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Change detection mapping of Landuse / Landcover area in Satna district: using remote sensing and Gis technique

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Abstract
The temporal change (2006 to 2014) in land use / land cover has been studied using temporal satellite data of Satna district. Land Use and Land Cover mapping is of great significance in scientific, research, planning and management. Regional land use pattern reflects the character of interaction between man and environment and influence to the mankind's basic economic activities. Due to advancement in satellite sensors, their analysis techniques are making remote sensing systems fruitful, realistic and attractive for use in research and management of natural resources. Land use map is a valuable tool for agricultural and natural resources studies, updation of these maps are essential due to strength of natural resources, Remotely sensed satellite images provides a synoptic overview of the terrain or earth in a very short time span. The major aim of this study is to prepare land use land cover and their change detections. The integration of remote sensing and GIS is a topic of general interest in the field of photogrammetry, remote sensing and GIS. It mainly contributes to two kinds of applications: one is GIS database updating by remote sensing images and the other is remote sensing analysis by the support of GIS data. These two aspects complement each other to make the GIS databases updated continually.

Keywords: Change detection, Satellite imagery, Land use, Land cover, unsupervised classification technique. Remote sensing and GIS.

Introduction
Land use and land cover is dynamic in nature and require regular monitoring to understand areas of rapid change. Land use/ Land cover change encompass some of the most important human alteration affecting the surface of the earth. Changes in land cover through cropping, forestry and urbanization represent the most substantial alternative through their interaction with most components of global environmental changes. Land use and land cover information are important for several planning and management activities concerned with the surface of the earth because it constitutes key environmental information for many scientific, resource management and policy purposes and a range of human activities. An accurate knowledge of land use and land cover features represents the foundation for land classification and management. Therefore a wide range of scientists and practitioners, land and water managers as well as urban planners seek information on the location, distribution, type and magnitude of land use and land cover change.

To prepare a land use map using satellite data, image classification is a powerful method of information extraction (Karteris, 1990). Successful use of satellite remote sensing for land use/land cover change detection depends upon an adequate understanding of landscape features, imaging systems and information extraction methodology employed with relevant to the aim of analysis. The information may be obtained by visiting sites on the ground and / or extracting it from remotely sensed data. Change detected from different temporal images usually reflects natural and human activity impacts. Many studies have demonstrated the effectiveness of using remotely sensed data as a powerful tool to detect land use change for critical environmental areas, vegetation dynamics and urban expansion. Remote sensing makes a major technological breakthrough in the method of acquiring information on land resources, agriculture, forestry, ocean resources and other studies (Rao, 1991). Remote sensing and GIS together can supply timely and accurate information needed for forest planning and management. Remotely sensed data provide striking spatial detail about the earth surface, which serve as a better data source for environmental change studies such as forest land cover transition.

Study Area
Satna district is situated between latitudes 23°58' and 25°12' north and longitude 80°21' and 81°23' east in mid northern part of Rewa Commissioner's Division in Madhya Pradesh state of India.

The area occupies the NEE part of Vindhyans. Satna district covers an area of 742432 Hectare / 7502 km^2. Its height from sea level is around 317 metres and the average rainfall is about 1100 mm. In the north, the district boundary merges with Chitrakoot District of Uttar Pradesh. Eastern part of the district runs with the Teonther, Sirmour and Huzur tehsils of Rewa district and a very small portion of the Gopadbanas tehsil of Sidhi District. The entire western boundary of the district touches the Panna district. The southern boundary abuts the Murwara tehsil of Katni district in the west, and Bandhogarh tehsil of Umaria district and Beohari Tehsils of Shahdol district on the east. The year is more or less divided into three seasons: the summer season extending roughly from middle February to middle June; the rainy season from middle June to September and the winter from November to middle February. The month of October witness the transition of rainy season to the winter season. Tons, Son, and Paisuni are the important rivers of the district draining them into the Ganga. The Kaimur and the Panna hills act as water-dividers. Most of the river flows towards the east, with an inclination in the north direction. The Simrawal and the Satna rivers are, however, inclined towards the south.

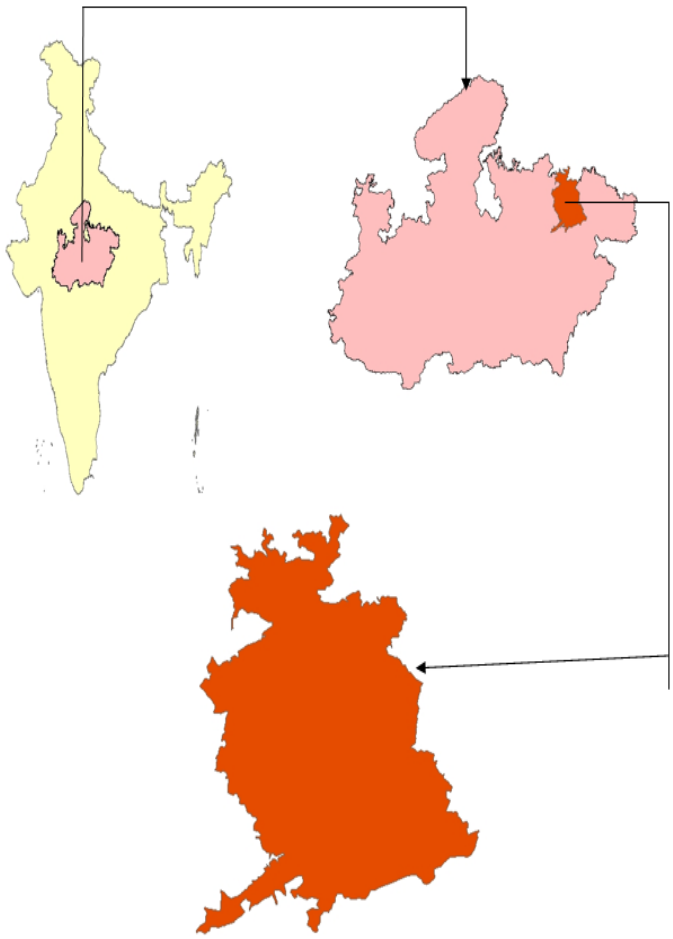
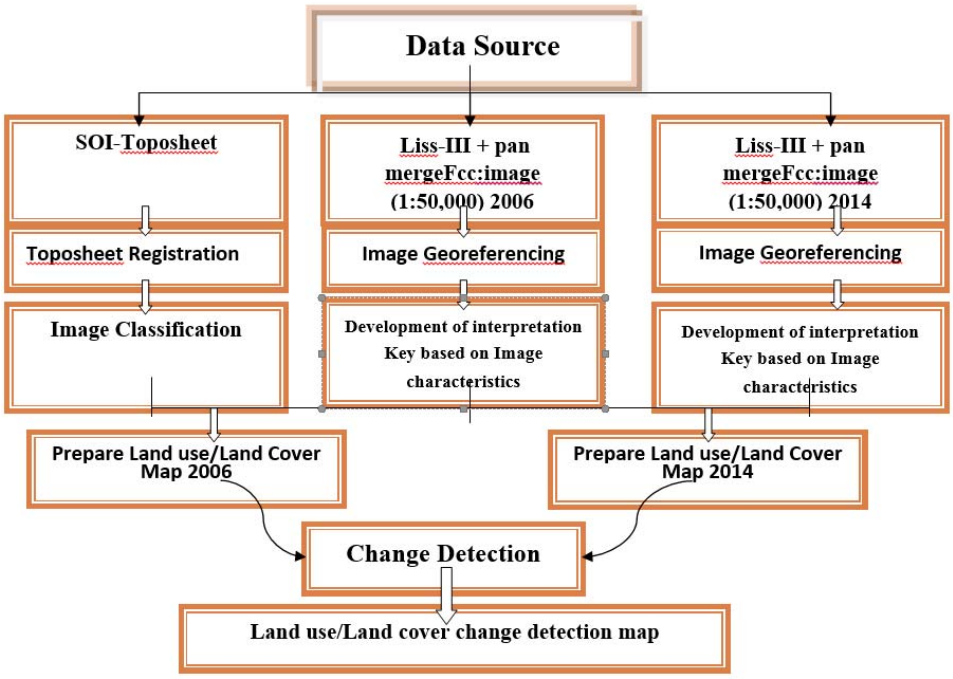


Fig 1: Location Map of the Study Area

Land use Land cover

The area includes arable land, waste land, urban settlement, limes-tone quarry and water body. According to the weight as-signed for ground water recharge point of view 72% of the area belongs to moderate water prospecting zone. The area having forest cover is attributed as good for water prospective aspect. The soil constituents and their texture, moisture content, mineral content etc. supports different types of vegetation, so we can say that they have close association with relation to moisture content and water yielding capacity.

Methodology



Data source in the present study pertaining to multidate satellite data of 2006 and 2014 of LISS III were used. The secondary data used in study Survey of India toposheets on 1:50,000. Visual interpretation technique was used for the mapping of land use/land cover. Prior to interpretation of multidate satellite data, a reconnaissance survey of the study area was done to develop a classification scheme based on local knowledge and ancillary information. An interpretation key was also developed based on standard Photo-elements like tone, texture, size, shape, association, pattern, location etc. to identify and map different classes. With the help of interpretation key onscreen preliminary interpretation of satellite data was done using ERDAS IMAGINE 9.2 software.

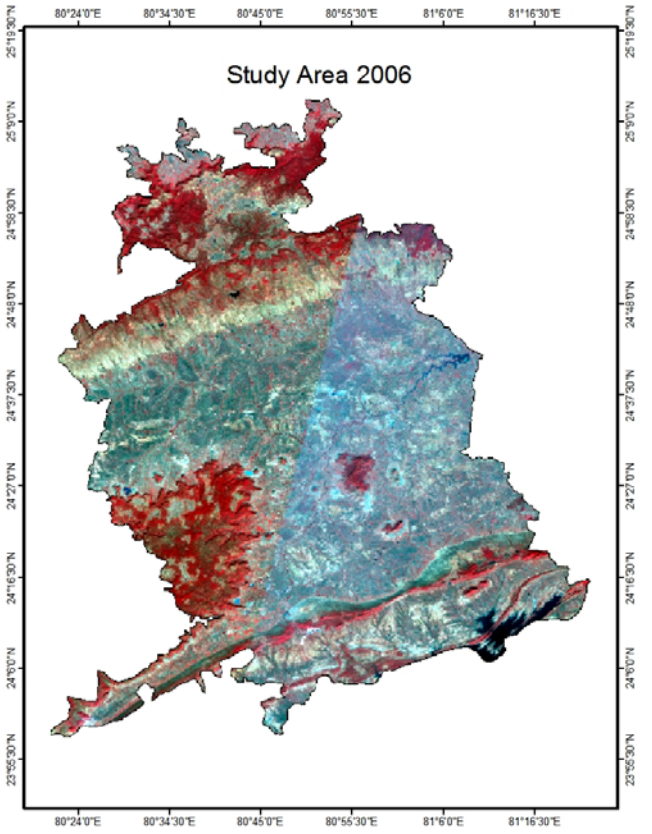


Fig 2: Satellite Image 2006

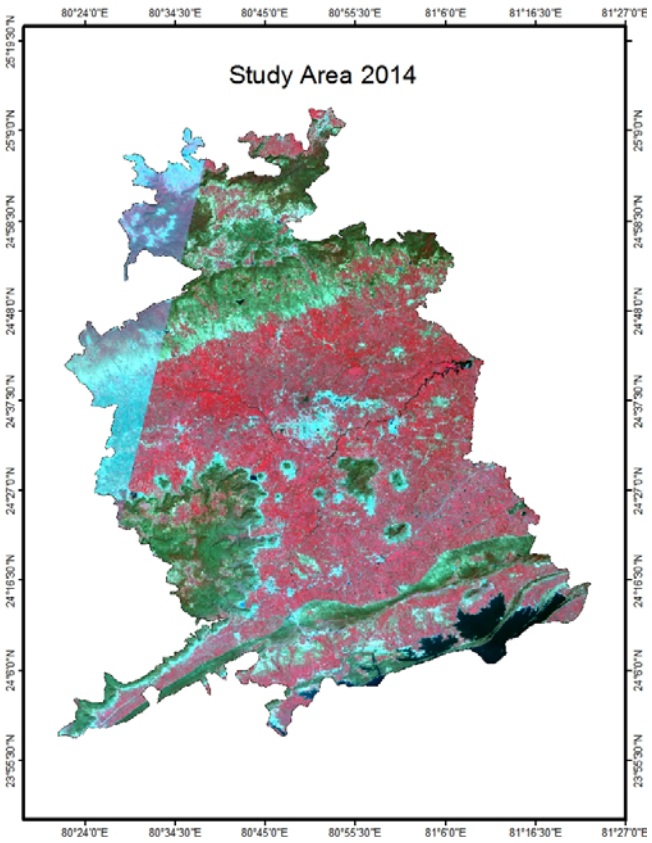


Fig 3: Satellite Image 2014

Union method is applied for Overlay analysis using Arc info Software. The final maps were prepared after reconciliation of doubtful areas observed in preliminary maps. The final maps were prepared and statistics of the area was generated using Arc Map 9.3 Software.

Result and Discussion

In the present study land use/ land cover of Satna district was mapped for the years 2006 and 2014. In order to monitor the changes in land use / land cover proper care was taken in the selection of cloud free temporal data. It was not possible to obtain the ground truth pertaining to older data i.e. IRS 2006, therefore a novice approach to overcome the same was followed. Mapping was done for the year 2014 data and was used as template to analyse the data of 2006.

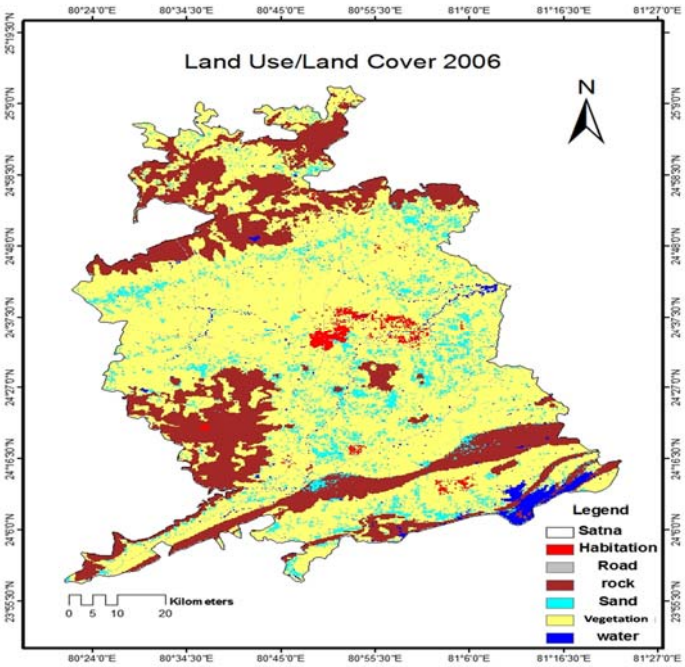


Fig 4: Classified Image 2006

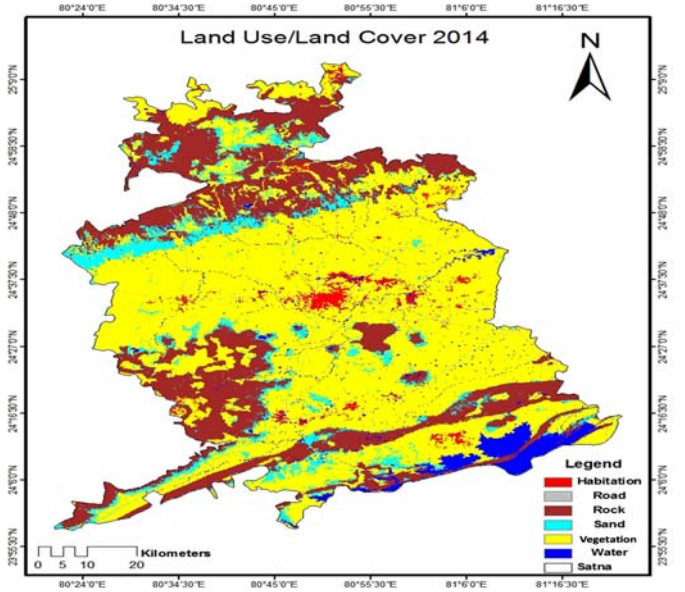


Fig 5: Classified Image 2014

Accuracy Assessment

The classification accuracy is most important aspect to assess the reliability of maps, especially when comparing different classification techniques. During this study the accuracy assessment methods were used. Accuracy assessment, automatic random point to be selected by software. This method shows accuracy of about above 90% or more.

Table 1: Classification Accuracy Assessment Report of Classified Image 2006

Class Name	Reference Total	Classified Total	Number Correct	Producers Accuracy	Users Accuracy	Kappa (K^) Statistics
Water	0	0	0	0	0%	0.0000
Rock	14	13	13	92.86%	100.00%	1.0000
Vegetation	33	31	31	93.94%	100.00%	1.0000
Sand	3	4	3	100.00%	75.00%	0.7344
Road	0	1	0	0	0%	0.0000
Residential area	1	2	1	100.00%	50.00%	0.4900
Column Total	51	51	48			
Overall Classification Accuracy = 94.12% Overall Kappa Statistics = 0.8893						

Table 2: Classification Accuracy Assessment Report of Classified Image 2014

Class Name	Reference Total	Classified Total	Number Correct	Producers Accuracy	Users Accuracy	Kappa (K^) Statistics
Water	3	4	3	100.00%	75.00%	0.7375
Rock	13	13	11	84.62%	84.62%	0.8062
Vegetation	37	43	35	94.59%	81.40%	0.5492
Sand	8	2	1	12.50%	50.00%	0.4273
Road	0	0	0	0%	0%	0.0000
Residential area	2	1	0	0.00%	0.00%	-0.0328
Column Total	63	63	50			
Overall Classification Accuracy = 79.37% Overall Kappa Statistics = 0.6725						

The major land use / land cover categories identified in the study area are settlement, barren rock, wasteland, vegetation, water and road, and their area extent are presented in Table 4 and Fig No.4 In general major area was occupied by vegetation followed by wasteland, barren rocks, settlement and minimum by water.

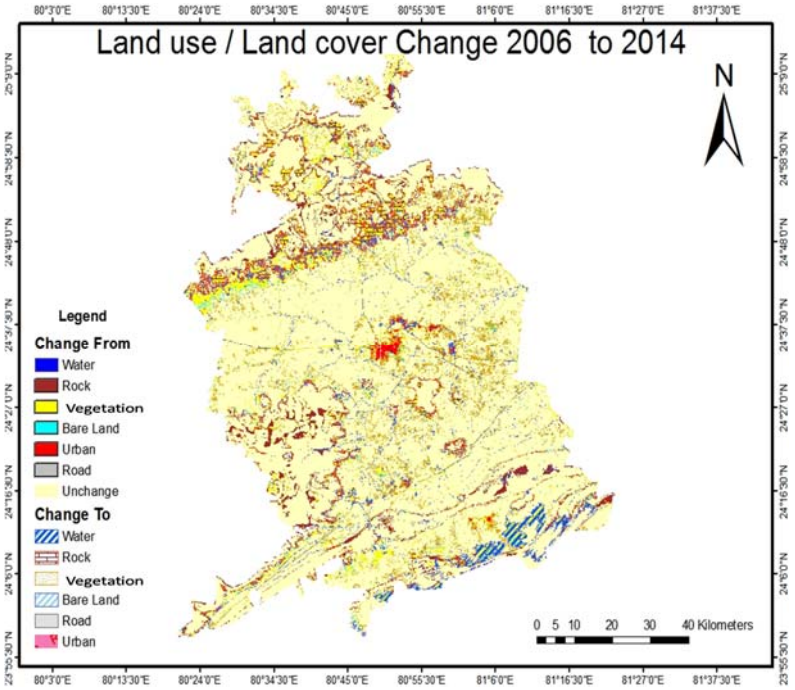


Fig 6: Land Use/Land Cover Change 2006-2014

Table 3: Area Statistics of Land Use/ Land Cover distribution in Satna district during 2006 to 2014

Landuse /Land Cover CategorIes	2006		2014		Change in %
	Area (km^2)	Area (%)	Area (km^2)	Area (%)	2006 to 2014
Water	124.7951	1.66	286.281	3.81	2.15
Rock	1797.16	23.98	1942.877	25.92	1.94
Vegetation	4915.768	65.58	4497.35	60.00	-5.58
Wasteland	530.1479	7.07	570.6946	7.61	0.54
Road	37.81742	0.50	44.34753	0.59	0.09
Settlement	90.24684	1.20	153.5782	2.05	1.20
total	7495.936	100%	7495.128	100%	

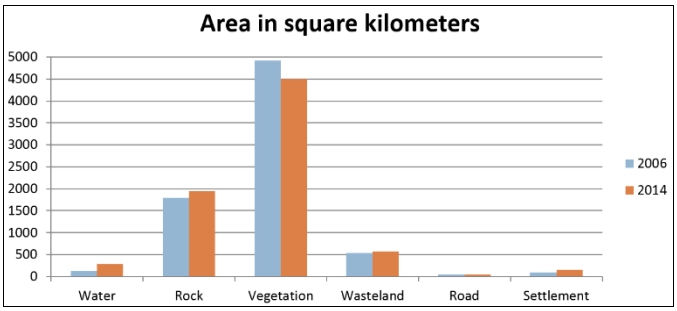


Fig 7: Land Use/Land Cover Change from 2006 To 2014

From the current study it is evident that there is considerable decrease in the vegetation (dense, moderate and open forest) from 2006 to 2014. Built-up land, waste lands, and water bodies show a decreasing trend and thereby resulting to the inference that the increased population pressure played a very active role for the decrease in forest cover. This is very much evident from the Table1& 2 and Figure 3, 4, 5 and 6 depicting the overall trend in the land use / land covers change for the period 2006 – 2014 years.

Conclusion

Current common methods of change detection are discussed, particularly analysis and comparison of image change detection after classification. The work has been done with the help of ERDAS software, analyzing their result in terms of land use/land cover changes from 2006 to 2014. The overall increase in built-up area was 1.5% during 2006 to 2014. The increase in built-up area was due to transformation of vegetation and wasteland into settlement though there is rise in the wasteland of 0.54%, and increase in water area upto 2.15%. This research also shows that visual elements in image interpretation can be used for forest/ non-forest change detection very effectively.

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