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Urban Landuse/Land-Cover Change Detection Analysis of Aurangabad City Using Geoinformatics Techniques

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Abstract- Urban expansion has been creating an alarming situation in all countries of the world. High rate of urban population growth has led to serious land use problems such as loss of agricultural land, unauthorized urban sprawl, high land values, pollution, poverty and social unrest making urban governance a difficult task to maintain healthy urban environment. In the emerging scenario it is essential to have up-to-date information in existing land use information system. In the recent times, remote sensing and geographical information system (GIS) are very valuable and advantageous in providing current land use information. The present study highlights significance of remote sensing in the detection of urban land use changes for the time periods (1989 and 2006) using satellite imageries from IRS-P6, LISS III, IRS-P5, PAN and LANDSAT TM. . The satellite imageries IRS-P6, LISS III and IRS-P5, PAN for two consecutive dates were merged to produce a single merged image of two satellite imageries. These merged image and LANDSAT TM were further subjected to supervised classification for change detection. The result of change detection shows that the significant decrease of agriculture area and increase in settlement area from year1989 to year 2006. The spatial information from the remote sensing satellites plays a vital role in analysis of changing land use/land cover pattern.

Index Terms- Change detection, Land use / Land cover, Remote Sensing, Urbanization

I. INTRODUCTION

Urbanization is a worldwide phenomenon where all mega cities are rapidly developing due to various factors including population increases, industrialization and rural-urban migration. Though urbanization is a worldwide phenomenon, it's more prevalent in India due to high growth rate over last few decades (H. Taubenbock 2008). Rapid urbanization and urban sprawl have significant impact on pressure on land, water and environment. Urban planning is a complex phenomenon hence accurate and updated information is needed to develop strategies for sustainable development. The land use maps are used to provide up to date information on the type, location, spatial, distribution and extend of land use / land cover. The ability to monitor urban land-cover/land-use changes is very useful for policy makers, particularly for town planners. The gross acreage estimates provided under different categories of land use / land cover will be useful to the departments like agriculture, irrigation, revenue, forest & environment, for land use planning and decision making.

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). There is a wide range of techniques used for land useland cover change detection. The various change-detection methods are image comparison, comparison of classified images, combination of classified images, radar classification (e.g., Green *et al*., 1994; Yang and Lo, 2002; Loveland *et al*., 2002). An attempt has been made here to demonstrate the potentials of remote sensing techniques in change detection analysis of urban land cover by using the technique of comparison of the classified images

II. STUDY AREA

Aurangabad, the head quarters of the district and also the Marathwada division is situated on the kham River. Aurangabad municipal corporation area lies between 19° 48' 1"N to 19° 56' 47"N latitude and 75° 14' 40"E to 75° 26' 24"E longitude shown in figure 1. The annual temperatures in Aurangabad range from 9˚C to 40˚C. The average annual rainfall is 725 mm.

III. DATABASE AND METHODOLOGY

Initially the SOI toposheets were scanned and georeferenced and used as base layer for image registration. The digital remote sensing data LANDSAT TM (December 1989), IRS-P6- LISS III (December 2006), IRS-P5- PAN (December 2006) having 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,so to improve resolution of multispectral image "Resolution Merge" technique is implemented.The satellite images and toposheets were reprojected into WGS

1984 Complex UTM Zone 43N projection system.The spatial data used for this study are 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.

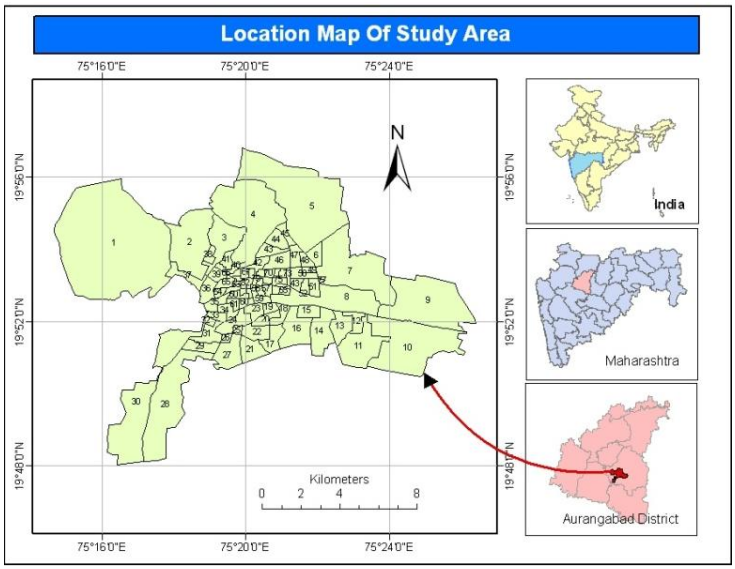

Figure 1: Location map of study area

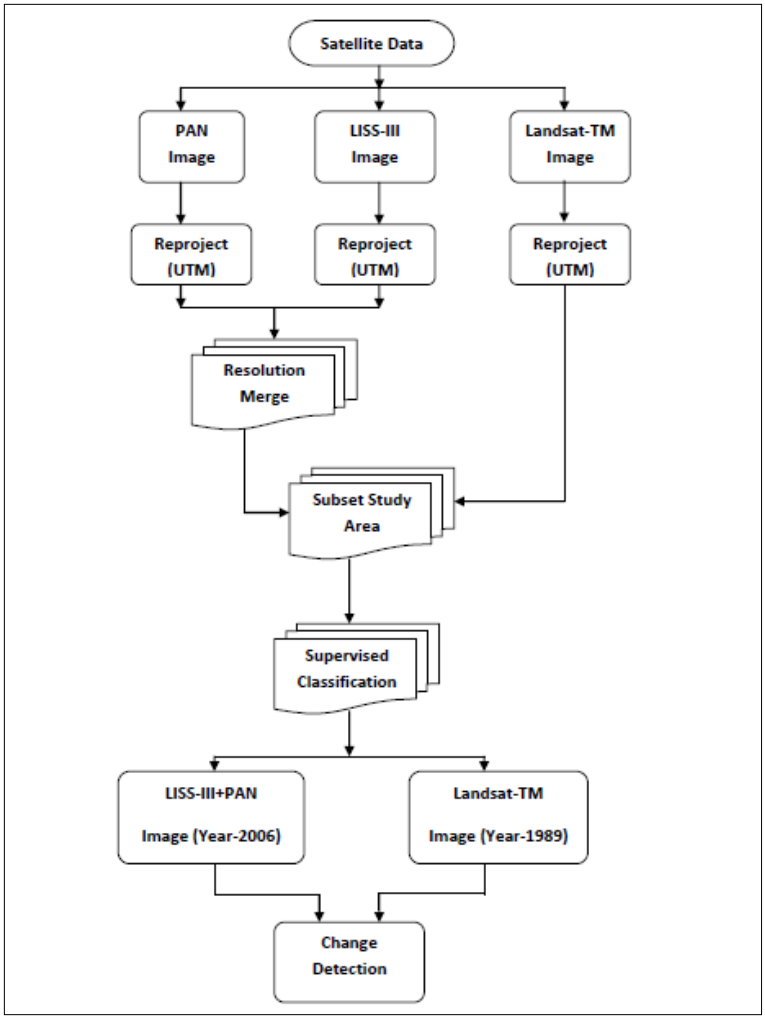

Figure2: Flow chart of Methodology

Table 1: Spatial data

Sr.No.	Used Data	Spatial Reference	Data Source
01	LANDSAT TM WRS-2, Path 146, Row 046 Dt.18-10-1989	28.5m	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)

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. Total five classes have been created i.e. agriculture, harvested area, water body, settlement and barren land for both the images. The flowchart of research methodology is shown in figure. 2

IV. Result and Discussion

4.1 LANDSAT TM Image

The classified image of LANDSAT Thematic Mapper (TM) is of year 1989. As per the map 67.0478 Sq.Km of total study area is agriculture which is maximum among the classified area, 35.414 Sq.Km of total area is settlement, 22.111 Sq.Km of total area is barren Land, 15.26 Sq.Km of total area is harvested Land and 1.6147 Sq.Km of the total study area is classified as water body which is minimum among the classified area. Figure 3 shows classified image of Land Use/ Land Cover map. The agriculture area is distributed throughout the study area whereas settlement is mostly concentrated in middle. The barren land is found mostly in west and north-west direction of study area. The water body covers minimum area and is in the form of small dam in the north region.

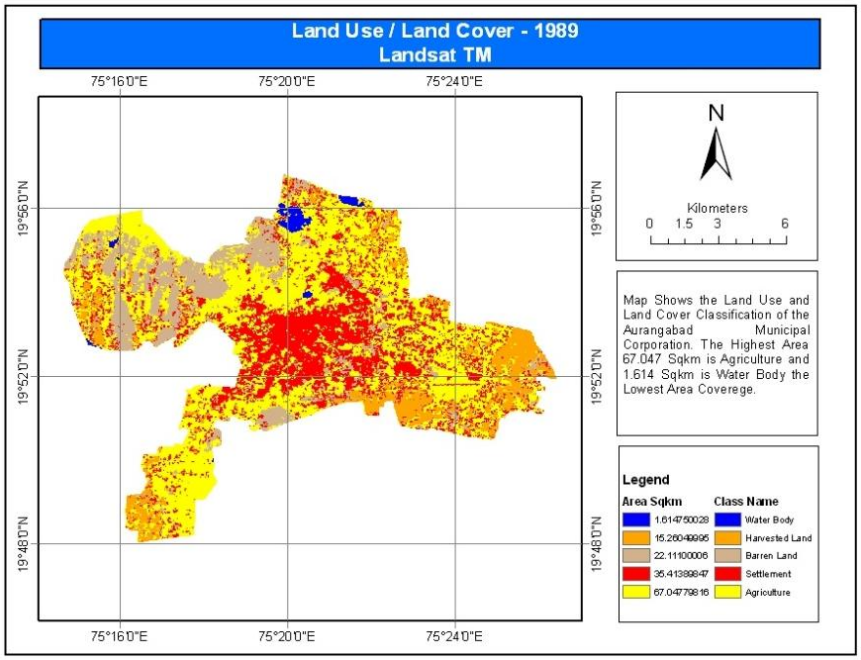

Figure3: Land Use/Land Cover - 1989

4.2 LISS-III + PAN Image

The classified merged image (i.e. LISS-III + PAN) is of year March 2006. As per the map 43.85 Sq.Km of the total study area is barren land which is maximum among the classified study areas, 39.633 Sq.Km of total area is settlement, 25.44 Sq.Km of total

area is agriculture, 25.93 Sq.Km area is harvested Land and 6.50 Sq.Km of the total study area is water body which is minimum among the classified areas. Barren land is mostly concentrated in North-West, South-West and East direction. Settlement is concentrated in the middle area and also segregated among study area. Agriculture is founded in the belt of North to East region and also in South-West region. The water body covers minimum area and is in the form of small dam in the north region and in West part of map. The classified image, Land use/ Land cover map of the study area is shown in figure 4.

4.3 Change detection

In the year 1989, the agriculture area was 67.048 Sq.Km and in year 2006 it was 24.449 Sq.Km, the total decrease of agriculture area is 41.6 Sq.Km i.e.62.044% of total agriculture area in 1989, simultaneously there is increase in barren Land, total increase is 21.74 Sq.Km i.e. 98% of barren land area in 1989. The barren Land has increased due to various reasons, one of them is, increase in industrialization after 1982 as Aurangabad council converted into Aurangabad Municipal Corporation, consequently settlement area also increased. The changes in area of various classes which occured during 1989 to 2006 is shown in table 1.

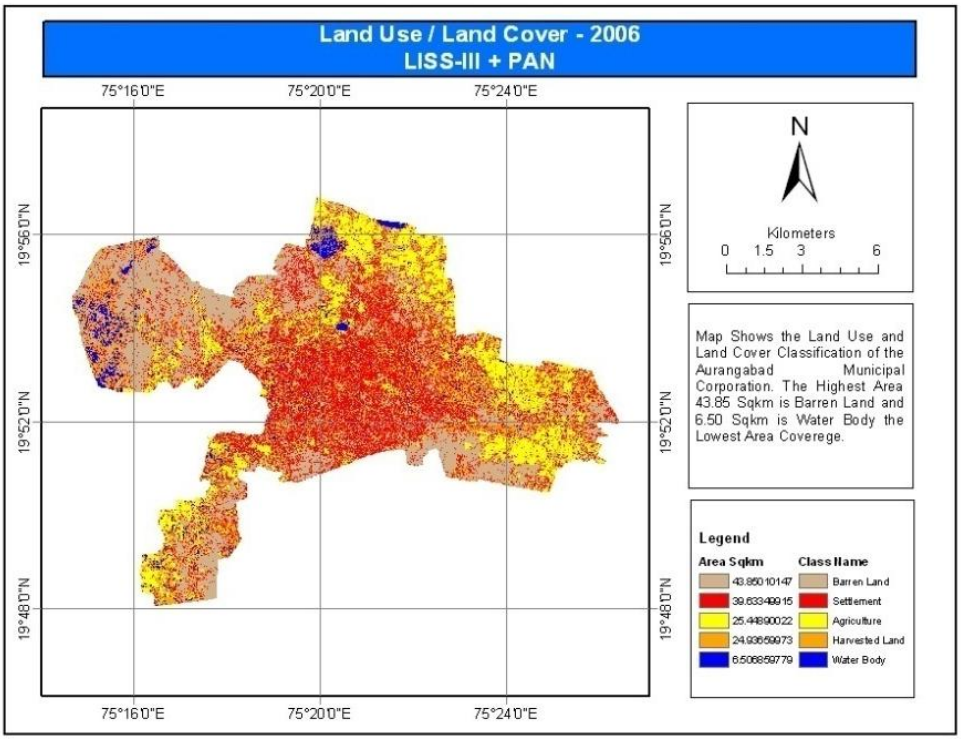

Figure4: Land use/Land cover - 2006

Table 2: Change During 1989 to 2006

Change Detection				
Sr.No.	**Class Name**	**LANDSAT-TM (Area %)**	**LISS-III+PAN (Area %)**	**Change (%)**
		1989	**2006**	
1	Agriculture	47.401	18.129	-29.272
2	Barren Land	15.632	31.237	15.605
3	Harvested Land	10.788	17.766	6.977
4	Settlement	25.037	28.233	3.196
5	Water Body	1.142	4.635	3.493

V. CONCLUSION

The present study has shown that remote sensing techniques have tremendous potential for mapping and monitoring of land use /land cover. There is significant decrease of agriculture area and increase in settlement area from year1989 to year 2006. The rapid urban growth has transformed most of the agricultural 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 has the capability to provide the necessary input for effectively mapping the landuse/landcover details rapidly.

REFERENCES

1. H. Taubenbock, M. Wegmannb, A. Roth, H. Mehl , S. Dech., 2008. Urbanization in India – Spatiotemporal analysis using remote sensing data. Computers, Environment and UrbanSystems, 33:179-188.
2. Batty, M., 2008. The size, scale, and shape of cities. Science, 319:769-771.
3. Green, K., D. Kempka, and L. Lackey, 1994. Using remote sensing to detect and monitor land-cover and land-use change, PhotogrammetricEngineering & Remote Sensing, 60:331–337.
4. Yang, X., and C.P. Lo., 2002. Using a time series of satellite imagery to detect land use and land cover changes in Atlanta, Georgia metropolitan area, International Journal of Remote Sensing, 9:1775–1798.
5. Loveland, T.R., T.L. Sohl, S.V. Stehman, A.L. Gallant, K.L. Sayler, and D.E. Napton., 2002. A strategy for estimating the rates of recent United States land-cover changes, Photogrammetric Engineering &Remote Sensing, 68:1091–1099.

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