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A HYBRID CLASSIFICATION APPROACH FOR LAND USE /LAND COVER CHANGE ANALYSIS OF BIRSINGHPUR TEHSIL, DISTRICT SATNA (M.P.)

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Abstract: *The Land use /Land cover is 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. Monitoring and analysis of the land use/land cover changes through the integration of remote sensing and GIS techniques. 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 (Supervised, Unsupervised and NDVI) 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 Bhander Series and located in North East part of Madhya Pradesh. It stretches between 80^0 48' 0.418" and 81^0 7' 30.063" E and 24^0 40' 57.984" and 24^0 57' 8.936" N.*

Key words: Land use/Land cover, Hybrid Classification, LISS-IV & LISS-III Image, LANDSAT-7

Introduction

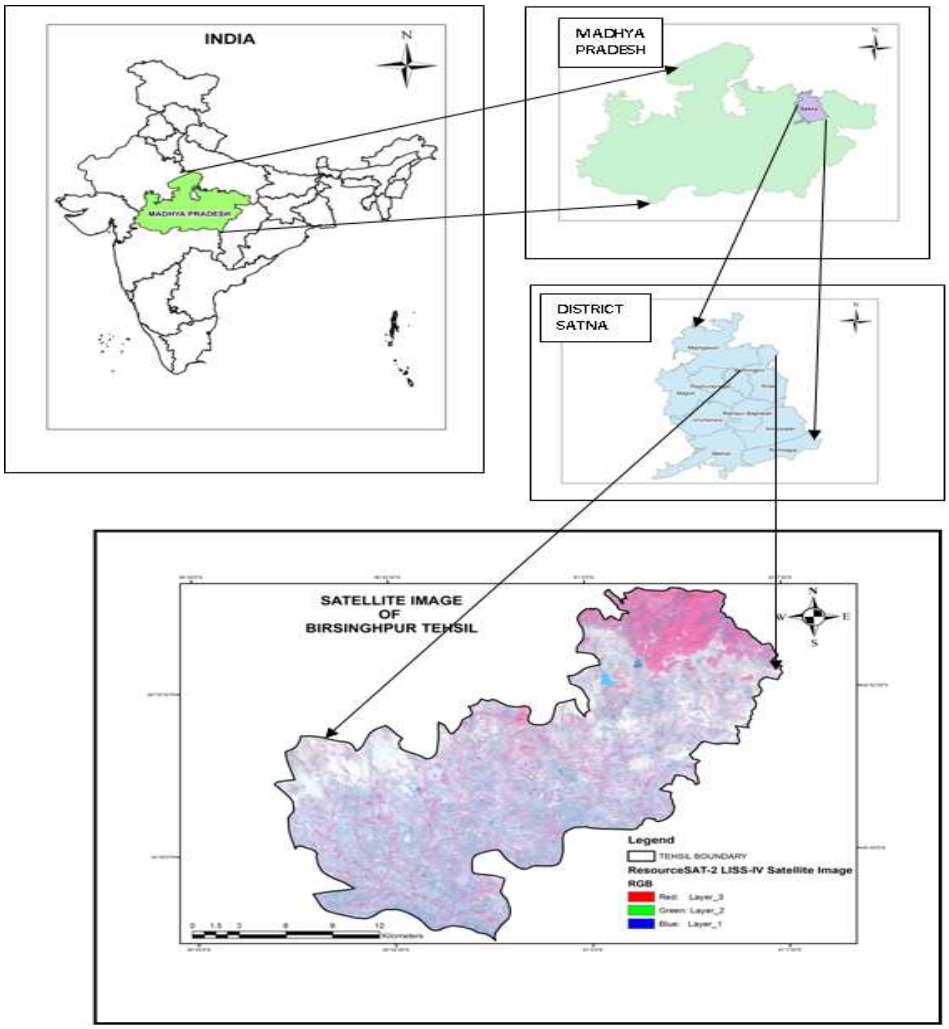
The land is one of the prime land resources. The term land use refers to how the land is being used by human beings, while land cover refers to biophysical materials found on the land. The land use and land cover inventories are very important for many planning and management activities. Land use and 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. 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). The spectral response of vegetation indices will detects changes in pixel-level vegetation conditions (Leckie et al., 2005; Wulder et al., 2005). The improvements in spatial and spectral resolution of the sensors, and computer hardware and image processing software have now made this technology competitive with traditional approaches for mapping land cover at local scales. The land use map, as a source of thematic information, has always been an important component of agricultural, rural, urban and regional planning; land improvement programs, watershed management, agricultural productivity improvement and scientific research involving carbon cycle, hydrologic cycle, energy budget studies, weather/climate prediction etc. (NRSC, 2012). The geospatial technique enables us to study dynamics, particularly in desert area using Remote Sensing (RS), Geographic Information System (GIS) and Global Position System (GPS). Remote sensing is being used to obtain quicker and of higher quality information about natural resources (Pathak Suparn, 2015). However, interfacing of GIS technology with remote sensing provides maximum information content and analysis capabilities and thus be of benefit to land-use planners (Nellis et al., 1990). So far, it has been widely recognised (Welch, 1985) that there are many advantages to combine remotely sensed data with existing spatial image and statistical data, and thereby maximising the information upon which responsible decisions for land use planning can be made (Paul et al., 1992). Availability of high spatial resolution satellite imagery has made various opportunities and

advantages to understand land use, resource assessment, and environmental monitoring issues in a better way.

Study Area

Birsinghpur Tehsil is a new Tehsil of Satna district cover total geographical area 446.221 Sq. Km. It comes under Vindhyan hill range covering Rewa and Bhander Series and located in North East part of Madhya Pradesh. The Study area is covering in the SOI Open Series Map, Datum-WGS84 (Part Sheet) G44U13, G44U14 and G44V1 (download from NAKSHE portal). It stretches between 80^0 48' 0.418" and 81^0 7' 30.063" East and 24^0 40' 57.984" and 24^0 57' 8.936" North (Figure1). 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. The study area is one of the most sensitive regions of Satna District (M.P.) in terms of its natural environment, and is characterized by its complexity of landforms & agro climatic conditions. 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 (1031 mm) (Source: http://www.mpwrd.gov.in/). The rainfall from 2001 to 2010 are showing decreasing trends while on from 2011 to 2017 are showing increasing trends. Due to Rainfall fluctuation, the study area comes under drought prone zone.

Figure 01: Location of Study Area

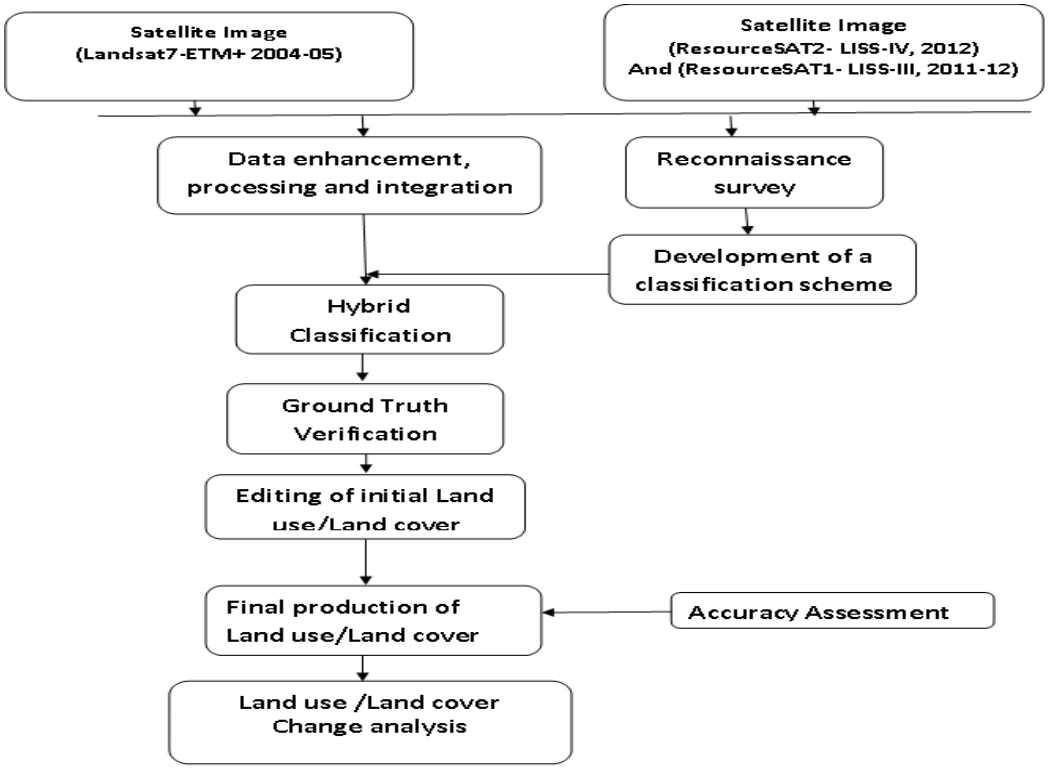


The main objective of this study, to monitor and analysis of land use /land cover changes through a hybrid classification approach using remote sensing and GIS techniques.

Material and Method

For Land use /Land cover mapping and change analysis study, The researcher has taken Resource SAT-1 LISS-III satellite image 2011 & 2012 for Kharif and Rabi season, were obtained from Bhuvan, NRSC (http://bhuvan.nrsc.gov.in/) website and ResourceSAT-2 LISS-IV 2012 for Zaid Season was procured from NDC-NRSC Hyderabad while LANDSAT-7 ETM+ Satellite images of 2004-05 (Kharif, Rabi & Zaid season) were obtained from Earth explorer (http://earthexplorer.usgs.gov/) website. Based on pre-field interpretation, training sets, preliminary digital classification was carried out and the different LU/LC units/classes were delineated. The doubtful areas were physically verified in the post-field survey.

Figure 02: Methodology Flow Chart



Final land use/ land cover maps are prepared using Hybrid classification. Hybrid classification defined as "A combination of supervised, unsupervised classification and NDVI (hybrid classification) is often employed; this allows the remote sensing program to classify the image based on the user-specified land cover classes, but will also classify other less common or lesser known cover types into separate groups". Supervised classification uses the spectral signature defined in the training set. For example, it determines each class on what it resembles most in the training set. The common supervised classification algorithms are maximum likelihood. In Unsupervised classification, ISODATA clustering technique was adopted to distinguish the different Land covers types. ISODATA algorithm calculates class means evenly distributed in the data space then iteratively clusters the remaining pixels using minimum distance techniques.

The Normalized Deferential Vegetation Index (NDVI) is a standardized vegetation index which allows us to generate an image showing the relative biomass. The chlorophyll absorption in Red band and relatively high reflectance of vegetation in Near Infrared band (NIR) are using for calculating NDVI. Calculating NDVI from Red and Infrared bands as I discussed earlier to find NDVI, We use the formula of **NDVI = (NIR-RED)/ (NIR+RED)**

The author has taken modified NRIS standards to classify Land use /Land cover classes. The Survey of India Open Series Map was referred for collateral information. The Land use /land

cover class statistics of the study area is generated. Three software 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

Development of a Classification Scheme

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 was identified by a single digit.

Result 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) showing in Figure 4, 5, 6, 7 and Table 2. The results are presented in the form of maps, charts and statistical tables with ground truth verification. The result of the study area was analyzed based on Hybrid classification like supervised classification (Maximum likelihood classification), unsupervised classification (ISODATA), Normalized Differential Vegetation Index (NDVI) and visual interpretation. The results are showing both positive and negative changes occurred in the land use/land cover pattern of the Biringhpur 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 percent, Industrial area 0.022 percent, Transportation 0.213 percent and Village rural 0.105 percent increases in 2011-12. In Agriculture land, Kharif crop area Increases by 0.047 percent, Rabi Crop has decreases of around 7.653 percent, Zaid crop area increases 1.89 percent, Double cropped area decreases 12.534 percent and Triple cropped area increases 0.883 percent 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 percent in 2011-12. Agriculture plantation area increases approx 0.291 percent in 2011-12. With the increase in population and development activity, the forest land has been occupied by local people in form of agriculture/built-up encroachment. Overall Forest area decreases 0.036 percent in 2011-12 and Crop land in forest area increases approx 0.36 percent in 2011-12. In Wasteland Category, Land with scrub area increases 1.029 percent and Land without scrub area also increases 0.025 percent, Mining/Industrial waste land area increases 0.018 percent and Barren rocky land decreases 0.034 percent in 2011-12. Overall area in terms of extent as well as number of water bodies has increased 0.51 percent in 2011 of the Birsinghpur Tehsil area. High resolution Satellite images (ResourceSAT-2 LISS-IV; Resolution 5.8 m) provide more accurate Land use /cover classification and pattern analysis, which could greatly improve the detection and quantification of land cover.

Conclusion

The Remote sensing and GIS has been used to understand the land use /Land cover dynamics with the topography. This paper 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. 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 percent for 2004-05 and 92.13 percent 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.

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