



ISSN - 2347-7075
Impact Factor - 8.141

INTERNATIONAL JOURNAL OF ADVANCE AND APPLIED RESEARCH

An International Double-Blind Peer Reviewed / Bi-Monthly /
Referred / Open Access Research Journal



Rayat Shikshan Sanstha's

Dr. Patangrao Kadam Mahavidyalaya Ramanandnagr (Burli)

Tal.- Palus, Dist.-Sangli, MH (India), 416303

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Department of Zoology & IQAC

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Vol. 7 No. 31

March - April 2026

International Journal of Advance and Applied Research (IJAAR)

*A Multidisciplinary International Level Referred and Peer Reviewed
Journal*

ISSN-2347-7075

Impact Factor-8.141

March - April 2026

Volume - 7

Issue – 31

Published by:

Young Researcher Association, Kolhapur, Maharashtra, India

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Monitoring Land Use and Land Cover Change in Tasgaon and Palus Tahsils Using Remote Sensing and GIS (1993-2023)

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DOI - 10.5281/zenodo.20292782

Abstract:

Land Use and Land Cover (LULC) change reflects the interaction between human activities and natural processes. The present study aims to monitor and compare land use and land cover changes in Tasgaon and Palus Tahsils of Sangli District, Maharashtra, between 1993 and 2023 using Remote Sensing and Geographic Information System (GIS) techniques. Landsat satellite imagery of the two selected years was used to generate LULC maps through supervised classification. Major land use and land cover categories identified include agricultural land, built-up area, water bodies, wasteland, and vegetation. The comparative analysis reveals significant transformations in land use patterns over the thirty-year period. The results indicate a notable increase in agricultural land and built-up areas, primarily due to the expansion of irrigation facilities, population growth, and infrastructural development. In contrast, wasteland and open land have decreased, reflecting intensified land utilization. Variations in water bodies and vegetation cover indicate changes in water availability and land management practices.

The study highlights the effectiveness of remote sensing and GIS techniques in detecting long-term land use and land cover changes and provides valuable insights for sustainable land use planning, agricultural development, and environmental management in Tasgaon and Palus Tahsils. The findings can support policymakers and planners in achieving balanced and sustainable regional development.

Keywords: Land Use Land Cover, Remote Sensing, GIS, Tasgaon Tahsil, Palus Tahsil, Change Detection.

Introduction:

Land is a vital natural resource that supports agricultural production, human settlements, economic activities, and ecological systems. The way land is utilized and transformed over time reflects socio-economic development as well as environmental stress. Land Use and Land Cover changes have become a major concern in geographical and environmental studies due to their direct impact on food security, water resources, biodiversity, and regional sustainability.

Land Use refers to the manner in which humans exploit land for activities such as agriculture, settlements, industry, and

transportation, whereas Land Cover denotes the physical characteristics of the earth's surface, including vegetation, water bodies, barren land, and built-up areas. Changes in land use often result in corresponding changes in land cover, making it necessary to study both together. In developing countries like India, rapid population growth, expansion of irrigated agriculture, commercialization of crops, and infrastructural development have accelerated changes in land use patterns. Semi-arid regions are particularly sensitive to such changes because land resources are limited and climatic conditions are uncertain. Unplanned land transformation may lead to soil

degradation, water scarcity, and environmental imbalance.

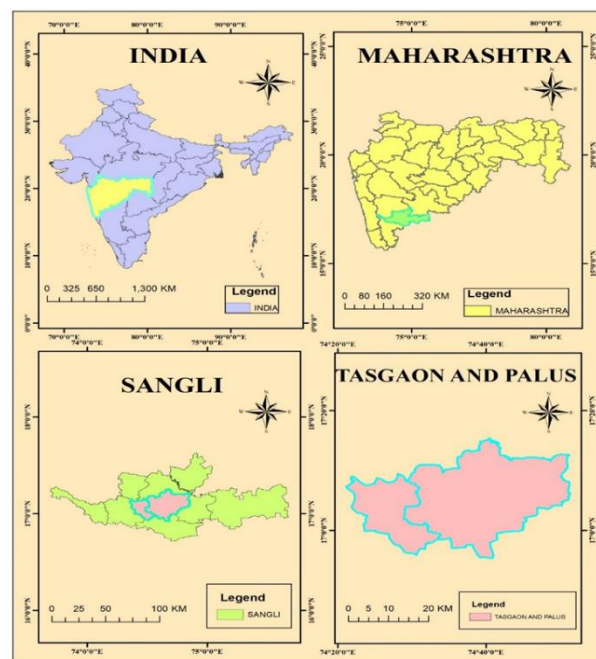
Need of the Study:

Rapid changes in land use and land cover in Tasgaon and Palus tahsils due to agricultural expansion, irrigation development, and settlement growth require scientific assessment. These changes impact water resources, vegetation cover, and land sustainability. The study is needed to understand spatial land transformation using Remote Sensing and GIS and to support sustainable land use planning

Study Area:

Tasgaon and Palus Tahsils are located in Sangli District, in the western part of Maharashtra. The region lies within the Krishna River basin and experiences a semi-arid climate. Rainfall is moderate but highly variable, with frequent drought conditions affecting agricultural activities. The terrain is largely flat to gently undulating, with fertile alluvial soils along river and canal command areas, while medium and shallow black soils dominate the remaining parts. Agriculture is the principal occupation of the population. Major crops include sugarcane, jowar, wheat, grapes, and pulses. The expansion of canal irrigation from the Krishna River system has transformed traditional rain-fed agriculture into irrigated farming, especially after the 1990s. Growth of sugar factories, agro-based industries, and improved transport connectivity has contributed to settlement expansion.

Location Map:



Review of Literature:

Several scholars have emphasized the importance of LULC studies for understanding environmental change and sustainable development. Earlier studies have demonstrated that remote sensing-based analysis is effective for identifying land transformation patterns and quantifying changes over time.

Research conducted in semi-arid regions of Maharashtra shows that irrigation development is a key driver of agricultural expansion and cropping intensity. Studies also indicate that reduction in wasteland is often associated with improved land utilization, though excessive exploitation may lead to groundwater depletion and soil degradation. Most previous studies are either district-level or regional-level analyses. Detailed tahsil-level studies covering long time spans are relatively limited. The present research attempts to address this gap by providing a focused, comparative analysis of Tasgaon and Palus Tahsils over a thirty-year period.

Objectives:

1. To analyse spatial and temporal changes in land use and land cover.
2. To classify major LULC categories using satellite imagery.
3. To examine the role of irrigation and human activities in land transformation.
4. To provide scientific inputs for sustainable land use planning.
5. To prepare Land Use and Land Cover maps of Tasgaon and Palus Tahsils for 1993 and 2023

Data and Methodology:**1.Data Sources:**

The study uses Landsat satellite imagery for the years 1993 and 2023. Survey of India topographical maps were used for reference and boundary demarcation. Secondary data related to population growth, irrigation, and agriculture were collected from government publications and statistical records.

2.Methodology:

The methodological framework involved the following steps:

- Acquisition of cloud-free satellite images
- Image preprocessing, including geometric correction and enhancement
- Delineation of tahsil boundaries in GIS
- Supervised classification using training samples
- Identification of LULC categories
- Preparation of thematic maps for both years
- Comparative change detection analysis
- The main LULC classes identified were agricultural land, built-up area, water bodies, barren-land, and vegetation.

Results and Discussion:

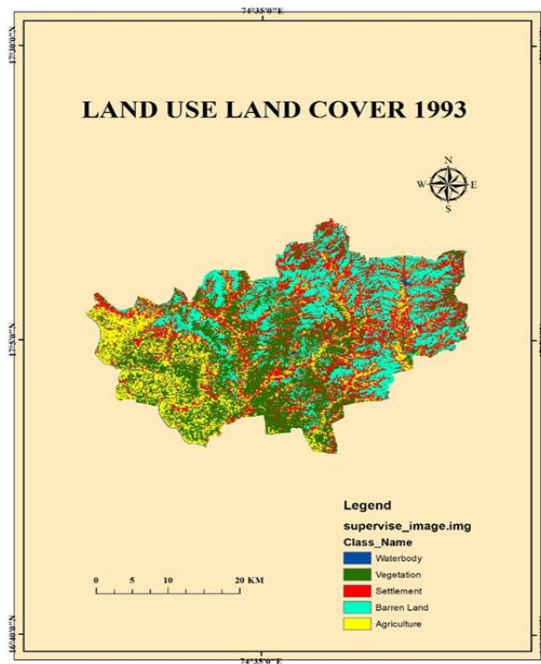
The analysis of Land Use and Land Cover (LULC) changes in Tasgaon and Palus Tahsils

between 1993 and 2023 reveals significant spatial and temporal transformations in the landscape. The results derived from supervised classification of satellite imagery clearly indicate that human activities, particularly agricultural expansion, irrigation development, and settlement growth, have played a dominant role in reshaping land use patterns over the last three decades. The interpretation of LULC maps prepared for both years provides a comprehensive understanding of the direction and magnitude of land transformation in the study area.

1.LULC Pattern in 1993:

The Land Use and Land Cover analysis for the year 1993 reveals a predominantly agrarian and semi-natural landscape in the study area, characterized by limited infrastructural development and moderate utilization of land resources. The classified LULC categories include water bodies, vegetation, settlement, barren land, and agriculture, each representing distinct land use characteristics and environmental conditions prevalent during the period.

Class_1993	Area_1993
Waterbody	12687.2235
vegetation	41117.3678
Settlement	1075.48597
Barren Land	19369.643
Agriculture	15301.5776



Vegetation constitutes the largest land cover class in 1993, occupying an area of 41,117.37 units, indicating extensive natural and semi-natural vegetation cover across the region. Barren land is the second most extensive class, covering 19,369.64 units of area. The large extent of barren land indicates limited land utilization and inadequate irrigation facilities during this period. These areas mainly consist of fallow land, rocky surfaces, scrubland, and agricultural land covers 15,301.58 units, reflecting the agrarian nature of the region. However, the comparatively lower extent of agricultural land in 1993 suggests that cultivation was restricted primarily to rain-fed areas and regions with limited irrigation access. Cropping intensity was relatively low, and large areas remained either fallow or underutilized. Water bodies occupy 12,687.22 units, representing rivers, streams, tanks, reservoirs, and seasonal water bodies. The moderate extent of water bodies indicates the presence of surface water resources, though many of them were seasonal in nature and dependent on rainfall. Settlement area is the smallest land use category, covering only 1,075.49 units, indicating

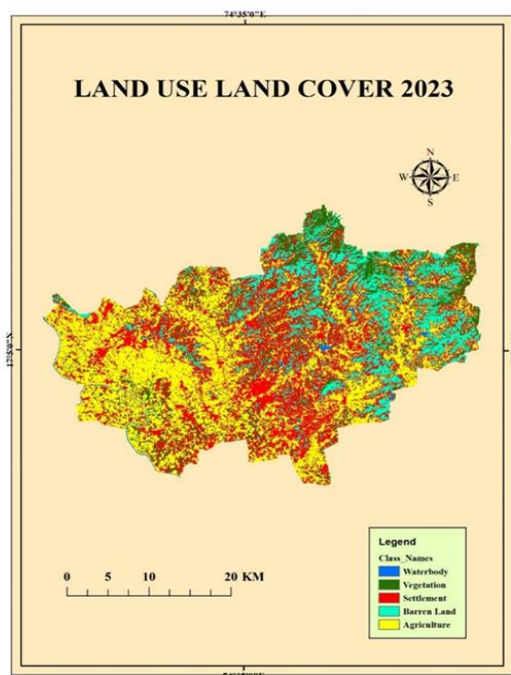
low levels of urbanization and infrastructural development in 1993.

Overall, the LULC pattern of 1993 reflects a landscape dominated by vegetation and barren land, with agriculture and settlements occupying relatively smaller areas. This land use structure indicates a traditional rural economy with limited irrigation, low urban growth, and moderate land resource utilization. The 1993 scenario thus serves as an important baseline for understanding subsequent land use transformations driven by irrigation development, agricultural expansion, and settlement growth in later years.

2. LULC Pattern in 2023:

The Land Use and Land Cover classification for the year 2023 reveals significant transformation in the spatial organization of natural and human-induced land categories in Tasgaon and Palus tahsils. The classified data indicate five major land use classes, namely Waterbody, Vegetation, Settlement, Barren Land, and Agriculture, each reflecting the combined influence of climatic conditions, irrigation development, agricultural practices, and socio-economic growth.

Class_2023	Area_2023
Waterbody	33687.1458
Vegetation	31196.1808
Settlement	30175.1239
Barren Land	1017.12429
Agriculture	39770.2322



In 2023, agriculture emerges as the dominant land use category with an area of 39,770.23 units, highlighting the continued importance of agriculture as the primary economic activity of the region. The extensive coverage of agricultural land reflects the expansion of irrigated farming, especially sugarcane cultivation, supported by improved irrigation facilities such as canals, lift irrigation schemes, and farm ponds. Waterbodies occupy a substantial area of 33,687.15 units, indicating a remarkable increase compared to earlier decades. This expansion is largely attributed to the construction of reservoirs, percolation tanks, check dams, and farm ponds under watershed development and irrigation programs. The vegetation class covers 31,196.18 units, representing a mixed landscape of cropland vegetation, plantations, orchards, and patches of natural vegetation. Although vegetation occupies a large area, its proportion indicates a shift from natural vegetation to managed and economically driven vegetation types. Settlement area has expanded significantly to 30,175.12 units, reflecting rapid population growth, rural-urban

transition, and infrastructure development. The growth of settlements is closely linked to agricultural prosperity, agro-based industries, sugar factories, transportation networks, and improved connectivity. In contrast, barren land has drastically reduced to only 1,017.12 units, indicating effective utilization of previously unused or degraded land. The decline in barren land suggests its conversion into agricultural fields, settlements, or water storage structures.

Overall, the 2023 LULC pattern demonstrates a shift towards intensive land utilization, characterized by expansion of agriculture, water infrastructure, and settlements, along with a sharp decline in barren land. These changes highlight the strong role of irrigation development, population pressure, and economic activities in shaping the present-day landscape of Tasgaon and Palus tahsils. While the trends indicate economic progress, they also raise concerns related to sustainable water use, loss of natural vegetation, and increasing pressure on land resources.

Change Analysis (1993–2023):

The comparative analysis of LULC in Tasgaon and Palus tahsils between 1993 and 2023 shows major transformation in land utilization. Agricultural land increased from 17.09% to 29.28%, indicating expansion of irrigated and commercial farming. Waterbodies rose significantly from 14.17% to 24.80% due to reservoirs, farm ponds, and irrigation projects. Settlement area recorded the highest growth, increasing sharply from 1.20% to 22.21%, reflecting population growth and infrastructural development. In contrast, vegetation cover declined from 45.91% to 22.96%, showing conversion of natural land into agricultural and built-up areas. Barren land reduced drastically from 21.63% to 0.75%, indicating effective utilization of previously unused land.

Role of Irrigation and Human Activities in Land Transformation:

The land use and land cover changes in Tasgaon and Palus tahsils from 1993 to 2023 are largely driven by irrigation development and increasing human activities. Expansion of canal irrigation from the Krishna River system, lift irrigation schemes, farm ponds, and check dams has increased water availability, leading to the conversion of barren and fallow land into irrigated agricultural land, particularly under sugarcane cultivation. Along with irrigation, population growth, expansion of settlements, agro-based industries, sugar factories, and improved transport infrastructure have significantly contributed to the growth of built-up areas. These human-induced changes have resulted in intensive land utilization, reduction of barren land, and decline in natural vegetation cover, reflecting both economic development and environmental pressure in the study area.

Vegetation Conservation and Afforestation Policy:

1. Conservation measures should be implemented to protect the remaining natural vegetation, as a significant decline in vegetation cover has been observed in the study area.
2. Afforestation and plantation programs should be encouraged on degraded lands, canal embankments, roadsides, and fallow areas to improve green cover.
3. These measures can help in maintaining ecological balance, reducing soil erosion, and improving environmental sustainability in Tasgaon and Palus tahsils.

Conclusion:

The study reveals that Tasgaon and Palus tahsils have undergone rapid land use transformation over the last three decades. Expansion of agriculture and water resources highlights the positive impact of irrigation development and improved farming practices. Growth of settlement areas reflects increasing population pressure and economic activities. However, the sharp decline in vegetation cover raises concerns regarding ecological balance and environmental sustainability. The near disappearance of barren land indicates improved land utilization but also increasing pressure on land resources. Overall, Remote Sensing and GIS proved to be effective tools for monitoring LULC changes and supporting sustainable land-use planning.

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