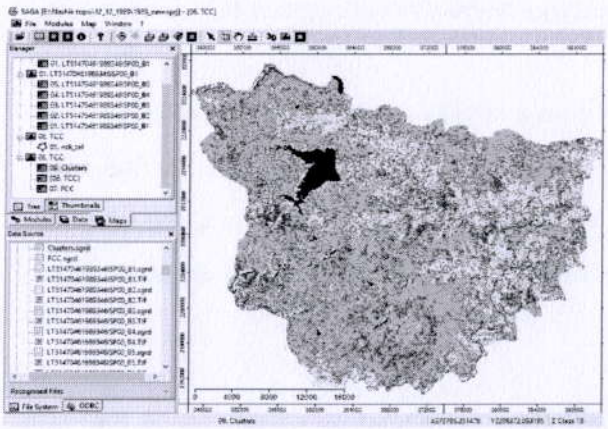
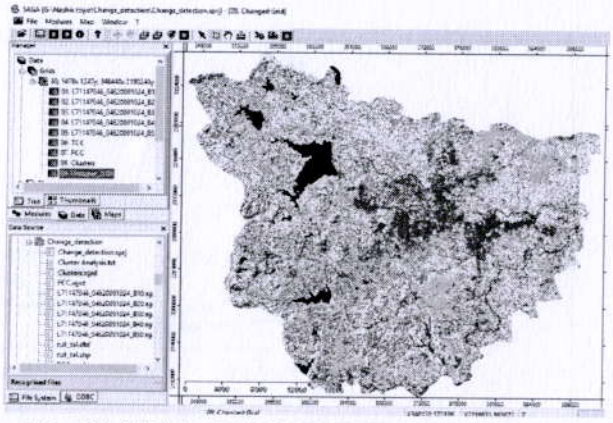


Fig.4 Unsupervised Classification for



Nashik Taluka LANDSAT TM 23 October 2009

Results and discussions

The data obtained through the analysis of multi-temporal satellite imageries are registered in Table 1 and the results are diagrammatically illustrated in Figs 3 and 4. Depicts LC/LU status of two study periods i.e., 1989 (Fig. 23) and 2009 (Fig. 4); depicts LC/LU change from 1989 to 2009 in different land use categories in built-up area, Forest, Barren land, Agricultural land and water bodies. The areas of different landuse classes were calculated for the both years through GIS and the difference with respect to change in LC/LU was studied for the twenty years period and the results were statistically tabulated.

Table 1. Land cover /Land use change (1989-2009)

Sr. No.	Classes	Area in sq. kms. (1989)	Area in sq. kms. (2009)	Difference
1	**Built-up**	48.35	103.25	54.90
2	**Water**	25.78	38.25	12.47
3	**Forest**	124.85	85.21	-39.64
4	**Barren land**	436.85	335.06	-101.79
5	**Agriculture**	175.06	249.12	74.06
	TGA	**810.89**	**810.89**	

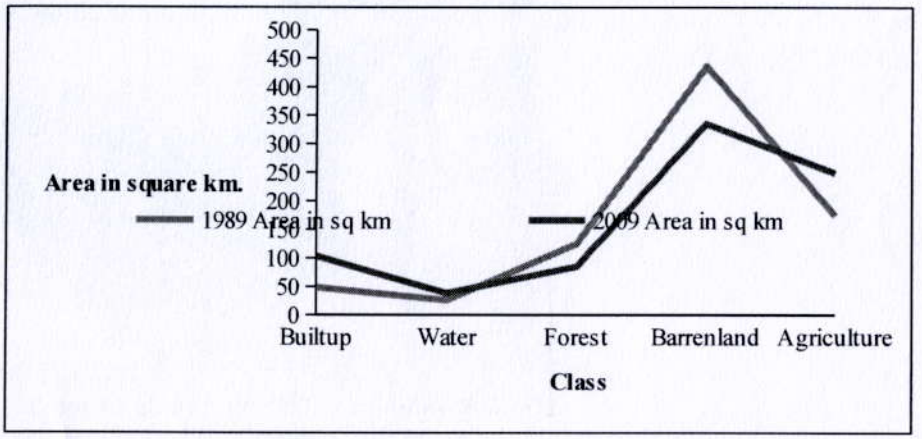


Fig.5 Change Detection 1989 – 2009

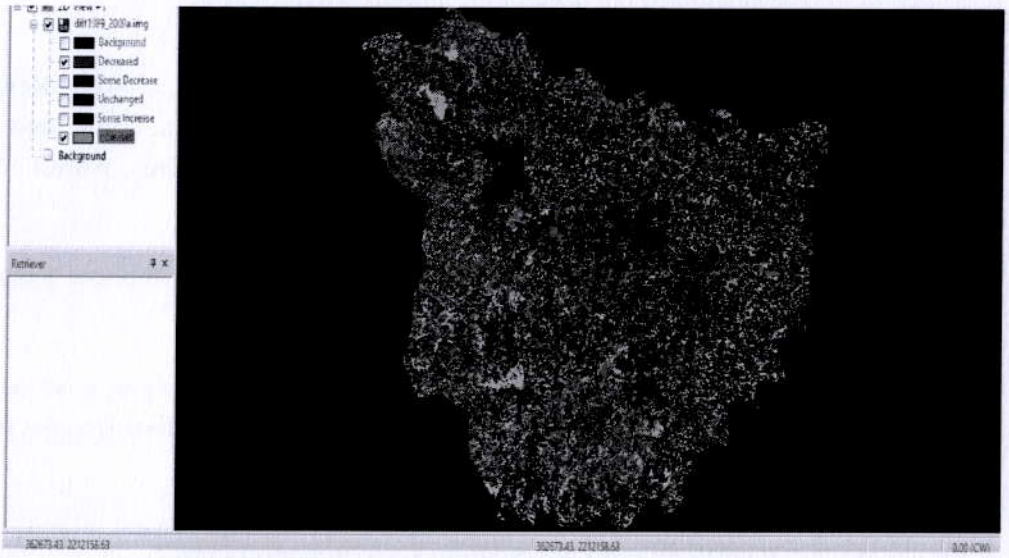


Fig. 6 Change Detection Map 1989 - 2009

The data presented in Table 1 and Fig. 6 depict that both positive and negative changes occurred in the land use/cover pattern in the study area, during the two decades. These degradation variables were assessed showing the changes that obtained during the period of 1989 and 2009 using multi-dates LANDSAT images.

Conclusion:

Present work advocates that multi-temporal satellite data are very useful to detect the changes in land use quickly and accurately. The study reveals that the major land use in the Nashik area is built-up area. During these two decades. Total Geographical area was 810.89 sq. km. in 1989, built up area covered 48.35 sq. km. and barren land covered 436.85 sq.km., while the agricultural land and forest covered 175.06 sq.km. and 124.85 sq.km. respectively. In the year 2009, built up area is dramatically increased, doubled, to cover 103.25 sq.km as 12.73% of the total area, this is the while the barren land area decreased intensely by 101.79 sq.km as 41.32% of the total area. Forest decreased with 39.64 sq. km. as 10.51% of the total area. The approach adopted in this study clearly demonstrated the potential of Geospatial techniques in measuring the change pattern of LC/LU in town area.

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