

# A Hybrid classification approach for Land use /land cover change analysis of Birsinghpur Tehsil, District Satna (M.P.)

Kutubuddin Beg<sup>1</sup>, Ravi Chaurey<sup>2</sup>

<sup>1</sup>Research Scholar, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, District Satna (M.P.) India

<sup>2</sup>Associate Professor, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, District Satna (M.P.) India

## Abstract

The Land use /Land cover are extremely important for understanding relationships and interactions between human and natural phenomena in order to promote better decision making and playing role in production development for both nation and region. In the present study, the analysis of land use /Land cover changes of Birsinghpur Tehsil area using Resourcesat-2 LISS-IV images and Resourcesat-1 LISS-III satellite images for the period of 2011-12 while LandsAT-7 ETM+ images for 2004-05. A hybrid classification approach coupled with geographical information systems (GIS) to detect changes in land use/cover pattern by providing more reliable direct quantitative information with the help of modified NRIS standards. The study area comes under Vindhyan hill range covering Rewa and Bhandar Series and located in North East part of Satna District, Madhya Pradesh. It stretches between 80° 48' 0.418" and 81° 7' 30.063" E and 24° 40' 57.984" and 24° 57' 8.936" N. Remote Sensing and GIS technique play an important role to Monitoring and analysis of the land use/land cover changes.

**Keywords:** Land use/Land cover, Hybrid Classification, Satellite Image, LANDSAT-7 ETM+ Image, Modified NRIS standard.

## 1. Introduction

The land is one of the prime land resources. The term land use refers to how the land is being used by human beings, while land cover refers to biophysical materials found on the land. The land use and land cover inventories are very important for many planning and management activities. Land use and Land cover (LULC) data provides useful information regarding developmental, environmental and resource planning applications at regional as well as global scale (Ramachandra et al., 2012). The growing population and increasing socio-economic necessities creates a pressure on land use/land cover. This pressure results in unplanned and uncontrolled changes in LULC (Seto, K.C, et al; 2002). Satellite Remote Sensing data, which are a useful source of information and provides timely and complete

coverage of any specific area, have proven useful in assessing the natural resources and monitoring the land use or land cover changes (Satyanarayana et al., 2001).

Birsinghpur Tehsil is a new Tehsil of Satna district and created from Majhgawan block, vide Madhya Pradesh Government Notification No. F-1-1-08-VII-Sec.-6 Dt. 15.05.2008

([http://www.censusindia.gov.in/2011census/dchb/DC\\_HB\\_A/23/2312\\_PART\\_A\\_DCHB\\_SATNA.pdf](http://www.censusindia.gov.in/2011census/dchb/DC_HB_A/23/2312_PART_A_DCHB_SATNA.pdf)). It cover total geographical area 446.221 Sq. Km. It stretches between 80° 48' 0.418" and 81° 7' 30.063" East and 24° 40' 57.984" and 24° 57' 8.936" North. Birsinghpur Tehsil is bounded in the North by Uttar Pradesh State Boundary, East by Rewa District boundary, South by Kotar Tehsil, North West by Majhgawa Tehsil and West by Raghuraj Nagar Tehsil. Climate of the area is dry and moist and hot in summer. The study area received Lower rainfall (850.50 mm) during kharif period of 2004 as compared to rainfall of 2011 (1031mm) (Source: <http://www.mpwr.gov.in/>). The rainfalls from 2001 to 2017 are showing fluctuation trends. Due to Rainfall fluctuation, the study area comes under drought prone zone. The main objective of this study to monitor and analysis of land use/land cover changes through a hybrid classification approach using Remote sensing and GIS techniques.

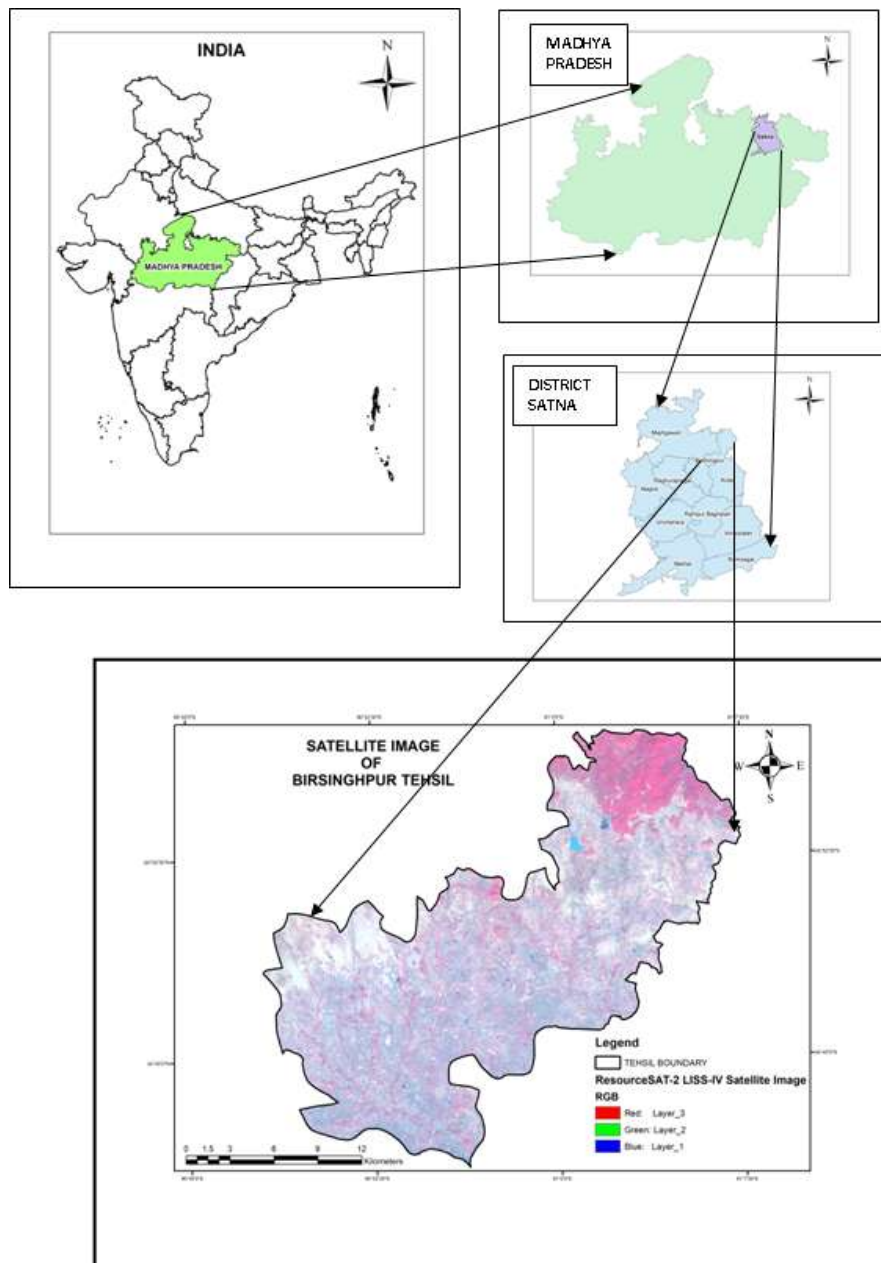
The Study area comes under Vindhyan hill range covering Rewa and Bhandar Group and located in North-East part of Madhya Pradesh. The Bhandar Group constitutes the youngest group of the Vindhyan Basin. The original classification proposed by Auden (1933) and Krishnan (1968) was modified by Sastry & Moitra (1984), Banerjee et al. (2006). With detailed study of literature, published maps, papers and ground survey; we have updated the Litho-stratigraphic sequence of study area showing in Table-1.

**Table-1:** Litho-stratigraphic sequence of the study area.

| Super-group    | Group   | Sub-group Formation                            |
|----------------|---------|--|
| 1              | 2       | 3  |
|                |         | Alluvium                                       |
| Upper Vindhyan | Bhander | Simrawal Shale                                 |
|                | Rewa    | Govindgarh Sandstone<br>(Upper Rewa Sandstone) |

The Soil of Study area comes under ITMA series. The Geomorphic landforms of study area were identified such as plateau highly dissected hills towards NE direction. We have identified like i.e. Escarpment slope near Dharkundi and Cuesta, Mesa, Butte, Inselberg, residual hills in Upper Rewa sandstone formation area, Most of these landforms covered by vegetation and carry a thinner soil cover. These zones provide a moderate to poor groundwater potential. Stripped Plain with shallow basement area identified in between and along the river channel of study area. Moderate and shallow pediplain areas were identified in Simrawal shale area.

**Figure 1:** Location of study area



Lineaments are natural, linear surface elements, interpreted directly from satellite imagery and geophysical map. Major lineaments (>3km) and Minor lineaments (<3km) were identified towards NNW-SSE, NW-SE, NNE-SSW, ENE-SSW and NE-SW direction.

**2. Materials and Methods**

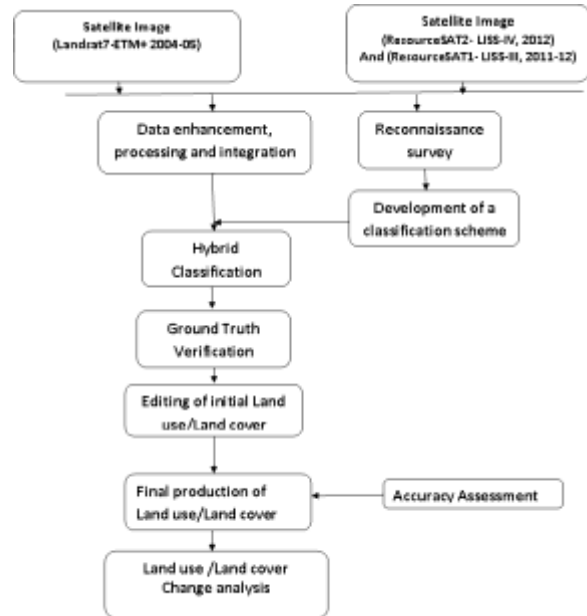
For detailed study of Land use /Land cover change analysis of study area, we have taken ResourceSAT-1 LISS-III satellite image 2011-12 for Kharif and Rabi season, were obtained from web-portal of Bhuvan, NRSC (http://bhuvan.nrsc.gov.in/) and ResourceSAT-2 LISS-IV 2012 for Zaid Season was procured from NDC-NRSC Hyderabad. LANDSAT-7 ETM+ Satellite images for 2004-05 (Kharif, Rabi & Zaid season) were obtained from Web-portal of Earthexplorer (http://earthexplorer.usgs.gov/). We have also taken SOI Open Series Map, Datum-WGS84 (Part Sheets) G44U13, G44U14 and G44V1 (download from NAKSHE portal) for updating Base layer. Based on a brief reconnaissance survey with additional information from previous research, a modified NRIS classification scheme has developed for the study area. The classification scheme developed gives a rather broad classification where the land use/ land cover were identified by a single digit.

**Table 2:** Modified NRIS standard

| DESCR-L1    | DESCR-L2                | DESCR-L3                       | DESCR-L4       |
|-------------|-------------------------|--------------------------------|----------------|
| BUILT-UP    | Townsi/City (Urban)     | Core-Urban                     |                |
|             |                         | Peri-Urban                     |                |
|             |                         | Industrial                     |                |
|             |                         | Others                         | Transportation |
|             |                         | Village (Rural)                | Village        |
| AGRICULTURE | Crop Land               | Kharif Crop                    |                |
|             |                         | Rabi Crop                      |                |
|             |                         | Zaid Crop                      |                |
|             |                         | Double Crop (Kharif + Rabi)    |                |
|             |                         | Triple Crop (Kharif+Rabi+Zaid) |                |
|             |                         | Fallow Land                    | Fallow Land    |
|             | Plantation              | Agriculture Plantation         |                |
| FOREST      | Deciduous (Moist/Dry)   |                                |                |
|             | Crop land in Forest     |                                |                |
| WASTELAND   | Land with Scrub         |                                |                |
|             | Land without Scrub      |                                |                |
|             | Mining/Industrial Waste |                                |                |
|             | Barren rocky/ Sheet     |                                |                |
|             | Rock                    |                                |                |
| WATERBODY   | River                   | Water Channel area             |                |
|             |                         | River Island                   |                |
|             | Canal                   |                                |                |
|             | Lakes/ Ponds            |                                |                |
|             | Reservoir/ Tanks        |                                |                |

With the help of NRIS standard, preliminary digital classification carried out and the different LU/LC units/classes were delineated. The doubtful areas were physically verified in the post-field survey.

**Figure 2:** Flow chart of methodology



The result of the study area was analyzed based on Hybrid classification approach viz; supervised classification (Maximum likelihood classification), unsupervised classification (ISODATA), Normalized Differential Vegetation Index (NDVI) and visual interpretation.

We use the formula for NDVI:-

$$NDVI = (NIR-RED) / (NIR+RED)$$

There are following three software were used for Land use/ Land cover mapping and change analysis viz;

1. ArcGIS 10.4 (ESRI Product)
2. ERDAS Imagine 2015 (INTERGRAPH)
3. Microsoft office 10

**3. Results and Discussion**

Land use /Land cover change analysis of the study area have been analyzed for the time periods of 2004-05 and 2011-12 (Kharif, Rabi & Zaid Season). The final data have been prepared in the form of maps, charts and statistical tables with ground truth verification. The results are showing both positive and negative changes occurred in the land use/land

cover pattern of the Birsinghpur Tehsil area. Core urban, Peri Urban, Industry, Transportation and Village (Rural) are comes under Built-Up land. Due to population growth, Peri-urban area increases 0.081%, Industrial area 0.022%, Transportation 0.213% and Village (Rural) 0.105% increases in 2011-12.

In Agriculture land, Kharif crop area has Increases by 0.047%, Rabi Crop has decreases of around 7.653%, Zaid crop area has increases 1.89%, Double cropped area has decreases 12.534% and Triple cropped area has increases 0.883% in 2011-12. from the base year of 2004-05.

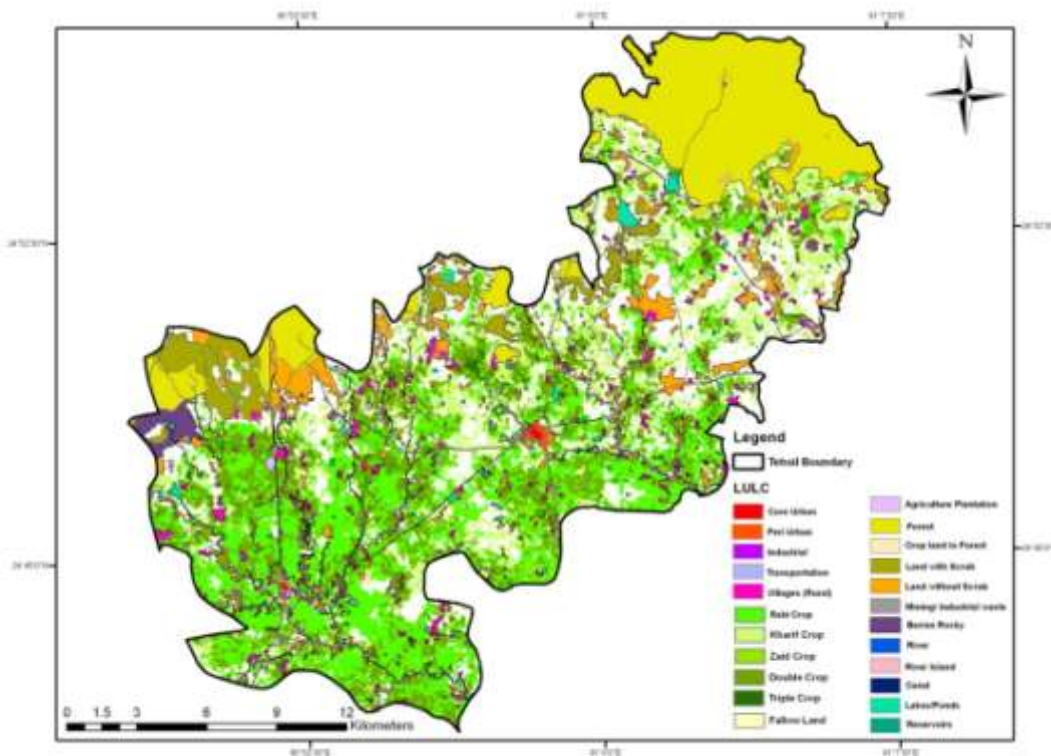
Fallow lands, which are taken up for cultivation but are temporarily allowed to rest, un-cropped for one or more seasons, but not less than one year. Fallow land has Increases 15.11% in 2011-12. Agriculture plantation area has increases approx 0.291% in 2011-12.

Due to population growth and human development activity, the forest land has been occupied by local people in the form of agriculture land /built-up land encroachment. Overall Forest area decreases 0.036% in 2011-12 and Crop land in forest area increases approx 0.36% in 2011-12.

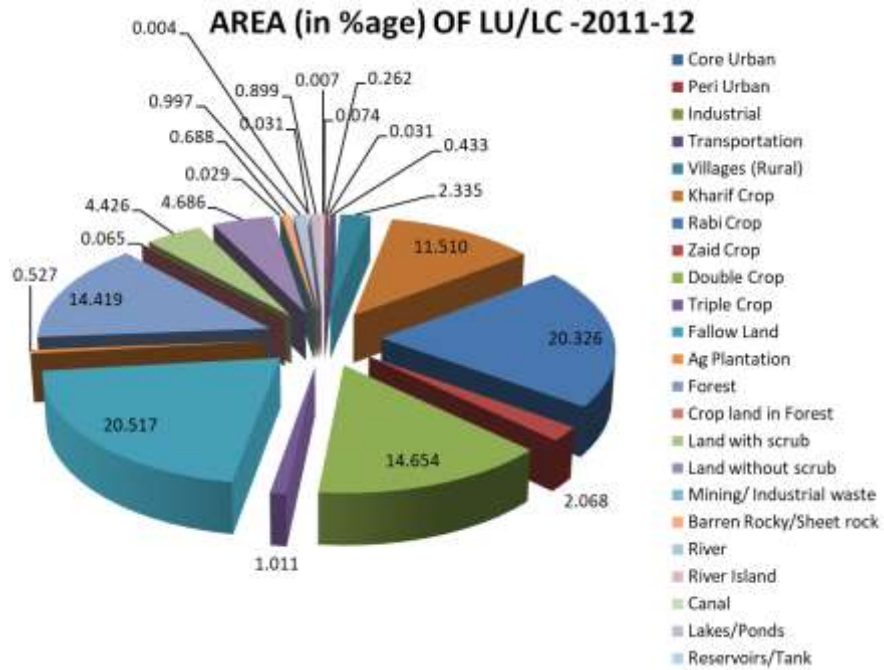
In Wasteland Category, Land with scrub area has increases 1.029% and Land without scrub area has also increases 0.025%, Mining/Industrial waste land area has increases 0.018% and Barren rocky land has decreases 0.034% in 2011-12.

Overall area in terms of extent as well as number of water-bodies has increased 0.51% in 2011 of the Birsinghpur Tehsil area. Remote sensing data has provide more accurate Land use /cover classification and pattern analysis, which could greatly improve the detection and quantification of land cover.

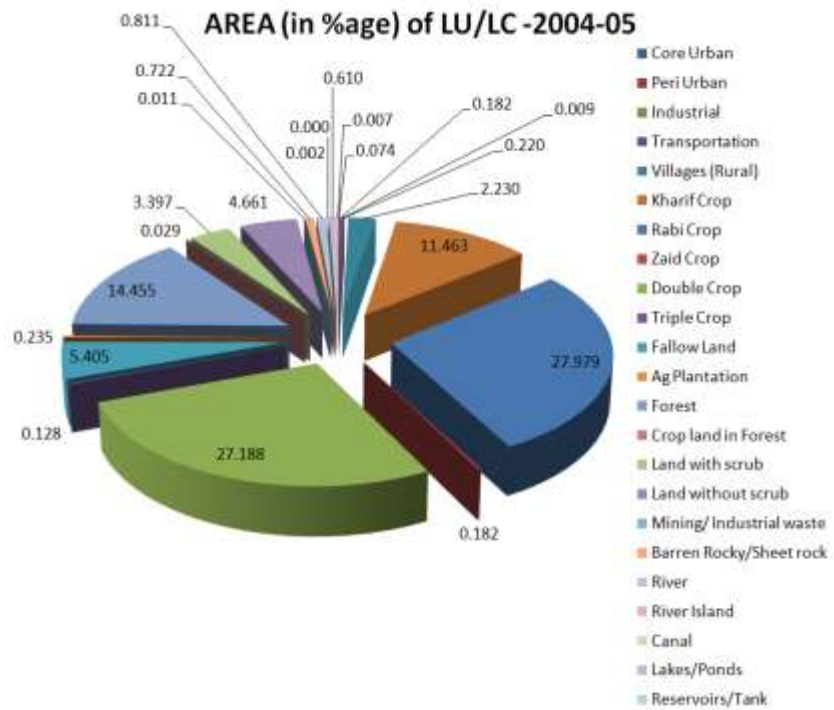
**Figure 3:** Land use / land cover map of Birsinghpur Tehsil – 2011-12



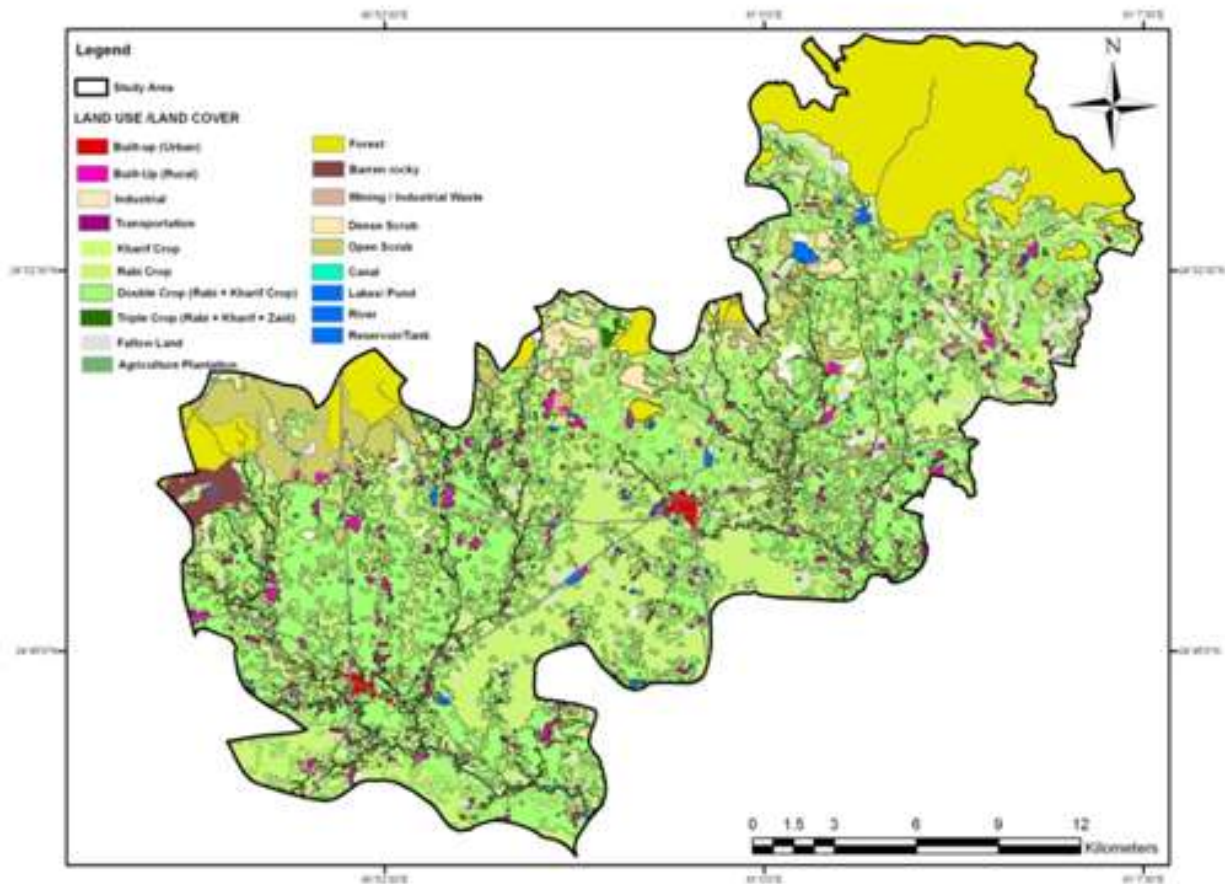
**Figure 4:** Distribution of area (%) of different LU/LC categories of Birsinghpur Tehsil (2011-12)



**Figure 5:** Distribution of area (%) of different LU/LC categories of Birsinghpur Tehsil (2004-05)



**Figure 6:** Land use / Land cover map of Birsinghpur Tehsil (2004-05).



#### 4. Conclusions

The Remote sensing and GIS has been used to understand the land use /Land cover dynamics with the topography. The study area lies in IIIes land capability sub class and Irrigability class 3s. The productivity potential is medium and they have medium available water holding (moderately slow permeability) and retentive capacity and medium fertility status. This study focuses on Land use /Land cover change analysis of Birsinghpur tehsil area. High resolution satellite images are valuable for more precise evaluation of land use/land cover area and edge in landscapes. Hybrid classification (Supervised, Unsupervised and NDVI) is an effective method to examine major trends and spatial patterns of land use/ land cover changes in Birsinghpur Tehsil area for the period between 2004-05 and 2011-12. There is significant expansion in Built-up area and

overall Agriculture land decreases in 2011-12 noticed. Double crop and triple crop area patterns are indicated ground water consumption behavior in study area.

Some classes underwent decrease in the first period and an increase in the second period and vice versa were true for other LULC categories. Accuracy assessment of the land use /land classification results obtained showed an overall accuracy of 87.1% for 2004-05 and 92.13% for 2011-12. Change detection is made possible by these technologies in less time, at low cost and with better accuracy. The study reveals that the LULC pattern and its spatial distribution are the major rudiments for the foundation of a successful land-use strategy required for the appropriate development of any area.

## 5. References

- [1] Auden, J.B., "Vindhyan sedimentation in Son Valley Mirzapur district". Mem. Geol. Surv. India, 62: 141-250, (1933).
- [2] Banerjee S., Bhattacharya S.K. and Sarkar S. "Carbon and oxygen compositions of the carbonate facies in the Vindhyan Supergroup, central India". Journal of Earth System Science, 115(1): 113-134, (2006).
- [3] Beg Kutubuddin, Chaurey Ravi, "Assessment of soil fertility and nutrients status of Simrawal and part of Asrawal watershed, Tons Sub-basin, Ganga basin", International Journal of advanced scientific research and management, vol.3, issue 6, papered-V3S6\_592, p.78, June (2018).
- [4] Chaurey Ravi and Beg K. "Morphometric analysis of sub-watershed of simrawal watershed, District satna (M.P.); Poster presentation on ISRS symposium, Dehradun (UK) December 7-9, (2016).
- [5] Chaurey Ravi, "Hydromorphogeological investigation of the area around Chitrakoot, Satna District, (M.P.), Ph.D.Thesis submitted and award on December (2006).
- [6] Gaur Mahesh Kumar, "High Resolution Satellite Data for Land Use/Land Cover Mapping - A Case Study of Bilara Tehsil, Jodhpur District" Annals of Arid Zone 54(3&4): 125-132, (2015).
- [7] Krishnan, M. S., "General Report of the Geological Survey of India for 1941". Records of the Geological Survey of India, 79(1): 258, (1953).
- [8] Krishnan, M. S., "Geology of India and Burma", Higginbothams (P) Ltd. Madras. 211p, (1968).
- [9] Kumar S, Sharma Mukund; "Vindhyan basin, Son valley area, Central India", The palaeontological society of India, Lucknow, first edition (2012).
- [10] Kuchay Sabzar Ahmad, "Land Use Land Cover Change Analysis of Uttara Kannada" Imperial Journal of Interdisciplinary Research (IJIR) Vol-2, Issue-4, ISSN: 2454-1362, (2016).
- [11] Leckie, D.G., Cloney, E., Joyce, S.P., "Automated detection and mapping of crown discoloration caused by jack pine budworm with 2.5m resolution multispectral imagery" International Journal of Applied Earth Observation and Geoinformation 7, 61-77, (2005).
- [12] NRSC, ISRO "Manual of National Land Use/Land Cover Mapping (Second Cycle) Using Multi-temporal Satellite Data" Department of Space, Hyderabad, (2012).
- [13] Pathak Suparn; "Study of Land Use/Land Covers Dynamics in Thar Desert Using Geospatial Technique" Annals of Arid Zone 54(1&2): 17-25, (2015).
- [14] Ramachandra, T. V., Chandran, M.D., and Joshi, N.V., "Landslide Susceptible Zone Mapping in Uttara Kannada, Central Western Ghats", (2012).
- [15] Ramachandra, T. V., Kumar, U., & Joshi, N. V. Landscape Dynamics in Western Himalaya-Mandhala Watershed, Himachal Pradesh, India. Asian Journal of Geoinformatics, 12(1), (2012).
- [16] Rawat J.S., "Monitoring and use /cover change using remote sensing and GIS techniques: A case study of Hawalbagh block, district Almora, Uttarakhand, India." The Egyptian Journal of Remote Sensing and space science, Volume 18, Issue 1, Pages 77-84, June (2015).
- [17] Sastry, M. V. A. and Moitra, A. K., "Vindhyan stratigraphy; a review". Memoirs of the Geological Survey of India, 116(2): 109-148, (1984).
- [18] Satyanarayana, B., Thierry, D., Seen, L., Raman, A.V. and Muthusankar, G., "Remote sensing in mangrove research— relationship between vegetation indices and endocentric parameters: a case for Coringa, east coast of India" Proceedings of the Asian Conference on Remote Sensing, Singapore, 5-9 November, 2001, pp. 567-572, (2001).
- [19] Seto, K.C.; Woodcock, C.E.; Song, C.; Huang, X.; Lu, J.; Kaufmann, R.K., "Monitoring land use change in the Pearl River Delta using Landsat TM" 1985-2004, International. Journal of Remote Sensing, 23, (10), (2002).
- [20] Web portal "Bhuvan" <http://bhuvan.nrsc.gov.in/gis/thematic/tools/document/LULC250/0607.pdf>
- [21] Web-portal, "Earth Explorer", <http://earthexplorer.usgs.gov/>
- [22] Web-portal of Survey of India, Department of Science and Technology, (<http://www.soinakshe.uk.gov.in/>)
- [23] Web-link [http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp\\_content/S000017GE/P001788/M025432/ET/1512641769Urban\\_new.pdf](http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000017GE/P001788/M025432/ET/1512641769Urban_new.pdf)
- [24] Web-portal "Census of India" ([http://www.censusindia.gov.in/2011census/dchb/DCHB\\_A/23/2312\\_PART\\_A\\_DCHB\\_SATNA.pdf](http://www.censusindia.gov.in/2011census/dchb/DCHB_A/23/2312_PART_A_DCHB_SATNA.pdf)).
- [25] Web-portal of Water resource department Madhya Pradesh, Rainfall data (<http://www.mpwrdd.gov.in/>)