



Quick Response Code:



Website: <https://wgges.us>



Creative Commons (CC BY-NC-SA 4.0):

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License, which allows others to remix, tweak, and build upon the work noncommercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Manuscript ID:
IJWGAFES-2026-030704

DOI: 10.5281/zenodo.22246271

DOI Link:
<https://doi.org/10.5281/zenodo.22246271>

Volume: 3
Issue: 7

July

Year: 2026

E-ISSN: 3066-1552

Submitted: 07 June 2026

Revised: 12 June 2026

Accepted: 12 July 2026

Published: 31 July 2026

¹Ph.D. Research Scholar, Shivaji University, Kolhapur, M.S
Email: desaiheena51@gmail.com

² Department of Geography, Raja Shripatrao Bhagwantrao Mahavidyalaya, Aundh, Satara, M.S

Address for correspondence:
Heena N. Desai

¹Ph.D. Research Scholar, Shivaji University, Kolhapur, M.S
Email: desaiheena51@gmail.com

How to cite this article:

Desai, H. N., & Telore, N. V. (2026). Land Use and Land Cover Change Detection in the Ghataprabha River Basin Using Remote Sensing and GIS. *International Journal of World Geology, Geography, Agriculture, Forestry and Environment Sciences*, 3(7), 16–22.
<https://doi.org/10.5281/zenodo.22246271>

Land Use and Land Cover Change Detection in the Ghataprabha River Basin Using Remote Sensing and GIS

Heena N. Desai¹, Namdev V. Telore²

Abstract

The objective of this research was to analyse and understand the dynamics of land use and land cover changes in Ghataprabha River Basin. This study uses remote sensing and Geographic Information System (GIS) to understand the spatiotemporal LULC variations between 2015 and 2025. The LULC map was created using data from the Landsat 8-9 OLI satellite, which has four spectral bands and a spatial resolution of 30m. Landsat images for 2015 and 2025 were processed, classified and analysed. Supervised classification used to create LULC and classification accuracy was assessed using the kappa coefficient and total accuracy. A classification comparison approach was employed on classified images to identify LULC changes between 2015 and 2025. The result indicates notable changes in land use pattern. Agricultural land was increased by 1.81% from 30.38% in 2015 to 32.19% in 2025. Rapid urbanization and infrastructural development are reflected in the substantial expansion of built-up areas, which increased by 0.64% from 1.04% to 1.68%. Water bodies grew from 1.45% to 1.92%, whereas vegetation cover expanded significantly from 2.46% to 6.20%, representing positive shift of 3.74% barren land. Barren land decreased from 64.67% in 2015 to 58.01% in 2025. This decline of 6.66% was caused by conversion into vegetation, agricultural land and built-up areas.

Keywords: Land Use/ Land Cover, Change Detection, Remote Sensing, GIS, Ghataprabha River Basin

Introduction

Land use and land cover (LULC) change has surfaced as one of the most critical environmental challenges worldwide due to its direct and circular impacts on ecological processes, hydrological cycles, biodiversity, and sustainable resource operation. The relationship between mortal-conditioning and natural processes, such as infrastructural development, urbanization, deforestation, and agricultural growth, is reflected in LULC dynamics (Turner et al, 2007). Timely and accurate change detection of Earth's surface features serves as a basis foundation for a deeper understanding of the relationship and interactions between natural and human processes with the aim of managing land resources. Change detection is commonly performed using multi-temporal datasets to quantitatively evaluate changes that occur over time and to understand their temporal impacts on landscapes (Lu et al., 2004). Urban expansion has emerged as a major driver of landscape transformation, producing significant environmental consequences through alteration in land use and land cover patterns (Carlson and Traci Arthur, 2000). LULC changes influence several components of the environment, including the hydrological cycle, climate conditions, geomorphological processes, and terrestrial ecosystems (Bisri et al., 2017; Dinka, 2012; Negassa et al., 2020). Urbanization alters the landscape through the development of transportation networks residential settlements, commercial infrastructure, and other urban facilities (Antrop, M. 2004). LULC change studies focus on the spatial distribution of changes, the categories of land cover undergoing transformation, the rate at which these changes occur and the factor responsible for them (Loveland et al., 2006). Increasing demand for food, fiber, livestock feed, and bioenergy has intensified pressure on land resources, resulting in the intensification of agricultural practices and the conversion of new land into agricultural use. Remote sensing and Geographic Information System (GIS) techniques offer a dependable and effective framework for observing LULC changes over temporal scales and spatial region. Remote sensing offers high resolution multispectral imagery with frequent temporal coverage, making it a valuable source of information for detecting and analyzing LULC changes within the study area (Xiao et al. 2006). Satellite-based observations allow consistent mapping and quantitative assessment of land surface changes, making them indispensable tools for spatio-temporal analysis (Lillesand et al., 2015; Jensen, 2016). Satellite data is a dependable source that provides precise and current data about the spatial dynamics of the land surface (Roy et al., 2008). A change detector that can automatically correlate and compare two sets of imagery acquired the same geographical area at different time periods and show the interpreter the variations and their positions is certainly required (Shephard, 1964).

The significance of geospatial methods for understanding land use and land cover (LULC) patterns at basins has been comprehensively illustrated by earlier research. Shinde et al. (2023) employed remote sensing and GIS to detect urban LULC changes in Phaltan City, revealing rapid expansion of built-up areas at the cost of agricultural and open lands due to influence of urbanization on regional land transformation. Kadam and Telore (2024) analyzed decadal LULC dynamics in the Koyna watershed using geomatics approaches and reported significant shifts among forest, agricultural, and barren land categories, emphasizing the role of physiography and human interventions in watershed level changes. At the river basin scale, Telore and Unde (2018) assessed LULC patterns in the semi-arid Yerla River Basin using Landsat data and identified notable reductions in vegetation cover accompanied by increases in agricultural and fallow lands, reflecting climatic stress and land-use pressure. Further, Telore (2022) examined LULC changes in the Nani watershed of the Yerla River Basin through integrated remote sensing and GIS techniques, demonstrating how temporal LULC transformations affect watershed sustainability and resource management. These studies provide a strong methodological foundation and regional context for the present Land Use and Land Cover Change Detection in the Ghataprabha River Basin Using Remote Sensing and GIS.

Changes in land use and land cover have an impact on the climate, ecosystem, water quality, and land resources. Evaluating changes in LULC is now essential for sustainable resource management and appropriate use. The current study assesses the spatiotemporal changes in land use and land cover between 2015 and 2025 using remote sensing and geospatial techniques. Supervised classification and percentage-based change analysis are used to examine the changes occurring during the study period. This study focuses on identifying prominent land transformation trends and produces information for sustainable land use planning and environmental management.

Study Area:

The Ghataprabha River forms an important right-band tributary of the Krishna River in India. It originates in the Western Ghats at an elevation of approximately 884 m and follows an eastward course for about 283 km before joining the Krishna River near Chikkasangam. The Ghataprabha basin extends across parts of Maharashtra and Karnataka and encompasses an area of approximately 8,825 square kilometers. Geographically, the sub-basin is situated between 15° 45' and 16° 25' N latitude and 70° 00' and 75° 55' E longitude (Figure 1). The Hiranyakeshi and Markandeya are the major tributaries associated with the Ghataprabha River.

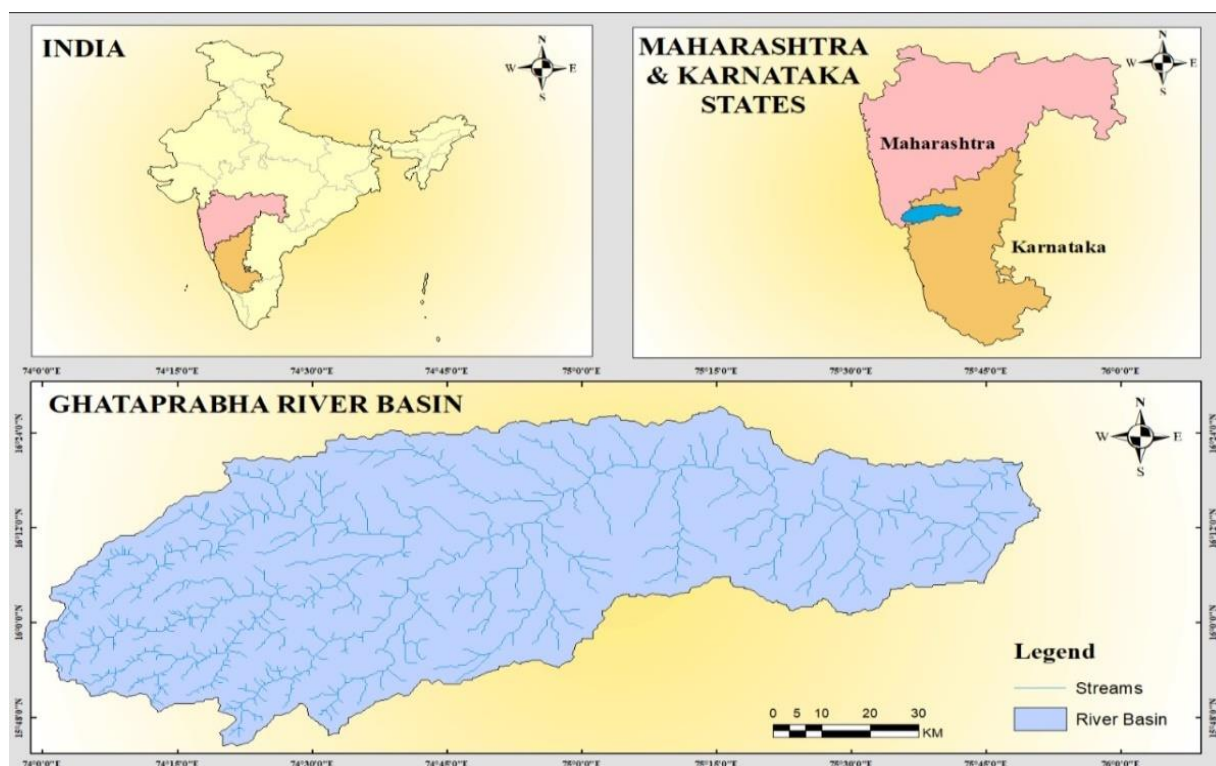


Figure1. Location Map

The study region has a semi-arid climatic character, with most of its annual precipitation concentrated during the southwest monsoon period, generally extending from June to October. Mean annual rainfall varies considerably across the basin, from around 5,000 mm in the Western Ghats to approximately 600 mm in the comparatively drier areas. Seasonal temperatures also show substantial variation, ranging from about 7°C during winter to nearly 41°C in summer. The principal soil types occurring within sub-basin include clay loam, sandy clay loam and clay soils.

Objective:

1. To prepare Land Use and Land Cover (LULC) maps of the study area.
2. To examine spatial and temporal variations in LULC patterns over the ten year period using change detection techniques.

Data Source:

The assessment of land use land cover dynamics in the study area is based on multi-temporal satellite imagery. Landsat satellite data covering the period from 2015 to 2025 were obtained from the United States Geological Survey (USGS) website. Landsat 8-9 Operational Land Imager (OLI) imagery with a spatial resolution of 30 m was used for the preparation of LULC maps for the selected years. Downloaded cloud free satellite image in the month February. After that ArcGIS 10.5 were used for layer stack the satellite data and composite into study area. ERDAS software then were used to supervised classification of those image and prepare Land Use/Land cover map of study area and then compared land use land cover change of both years. Ground truth survey carried out using handheld Garmin GPS for rectification (Figure 2).

Table1. These satellite images taken are explained in Table:

Source	Series	Sensor	Acquiring date	Spatial resolution
Earth explorer	Landsat 8-9	OLI	22/02/2015	30m x 30m
	Landsat 8-9	OLI	24/02/2025	30m x 30m

Methodology:

Supervised classification was used as the method to classify land use and land cover form multi-temporal satellite images. LULC information was derived from the spectral and spatial characteristics of various features visible in the satellite imagery. A supervised classification method was adopted to assign the pixels to their respective land use and land cover categories. This method allows the classification of image data based on representative training samples collected for known land cover features, thereby improving the identification and differentiation of individual classes. A land-use classification system should consist of multiple classes that are mutually exclusive and collectively cover all categories of land use (Rhind and Hundson 1980). In this classification, satellite imagery is categorized into five major classes: agriculture, vegetation, barren land, built-up cover (LULC), and water bodies.

Table 2. Description of LULC classes in the River Basin:

LULC CLASSES	Description of LULC classes
Agriculture	Irrigated and rainfed cropland, seasonal crops, follow lands and plantations.
Built-up Area	Settlements and infrastructure, residential area, commercial, industrial buildings, transportation networks.
Barren Land	Land with little or no vegetation cover, exposed soil, rocky surface, wastelands, and degraded areas.
Vegetation	Vegetation such as forests, shrubs, grasslands, and dense tree cover.
Water Body	Rivers, streams, lakes, reservoirs, ponds, and tanks.

1. Trends of LULC change:

The spatial and temporal dynamics of LULC were assessed by comparing the classified land use land cover generated maps for 2015 and 2025 in the study area. The actual area under each LULC class was calculated for both periods and compared to decide on the nature and amount of change. The trend analysis used to depict the time and pattern of land conversions, which helped evaluate the dominant processes of land transformation. The intensity and speed of land use transitions were measured by calculating the percentage change and yearly rate of change for each class of LULC using the absolute change magnitude between the two time periods. The rate of change calculated using following equation (Singh, 1989; Rawat & Kumar, 2015).

$$\text{Rate of Change} = \frac{A_2 - A_1}{T}$$

A1 = area of a specific LULC class at the initial time period (2015),

A2 = area of a specific LULC class at the final time period (2025),

T = time interval between the two periods.

2. Work flows of the present research are shown in:

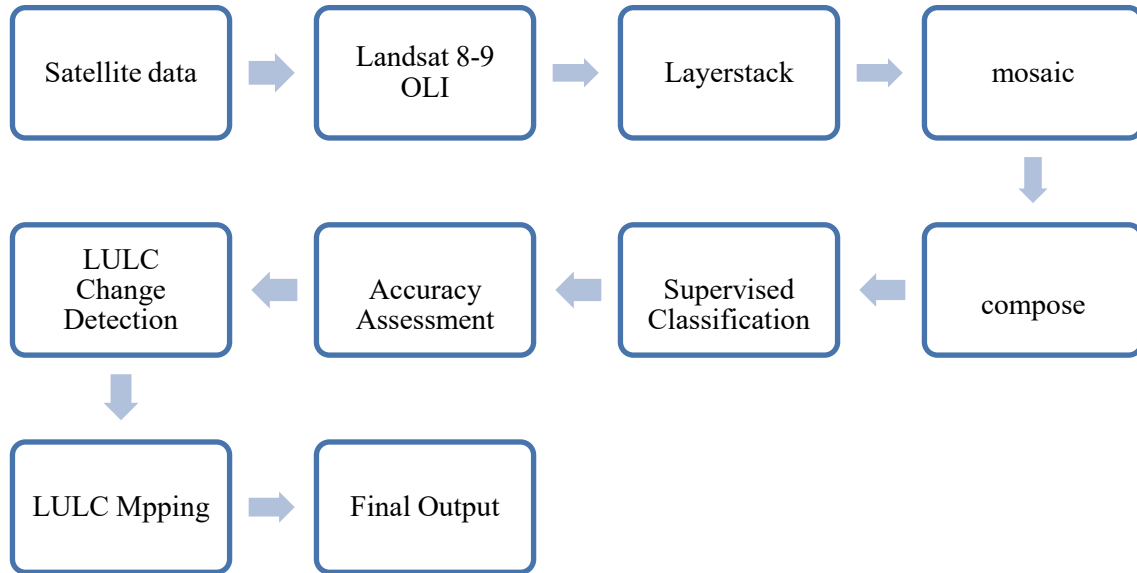


Figure 2 Work flow

Analysis and Discussion:

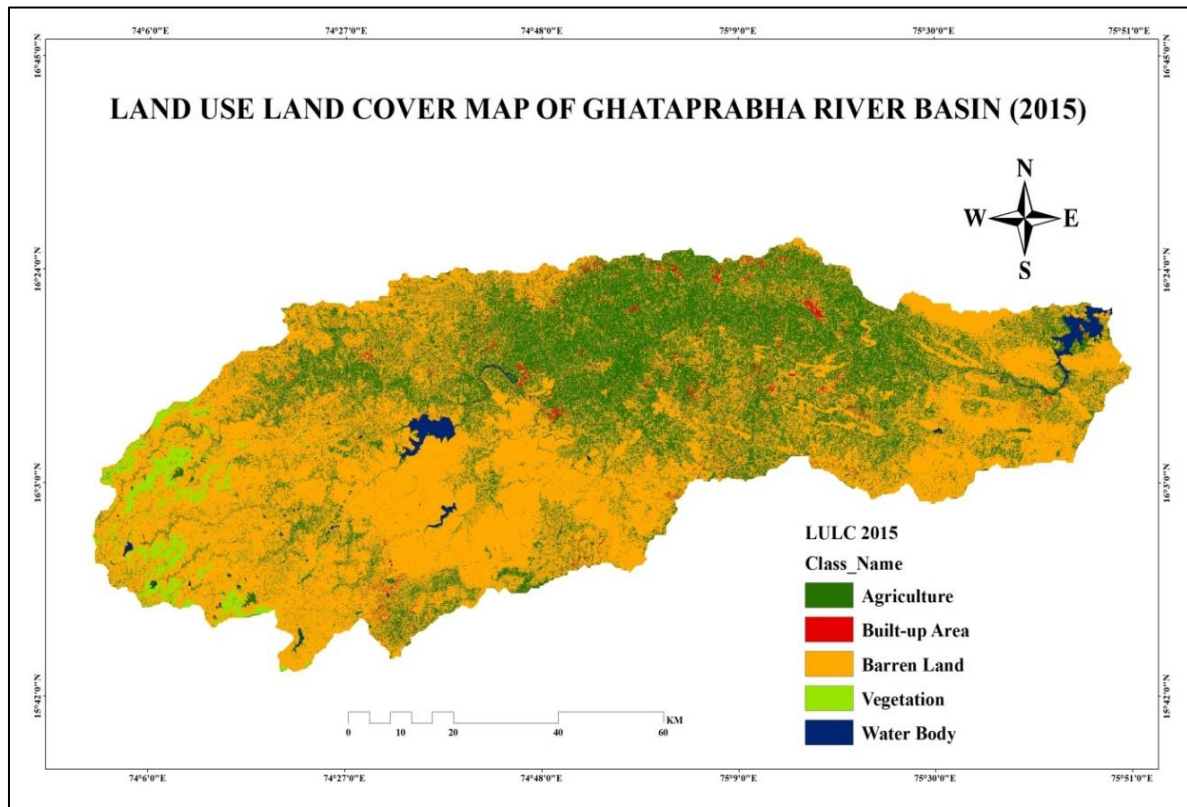


Figure 3 Land Use and Land Cover map (2015).

The comparison reveals some noteworthy changes in land use pattern in Ghataprabha River Basin between 2015 and 2025. The expansion of residential areas and agricultural areas, with the reduction of barren land indicates urbanization and potential changes in the natural environment these changes might be attributed to factor such as population growth, urban development, agricultural practices, and land management.

The results reveal that agricultural land increased from 30.38% in 2015 to 32.19% in 2025, representing a net change of +1.81% over the study period. Built-up area increased from 1.04% to 1.68%, equivalent to an expansion of +0.64% over ten year period. This growth in built-up areas associated with increasing population and the development of infrastructure within the study area. Barren land decreased from 64.67% to 58.01% with a -6.66% land decreasing rate from 2015 to 2025. Climatic change and erosional processes led to a notable change in water bodies in last decade the in

Ghataprabha the river basin, where it is expanding from 1.45% with o 1.92%, water bodies increasing slightly at a +0.47% expansion rate. Vegetation also increased in basin rise point from 2.46% to 6.20% in 2025 (Table3).

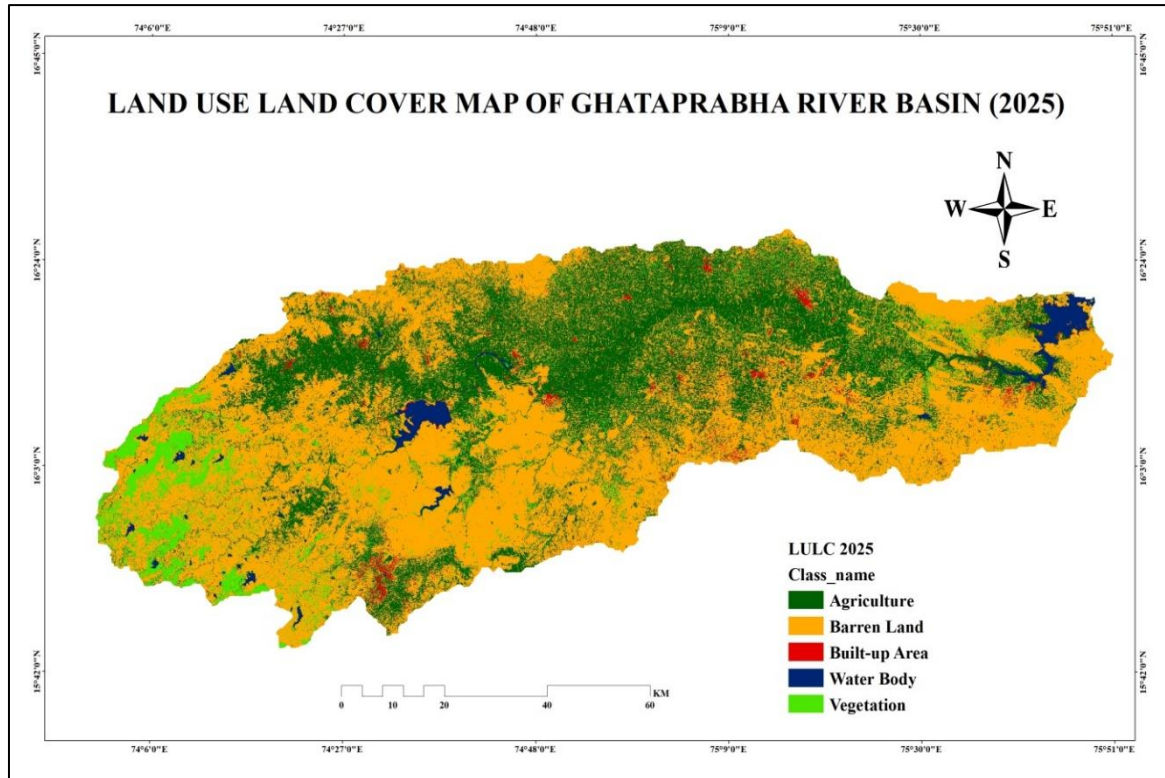


Figure 4 Land Use and Land Cover map (2025).

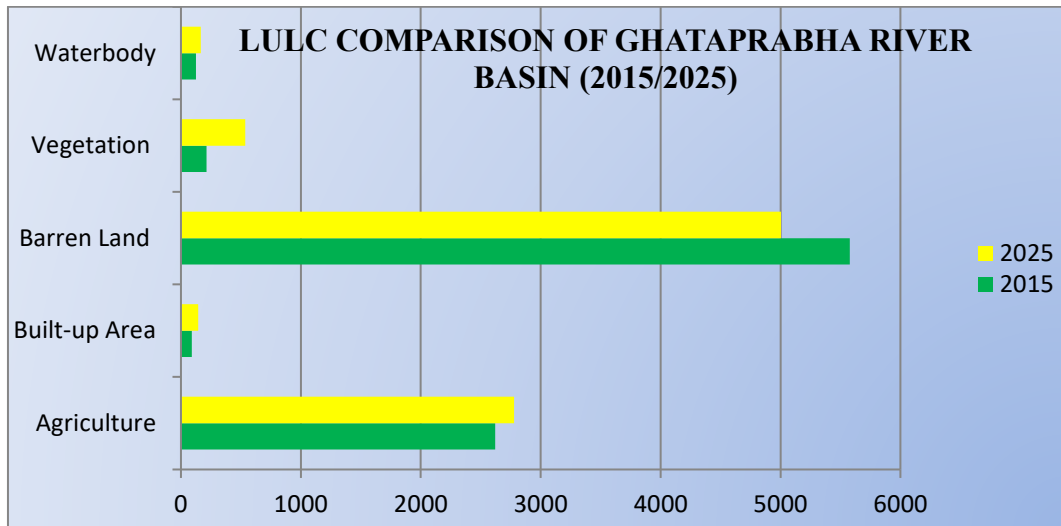


Figure 5 Graphical Representation of LULC (2015/2025).

Table 3 Trends Land Use Land Cover Change:

LULC Class	LULU Areas in Sq. Km.		Area in %		Change (%)	Trend
	2015	2025	2015	2025		
Agriculture	2620	2777	30.38	32.20	1.81	Increase
Built-up Area	90	145	1.04	1.68	0.64	Increase
Barren Land	5578	5003	64.67	58.01	-6.66	Decrease
Vegetation	212	535	2.46	6.20	3.74	Increase
Water Body	125	165	1.45	1.91	0.47	Slightly Increase
Total	8625	8625	100	100		

Accuracy Assessment:

The classification assessment produced an overall accuracy of 98% for 2015, accompanied by a Kappa coefficient value of 0.9700. For the 2025 LULC classification, the overall accuracy was 86%, while the corresponding Kappa value was 0.7823.

Main Finding:

The current study reveals significant changes in land use and land cover within the Ghataprabha river basin. There is a gradual increase in agricultural land, indicating an expansion of cultivation activities in the basin. Due to population expansion, urbanization and infrastructural development, built-up areas have increased. Vegetation Cover reflects a clear improvement, an increase in water bodies was observed, possibly influenced by variations in rainfall patterns and changes in water storage conditions. Barren land has reduced considerably, indicating the conversion of previously unused or degraded land into agricultural and vegetated areas. The results integrated that human activities along with natural factors have played a major role in reshaping the land use pattern of the Ghataprabha River Basin.

Conclusion:

In the present study, the spatial and temporal dynamics of land use and land cover changes in Ghataprabha River Basin have been successfully analyzed between 2015 and 2025 through remote sensing and GIS approaches. Through supervised classification and percentage change, there has been noted that an increased agricultural land and built-up land in the basin due to increased human activities and developments in the area. The reduction in barren land shows that the land has been put to better use; increases in vegetation cover and water bodies indicate improved land and water resource utilization. The detected LULC changes emphasize the increasing demand on land and water resources and, hence, the pressing need for sustainable land use planning and management. Monitoring of these changes through geospatial technology is important for evidence-based decision making that considers both development and conservation of the environment. The results of this study will be useful in the future planning and management of the basin for ecological sustainability. Future researches should focus on high resolution seasonal data and socio-economic variables.

Acknowledgement

The authors gratefully acknowledge the support received from Department of Geography, Shivaji University, Kolhapur during the course of this research.

Financial support and sponsorship

Nil.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Reference

1. Antrop, M. (2004). Landscape change and the urbanization process in Europe. *Landscape and Urban Planning*, 67(1-4), 9-26. [https://doi.org/10.1016/S0169-2046\(03\)00026-4](https://doi.org/10.1016/S0169-2046(03)00026-4)
2. Bisri, M., Limantara, L.M., Prasetyorini, L., Chasanawati, D., 2017. Application of the Kinos model for predicting the effect of land use on the surface run-off case study in Brantas sub-watershed, Klojen district, Malang City, East Java Province of Indonesia. *J. Water Land Dev.* 35, 3–9. <https://doi.org/10.1515/JWLD-2017-0062>.
3. Carlson, T. N., & Arthur, S. T. (2000). The impact of land use—land cover changes due to urbanization on surface microclimate and hydrology: A satellite perspective. *Global and Planetary Change*, 25(1-2), 49-65. [10.1016/S0921-8181\(00\)00021-7](https://doi.org/10.1016/S0921-8181(00)00021-7)
4. Dinka, M.O., 2012. Analysing decadal land use/cover dynamics of the Lake Basaka catchment (Main Ethiopian Rift) using LANDSAT imagery and GIS. *Lakes Reserv* 17, 11–24. <https://doi.org/10.1111/J.1440-1770.2012.00493.X>.
5. Jensen, J. R. (2016). *Introductory digital image processing: A remote sensing perspective* (4th ed.). Pearson Education.
6. Kadam, Y. U. and Telore, N. V. (2024). Dynamics of land use and land cover change using Geomatics: a case study of Koyna watershed, Maharashtra. *Mukt Shabd Journal UGC Care*, Vol. XIII, Issue XII, December 2024 pp. 1170-1175 DOI:10.0014.MSJ.2024.V13 I12.0086781.262520
7. Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2015). *Remote sensing and image interpretation* (7th ed.). Wiley, New York.
8. Loveland, T. R., & Acevedo, W. (2006). Land cover change in the Eastern United States. US Geological Survey. <https://landcover.trends.usgs.gov/east/regionalSummary.html>.
9. Lu, D., Mausel, P., Brondizio, E. S., & Moran, E. (2004). Change detection techniques. *International Journal of Remote Sensing*, 25(12), 2365–2401. <https://doi.org/10.1080/0143116031000139863>
10. Malede, D. A., Alamirew, T., Kosgie, J. R., & Andualem, T. G. (2023). Analysis of land use/land cover change trends over Birr River watershed, Abbay Basin, Ethiopia. *Environmental and Sustainability Indicators*, 17, 100222 <https://doi.org/10.1016/j.indic.2022.100222>.
11. Negassa, M.D., Mallie, D.T., Gameda, D.O., 2020. Forest cover change detection using Geographic Information Systems and remote sensing techniques: a spatio-temporal study on Komto Protected forest priority area, East Wollega Zone, Ethiopia. *Environmental Systems Research* 9, 1–14. <https://doi.org/10.1186/s40068-020-0163-z>.
12. Rawat, J. S., & Kumar, M. (2015). Monitoring land 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 Sciences*, 18(1), 77–84. [10.1016/j.ejrs.2015.02.002](https://doi.org/10.1016/j.ejrs.2015.02.002)
13. Rhind, D., & Hudson, R. (1980). *Land use*. Routledge. <https://doi.org/10.4324/9781003394297>. Roy, P. S., & Giriraj, A. (2008). Land Use and Land Cover Analysis in Indian Context. *Journal of Applied Sciences*, 8, 1346-1353. <https://doi.org/10.3923/jas.2008.1346.1353>

14. Shepard J: R., 1964, A concept of change detection. *Photogrammetric Engineering*, 30, 648-651. Singh, A. (1989). Digital change detection techniques using remotely-sensed data. *International Journal of Remote Sensing*, 10(6), 989–1003.
15. Shinde, P. S., Telore, N. V., & Chaure, R. S. (2023). Urban land use and land cover change detection in Phaltan City of Satara District, Maharashtra, using geospatial technology. In N. V. Telore & S. A. Borude (Eds.), *Advances in Geographical Research* (pp. 32–44). Jyotikiran Publication, Pune, India. DOI: 10.5281/zenodo.10559048
16. Thapa, R. B., & Murayama, Y. (2010). Drivers of urban growth in the Kathmandu valley, Nepal: examining the efficacy of the analytic hierarchy process. *Applied Geography*, 30(1), 70e83.
17. Telore, N. V. (2022). Analyzing land use land cover changes using remote sensing and GIS in the Nani watershed of the Yerla River Basin. *International Journal of Early Childhood Special Education (INT-JECSE)*, 14(Spl Issue 3), 30–36. DOI: 10.9756/INT-JECSE/V14S3.4
18. Telore, N. V., & Unde, M. G. (2018). Land use and land cover analysis of the semi-arid Yerla River Basin, Maharashtra using Landsat data. *Electronic International Interdisciplinary Research Journal (EIIRJ)*, 7(13), 119–126. ISSN: 2277-8721. Retrieved from <http://www.aarhat.com/eiirj/wp-content/uploads/2018/08/Final-Book.compressed.pdf>
19. Turner, B. L., Lambin, E. F., & Reenberg, A. (2007). The emergence of land change science for global environmental change and sustainability. *PNAS*, 104(52), 20666–20671.
20. Xiao, J. Y., Shen, Y. J., Ge, J. F., Tateishi, R., Tang, C. Y., Liang, Y. Q., et al. (2006). Evaluating urban expansion and land use change in Shijiazhuang, China, by using GIS and remote sensing.
21. *Landscape and Urban Planning*, 75, 69–80 <https://doi.org/10.1016/j.landurbplan.2004.12.005>
22. Yin, J., Yin, Z., Zhong, H., Xu, S., Hu, X., Wang, J., & Wu, J. (2011). Monitoring urban expansion and land use/land cover changes of Shanghai metropolitan area during the transitional economy
23. (1979–2009) in China. *Environmental Monitoring and Assessment*, 177(1–4), 609–621. <https://doi.org/10.1007/s10661-010-1660-8>