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Land use land cover classification and two decade change detection using remote sensing and GIS of Mungeli district

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Abstract
Mungeli, a relatively newly formed district in Chhattisgarh, India, is undergoing rapid socio-economic and infrastructural development. As such, understanding the spatio-temporal dynamics of its land use and land cover (LULC) is essential for informed planning and sustainable growth. This study employs multi-temporal satellite data from Landsat (2000 and 2020) and GIS-based supervised classification using the Maximum Likelihood Classifier (MLC) to evaluate LULC changes over a 20-year period. Five key LULC classes were identified: agricultural land, forest, barren land, built-up area, and waterbodies.
The results reveal a significant decline in agricultural land (−4.56%) and forest cover (−2.61%), accompanied by substantial increases in built-up areas (+186.6%) and waterbodies (+255.5%). These transformations point to urban expansion and changing land use priorities, potentially at the cost of ecological balance.
Given Mungeli's status as a developing administrative region, these findings are crucial for resource allocation, environmental conservation, and infrastructure development. The study demonstrates the effectiveness of remote sensing and GIS in generating timely, accurate, and actionable insights for regional planning and supports the integration of geospatial tools into policy-making frameworks for newly formed districts in India.

Keywords: Land use, land cover, change detection, remote sensing

1. Introduction
Land use/land cover (LULC) changes are critical indicators of global environmental change. Satellite-based remote sensing data, with their repetitive and synoptic coverage, have proven highly effective in mapping LULC patterns and changes over time. Geographic Information System (GIS) techniques allow for the quantification of such changes, even when spatial datasets differ in resolution or scale. These techniques have enhanced our understanding of the dynamics of human activities across space and time.
Land use typically refers to the human utilization of land—such as for agriculture, settlements, or industrial activities—while land cover denotes the physical material on the Earth's surface, including natural vegetation, water bodies, soils, and built-up features (NRSA, 1989). Land cover reflects the biotic and abiotic features present on the Earth’s surface, whereas land use describes the ways humans modify or manage this cover. Land cover categories may include forests, grasslands, water bodies, and barren land, while land use includes cropland, built-up areas, and recreational spaces.
Over the years, remote sensing and GIS have played a crucial role in LULC mapping across various regions of India. These technologies allow the assessment of land cover transformations with greater accuracy, lower cost, and less time. They also serve as vital tools for sustainable land management and environmental planning.
In the present study, an investigation has been carried out in the Mungeli district of Chhattisgarh to detect LULC changes over a 20-year period from 2000 to 2020. This region, which has seen notable changes in agricultural practices and rural development in recent decades, presents an important case for evaluating human-induced impacts on the environment. This study aims to identify and analyze LULC changes and to contribute to sustainable land resource management in the region.

2. Methodology

2.1 Study area

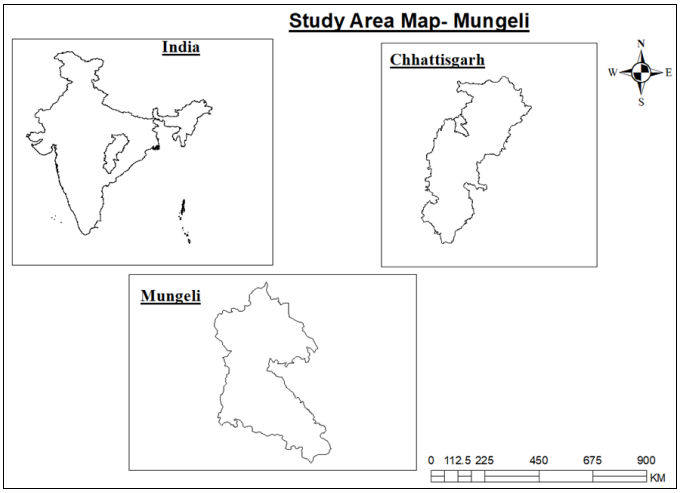

Fig 1: Study Area Mungeli

The present study area is Mungeli District in central Chhattisgarh, India, bounded by longitude 81°45'-82°28' East and latitude 22°-23° North. Located in the Mahanadi River basin, the district covers an area of about 80-100 km in breadth. Rated irrigation area of Mungeli is around 35, 000 hectares. Surface irrigation accounts for about 32, 000 hectares while well irrigation account for approximately 3,000 hectares. It is irrigated through several irrigation projects. There are several minor irrigation schemes besides many traditional water conservation structures like ponds and check dams. Number of Population

As of the 2011 Census 11, 24, 342 people were living in the district. Annual rainfall averaged about 1, 200 mm. Max Temperature in summer ranges from 40-43 °C and min Temperature in winter ranges from 10-12 °C. Relative humidity ranges from 40% to 85%.

2.2 Aim and Objectives

Aim

The aim of this study is to produce a land use/land cover (LULC) map of Mungeli district, Chhattisgarh, in order to detect changes that have occurred over a 20-year period (2000-2020) using change detection techniques.

Objectives

1. To classify and analyze different land use and land cover types in the study area using remote sensing and GIS techniques.
2. To generate two decade LULC map.
3. To assess spatial and temporal changes in LULC over two decade.

2.3 Land Use and Land Cover

Temporal satellite data from USGS Landsat archives was used for the analysis of the study area, covering two reference years: Landsat 7 ETM+ Collection 2 Level-2 data for 2000, and Landsat 8-9 OLI/TIRS Collection 2 Level-2 data for 2020. Satellite images for both pre-monsoon and post-monsoon seasons were selected to capture seasonal variations. Prior to analysis, the images were co-registered, radiometrically normalized, and subset to the study area for further classification and change detection.

Land use/land cover (LULC) classification was carried out using the Maximum Likelihood Classifier (MLC) within ArcMap, following a supervised classification methodology. The choice of MLC was guided by extensive literature review, including studies by Rao & Narendra (2006) [5], Remi *et al*. (2007) [6], Chaudhary *et al*. (2008) [4], who all found MLC to be a reliable and well-established technique for remote sensing-based LULC mapping. Its robustness and ease of implementation have been well documented by Lillesand & Kiefer (2000).

For Level I classification, a total of seven LULC classes were identified: Agricultural Land, Water Body, Forest, Plant, Barren Land and Built-Up Area. These categories were selected to meet the objectives of the study and to effectively map features relevant to land management and environmental assessment. Classification at this generalized level allows for consistent interpretation across both time periods with an expected accuracy of 85-90%, as supported by Anderson *et al*. (2001) [1]. This level of classification is particularly suitable for regional-scale studies such as district-wide assessments.

Table 1: Interpretation Key for Understanding Satellite Imagery Elements

Elements	Interpretation Technique	Description	Map Legend
Agricultural Land	Appears in Solar Yellow; usually has a patchy to continuous pattern with medium texture.	Land used for seasonal or perennial crop cultivation, fallow lands, and agricultural operations.	Solar Yellow
Barren Land	Appears in Electron Gold; rough texture and irregular shape.	Exposed soil or rock, devoid of vegetation; unused or unproductive areas.	Electron Gold
Built-Up Land	Appears in Mars Red; regular or block-like structure, sharp boundaries.	Includes settlements, buildings, roads, and associated urban infrastructure.	Mars Red
Forest Land	Appears in Leaf Green; dense texture and large, cohesive patches.	Natural forest cover with dense vegetation, both reserved and protected areas.	Leaf Green
Waterbody	Appears in Lapis Lazuli; smooth texture, uniform color, distinct shape.	Includes ponds, lakes, tanks, and other surface water bodies.	Lapis Lazuli

The area statistics for each land use/land cover (LULC) category were calculated in square kilometres using the attribute table. The LULC classes include Agricultural Land, Barren Land, Built-up Land, Forest Land, and Waterbodies. These categories were identified through visual interpretation of satellite imagery, corroborated with field verification. The digitized features were analysed to obtain land use/land cover statistics for each class for both the years under study.

3. Results and Discussion

The general land use of an area depicts an idea of overall areal utilization of resources, whether natural or cultural. In this paper, changes in the land use and land cover of Mungeli district are evaluated from the differences between a 20-year period (2000-2020), as shown in figure-3 and figure-4. The findings of the present investigation are presented in Table 2.

Agricultural land showed a decrease from 1436.52 km² (52%) in

2000 to 1370.99 km² (49%) in 2020. Forest land also declined slightly from 1044.01 km² (38%) to 1016.76 km² (36%). In contrast, built-up land expanded significantly from 42.91 km² (2%) to 123.01 km² (4%), indicating urban growth and infrastructure development in the district.

Table 2: Change in LULC

Category	2000 Area (km²)	2020 Area (km²)	2000 (%)	2020 (%)	Absolute Change (km²)	Change (%)
Agricultural Land	1436.52	1370.99	51.60%	49.30%	-65.53	-4.56%
Barren Land	185.99	221.55	6.70%	8.00%	35.56	19.12%
Built-Up Land	42.91	123.01	1.50%	4.40%	80.1	186.67%
Forest Land	1103.77	1019.03	39.70%	36.60%	-84.74	-7.68%
Waterbody	13.52	48.07	0.50%	1.70%	34.55	255.55%
Grand Total	2782.71	2782.65	100%	100%	-0.06	~

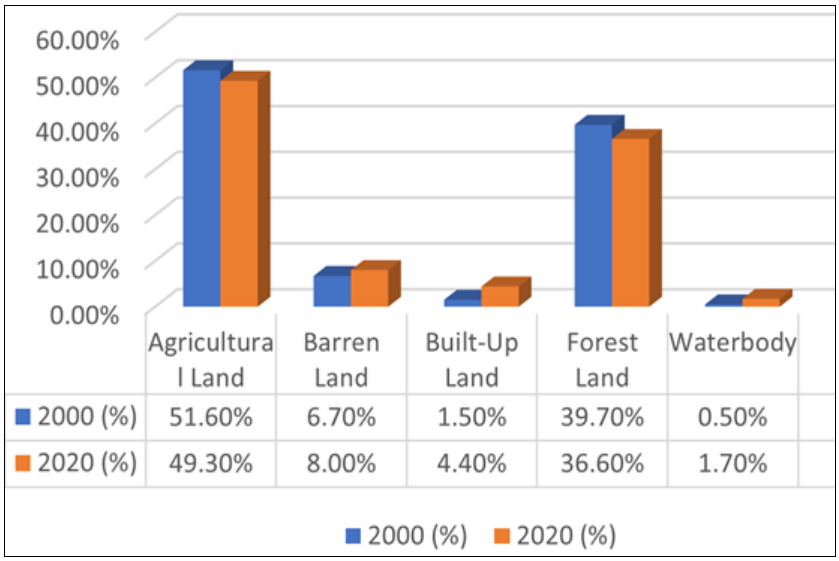

Fig 2: LULC Data

Barren land increased from 185.99 km² (7%) in 2000 to 221.55 km² (7%) in 2020, reflecting possible land degradation or loss of productive use. Waterbodies showed a remarkable increase from 13.52 km² (0.5%) to 48.07 km² (1.5%), suggesting improvements in water storage or irrigation systems.

The reasons for these changes have been discussed in the context of agricultural expansion, population pressure, and infrastructure development. While agricultural activities have declined, urbanization and built-up areas have shown an increasing trend, implying a shift toward urban and semi-urban land use. This trend, combined with the decline in forest cover, highlights the influence of human activity on land cover dynamics.

The satellite datasets used in the current study yielded the following comparisons with respect to land use/land cover change detection: from the current study, it is evident that there has been a considerable decrease in agricultural and forest areas and a significant increase in built-up and waterbody areas over the period of 2000 to 2020. Mungeli district, which is primarily agricultural, is experiencing growing urbanization and land conversion pressures. It is necessary to closely monitor the land use/land cover changes to maintain a sustainable environment and ensure proper regional development.

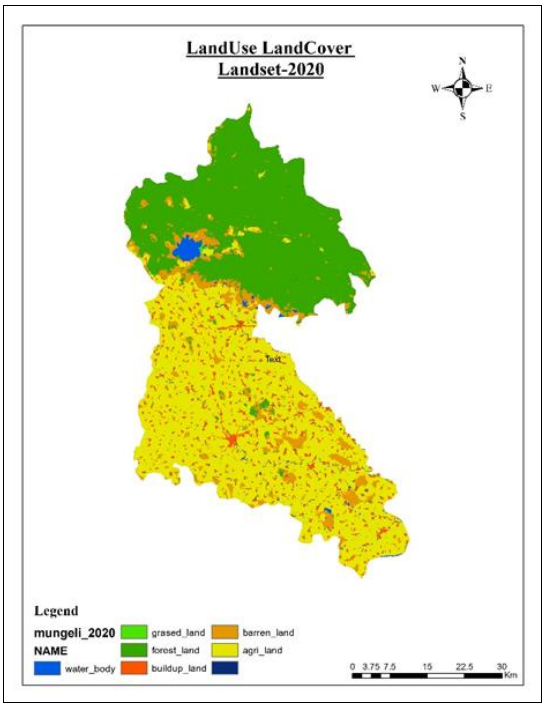

Fig 3: LULC 2000

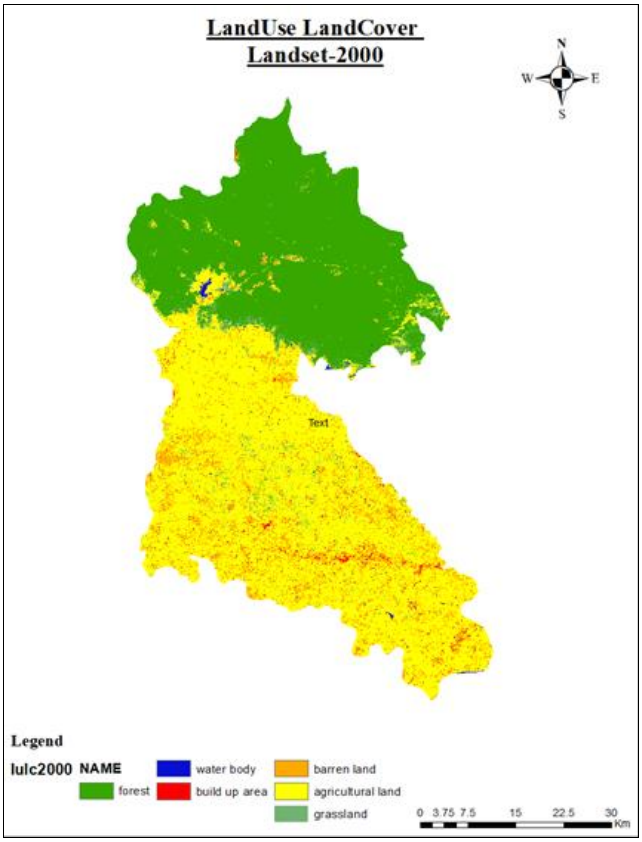

Fig 4: LULC 2020

4. Conclusion

The present study successfully demonstrates the utility of remote sensing and Geographic Information System (GIS) technologies in detecting, analysing, and interpreting land use and land cover (LULC) changes over a 20-year period (2000-2020) in Mungeli district, Chhattisgarh, India. Through supervised classification of multi-temporal Landsat data, significant patterns of land transformation have been identified, with key findings indicating a decline in agricultural (−4.56%) and forest areas (−2.61%), and a pronounced increase in built-up land (+186.6%) and waterbodies (+255.5%).

These changes point toward a shift in land utilization driven by urbanization, population growth, and evolving agricultural practices. Such trends have direct implications for local ecosystems, agricultural productivity, and long-term environmental sustainability.

The study underscores the importance of continuous LULC monitoring using high-resolution satellite imagery and GIS-based analytics for evidence-based planning and policy formulation. Effective land management strategies are required to mitigate environmental degradation, balance development with conservation, and guide infrastructure expansion in a sustainable manner. Moving forward, integration of socio-economic data with LULC trends would enhance the scope of such research, supporting holistic land governance frameworks not only for Mungeli district but also for other rapidly transforming regions in India.

5. References

1. Anderson JR, Hardy EE, Roach JT, Witmer RE. A land use and land cover classification system for use with remote sensor data. US Geological Survey Professional Paper 964. 2001.
2. Kaul HA, Ingle ST. Land use land cover classification and change detection using high-resolution temporal satellite data: A case study of Jalgaon District, Maharashtra. J Environ. 2012;1(4):146-52.
3. Pandian M, Rajagopal N, Sakthivel G, Amrutha DE. Land use and land cover change detection using remote sensing and GIS in parts of Coimbatore and Tiruppur districts, Tamil Nadu, India. Int J Remote Sens Geosci. 2014;3(1):15-20.
4. Chaudhary BS, Saroha GP, Yadav M. Anthropogenic influence on land use/land cover changes using remote sensing and GIS: A case study from Haryana, India. J Hum Ecol. 2008;23(3):243-52.
5. Rao KN, Narendra K. GIS and remote sensing-based analysis of urban expansion in the Mehadrigedda watershed, Visakhapatnam. Curr Sci. 2006;91(11):1552-7.
6. Remi A, Huang S, Jiren L, Herve Y, Yvew-Louis D. Envisat ASAR data for large scale land cover mapping: Application to Poyang Lake Area, China. In: Envisat Symposium Proceedings (ESA SP-636). 2007.
7. Phukan P, Thakuriah G, Saikia R. Land use/land cover change detection using remote sensing and GIS techniques: A case study of Golaghat District of Assam, India. Int Res J Earth Sci. 2013;1(1):11-5.
8. Prakasam C. Land use and land cover change detection through remote sensing approach: A case study of Kodaikanal Taluk, Tamil Nadu. Int J Geomatics Geosci. 2010;1(2):150-8.
9. Kotoky P, Dutta MK, Borah GC. Changes in land use and land cover along the Dhansiri river channel, Assam - a remote sensing and GIS approach. J Geol Soc India. 2012;79:61-8.
10. Tiwari K, Khanduri K. Land use/land cover change detection in Doon Valley (Dehradun Tehsil), Uttarakhand using GIS and remote sensing. Int J Geomatics Geosci. 2011;2(1):34-42.
11. Zubair AO. Change detection in land use and land cover using remote sensing data and GIS: A case study of Ilorin and its environs in Kwara State [MSc thesis]. Ibadan: University of Ibadan; 2006.