Land Use And Land Cover Analysis of Bengaluru Urban District

Raghav V[1] Sachin R. Kulkarni[2]
[1]Student [2]Assistant Professor
[1,2]Department of Civil Engineering
[1,2]RNS Institute of Technology, Bengaluru, Karnataka, India

Abstract — The study explores the dynamic changes in land use and land cover (LULC) within Bengaluru, India, over seven years from May 2015 to May 2023. Utilizing LANDSAT 8 images and employing remote sensing techniques, the research aims to identify and analyze alterations in LULC patterns. The methodology involves geo-correction of remote sensing data, creation of false colour composites (FCC), generation of training polygons, and supervised classification of land use categories. Results indicate significant transformations, including the expansion of built-up areas, depletion of wetlands, and conversion of natural land cover into urban zones. Notably, only a small fraction of forest and agricultural land remains, while barren land presents an opportunity for cultivation. This research underscores the importance of understanding and managing LULC changes for sustainable urban development in rapidly growing cities like Bengaluru.

Keywords: LULC, Geo-Correction, FCC, Training Polygons, Supervised Classification, Sustainable Urban Development

I. Introduction

Urban areas have been pivotal in shaping society, serving as catalysts for significant social, economic, and political transformations. Urbanization, occurring at an unprecedented scale and pace worldwide, stands as a profound social and economic phenomenon (Sun et al., 2013). Urban areas expand outward as a result of the conversion of agricultural and other natural land cover types into built-up areas (Dutta et al., 2020). The transformation of natural land cover into artificial land use types is regarded as a key driver of global environmental changes. These changes are primarily fueled by human needs for food, water, and shelter. Therefore, studying land use and land cover changes can offer frameworks for managing and planning natural resources at various spatial and temporal scales (Mohd Waseem Naikoo et al., 2020).

Understanding changes in LULC is crucial for effective planning, optimal use of natural resources, and sustainable management. (Asselman et al., 1995). The degradation of the environment and its impact on human health is a growing concern in urban areas, with both natural and human-induced environmental changes contributing to this issue (Jat et al., 2008). Poor planning and management have hastened urban expansion, resulting in significant land loss and posing a major challenge to sustainable urban development. Remote sensing and Geographical Information System (GIS) techniques can serve as effective tools for detecting and assessing land use changes. (Reveshty et al.,2011).

II. Study Area

Bengaluru is the capital city of Karnataka, a southern Indian state. It has a population of about 8 million and an area of 741 sq km. Bengaluru saw a sudden change in land dynamics after the IT evolution during the 2000s. During this period the city became a hub for most of the tech companies, which caused rapid urbanization.

III. Methodology

For the present study, the aims are to identify the changes for the period of 7 years starting from May 2015 to May 2023. To understand the changes LANDSAT 8 images were taken. Figure 1 shows the pictorial representation of the methodology adapted for the LULC analysis. The analysis of LULC follows the subsequent steps:

1) Collection of remotely sensed data from USGS, Registration and geo-correction of RS data with varying spatial and temporal resolutions.
2) Creation of a false colour composite (FCC) using bands 2 (Green), 3 (Red), and 4 (NIR) to detect diverse patches.
3) Generation of training polygons representing these patches.
4) Employing supervised classification of the RS data aided by the number of distinct peaks in the histogram.
5) Conducting supervised classification of land use into five distinct categories – built-up areas, water bodies, agriculture, vegetation/open space, and scrubland using QGIS.

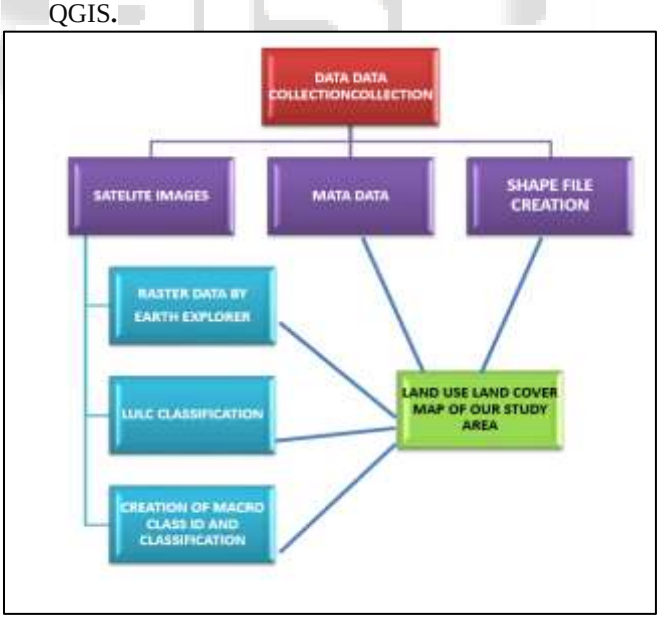

Fig. 1: Methodology Adapted For Lulc Analysis

IV. Results and Discussion

To understand changes LULC was conducted for Bengaluru city, for the years 2015 and 2023. The initial step involved generating false-color composite (FCC) images through raster processing for the years 2015 and 2023. Subsequently, these images were transformed into natural colour composites

(NCC) (Figures 2 & 3) to facilitate a thorough understanding of land utilization patterns.

To ascertain changes over time, temporary training datasets were generated, focusing on distinct categories such as water bodies, agricultural land, forest areas, barren land, and built-up areas. These datasets served as crucial reference points for analyzing alterations in land cover. Utilizing these training sets, the extent of changes occurring during the specified timeframe was noted. The analysis aimed to provide valuable insights into the evolving landscape dynamics of Bengaluru, offering a comprehensive perspective on the shifts in land utilization over the seven years.

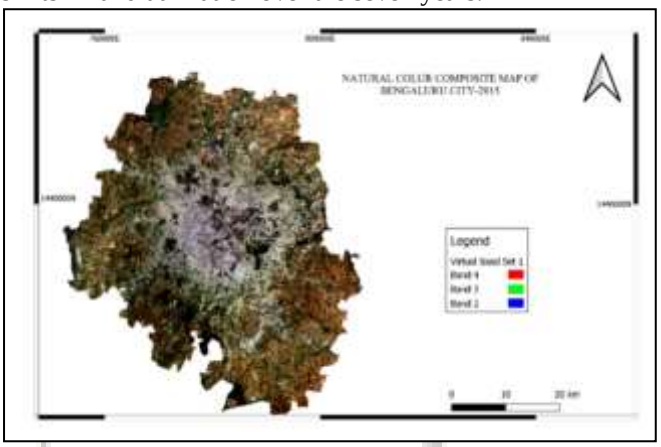

Fig. 2: NCC Map of Bengaluru City During 2015

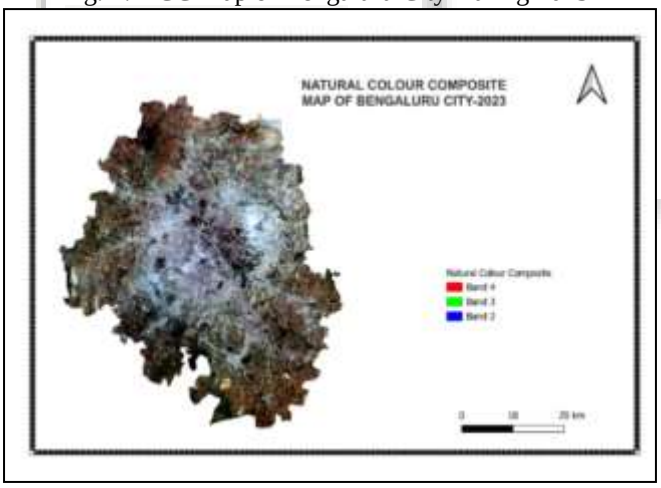

Fig. 3: NCC Map of Bengaluru City During 2023

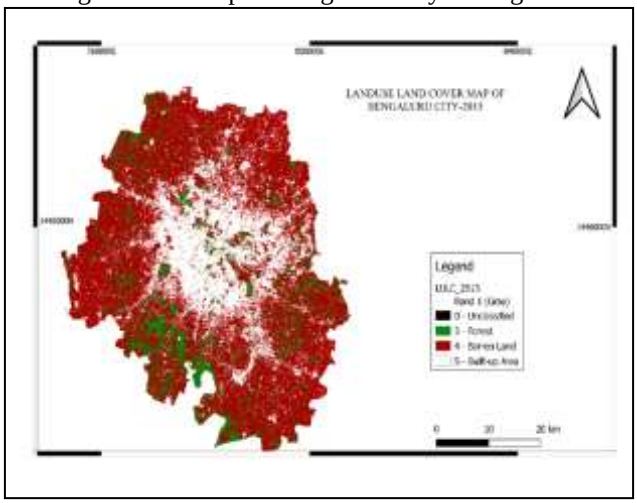

Fig. 4: LULC Map of Bengaluru City During 2015

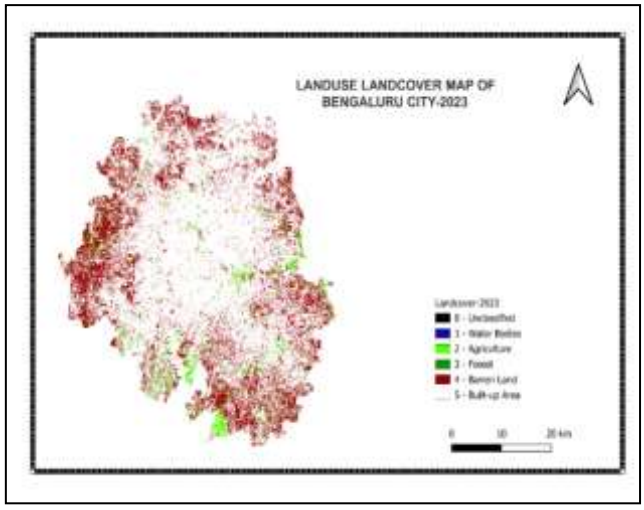

Fig. 5: LULC Map of Bengaluru City During 2023

Based on the results obtained by processing the training data sets, it was found out the maximum of amount land changes has occurred during 7 years (Figures 4 and 5). The total amount of land changes from one category to another category can be seen in Table 1.

LULC Change	Area in sq. km
Forest to Agriculture	21,455
Barren Land to Agriculture	53,162
Forest (No Change)	2,748
Barren Land to Built-up area	8,68,299
Barren Land to Forest	31,667
Forest to Built-up area	33,041
Forest to Barren Land	4,37,872
Barren Land (No Change)	2,16,148
Built-up area (No Change)	5,31,400

Table 1: Shows the Amount of Land Changes

Fig. 6: Graphical Presentation of Change in Area

From Table 1 it is evident that a large amount of land has been changed to the built-up category which counts about 66% (Figure-8) of the total Land of the Bengaluru urban district. This can be seen in Figure 6, which shows the total amount of changes from 2015 to 2023.

Category	Area in sq. km
Forest	34,415
Agriculture	53,162
Barren	6,54,019
Builtup Area	14,32,740

Table 2: Amount land utilization as of 2023

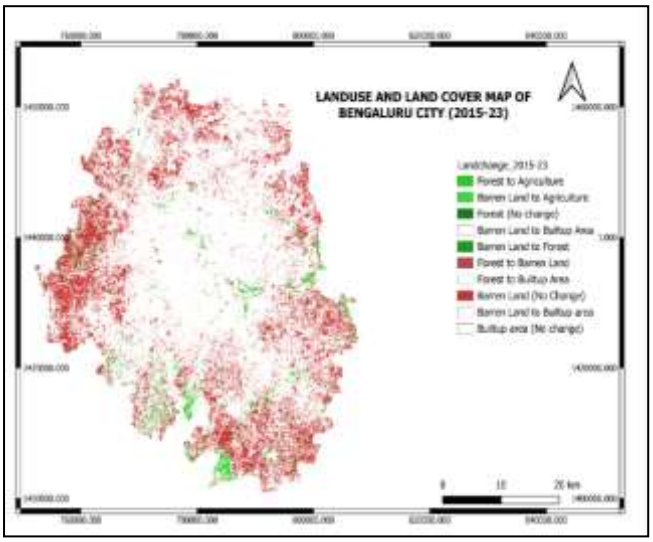

Fig. 7: Changes in Bengaluru City from 2013 To 2023

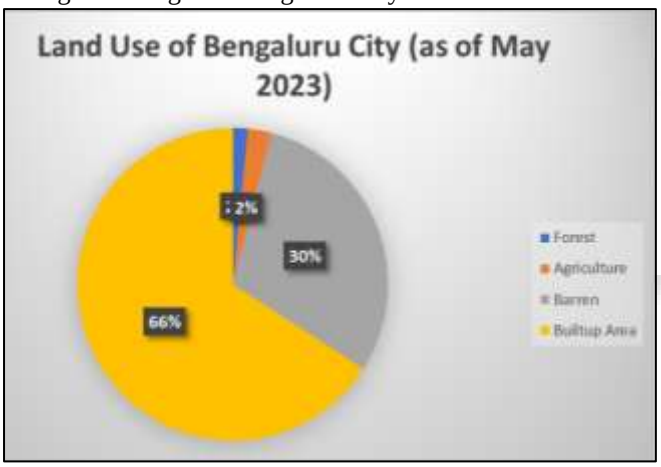

Fig. 8: Total amount of Land Utilization.

V. Conclusion

The discernible LULC changes reveal a dynamic transformation, notably characterized by the fluctuating forest types, expansion of built-up areas, and significant depletion of wetlands. The findings underscore a profound alteration in Bengaluru's landform, evidenced by the drastic reduction and fragmentation of water bodies. The graphical representation highlights a predominant conversion of forested, agricultural, and barren lands into urbanized zones. Remarkably, a mere 2% of forest and agricultural terrain remains, while 30% of barren land holds potential for cultivation.

References

[1] Cheng Sun, Wu. Zhi-Feng, Zhi-qiang Lv, Na. Yao, Jian-bing Wei Quantifying different types of urban growth and the changing dynamics in Guangzhou using multi-temporal remote sensing data Int. J. Appl. Earth Obs. Geoinf. (2013), p. 21

[2] D. Dutta, A. Rahman, S.K. Paul, A. Kundu, Estimating urban growth in peri-urban areas and its interrelationships with built-up density using earth observation datasets The Annals of Regional Science (2020).

[3] M. K. Jat, P. K. Garg, and D. Khare, "Monitoring and modelling of urban sprawl using remote sensing and GIS techniques," International Journal of Applied Earth Observation and Geoinformation, vol. 10, no. 1, pp. 26–43, 2008.

[4] Mohd Waseem Naikoo, Mohd Rihan, Mohammad Ishtiaque, Shahfahad Analyses of land use land cover (LULC) change and built-up expansion in the suburb of a metropolitan city: Spatio-temporal analysis of Delhi NCR using Landsat datasets Journal of Urban Management, Volume 9, Issue 3, September 2020, Pages 347-359

[5] N. E. M. Asselman and H. Middelkoop, "Floodplain sedimentation: quantities, patterns and processes," Earth Surface Processes & Landforms, vol. 20, no. 6, pp. 481–499, 1995

[6] Reveshty, M.A., 2011. The assessment and prediction of land use changes to the urban area using multi-temporal satellite imagery and GIS: A case study on Zanjan, IRAN (19842011). Journal of Geographic Information System, 3(04), p.29

