LAND USE/ LAND COVER CHANGE DETECTION USING REMOTE SENSING AND GIS

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ABSTRACT

Land use/ Land cover is a vital component in understanding the relation of the human activities with the environment and therefore to maintain a sustainable environment change detection is necessary. In this paper an attempt has been made to study the changes in land use/ land cover in some parts of Aurangabad and Jalna districts. The study was carried out through Remote Sensing and GIS approach using SOI toposheet, IRS-P6-LISS-III (2008) and Land Sat 7 ETM+ (2015). Land use/ Land cover changes have been detected by using image processing software EDRAS imagine 2013. Survey of India toposheet and satellite images are used to perform land use/ land cover classification. GIS software is used to prepare the thematic maps. The seven year time period of 2008 - 2015 shows the major type of land use change. Agricultural activities were increased from 18.28% to 46.54%, alternately fallow land was increased from 18.56% to 20.55% and built-up-land was increased from 1.03% to 3.98%. The reasons for this change detection have been discussed. However water bodies and waste land have also experienced the change.

Key words: Land use/ Land cover, change detection, Remote sensing, GIS.

I. INTRODUCTION

Land use/Land cover (LULC) maps describe the vegetation, water and natural features on the land surface. Although the terms land cover and land use is often used interchangeably, their actual meanings are quite distinct. Land cover refers to the surface cover on the ground, whether vegetation, urban infrastructure, water, bare soil or other. Identifying, delineating and mapping land cover is important for global monitoring studies, resource management and planning activities. Identification of land cover establishes the baseline from which monitoring activities like change detection can be performed and provides the ground cover information for baseline thematic maps.

Land use refers to the purpose the land severs, for example, recreation wildlife habitat, or agriculture. Land use applications involve both baseline mapping and subsequent monitoring, since timely information is required to know what current quantity of land is in what type of use and to identify the changes from year to year. Over the years, remote sensing has been used for land use/land cover mapping in different parts of application of remotely sensed data made possible to study the changes in less time, at low cost and with better accuracy. Remote sensing and Geographic Information System (GIS) provide efficient methods for analysis of land use issues and tools for land use planning and modeling.

In this present study, an investigation has been carried out in parts of Aurangabad and Jalna district of Maharashtra to detect the land use/ land cover changes. This area is facing severe drought, hailstorm and less rainfall since past years. Study area falls under the drought prone area of Aurangabad and Jalna districts and the agricultural activities are entirely dependent on monsoon. Looking the situation of area and conditions of villages Government of Maharashtra has started the implementation of the water conservation activities. The activities are implemented by keeping expected rainfall. It is believed that these activities might have influenced on the land use/land cover patterns

resulting in a possible impact on the environment.

II. STUDY AREA

The study area is located in between 75° 30'1.58''N to 75° 39' 10."6 N Latitudes a nd 20° 0' 1.58" E to 20° 13' 39.58'' E Longit udes, falling in Survey of India toposheet 46 P/12 with an aerial extent of 29146.63 Ha and found on the boundary of Aurangabad and Jalna district of Maharashtra. The average annual rainfall in the study area is only 535 mm and the soil is of silty loam and silty clay type. The study area is the group of small villages having the total population recorded as 4611 persons according to census of India 2011.

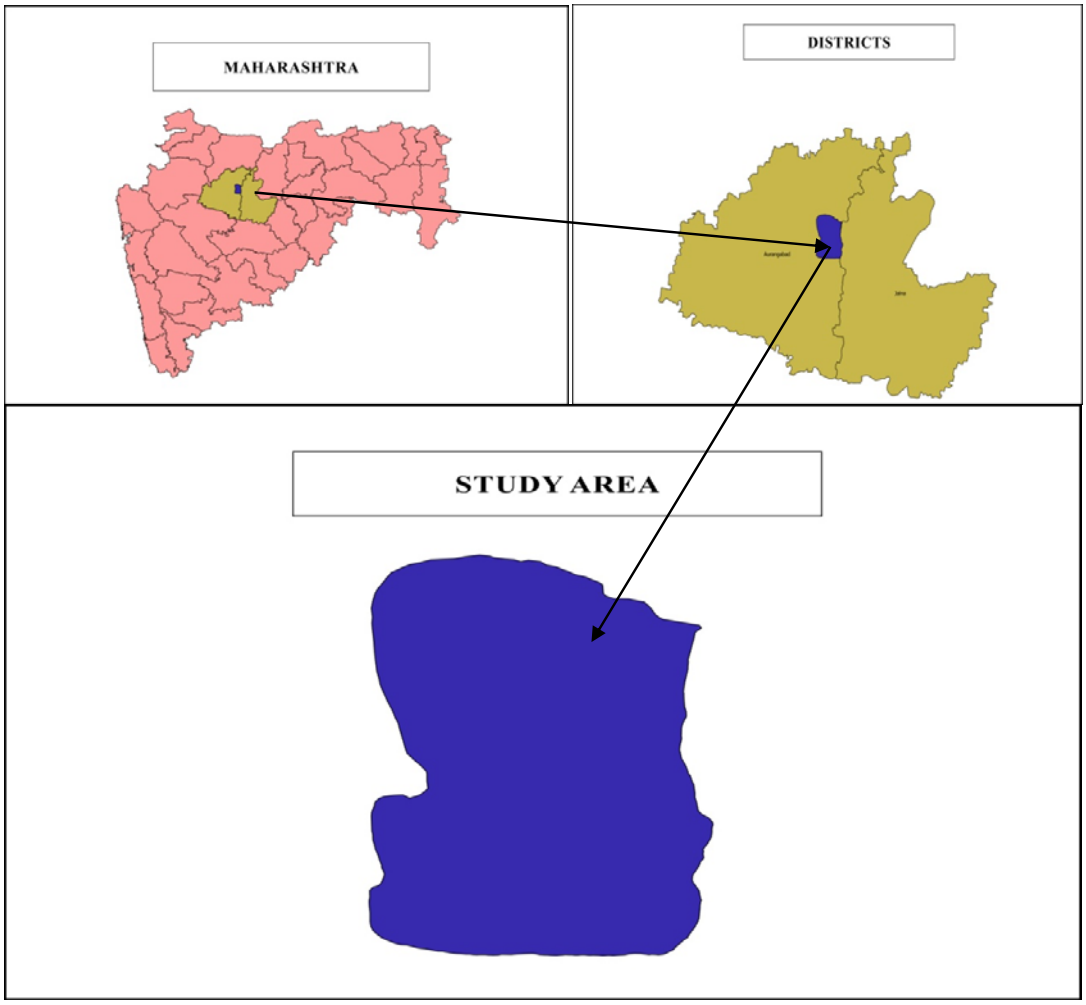

Fig.1: Location map of the study area

III. AIMS AND OBJECTIVES

The aim of this study is to produce a land use/land cover map of study area and the change detection analysis over a period of time. The specific objectives are as given below:

1) To prepare land use / land cover maps of study area for 2008 and 2015.
2) To assess the land use and land cover change of the study area.
3) To determine the extent of inter-class changes of land use and land cover.

IV. MATERIAL AND METHODS

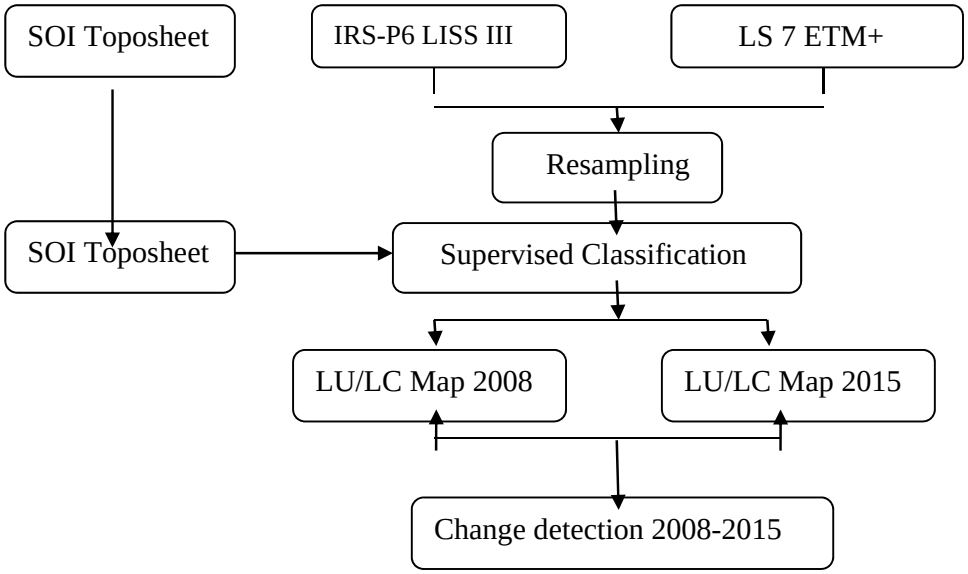

Fig.2: Flow chart of methodology for Land Use/land Cover change detection

1. Database preparation

Data used in this study is digital topographic map dated 1976 and with 1: 50000 scale. IRS-P6 LISS III and Land Sat 7 ETM+ satellite data were used to generate land use map for 2008 and 2015. The base map of the study area is prepared from the Survey of India 1:50,000 scale topographical sheet 46 P/12.The image processing and interpretation for the preparation of Land use/ Land cover maps is done in ERDAS imagine 2013 software. ERDAS is satellite image processing software to create a false colour composite (FCC). The layer stack option in spectral tool box was used to generate FCCs of the study area. The extraction of the study area is done by using sub setting tool where images are saved as AOI (Area of Interest).

2. Image Classification

For Land use/ Land cover classification, supervised classification method was applied in ERDAS imagine 2013 software. Supervised classification as the name indicates supervision of the user to carry out the process. The signature sets will be defined which corresponds to a particular class such as water, urban, vegetation, etc. Each pixel in the image is compared with each signature and classified accordingly. If there is no match found pixel is unclassified and grouped into separate class. Based on the ground truthing, the misclassified areas were corrected using Recode option in ERDAS Imagine. Five land use/land cover types are identified in the study area viz.,(i) Water body, (ii) Agricultural Land, (iii) Built up area, (iv) Fallow/ Non-agricultural Land, (v) Grass Land / Waste Land.

3. Change detection

Change detection analysis method is used to identify, describe and quantify differences between images of the same area at different times. Change detection is the pixel based comparison and thus, interprets the changes more efficiently. Data from two different images were compared using cross- tabulation in order to determine the changes for the periods from 2008 to 2015. With the help of ERDAS imagine 2013 change matrix was produced. The areal data of the overall land use/ land cover changes as well as losses and gains in each class between 2008 and 2015 were compiled.

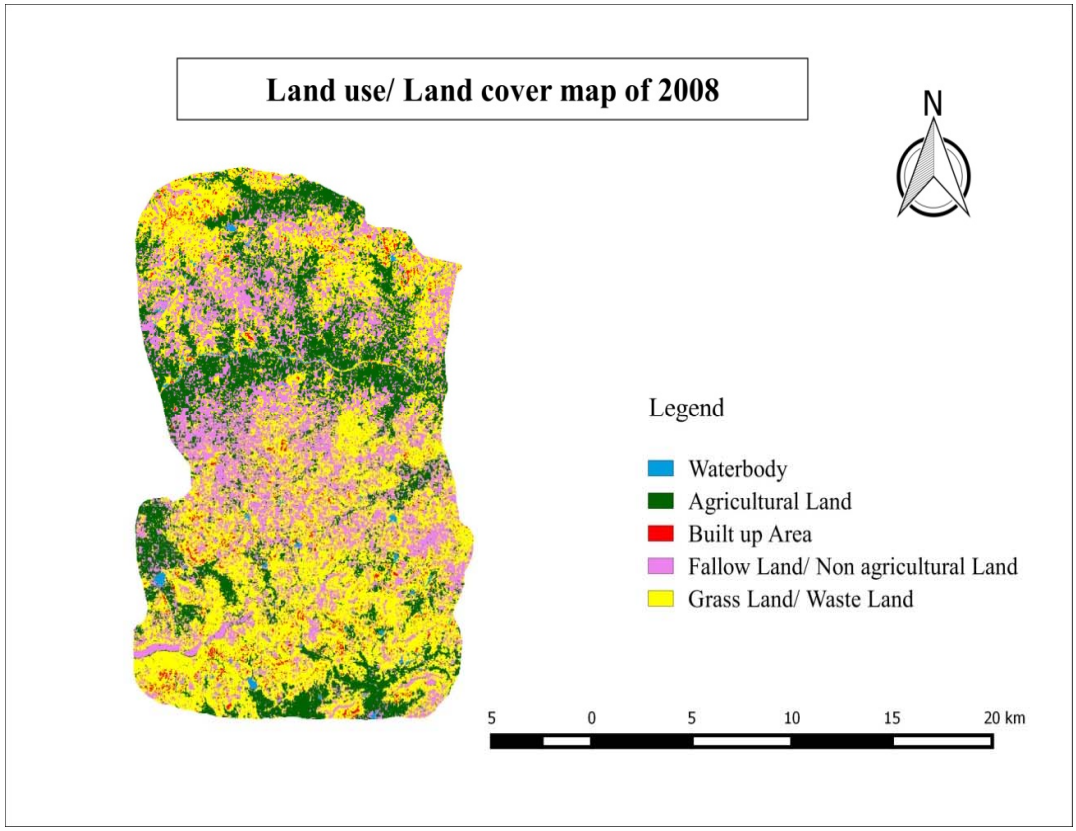

Fig.3: Map showing the Land use/Land cover categories for the year 2008

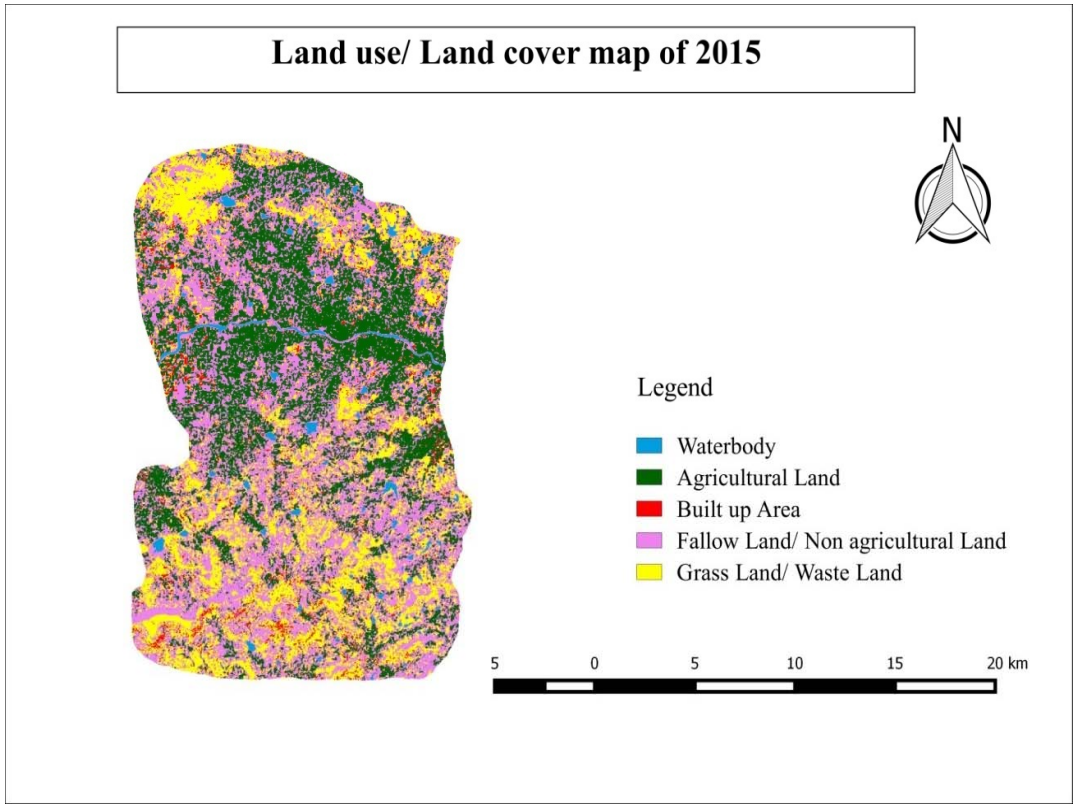

Fig.4: Map showing the Land use/Land cover categories for the year 2015

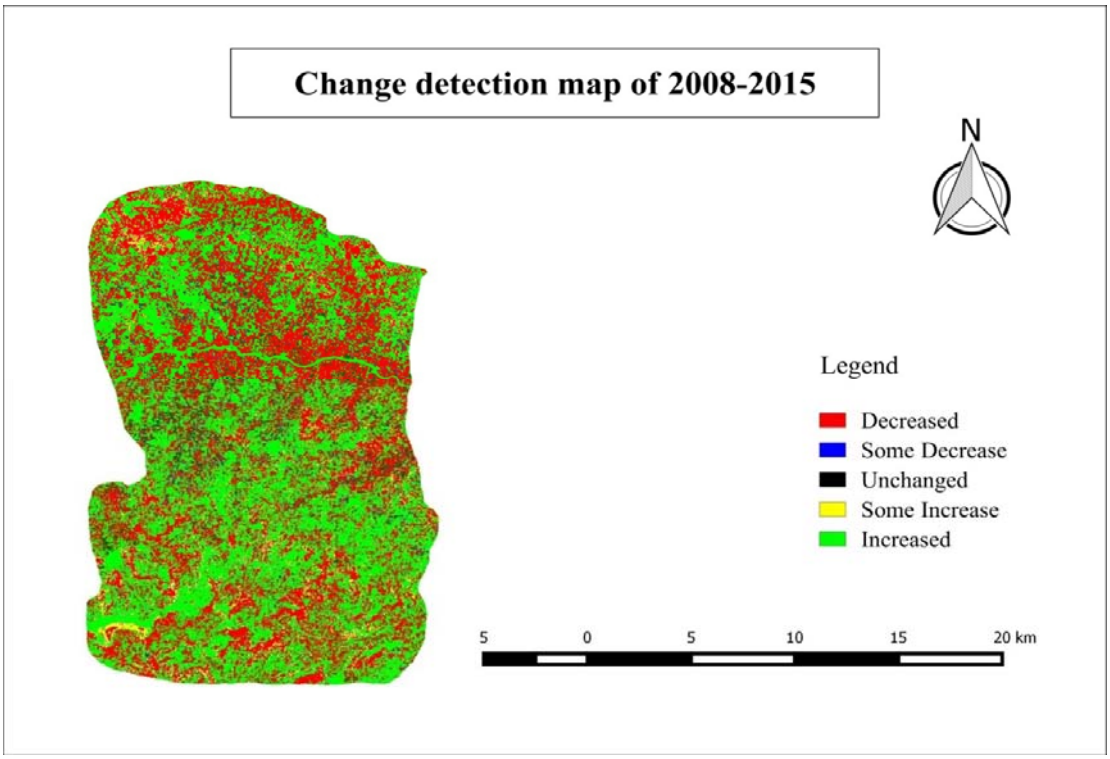

Fig.5: Change Detection Map for the year 2008- 2015

V. RESULTS AND DISCUSSION

The Land use/ Land cover categories such as water body, agricultural land, built up area, fallow land/ non agricultural land and grass land / waste land have been identified and mapped from IRS -P6 LISS III and Land Sat 7 ETM+ of 2008 and 2015. The change detection map is showing in the fig 5. Due to the effective watershed management programme in the study area water bodies during 2008 and 2015 are changes from 3.97% to 20.68%. People utilize the land for agricultural purposes. The area occupied by the agricultural land is about 18.28% (2008) and 46.54% (2015). This is due to the shifting of grass land / waste land to the agricultural land. The area occupied by the grass land / waste land is decreased from 58.16 %(2008) to 8.25% (2015). Due to increase in water conservation techniques in study area there is increase in water bodies and agricultural land. Built up area is increased from 1.03% (2008) to 3.98% (2015).

Table 1: Area under different Land use / Land cover categories during 2008-2015

Land use / Land cover type	2008 (Ha)	Area in %	2015 (Ha)	Area in %	Difference
Water body	1157.12	3.97	6027.53	20.68	+16.71
Agricultural land	5328.02	18.28	13564.85	46.54	+28.26
Built up area	300.21	1.03	1160.03	3.98	+2.95
Fallow land / Non-agricultural land	5409.62	18.56	5983	20.55	1.99
Grass land / Waste land	16951.66	58.16	2404.59	8.25	-49.91
Total	**29146.63**	**100**	**29146.63**	**100**	

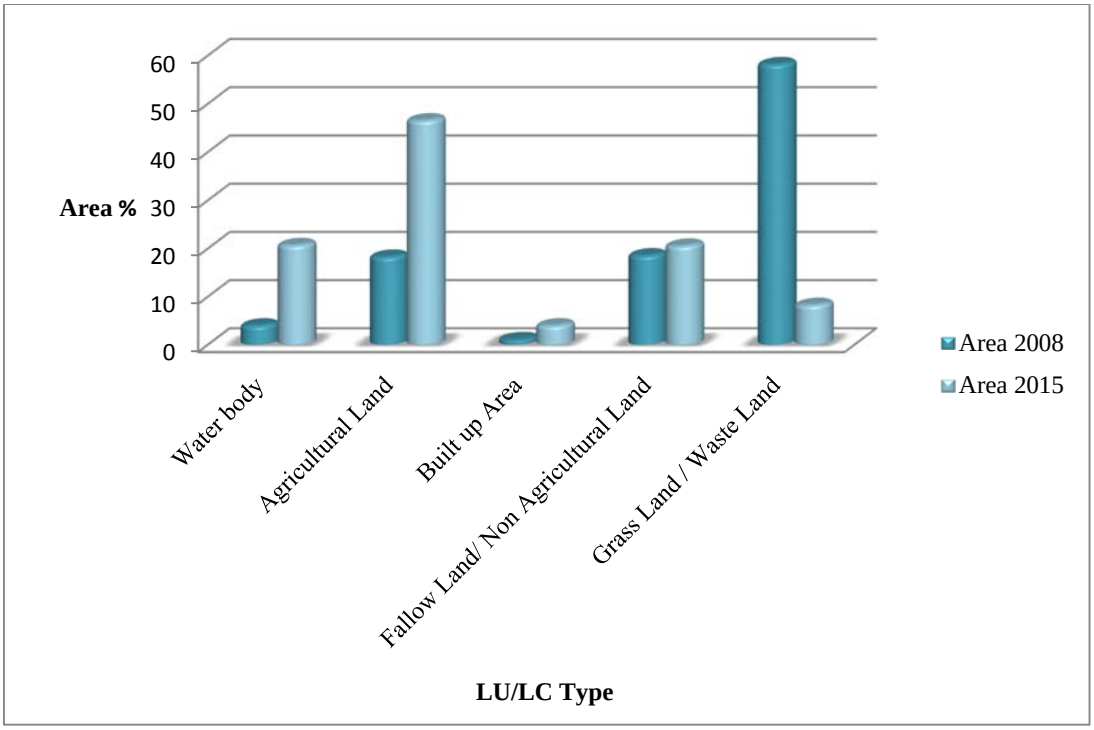

Fig.6: Land use / Land cover change, 2008-2015

VI. CONCLUSIONS

Based on the study carried out different conclusions drawn are as given below:

1) The study clearly established that the satellite remote sensing coupled with GIS can be a powerful tool for mapping and evaluation of land use/land cover changes of a given area.
2) The high resolution satellite data such as IRS P6 LISS III data and Land Sat 7 ETM+ are good source to provide information accurately.
3) The significant changes in the land use/land cover during the study period between the years 2008 to 2015 recorded.
4) The study revealed that the major changes occurred in water bodies, agricultural land and grass land/ waste land.
5) The features named as Grass land / waste land indicated a decreasing trend where as the features like fallow land/ Non agricultural land indicated an increasing trend. The reasons attributed for this are due to the changes in the pattern of agricultural activity and increased in water conservation techniques.
6) In general the land use/land cover data during the study period (2008-2015) of the study area indicated certain significant changes which may not show any significant environmental impact. However, these trends need to be closely monitored for the sustainability of environment in future.
7) Built up area were found to occupy the lowest area compared to other land use categories.
8) Change detection analysis brings out the actual land loss and land gain on fallow land / non agricultural land and agricultural land.

VII. REFERENCES

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