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ANALYSIS OF LAND USE/LAND COVER CHANGES USING REMOTE SENSING DATA AND GIS TECHNIQUES OF PATUR TALUKA, MAHARASHTRA, INDIA

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Abstract: Rapid population growth and anthropogenic activities on earth is changing the natural environment profoundly. Hence, an attempt has been made in this paper to determine and identify changes in Land use/ Land cover, of Patur taluka in Akola district. The study was carried out through Remote Sensing and GIS approach using SOI toposheets, Landsat imagery of 2013 and IRS-1D-LISS-III 2007. The land use/land cover classification scheme has performed based on the Survey of India toposheets and Satellite imageries. The Arc GIS 10.1 software has used to prepare the LULC maps and ground truth observations were also performed to check the accuracy of the classification Scheme. The study area has classified into five categories on the basis of field study, geographical conditions, and remote sensing data. The comparison of LU/LC in 2007 and 2013 derived from satellite imagery interpretation indicates that there is a significant increase in built-up area, open forest, water body, waste land and other lands. The agricultural land is decrease in 2013 as compare to 2007. Though there are some changes detected in land use/land cover analysis of the period 2007-2013, it does not indicate any significant environmental impact on the study area. However, it is necessary to closely monitor the land use/land cover changes for maintaining a sustainable environment.

Keywords: Land use Land Cover changes, Remote sensing data, GIS and ETM+.

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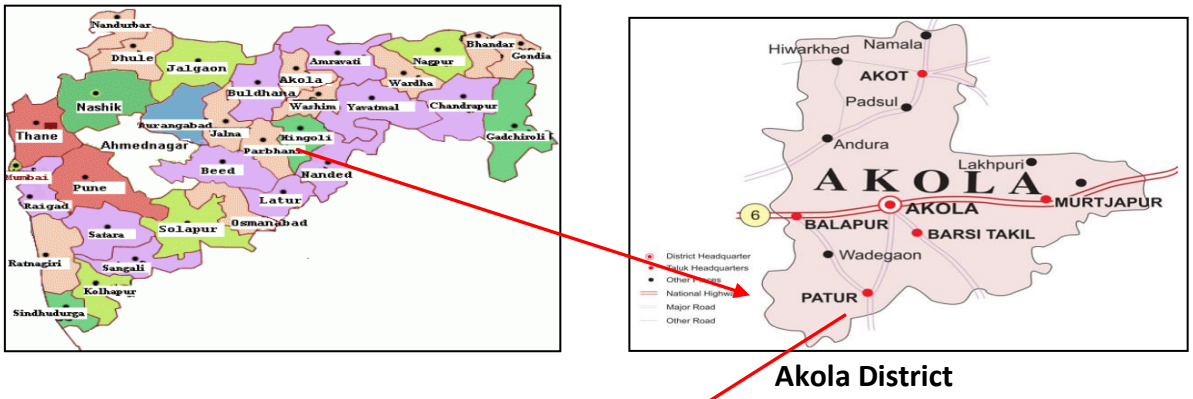
INTRODUCTION

The land use/land cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on land use/land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population. Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes. The advancement in the concept of vegetation mapping has greatly increased research on land use/ land cover change thus providing an accurate evaluation of the spread and health of the world's forest, grassland, and agricultural resources has become an important priority. Viewing the Earth from space is now crucial to the understanding of the influence of man's activities on his natural resource base over time. In situations of rapid and often unrecorded land use change, observations of the earth from space provide objective information of human utilization of the landscape. Over the past years, data from Earth sensing satellites has become vital in mapping the Earth's features and infrastructures, managing natural resources and studying environmental change. Further, satellite remote sensing data have been successfully used to estimate Leaf Area Index (LAI), based on the relationship between LAI and the Normalized Difference Vegetation Index (NDVI) (Kale et al., 2005). An accurate forest cover-type and/or land-classification system is essential to providing information for effective management of natural resources (Schriever and Russell, 1995). The remote sensing technology in integration with Geographical Information System (GIS), helps in extracting maximum amount of vegetal information that describe vegetation diversity i.e. extent, structure, composition and condition. The availability of new high-resolution satellite image sources e.g., IKONOS Provides an opportunity to map ground features that was not previously available using medium resolution imagery (e.g. Landsat, SPOT 4). Remote Sensing (RS) and Geographic Information System (GIS) are now providing new tools for advanced ecosystem management. The collection of remotely sensed data facilitates the synoptic analyses of Earth - system function, patterning, and change at local, regional and global scales over time; such data also provide an important link between intensive, localized ecological research and regional, national and international conservation and management of biological diversity (Wilkie and Finn, 1996).

The present study has been taken up in order to understand the changes that have taken place in land use/land cover in Patur Taluka of Akola district. Therefore, attempt will be made in this study to map out the status of land use land cover of Patur Taluka between 2007 and 2013 with a view to detecting the land consumption rate and the changes that has taken place in this status particularly in the built-up land so as to predict possible changes that might take place in this status in the next 14 years using both Geographic Information System and Remote Sensing data.

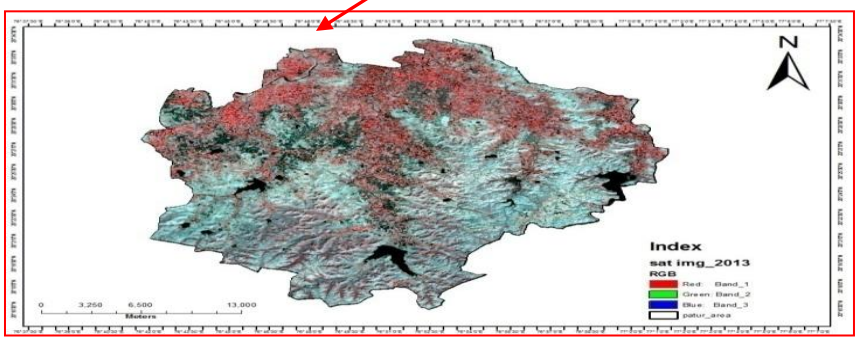
Study Area:-

The study area is located in and around the southern parts of Akola district, Maharashtra. The area covered in this investigation is about 701.67 sq.km lying in between 76°37'30"E to 77°7'30''E longitude and to 20°34'30" N to 20°16'30'' N. (Fig: 1). The study area is covered by Survey of India (SOI) toposheet 55H/6, 55H/7, 55H/1 and on 1:50,000 scale.



Akola District

Maharashtra State of India



Patur Taluka

Figure 1. Location Map of Study Area

Objectives:-

The aim of this study is to produce a land use/land cover map of southern parts of Akola district and surrounding areas in order to detect the changes that have taken place over a given period using change detection method.

The following specific objectives will be pursued in order to achieve the aim above.

- To Create Land Use Land Cover mapping from satellite images of 2007.
- To Create Land Use Land Cover mapping from satellite images of 2013.
- To determine the trend, nature, rate, location and magnitude of land use / land cover change.

Data Used:-

The study has made use of various primary and secondary data. These include Survey of India (SOI) topographic sheets of 1:50,000 scale and satellite images LISS-III and Landsat TM of 2007 and 2013. These (Landsat) data were visually and digitally interpreted by using the Arc GIS 10.1 Software (for processing, analysis and integration of spatial data) to reach the objectives of the study.

Methodology:-

In the present study Image processing and visual interpretation technique are carried out to Land use / Land cover classification using digital data and standard False Colour Composite (FCC) satellite image. The classification is adopted to prepare land use and land cover map. Standard False Colour Composite (FCC) for satellite image LISS-III and Landsat TM image is used for mapping land use/land cover for the year 2007 and 2013. The interpretation is based on shape, size, tone / colour, texture, and pattern, and location aspects of the particular feature on the satellite imagery. Using the above interpretation keys, a thematic layer of Land use/land cover for the year 2007 and 2013 is prepared. The topographic map 55H/6, 55H/7, 55H/1 (1:50,000 scale) is obtained from the Survey of India, Hyderabad, which was surveyed and prepared in 1976; it is converted to digital mode using scanning. The topographic map is georeferenced with longitude and latitudes using the Arc GIS software and spatial analyst tools and demarcated the boundary of study area. The feature classes were identified based on the visual interpretation of the satellite imagery coupled with field checks. These datasets were

digitized and analyzed to obtain land use/land cover statistics for the areas under each of these categories for both the years.

Image classification

The initial LISS-III (2007) and Landsat TM (2013) imageries were subjected to a classification zones. Visual image interpretation was utilized to classify the images to different land use categories. In order to classify the rectified images, five classes were delineated in the images namely, agriculture, fallow land, scrub land, industry and built up. The overall testing accuracy for the classification of Landsat TM (2013) was 85.3%, while it was 87.5% for IRS IC LISS III image (2007). The land use map prepared for the year 2007 and 2013 are shown in figure 2 and 3 respectively.

Change detection:-

Change detection analysis encompasses a broad range of methods used to identify, describe and quantity differences between images of the some scene at different times or under different conditions many of the tools can be used independently or in combination or in combination as part of a change detection analysis. Change detection menu after a straight forward approach to measuring changes between a pair of images that represent a pair of images that represent on initial stage and final stage. The change detection statistics for classification images average used for the compute difference map for images.

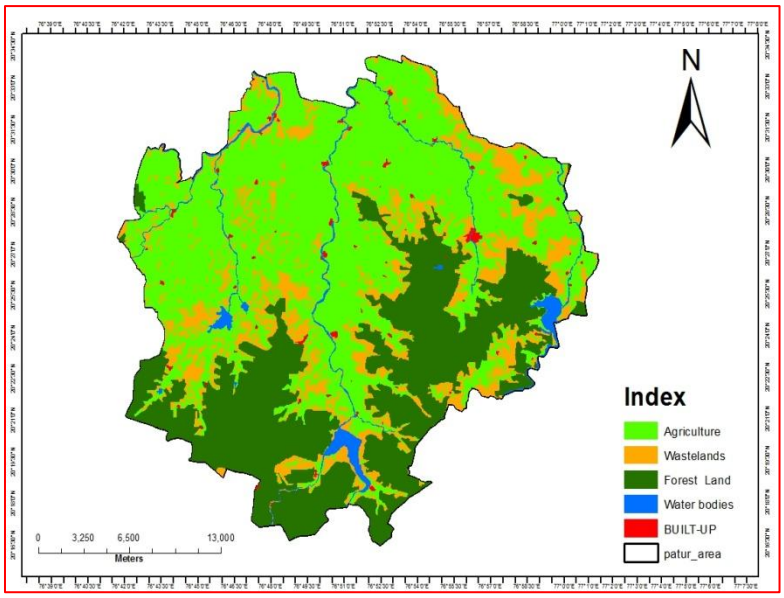


Figure 2. Map showing the Land use categories for the year 200

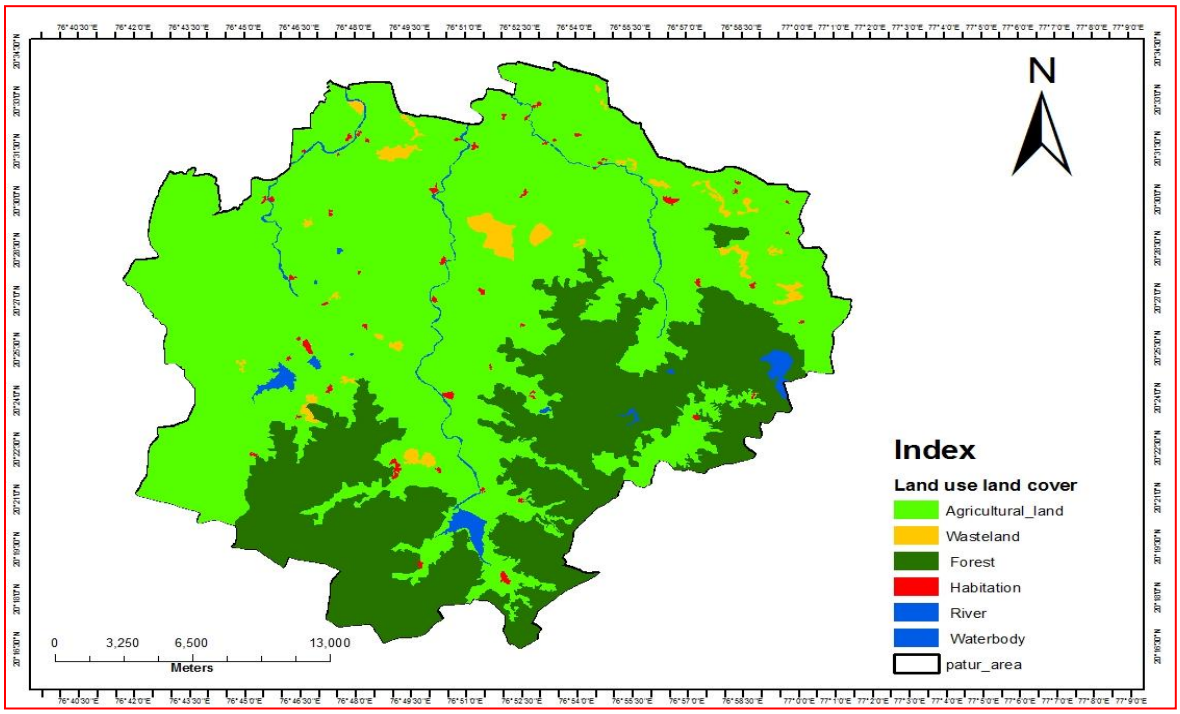


Figure 3. Map showing the Land use categories for the year 2013

Results and Discussion:-

The land use categories such as built up land, agriculture, water body, wasteland and others have been identified and mapped from the Land sat TM and IRS LISS III of 2013 and 2007. About 0.60% of the areas are occupied by built up land during 2007 and about 1.34% areas are occupied by built up during 2013. People utilize the land for agricultural purposes. Under utilization, mis management could be observed in the field. The area occupied by the agriculture is about 49.92% (2007) and 46.12% (2013). This is due to shifting of agricultural land to built up and other land. Owing to the increase in human population the waste land category have been decreased from 16.82% to 13.87%. Decrease of about 2070.4 ha of the wasteland during 2013 when compared to 2007. Table 1 shows the change in land use pattern.

Table 1. Area under different land use / land covers categories during 2007-2013

Land Use Land Cover Classes	2007 (Ha)	Area in %	2013(Ha)	Area in %
Farm Land	35030.92	49.92%	32364.75	46.12%
Waste Land	11807.45	16.82%	9737.05	13.87%
Built-Up Land	426.71	0.60%	944.06	1.34%
Forest Land	21063.28	30.01%	24754	35.28%
Water Body	1841.66	2.62%	2369.89	3.37%
Total	70170.02	100%	70170.02	100%

CONCLUSIONS:-

This paper focuses on LU/LC changes in a patur taluka, Maharashtra, India, using remote sensing data and GIS technology. Our results clearly show that LU/LC changes were significant during the period from 2007 to 2013. On the other hand there is decrease in agricultural area water spread area, and forest areas. This study clearly indicates the significant impact of population and its development activities on LU/LC change. This study proves that integration of GIS and remote sensing technologies is effective tool for land land cover planning and management. The quantification of LU/LC changes of Patur area is very useful for environmental management groups, policymakers and for public to better understand the surrounding.

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