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"CHANGE DETECTION ANALYSIS OF LAND USE / LAND COVER OF AURANGABAD CITY USING REMOTELY SENSED DATA"

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Abstract

The study of land use / land cover changes is an essential feature of urban geography. The process of urbanization is a universal phenomenon taking place all over world and has increasingly become a major issue facing many metropolitan areas. The land use/land cover pattern of a city or region is an outcome of natural and socio–economic factors and its utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural activity, urban sprawl and demographic pressure. Hence, information on land use / land cover and possibilities for its 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. The information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population. It is also useful to the different departments and government agencies like revenue, agriculture, irrigation, forest, environment, urban development & urban planners for land use planning and decision making. For betterment of human beings well planning of city is needed. In this regard there is need to study urban growth and land use /land cover.

Land use / land cover layers represent the digital image of city classified into ten classes as residential, commercial, industrial, transportation, agriculture, vegetation, barren, scrub, mixed land and water bodies etc. The area was measured and presented in tabular form to get the clear scenario of land use / land cover. During the years 1989 -2000 the major changes were detected in the residential and industrial land use category and significant change also observed in commercial, transportation and barren land use. Other categories like agriculture, vegetation, scrub, mixed land and water bodies land use declined in the period of investigation. During the years 2000 - 2008 the major changes were detected in the residential, barren land, industrial, transportation land use category and also significant change in commercial and mixed land use. Other categories expect from above was declined in the period of investigation.

Introduction:

Urbanization has become a dominant trend all over the world. It is responsible for extraordinary growth of cities and towns, particularly in the economically developed and developing areas. India has also shown a considerable level of urbanization mainly after independence. However, urban growth is not same everywhere and every time. Few urban centers show faster pace of growth, while other witnesses slow growth or stagnation. In fastly growing urban areas, due to over concentration of population certain problem arises such as inadequate housing, drinking water, sanitation, health, employment and education facilities.

The study of land use / land cover changes is an essential feature of urban geography. The process of urbanization is a universal phenomenon taking place all over world and has increasingly become a major issue facing many metropolitan areas. The land use/land cover pattern of a city or region is an outcome of natural and socio–economic factors and its utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural activity, urban sprawl and demographic pressure. Hence, information on land use / land cover and possibilities for its 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. The information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population. It is also useful to the different

departments and government agencies like revenue, agriculture, irrigation, forest, environment, urban development & urban planners for land use planning and decision making. For betterment of human beings well planning of city is needed. In this regard there is need to study urban growth and land use /land cover.

The rapid development of multi-spatial and multi-temporal remote sensing data has now made it possible to monitor urban land-use / land-cover changes in a very efficient manner. Remote sensing techniques have proven very useful in urban mapping (M. Batty 2008). Keeping this view in mind it was decided to study the land use/land cover in Aurangabad city of Maharashtra State (India) using applications like remote sensing and geographical information system.

Study Area:

In this research paper Aurangabad Municipal Corporation limits have been selected as the study area. Aurangabad is an ancient and historical city situated in central part of Maharashtra state. Aurangabad city is the headquarters of Aurangabad district and also the divisional head quarter of the administrative region of Marathwada. Formerly, there was a small village named Kirki (Khadki) where the city stands today. It is situated on the bank of the river Kham, a tributary of Godavari. The city is located at the latitude of 19o 53' 50" north and longitude of 75o 22' 46" east. It sits in a strategic position on the Deccan Plateau. The population of the city as per census 2011 is 11,75,116 experiencing a phenomenal growth rate of above 70% in last four decades due to economy buildup caused by industrialization and tourism. The Aurangabad Municipal Council was formed in 1936 when the geographical area of the town was 63.41 sq km. In 1982, the council was converted into a Municipal Corporation and 18 nearly villages were included in the city. The area of the Municipal Corporation at present is 138.5 sq km.

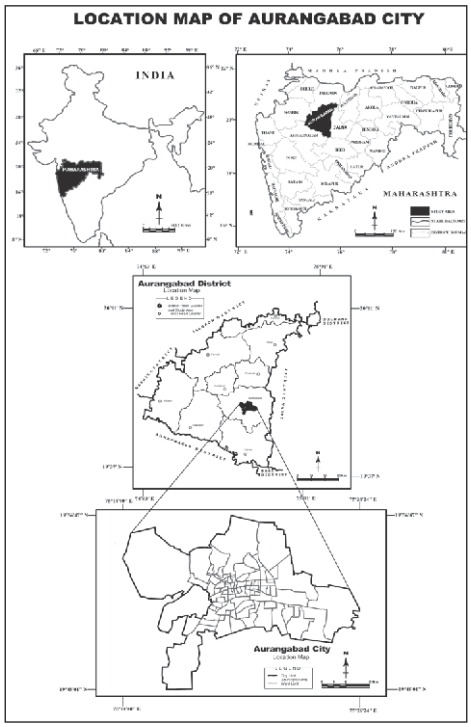


Figure : Location of Aurangabad City

Origin of the research problem:

Urbanization is needed for development (Bekele, 2005). Which is a global phenomenon mainly driven by population growth and large scale migration. In developing countries like India, where the population is over one billion, one-sixth of the world's population, urban sprawl is taking its toll on the natural resources at an alarming pace. A major confront in the future, therefore, will be to achieve a higher standard of living than what we presently enjoy, while avoiding loss and destruction of environmental assets from rapid urbanization and accomplish sustainable development. Urban planners require information related to the rate of growth, pattern and extent of sprawl to provide utility services such as water, sanitation, electricity, medical facility etc. In the absence of such information, most of the sprawl areas lack basic infrastructure facilities. Pattern and extent of sprawl could be modelled with the help of spatial and temporal data. GIS and remote sensing data along with collateral data might help in analysing the growth, pattern and extent of sprawl. Urban sprawl studies are done to help monitor the spread of built-up areas and quantify the sprawl in order to determine the trend, the extent, and avert the associated complications (Yeh and Li, 2001; Sudhira et al., 2004; Jat et al., 2007). For understanding and modelling this dynamic phenomenon, prominent causative factors are considered to design sustainable urban planning.

Significance of the study:

Presently, Indian population is becoming more urban resident, earlier dominated by rural population. In India 1951 urban population was 62.44 million constitute 17.29 percent, year of 1981 was 23.33 percent, which increased to 377.1 million comprising 31.16 percent of total urban population in 2011. The number of million cities and actual area under these cities are also increasing. The increasing rate of urbanization creates problems like traffic congestion, environment pollution, inadequate water supply, electricity, housing, drainage-sewage system, garbage disposal etc. So there is need to understand urban growth using advanced techniques like RS & GIS. Therefore in present study we are going to focus on the urban sprawl for sustainable urban planning.

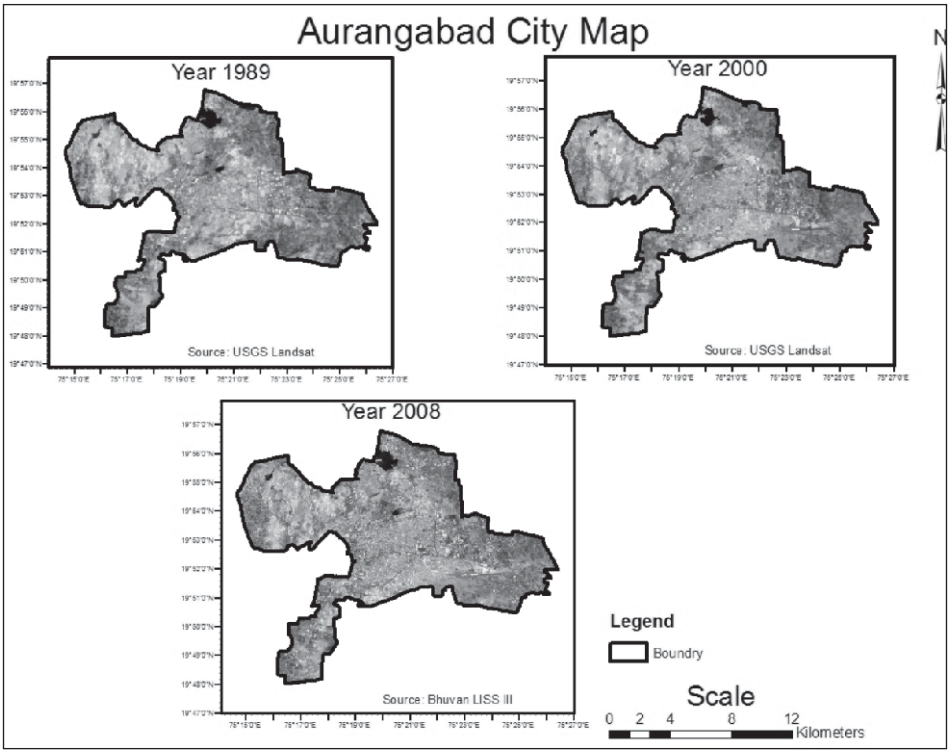
Objectives:

The main objective of the present research work is to use the modern technologies like Remote Sensing, Geographic Information System and Global Positioning System. As well as analyze the land use / land cover changes in study area over period of time of the Aurangabad city for the sustainable urban planning.

Data Base and Research Methodology:

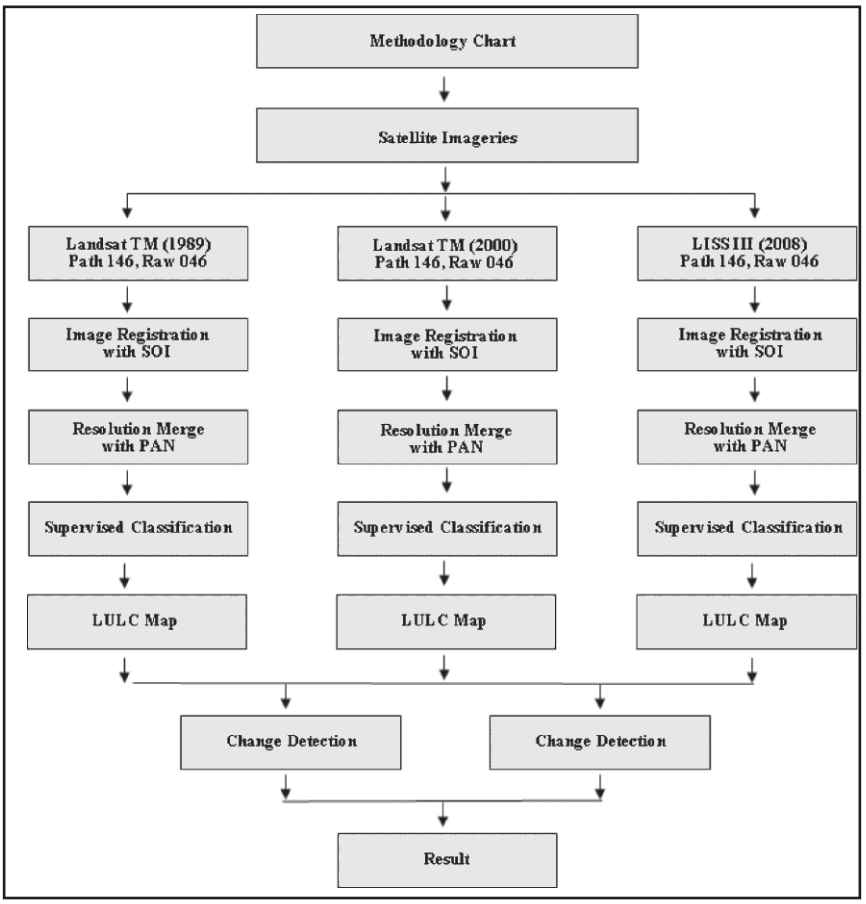
For the study initially the SOI toposheets were scanned and geo-referenced to use as base layer for image registration. The digital remote sensing data LANDSAT TM (December 1989), LANDSAT TM (December 2000), IRS-P6- LISS III (December 2008) have spatial resolution 28.5m, 23.5m and 5m were processed and geo-referenced using Ground Control Points (GCP) from survey of India map. Registration of the IRS-P6, LISS III image with panchromatic image has been done by identifying common GCP's from both the images. IRS-P6, LISS III has a resolution of 23.5 m and IRS-P5, PAN has a resolution of 5 m, to improve resolution of multispectral image “Resolution Merge” technique is implemented. The satellite images and toposheets were projected into WGS 1984 Complex UTM Zone 43N projection system. The spatial data used for this study is shown below in Table 1. The Aurangabad boundary layer was overlaid upon the merged layer, so that study area could be extracted from the whole image.

Table 1.Data Source



Sr.No.	Used Data	Spatial Reference	Data Source
01	LANDSAT TM WRS-2, Path 146, Row 046 1989 & 2000	28.5m	USGS www.glcf.com
02	IRS-P6, LISS III	23.5m	NRSC, Hyderabad.
03	IRS-P5, PAN	5m	NRSC, Hyderabad
04	Toposheet : 47M/5	1:50000	Survey Of India (SOI)

Figure : Base map (Source: USGS Landsat, Bhuvan LISS III)



Brief Account of Arial Growth:

Aurangabad was originally a small town called Khirki, later on the walled city came up which was 5.35 Ha in area. Then the cantonment area was established towards the end of 19th century, which was developed on the western bank of the south-west walled city. Till the beginning of this century the development of the city was limited within the walled city, Begampura and Cantonment. As population started growing area outside the walled city started developing. The development was not possible on the northern part of the city due to the hilly land, which acts as a major physical constraint. Hence city started developing towards south and areas like Usmanpura, Padmpura, Kranti Chowk etc started developing. The Aurangabad Municipal Council was formed in 1936 when the geographical area of the town was 63.41 sq km.

CIDCO was established during 1972 as a special planning authority and New Aurangabad Township was developed towards east side of the city during 1971-81. Eastern and north-eastern areas like Chikalthana and Harsool which were located near the city started developing due to establishment of CIDCO. The MIDC area just on the east of the Municipal limits have given a great inputs for development along Aurangabad Road, the proximity of the area to the northern Delhi Gate with the

Himayat Bagh, the Government Office Complex, the Shahaganj area (city centre). Areas like Jyotinagar, Jawahar Colony and Garkheda etc started developing in 1980s with large no of apartments and are still developing today. On the south-west, city started developing towards Paithan road in the areas like Kanchanwadi, nakshtrawadi etc. In 1982, the council was converted into a Municipal Corporation and 18 nearly villages were included in the city. The area of the Municipal Corporation at present is 138.5 sq km.

After establishment of the Municipal Corporation, the city is developing in three main directions, which are

- South of Railway Station
- Along the Aurangabad Road towards the east
- Towards north along Jalgaon Road and northwest side beyond Dr. Babasaheb Ambedkar Marathwada University.

Now city is developing beyond Garkheda towards Satara near Bid Bypass Road on the Southern side. This area is outside the Aurangabad Municipal corporation limit. Also due to establishment of new Five Star Industrial Estate at Shendra towards east, city is expected to grow in that direction.

Result and Discussion

Land Use Change From 1989-2000 (Landsat TM Image)

The satellite imagery has been obtained from USGS Earth Resources Observation & Science (EROS) and National Remote Sensing Centre, Hyderabad. The base map of the city and Aurangabad guide map obtained from Survey of India (SOI). The subset for LANDSAT TM image and resolution merged image of LISS III and PAN were taken for further interpretation and classification process. Supervised classification for the merged image product as well as for LANDSAT TM has been performed with parametric rule as maximum likelihood in Erdas 9.1 software.

Table 2 : Land Use / Land cover Change Detection

Sr.No.	Class	1989	2000	Change (%)
1	Residential	8.365	18.520	10.155
2	Commercial	0.580	1.254	0.674
3	Industrial	3.545	6.464	2.919
4	Transportation	2.600	4.219	1.619
5	Agriculture	24.375	19.713	-4.662
6	Vegetation	21.255	16.290	-4.965
7	Barren Land	20.010	21.260	1.250
8	Scrub Land	10.260	8.880	-1.380
9	Mixed Land	7.556	2.135	-5.421
10	Water Body	1.454	1.265	-0.189

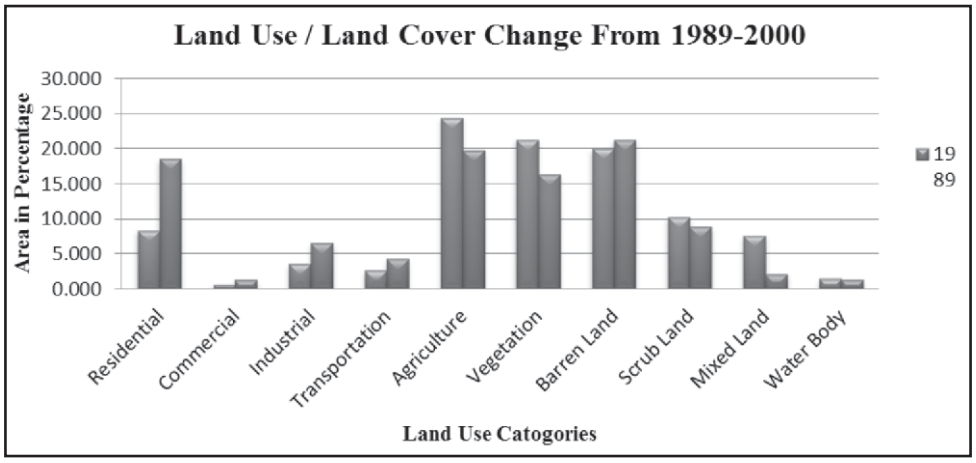


Figure 1: Land Use / Land Cover Change during 1989-2000

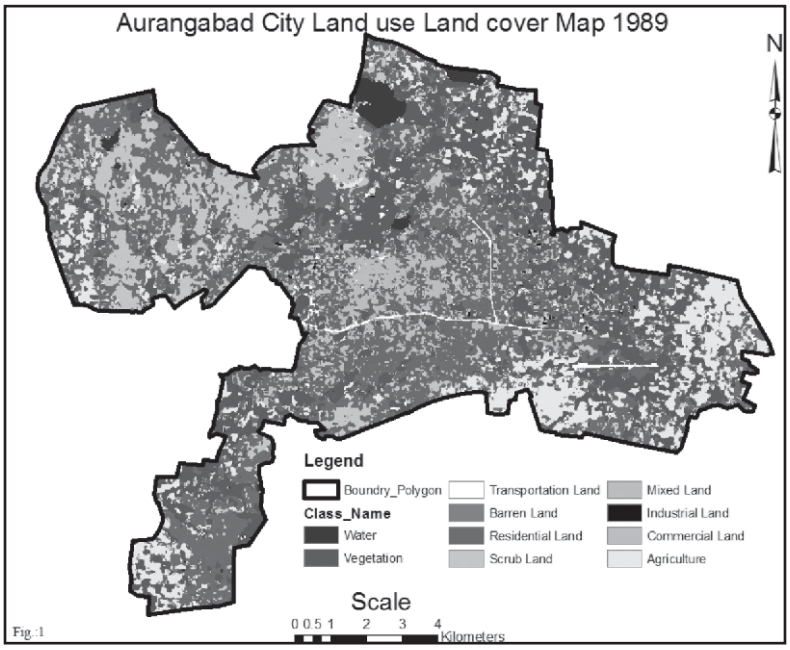


Figure : Aurangabad City Land Use / Land Cover Map 1989

Land use / land cover layers represent the digital image of city classified in to ten classes as residential, commercial, industrial, transportation, agriculture, vegetation, barren, scrub, mixed land and water bodies etc. The area war measured and presented in tabular form to get the clear scenario of land use and land cover. during the years 1989 and 2000 the major change were detected in the residential and industrial land use category and significant change also observed in commercial and transportation and barren land use. Other categories like agriculture, vegetation, scrub, mixed land and

water bodies land use declined in the period of investigation. In 1989 land use / land cover map of Aurangabad city, residential land use was 08.365% of the total geographical area of the city. By the year 2000 under this category increased up to 18.520% of the total geographical area due to increase in the industries and employment opportunities in the city area. Commercial land use in 1989 was 0.580% and increase up to 1.254% in the year 2000. Industrial land use and transportation land use increased 2.9% and 1.6% between the investigation periods. The area under barren land was 20.010% in the year 1989 land use map, where it was 21.26% in 2000. In 1989 agriculture 24.37% shown and declined by the year 2000 with 19.71% of total geographical area. As per 1989 vegetation 21.25%, scrub land 10.26%, mixed land 07.55% and water body 01.45%, all this categories declined in 2000 that is vegetation 16.29%, scrub land 08.88%, mixed land 02.13% and water body 01.26 %.

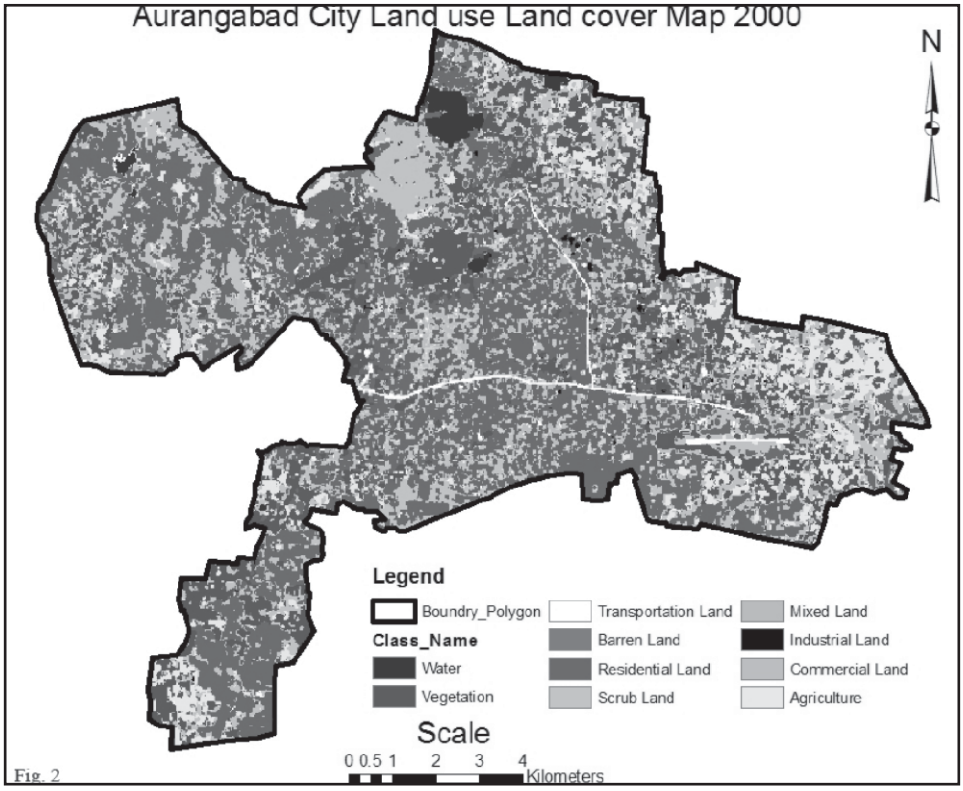


Figure : Aurangabad City Land Use / Land Cover Map 2000

Land Use Change From 2000-2008 (Landsat TM Image & LISS III PAN)

During the year 2000 and 2008 the major change were detected in the residential, barren land, industrial, transportation land use categories and significant changes in commercial and mixed land use. Other categories expect from above was declined during the investigation.

Table 3 : Land Use / Land cover Change Detection

Sr.No.	Class	2000	2008	Change (%)
1	Residential	18.520	31.456	12.936
2	Commercial	1.254	2.789	1.535
3	Industrial	6.464	8.690	2.226
4	Transportation	4.219	6.450	2.231
5	Agriculture	19.713	15.724	-3.989
6	Vegetation	16.290	13.160	-3.130
7	Barren Land	21.260	10.945	-10.315
8	Scrub Land	8.880	6.110	-2.770
9	Mixed Land	2.135	3.624	1.489
10	Water Body	1.265	1.052	-0.213

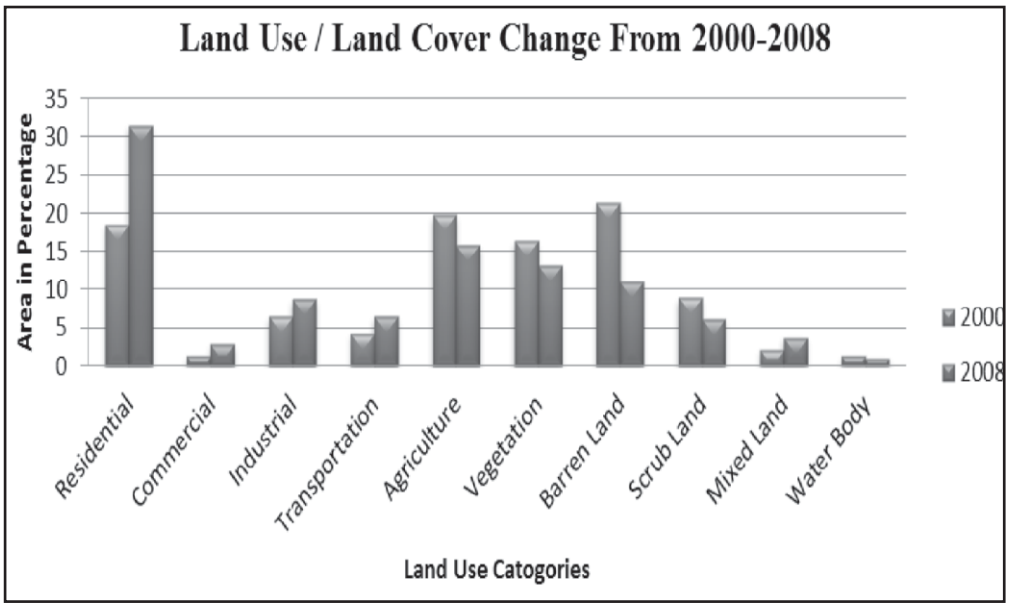


Figure : Land Use / Land Cover Change during 2000-2008

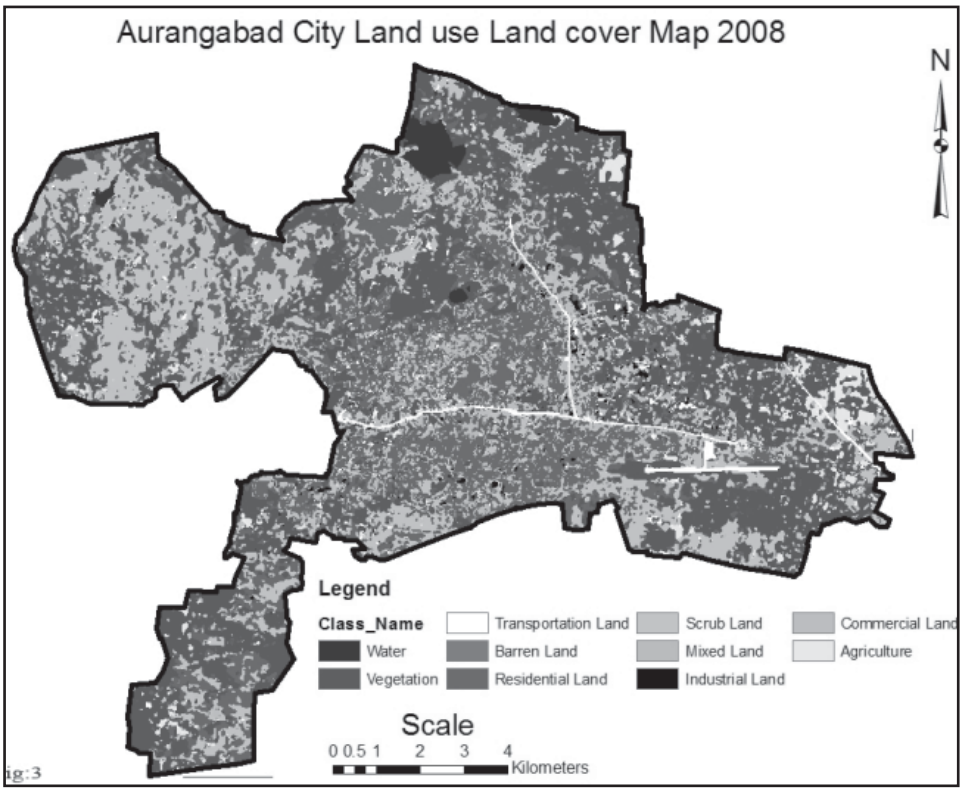


Figure : Aurangabad City Land Use / Land Cover Map 2008

In the year 2000 land use / land cover map of Aurangabad city, residential land use was 18.520% of the total geographical area of the city. By the year 2008 under this category increased up to 31.456% of the total geographical area due to increase the industries, development of service sector, educational facilities and employment opportunities in the city area. Commercial land use in 2000 was 1.254% and increase up to 2.789% in the year 2008. Industrial land use and transportation land use increase 8.690% and 6.450% between the investigation periods. The area under barren land was 21.260% in the year 2000 land use map, where it was 10.945% in 2008. From the study of satellite imagery it is resulted that -10.315% declined due to development of government projects and development of real estate projects on barren land area within the city limits. In 2000 agriculture land use was 19.713% and was declined by the year 2008 with 15.724% of total geographical area. As per 2000 vegetation was 16.290%, scrub land 8.880% and water bodies 1.265%, all these categories were declined in 2008 that is vegetation 13.160%, scrub land 6.110%, and water bodies 1.052% which is -0.213% change detect.

Conclusion

The present study has shown that the remote sensing techniques have remarkable potential for mapping and monitoring of land use /land cover. There is significant decrease in agriculture, vegetation, barren, scrub and water bodies' area and increase in residential, commercial and industrial area during twenty years that is 1989 to 2008. The rapid urban growth has transformed most of the agricultural, barren land into residential area. The conventional methods of obtaining urban land cover

data require a great deal of time, effort and money. The modern technology of remote sensing high spatial resolution and multi-spectral satellite data have the capability to provide the necessary input for effectively mapping the land use / land cover details rapidly.

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