Land Use Land Cover Change Analysis of Nashik City Using Remote Sensing and GIS Techniques

Pallavi Nivritti Gaikwad[1], Vrushali Haridas Chavhan[2], Sudarshan Mhaske[3]
Bhushan Harak[4], Prof. P. R. Kshatriya[5], Prof. S. S. Shelar[6]
Students, Department of Civil[1-5]
HoD, Department of Civil[6]
Matoshri Asarabai Institute of Technology and Research Centre Nashik, Maharashtra, India
pallavigaikwad9209@gmail.com, vrushalichavhan0@gmail.com, sudarshanmhaske6113@gmail.com
bhushanharak999@gmail.com, Kankrejpooja@gmail.com, Shraddha.patil@matoshri.edu.in

Abstract: *Rapid urbanization has significantly transformed land use and land cover patterns in growing Indian cities. Nashik City, one of the fastest-developing urban centers in Maharashtra, has experienced considerable spatial expansion over the last two decades. This study presents a comprehensive Land Use Land Cover (LULC) analysis of Nashik City using Geographic Information Systems (GIS) and remote sensing techniques. Multi-temporal satellite imagery obtained from Landsat datasets was processed and classified using supervised classification methods in QGIS and ArcGIS environments. LULC maps were generated for different years to identify spatial and temporal changes in agricultural land, built-up areas, forests, barren land, and water bodies.*

The results indicate a steady increase in built-up areas accompanied by a reduction in agricultural and forest land due to population growth and infrastructure development. Accuracy assessment confirmed reliable classification performance. The study highlights the importance of GIS-based LULC analysis for sustainable urban planning, environmental conservation, and disaster risk management. The findings provide decision-support information for planners and policymakers to promote balanced urban growth in Nashik City.

Keywords: Land Use Land Cover, GIS, Remote Sensing, Urbanization, Nashik City, Change Detection, Sustainable Planning

I. INTRODUCTION

Background: Rapid population growth and urban expansion have resulted in significant land transformation across urban regions. Traditional land monitoring methods are time-consuming and insufficient for analyzing large geographic areas. Remote sensing and Geographic Information Systems (GIS) provide efficient tools for monitoring spatial and temporal land changes.

Nashik City is among the fastest-growing cities in Maharashtra, experiencing industrial development, migration, and infrastructure expansion. These factors have altered land use patterns, making LULC analysis essential for sustainable planning and environmental management.

Problem Statement: Existing urban development processes often occur without continuous monitoring of land transformation. This results in:

- Loss of agricultural land and green cover
- Unplanned urban expansion
- Environmental degradation
- Increased flood and heat island risks

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Therefore, systematic LULC analysis using GIS is required to understand land transformation trends and support informed decision-making.

Objectives: The main objectives of the study are:
- To analyze land use and land cover patterns of Nashik City using GIS techniques
- To prepare LULC maps using satellite imagery
- To identify spatial and temporal land cover changes
- To quantify variations in major land categories
- To support sustainable urban planning and environmental management

II. LITERATURE SURVEY

Concept of LULC: Land Use Land Cover (LULC) analysis helps in understanding how land is utilized and how natural surfaces change over time due to human activities and urban development.

Role of Remote Sensing and GIS: Remote sensing and GIS techniques are widely used for preparing thematic maps and analyzing land changes using satellite imagery in an accurate and time-efficient manner.

Previous Research Studies: Earlier studies in Indian cities show rapid growth of built-up areas and reduction in vegetation and agricultural land due to population increase and infrastructure expansion.

Data Sources: Satellite data provided by Indian Space Research Organisation (ISRO) through the Bhuvan geoportal supports LULC mapping and change detection analysis for urban planning and research purposes.

III. METHODOLOGY

3.1 Data Collection

LULC thematic maps of Nashik city were collected from the Bhuvan portal developed by Indian Space Research Organisation (ISRO). Multi-temporal datasets of different years were used for comparison and analysis.

3.2 Data Preparation

The downloaded LULC maps were processed and organized according to classification categories such as built-up area, vegetation, water bodies, agricultural land, and barren land for further study.

3.3 LULC Analysis

Spatial analysis was carried out by comparing LULC maps of different years to identify land transformation patterns. Area calculations were performed to determine increases or decreases in each land cover category.

3.4 Change Detection

A comparative analysis method was applied to evaluate land use changes over time. The results were interpreted to understand urban growth trends and environmental impacts in Nashik city.

3.5 Map Interpretation

The classified maps were visually analyzed to understand spatial distribution patterns and expansion of urban areas within Nashik city.

3.6 Result Validation

The obtained results were verified by comparing thematic maps and ensuring consistency in classification to improve reliability of the LULC analysis.

Tools and Applications Used:

- **Bhuvan Geoportal**: Used for downloading LULC thematic maps and satellite-based datasets.
- **Indian Space Research Organisation (ISRO) Data Services**: Provided authenticated geospatial data for analysis.
- **GIS Software**: Used for visualization, spatial analysis, and preparation of thematic maps.
- **Microsoft Excel**: Used for area calculation, tabulation, and graphical representation of LULC changes.
- **Computer System**: Used for data processing, comparison, and report preparation.

IV. LULC IMPLEMENTATION

4.1 Study Area Description
This section describes the geographical location and characteristics of Nashik city. Nashik is one of the rapidly developing cities in Maharashtra, experiencing significant urban growth due to industrial development, population increase, and infrastructure expansion. Understanding the study area helps in analyzing how land use patterns have changed over time.

4.2 LULC Classification
The collected LULC maps were classified into major land cover categories such as built-up area, vegetation, agricultural land, water bodies, and barren land. Each category represents a specific type of land utilization or natural surface, which helps in understanding the distribution of land resources within the city.

4.3 Map Preparation
The thematic LULC maps obtained from the **Bhuvan** portal of **Indian Space Research Organisation (ISRO)** were organized year-wise for analysis. The maps were properly labeled and arranged to enable easy comparison between different time periods.

4.4 Area Calculation
Area under each land use category was calculated using GIS tools and supporting software. The calculated values were tabulated to represent the spatial extent of each land class. These calculations helped in identifying quantitative changes in land distribution.

4.5 Change Detection Analysis
A comparative analysis was carried out between LULC maps of different years to detect changes in land cover. The increase in built-up areas and decrease in vegetation or agricultural land were identified through statistical comparison and visual interpretation of maps.

4.6 Result Interpretation
The obtained results were analyzed to understand urban expansion trends and environmental impacts in Nashik city. The interpretation highlighted patterns of land transformation and provided insights useful for sustainable urban planning and future development strategies.

V. RESULT

5.1 LULC Analysis Results
The analysis of Land Use Land Cover (LULC) maps of Nashik city revealed noticeable changes in land distribution over the selected study years. The comparison showed variation in built-up areas, vegetation cover, agricultural land, water bodies, and barren land.

5.2 Change in Built-up Area

The built-up area showed a significant increase due to rapid urbanization, population growth, and infrastructure development. Expansion of residential, commercial, and industrial zones contributed to the rise in urban land cover.

5.3 Change in Vegetation and Agricultural Land

Vegetation and agricultural land experienced a gradual decrease as open spaces were converted into developed areas. This indicates increasing pressure on natural resources caused by urban expansion.

5.4 Water Bodies and Barren Land

Minor variations were observed in water bodies and barren land categories. Seasonal factors and land development activities influenced these changes in certain regions of the city.

5.5 Comparative Analysis

A comparative study between different years clearly indicates transformation from natural land cover to built-up areas. The results demonstrate the impact of urban growth on land use patterns in Nashik city.

5.6 Discussion

The findings highlight the importance of continuous LULC monitoring for sustainable urban planning. Proper land management strategies are necessary to balance development with environmental conservation and resource protection.

FIG 1 : LULC AREA

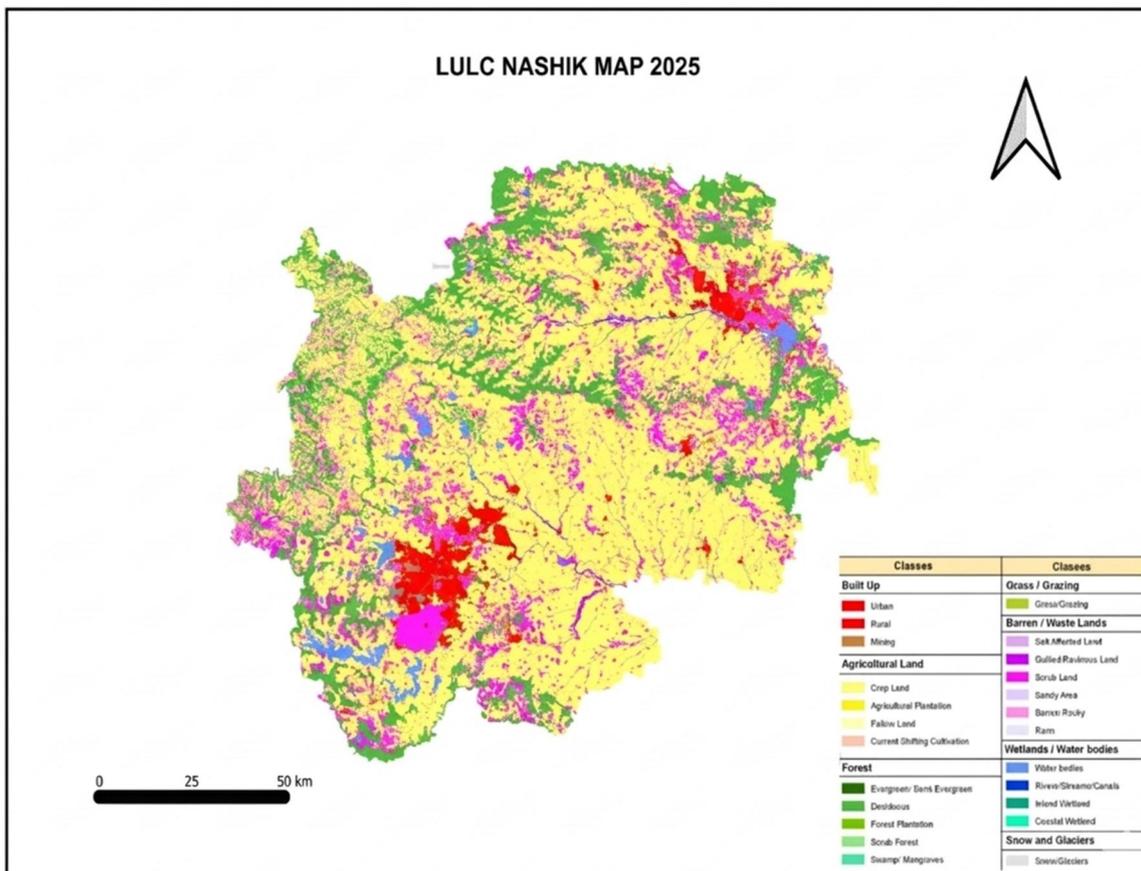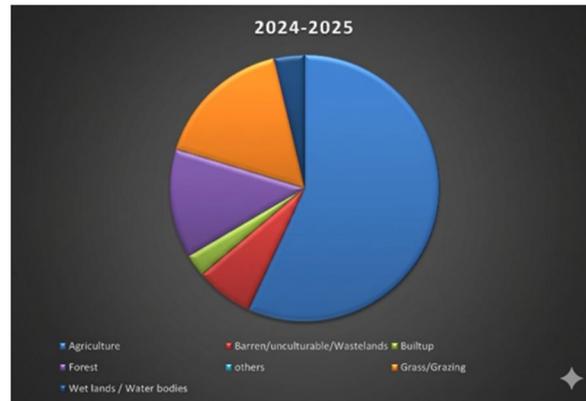| Land Cover Type	2024-2025 (Area in hectares)
Agriculture	8,901
Barren/Uncultivable/Wasteland	1,056.2
Built-Up	350.18
Forest	2,070.12
Others	2,579.97
Inland Wetlands/Water Bodies	-
Rivers/Streams/Canals	179.69
Water Bodies	398.49
Total	15,535.65

FIG 2 ; Graph Variation of Land Use

FIG 3 : LULC OF NASHIK CITY (2021)

VI. CONCLUSION

The Land Use and Land Cover (LULC) analysis is a vital tool for sustainable urban planning in cities like Nashik. It helps balance urban growth with environmental conservation by identifying changes in land use, such as the expansion of built-up areas and the loss of green spaces. This analysis supports informed decision-making, enabling the creation of sustainable development strategies, climate resilience, and biodiversity conservation.

For Nashik, integrating LULC data into urban planning ensures the preservation of agricultural land, green spaces, and water bodies, enhancing quality of life and mitigating urban heat effects. In summary, LULC analysis helps guide Nashik's growth toward a more sustainable and resilient future

REFERENCES

[1]. Landsat-5 and Landsat-8 Satellite Imagery, USGS Earth Explorer, accessed 2020. Available: https://earthexplorer.usgs.gov

[2]. "ArcGIS," Environmental Systems Research Institute (ESRI), version 10.x, Redlands, California, USA, 2020

[3]. P. S. Roy, et al., "Remote sensing applications for land use and land cover mapping," *Current Science*, vol. 85, no. 10, pp. 1441–1447, 2003

[4]. Nashik Municipal Corporation Data, "Administrative boundaries and urban planning resources," Nashik, Maharashtra, India, 2020

[5]. S. R. Jenson and J. O. Domingue, "Extracting topographic structure from digital elevation data for geographic information system analysis," *Photogrammetric Engineering and Remote Sensing*, vol. 54, no. 11, pp. 1593–1600, 1988