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Change Detection Analysis of Land Use / Land Cover of Jalna City Using Remotely Sensed Data: 1998-2008

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Introduction:
Land use and land cover is important for many planning and management activities and his concern and essential element for modeling and understanding the earth as a system. Land cover map for presently being developed from local to National to global scales. The use of panchromatic medium scale aerial photographs to map land use has been accepted practice change the 1940s. More recently high resolution satellite images have been utilized for land use /land cover mapping (Lillesand & et al 2016).
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 using applications like remote sensing and geographical information system.

Objectives of the study:
The main aim of the present research work is analyse the land use/ land cover changes and mapping using satellite remote sensing digital techniques with field survey to carry out change detection studies in the study area over period of time. The study has been carried out with following objective.
To prepare the map of land use/land cover classification for the study area using satellite remote sensing data and supervised classification algorithm.

Study area
Jalna is situated on the bank of river Kundalika at an elevation of 508 meter above mean sea level. It is the district headquarters of Jalna district and well known trade centre of the Marathwada region of Maharashtra State. Total area occupied by Municipal limit of Jalna city is about 81.64 sq.km which lies between 19^0 48' 25"N to 19^0 54' 05"N latitudes and 75^0 48' 47"E to 75^0 55' 46"E longitude (Fig. 1). In the vicinity of Jalna city the numbers of large, medium and small-scale industries are rapidly growing. Due to number of pull factors as well as natural growth, the population of city is increasing rapidly. According to 2011 census, the population of Jalna city is 2,85,577 which is distributed in 54 wards.

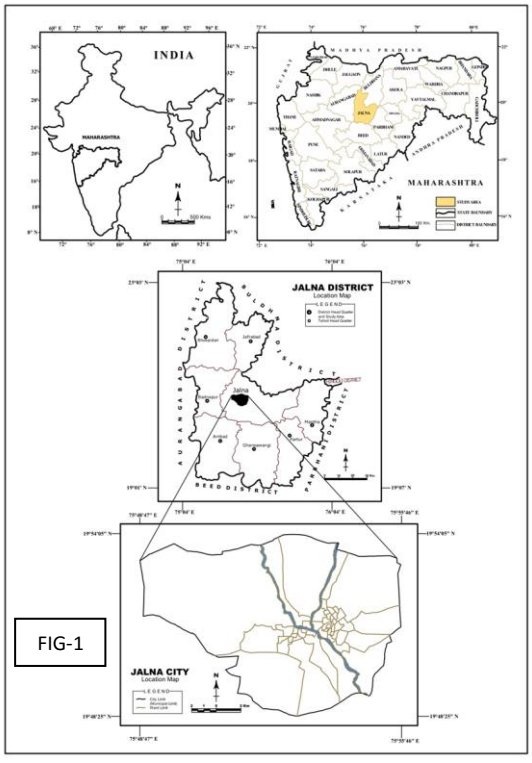

FIG-1

Background of the Study Area
At present, India is going through rapid urbanization. The number one-lakh and million cities increased and along with them increased the urban population. The proportion of urban population to total population increased from 17.3% in 1951 to 27.8% in 2001. Among the major states of India, Maharashtra is one of the most urbanized states. It is clear from the fact that in Maharashtra proportion of urban population to total population was about 42.4% in 2001. It has large number of big cities and medium sized cities. Various aspects of big cities are studied by urban geographers. However, medium sized cities like Jalna have been neglected by the researchers from the view of point of land use / land cover. In recent decades, Jalna city shows rapid growth rate. In the city land use is changing rapidly. So the selection of Jalna city is not arbitrary. It can be considered as a representative of rapidly growing medium size cities of

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nation. Besides, researcher is familiar with the study region and also there is a close attachment with it. All these considerations motivated the researcher to undertake the present study.

Parameters for Land Use/ Land Cover

In this study the selection of parameters for land use/ land cover classification system in order to arrange it under suitable framework to facilitated systematic land use inventory, mapping and change detection study. The important features used for analysis are agriculture, vegetation, built up, barren land and fallow land.

Source of Data Base and Research Methodology:

To study the land use/land cover changes in Jalna city from 1998 to 2008 the satellite imageries have been obtained from United States Geological Survey's (USGS) Earth Resources Observation & Science (EROS) The base map of the city and Jalna guide map obtained from Survey of India (SOI). The subsets for LANDSAT TM image were taken for further interpretation and classification process, false color composite (FCC) image showing in fig no. 2 & 3. Supervised classification for the LANDSAT TM has been performed with parametric rule as maximum likelihood in Erdas 14 software. The classified images showing area under different land use categories in 1998 & 2008 are given in figure 5 and 6 respectively. The resulted data have been used for land use / land cove change detection analysis.

For the present 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 (May 1998) & LANDSAT TM (May 2008) having spatial resolution 30m, were processed and geo-referenced using Ground Control Points (GCP) from Survey of India map. The satellite images and toposheets were projected into WGS 1984 Complex UTM Zone 43N projection system. The data used for this study is mentioned in Table 1. The Jalna city boundary AOI layer was overlaid upon so that study area could be extracted from the whole image.

Table No.1: Remote Sensing Data Source.

Sr. No.	Used Data	Spatial Reference	Data Source
1	LANDSAT TM Path 146, Row 046 (1998 & 2008)	30m	USGS https://earthexplorer.usgs.gov/
2	Toposheet : 47M/13	1:50000	Survey Of India (SOI)

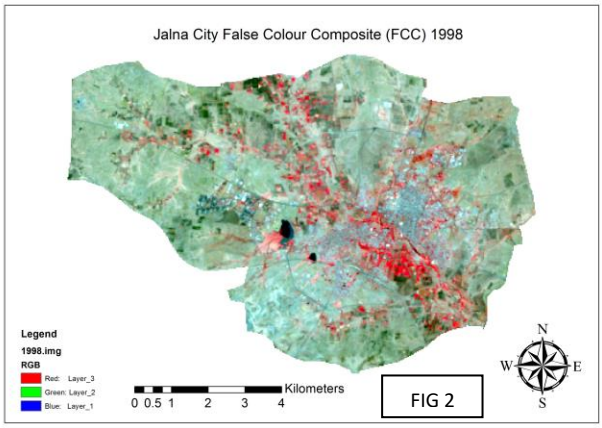

FIG 2

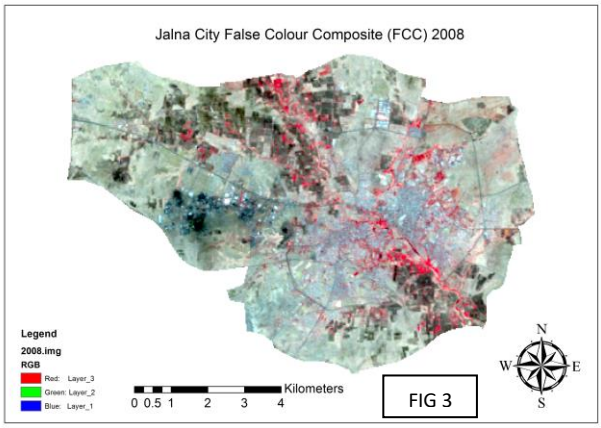

FIG 3

Ground Truth Verification

For this study, ground truth verification is done for land use/land cover analysis for unclassified areas. Spatial locations of all land use/land cover taken using Garmin GPS instrument. Due to ground truth verification the accuracy of interpretation has been enhanced. The doubtful areas were physically verified in the field work and observation for modification of thematic details.

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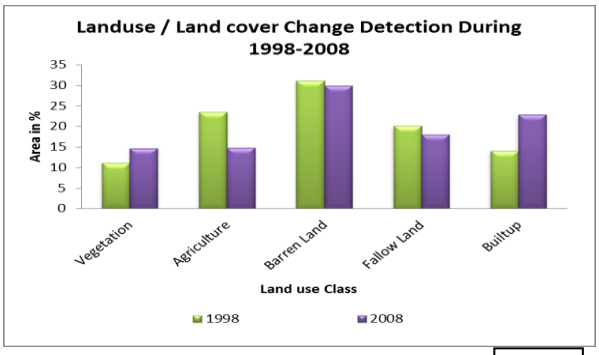

FIG 4

Results and Discussion:

Land Use/Land Cover Change from 1998 to 2008 (Landsat TM Image):

Land use/land cover layers represent the digital image of city classified into five classes as agriculture, vegetation, built up, barren land and fallow land. To get the clear scenario of land use/ land cover, the area was measured and presented in tabular form (Table 2). The same is represented by bar graph in figure 2.

Change detection during the period 1998 to 2008 given in table no. 2 and land use/land cover map depicted in the figure 3 and 4 respectively. Study reveals that, the major changes were detected in the built-up and agricultural land use categories. Significant changes also observed in vegetation land cover. Percentage share of other categories like agriculture, barren and fallow land declined in the period of investigation. In 1998 land use/ land cover map of Jalna city, the vegetation land was 11.12 percent of the total geographical area of the city. By the year 2008, area under this category increased up to 14.62 percent of the total geographical area due to social plantation on government land within the city limit. Agricultural land in 1998 was 23.54 percent and it decreased by 14.41 percent (-8.82) in the year 2008 due to lack of irrigation facility within the city limit.

Table: 2 Land Use/Land Cover Change during 1998 to 2008

LULC Class	1998 (%)	2008 (%)	Change (%)
Vegetation	11.12	14.62	3.50
Agriculture	23.54	14.71	-8.82
Barren Land	31.14	29.89	-1.25
Fallow Land	20.15	17.95	-2.20
Built-up	14.06	22.83	8.77

Barren land also decreased from 31.14 in 1998 to 29.89 in 2008 due to many industrial establishments on government land. Fallow land decreased due to agriculture land converted in to non-agriculture. Under this category 20.15 percent in 1998 and it deceased by 17.95 of total geographical area. Major changes were detected in built-up land use/ land cover. In this category 14.06 percent in 1998 and it increased up to 22.83 (+8.77) in 2008, due to increasing population and people came to settle from nearby rural areas for employment opportunities available in industrial sector of Jalna city.

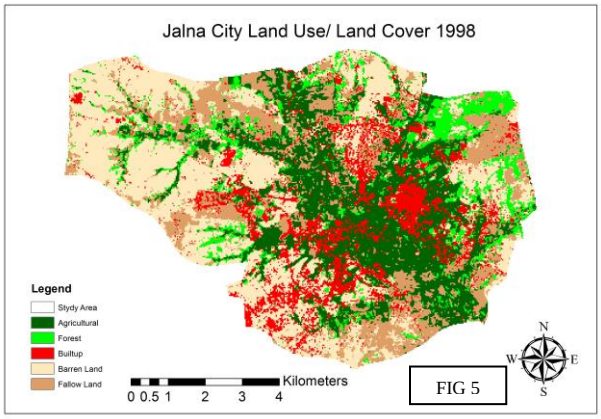

FIG 5

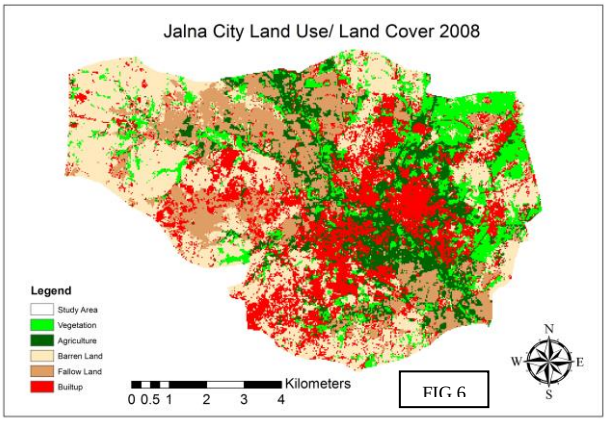

FIG 6

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Change Detection Analysis

The present study reveals the changes in the land use/land cover pattern of Jalna city between the years 1998 to 2008. The changes in land use/land cover can said to be positive change in built-up land. On the other hand, the change are said to be negative in other land use categories like vegetation cover, agriculture, barren and fallow land.

Table no. 3 reported change detection in the year 1998 to 2008 during these ten years of period the maximum changes observed in built-up land. Maximum agricultural, barren and fallow land converted in to built-up land. On the other hand, minimum areas of vegetation were converted into other classes.

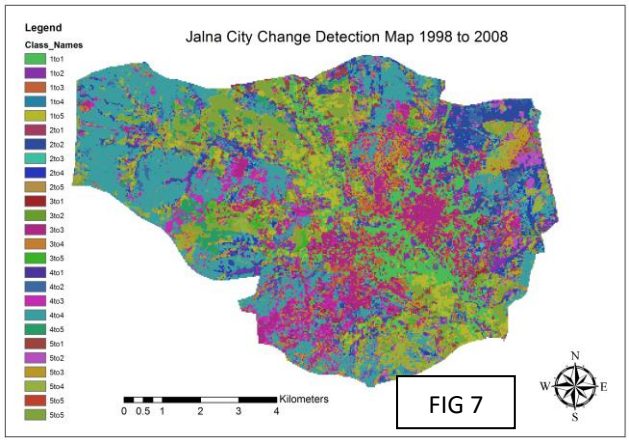

FIG 7

Table No. 3 Change Detection from 1998 to 2008

Sum of area	Column Labels					
Row Labels	**1 Agriculture**	**2 Vegetation**	**3 Built-up**	**4 Barren**	**5 Fallow**	**Grand Total**
1 Agriculture	741.78	294.93	314.37	59.22	358.11	1768.41
2 Vegetation	75.24	346.86	94.14	130.86	95.67	742.77
3 Built-up	60.39	59.58	642.51	142.47	80.73	985.68
4 Barren	33.66	194.4	377.82	1642.77	149.67	2398.32
5 Fallow	128.07	135.45	281.34	321.84	622.35	1489.05
Grand Total	**1039.14**	**1031.22**	**1710.18**	**2297.16**	**1306.53**	**7384.23**

Conclusion

- Land use/land cover layers represent the digital image of city classified into five classes as agriculture, vegetation, built up, barren land and fallow land.
- Study reveals that, the major changes were detected in the built-up and agricultural land use categories.
- Total agricultural land in 1998 was 1765.1 ha and 1039.14 in 2018. It shown as increasing built-up land and agriculture land converted in to non-agriculture due to the demand of new residential colonies. It also agricultural land converted into fallow land.
- Vegetation cover in 1998 was 739 and it increased by 1031.22 ha in 2008. Due increasing social forestry on forest land and government land it resulted positive changes observed in vegetation land cover.
- In the built-up are considerable level increased by 1710.18 ha in 2008 and it was only 938.04 ha in 1998. In the 20 years of investigation period the built-up land was significantly increased. Due to the more demand of housing.
- Barren land was marginally declined during the study. It was 2380 in 1998 and declined in 2008 with 2298.32 ha. Due to increased government projects on barren land.
- Fallow land in 1998 was 1479.46 ha it is decreased with 1306.53 in the year 2008.
- Barren and fallow land is marginal stable during the period of investigation.
- The changes in land use/land cover can said to be positive change in built-up land. On the other hand, the change are said to be negative in other land use categories like vegetation cover, agriculture, barren and fallow land.

The land use/land cover assessment using satellite imagery provides reliable and accurate information, which cost and time effective. It also offers a holistic view of large areas for better monitoring of land use/land cover. Hence, the satellite remote sensing is useful for assessing the land use/land cover.

From the above study, it is concluded that analysis of land use/land cover of the area can be effectively determined and can be used for future planning.

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