A Study of Change in Agricultural and Forest Land in Gwalior City Using Satellite Imagery

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Abstract

The relative evaluation of land use and land cover for various uses such as forest, agriculture and water bodies etc. is the important issue in the semiarid region. Application of Remote Sensing technology for Land Use and Land Cover (LULC) change analysis has been carried out in semi-arid region of Madhya Pradesh, central part of India and found that the use of remote sensing along with Survey of India toposheets could be used appropriately for LULC mapping. The semi-arid regions are characterized by erratic rainfall and high rate of vegetation dynamics. The increasing biotic pressure together with increasing human demands exerts pressure on the available land resources all over the region. Therefore, in order to have best possible use of land, it is not only necessary to have the information on the existing LULC, but also to monitor the dynamic land use resulting because of increasing demands aroused from the growing population. Continuous overexploitation of natural resources like land, water, and forest has caused serious threat to the local population of the semi-arid region. This causes problems like little scope for soil moisture storage, high rate of soil erosion, declining groundwater level and shortage of drinking water.

1. INTRODUCTION

Due to rapid urbanization, there is very fast growth in the anthropogenic activities which cause significantly change in the earth surface in some manner. Various studies show that there remain only few landscapes that are still in their natural state. Change in the LULC is an phenomenon which is depends on the natural and socio-economic factors and their utilization by man in time and space. Hence, information on LULC with change in that is essential for optimal utilization of land surface. It also helps in the planning and implementation of land surface for the sustainable development of the area. Outcomes of the analysis help in the study of the dynamics of the LULC with changing demands of increasing population. Various studies was done for the coal fields by different researchers (Singh *et al*, 1997; Sarma *et al*, 2005; Ololade *et al*, 2008; Chitade *et al*, 2010). Some studies were found for the gold mines also (Duncan *et al*, 2009). Many studies are available in the literature to analyze the effects of land policies qualitatively.

2. STUDY AREA

The study area of this project work is the Gwalior district having coordinate (latitude 26° 5'-26° 25' N and longitude 78° 10'-78° 25' E), of about 405 sq km, in the northern part of Madhya Pradesh, India in the Indo-Gangetic Plain (Fig.1). The Gwalior city consists of three distinct urban areas: old Gwalior in the north, Lashkar to the

southwest and Morar towards the east. This region is dominated by semi-arid climate marked by extreme temperatures and erratic rainfall patterns. Geologically, Gwalior group of litho units rest uncomfortably over Bundelkh and granite and comprise basal erinaceous Par formation which is overlain by volcano-sedimentary sequences of Morar formation consisting of ferruginous shale with bands of chert-jasper.

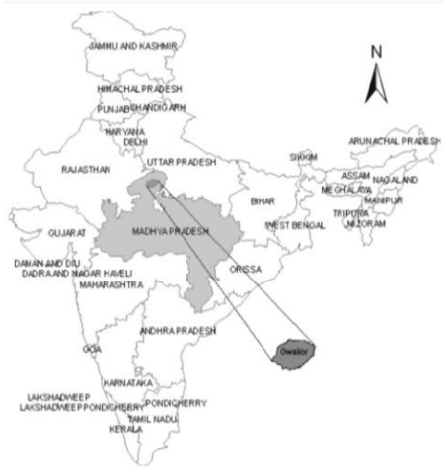

Fig.1: Location Map of the Study Area

3. USED DATA & METHODOLOGY

In this study, ortho-rectified Landsat-8 satellite imagery was used. Landsat-8 satellite have eleven bands in which two bands are thermal bands having 100 m resolution while one band have 15 m resolution called panchromatic band and rest of the bands have 30 m resolution. This satellite data can be downloaded from the USGS website (www.usgs.gov). For identification of change detection download the images for two or more different years. Here, satellite images of 2006 and 2012 are used. After downloading the satellite images, prepare the Land Use Land Cover map for the study area using supervised classification. Before classification, a number of image processing tools were applied. All the processing has been done on ERDAS Imagine and Arc GIS software. Field checks have been performed for ascertaining the ground truth. Error Matrix for accuracy assessment has been generated and finally the land use map and reports have been prepared.

4. RESULTS AND DISCUSSION

After the enhancing of raw data of Landsat 8, images gets geo-reference and classification was done using supervised approach. LULC map of the study area is presented in the figure 2 for year 2002 and LULC for year 2012 is shows in figure 3. Different classes are represented by different colours. In this study, six classes are formed namely Forest, Grass & Shurb, Water bodies, Agricultural land, Built-up land and barren land. Major area is covered by agricultural land followed by grass and shrub.

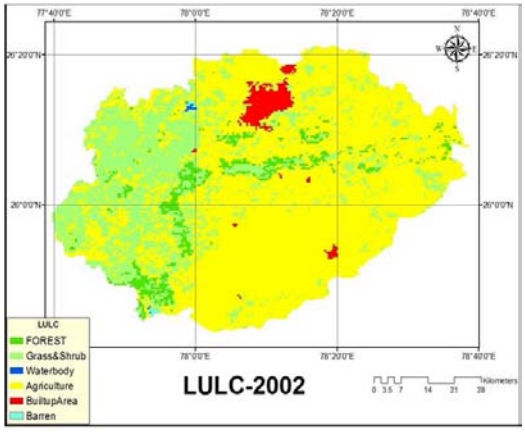

Fig.2 : LULC map of Gwalior in 2002

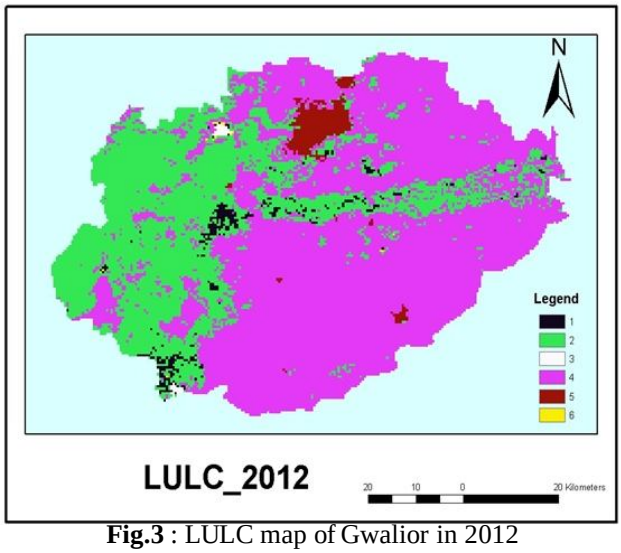

Fig.3 : LULC map of Gwalior in 2012

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Multi-temporal images are taken in this study and results are analyzed and presented in the tabular form in table 1.

Table-1: Shows Change Detection over the Decades

Land Use/ Land Cover	Year 2002		Year 2012		Difference (%)
	Area(km^2)	%	Area(km^2)	%	
Forest	1018	4.53	383	1.60	2.92
Grass And Shrub	5927	24.8	7790	33.2	8.40
Water Body	17	0.07	49	0.21	5.08
Agriculture	16285	68.3	15049	63.1	5.20
Built-up Area	527	02.2	527	2.24	0.004
Barren Area	41	0.17	17	0.07	0.01
Total	**23815**		**23815**		

As LULC map of the study area for year 2002 shows that most of the study area is covered by forest. In 2002, area occupied by forest area was 1018 km^2, 4.2% of the total area. Grass and shrub occupied 5927 km^2. This is more than 24.80% of the total study area. Area of water bodies was 17 km^2 only 0.0713% of total study area. Agricultural area was 16285 km^2. This was 68.30% of the total study area. Built up area was 527 km^2 which was 2.24% of the total area. Barren area was 41 km^2 which was 0.172% of total area. "In 2002 Water body occupied the minimum area whereas Agriculture area and Grass and shrub percentage was maximum."

From 2012 LULC map, a change is observed in all the classes. During the period, from 2002 to 2012, forest area decrease by 635 km^2, and percentage change of 1.625%. Grass and shrub area observed an increase during the same period from 5927 to 7790 km^2. The change area in percentage of grass and shrub is 8.4%. Area of water bodies increase from 17 to 49 km^2 during the period 2002 to 2012. There was a decrease in Agriculture area by 1236 km^2 a percentage decrease of 5.20%. There was decrease in Barren area by 24 km^2 a percentage decrease of 0.10%.

5. CONCLUSION

The present research work demonstrates the capability of geospatial techniques to capture the land use/land cover categories in a semi-arid region such as Gwalior city of Madhya Pradesh, India, which are necessary for optimum and sustainable utilization of land resources and prevention of further undesirable deterioration in land use. Analysis also shows the agricultural area mostly found in the northern portion whereas southern portion of the basin is occupied by the forest cover over the denudation hills. The result of the work showed that there was a rapid change of agriculture and forest during the period from 2002 to 2012. Therefore, it can be concluded that increase in mining activities is damaging to vegetation. The observation also shows major portion of the basin affected by severe soil erosion due to the occurrence of shales and steep slope. Therefore, the present work suggested that area urgently needs to minimize soil erosion by applying various techniques of soil conservation and large scale aforestation.

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