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Assessment Of LULC Changes Using Spatial Techniques in Budameru Catchment Area, Andhra Pradesh.

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Abstract: Urban growth is a major concern in rapidly developing cities like Vijayawada, Andhra Pradesh. This study focuses on land use and land cover (LULC) changes using satellite imagery and GIS tools on the Budameru Rivulet. The increasing of urban growth around the rivulet has resulted on the loss of natural flood buffers and an increase in impervious surfaces, thereby exacerbating flood risks. Satellite data from 2016 & 2025 were utilized to assess the spatial and temporal evolution of land cover in the region, revealing an enormous change of 3.5% variation of agricultural area, water bodies like mainly flood plain areas being encroached by 0.5%, vegetation has reduced by 0.09%, the total catchment area of the region is 1400 sq km and in that catchment area nearly 32 sq. km area occupied by urban activities in the period of 2016 to 2025. These LULC changes were mapped using visual interpretation revealing a significant rise in the built-up areas and a decline in agriculture land over past one decade. This study underscores the importance of LULC mapping providing critical insights for urban planning.

Keywords: Land Use and Land Cover (LULC), urban growth, GIS, visual interpretation.

I.INTRODUCTION

Land Use Land Cover (LULC) analysis is a crucial component environmental monitoring, urban planning, and resource management. Land use pertains to how humans utilize the land such as for agriculture, settlements, industry. While land cover refers to the physical materials present on the surface, including vegetation, water bodies, built-up areas, and barren land. Understanding changes in LULC is vital for assessing the impacts of natural processes and human activities on the landscape. These changes often affect ecological balance, water cycle, soil transformation, monitoring LULC patterns over time has become essential for sustainable development planning and disaster risk reduction. Remote sensing techniques, particularly, offer valuable data for accurately and efficiently identifying and tracking these changes.

Land use and Land cover (LULC) patterns are dynamic outcomes shaped by both natural factors and socio-economic influences. Land use and Land cover (LULC) mapping is crucial for understanding the relationship between land transformation and environmental hazards like flooding. Land cover types, such as built-up areas, agriculture fields, and natural vegetation, directly affect the hydrological behavior of a region (*Tabaro Kabanda,2013*). Urbanization leads to conversion of permeable surfaces into impervious surfaces like roads and buildings, reducing water infiltration and increasing surfaces runoff, which in turn elevates flood risk. LULC mapping can be performed using various techniques, in areas where the landscape is heterogeneous or where ground truth data is scarce, visual interpretation of satellite imagery provides a valuable alternative.

Visual interpretation involves analyzing satellite images based on visual cues such as tone, texture, shape, pattern. It allows for the classification of land cover types based on the analyst's knowledge and judgement, and is particularly effective in distinguishing complex urban features that may be difficult for automated systems to classify accurately. This study focuses in using visual interpretation to map LULC changes around the Budameru rivulet, with an emphasis on detecting urban growth. Satellite imagery from 2016 and 2025 are used to visually identify and categorize land cover types, such as built-up areas, agriculture land, vegetation and water bodies (*Prasad, Ramamurthy, and Krishna, 2022)*. The visual interpretation of LULC changes by analyzing the proximity of different land cover types to the Budameru rivulet and by considering the regions topographic features. By focusing on LULC changes through visual interpretation, this study aims to provide a clearer understanding of the impact of urban growth.

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Visual interpretation has been a cornerstone method in geographic and environmental studies since the early use of aerial photographs, and it continues to hold significant value, especially when high precision is needed, while working with high resolution imagery, or in areas where training data for automated classification are limited or unavailable. Despite Being more time consuming than automated techniques, visual interpretation is often preferred when accuracy is prioritized over speed. It also avoids many of the limitations associated with classification algorithms, such as spectral confusion, misclassification of mixed pixels, and dependency on extensive training data. Moreover, it enables the interpreter to handle cases such as differentiating between similar land covers like dry grassland and bare soil, or small urban structures, vegetation. In many professional and academic projects, especially those involving detailed case studies or small to medium geographic extents, visual interpretation remains the most effective and dependable method. This information is critical for urban planners, disaster management authorities, informing the development strategies for enhanced urban planning practices.

Study Area:

Originating near Kondapalli in the Eastern Ghats, Budameru rivulet a seasonal water course situated in the Krishna district, a region of immense agricultural, economic, and cultural significance in Andhra Pradesh, India. Geographically, the area is located between 16°30′ N latitude and 80°42′ E longitude, the total catchment area 1400 sq.km is covering a stretch that includes portions of Vijayawada city and adjacent peri-urban zones. Prominent land marks, including Kondapalli Fort, Ibrahimpatnam hills and the Enikepadu industrial area are situated within or proximate to its course, underscoring its cultural and economic importance. This rivulet once served as a natural drainage channel for the region. However, due to rapid urban expansion, especially within the jurisdiction of Vijayawada Municipal Corporation, its role has been significantly altered. This study area encompasses a diverse range of land uses, including residential colonies, agricultural fields and industrial areas. Areas such as Arjit singh Nagar, Payakapuram, Enikepadu, Ramavarappadu, and parts of Benz Circle and Auto Nagar fall within the high-risk flood zones influenced by the Budameru. Over the years, the Budameru has suffered from channel encroachment, solid waste dumping, and unregulated construction, which have reduced its flow capacity and led to frequent urban flooding, particularly during the monsoon season. The rivulet drainage basin influences areas across mandals such as Mylavaram, G.Konduru, Unguturu and Vijayawada contributing to both irrigation and periodic flooding challenges in the region. The Rainfall and Temperature Data for 2016-2025 are in Table 1. The Study Area is in Figure 1.

Table 1: Rainfall and temperature Data for 2016 to 2025

STATION	YEAR	RAINFALL (mm)	MAXIMUM (Temp)	MINIMUM (Temp)
VIJAYAWADA	2016	1187	35.2	24.3
VIJAYAWADA	2017	1035	35.9	23.4
VIJAYAWADA	2018	1206.6	36.0	23.5
VIJAYAWADA	2019	761.45	35.2	23.6
VIJAYAWADA	2020	852.05	36.6	24.2
VIJAYAWADA	2021	966.15	35.6	23.8
VIJAYAWADA	2022	980.54	34.3	24.1
VIJAYAWADA	2023	976.17	34.4	24.4
VIJAYAWADA	2024	1074.44	35.4	24.2
VIJAYAWADA	2025	943.93	34.9	23.5

Data Used and Methodology:

Survey of India (SOI) topographical maps No.'s 65 D/6,65 D/9, 65 D/10, 65 D/13, 65 D/14,65 D/15 on a 1:50,000 Toposheets were mosaicked and the area of interest was restricted to prepare the base map. The present study attempts to assess the changes in land use land cover using multi-temporal satellite data in Budameru Rivulet, Vijayawada District. Using the ArcGIS-pro software (version 3.1.41833), these maps were derived from geocoded data-positive False Color Composites (FCCs) of Sentinel-2(B) data from (Copper-Nicus) in the period of 2016 to 2025 (Table:2). The present study demonstrates the extension, approach, and result of change analysis which might be helpful for decision-making and sustainable growth.

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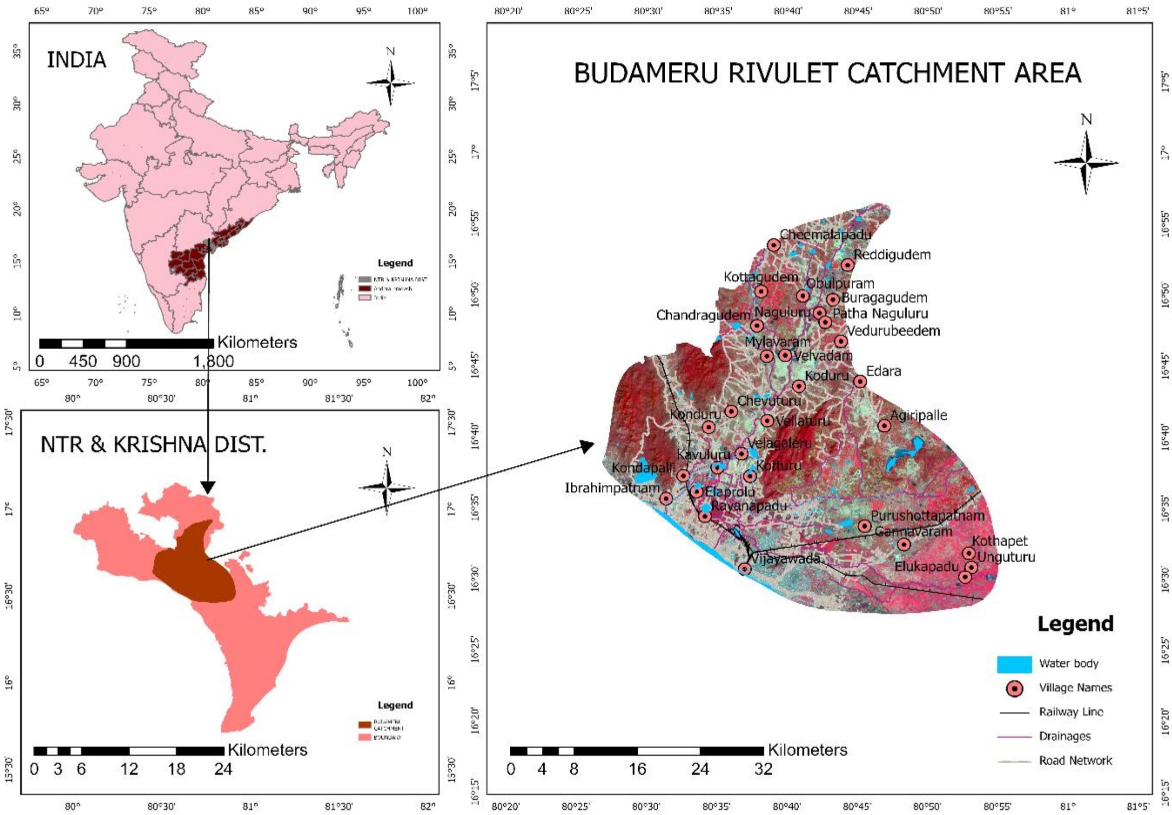

Figure 1: Location Map of Study Area

Visual interpretation of satellite imagery is a technique that involves the manual analysis and classification of land cover types based on observe features within the imagery. This method is commonly used in remote sensing applications to identify and delineate various land cover types, such as urban areas, agricultural land, water bodies and vegetation by examining their spectral characteristics, texture, color and shape. The analyst examines the image carefully, identifying distinct land cover classes by recognizing the unique spectral signatures of each feature. By manually delineates the boundaries of each land cover class based on the visual cues from the image, creating polygons or regions that represent specific land cover types. These boundaries are then digitized, resulting in a land cover map that visually represents the distribution of different land use types across the study area. This method allows for a deeper understanding of land cover dynamics, especially when combined with multi temporal imagery, which can be used to detect changes in land cover over time. The result9ing land cover maps are essential for a variety of applications, including environmental monitoring, urban planning, resource management and flood risk assessment. In this approach, visual interpretation provides a cost effective ana reliable means of mapping land use and land cover changes, especially when high accuracy is required for planning and decision-making purposes.

Table 2: List of Satellite Images used in the study

Image	Sensors	Spatial resolution	Wave length range	Selected bands	%of Scene cloud coverage	Date of acquisition
Sentinel-2B	Multi Spectral Instrument (MSI)	10 m	443-2190 nm	8,4,3	0.2%	23/10/2016
Sentinel-2B	Multi Spectral Instrument (MSI)	10 m	443-2190 nm	8,4,3	0.2%	19/01/2025

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II.RESULTS AND DISCUSSION

LULC classes of the study area were classified from sentinel-2 images of 2016 to 2025 over the study period. The LULC classes consists of agricultural land, vegetation, built-up area and water bodies in the study area. The areas of the LULC Classes 2016 are as follows: agricultural land is 1005.044km², built-up area is 133.280km², waterbodies cover 39.060km², vegetation is 221.749 km². The LULC Classification Map for the study area (2016) is shown in Figure 2, along with graphical representation of the LULC classes for the study area (2016) in Figure 3.

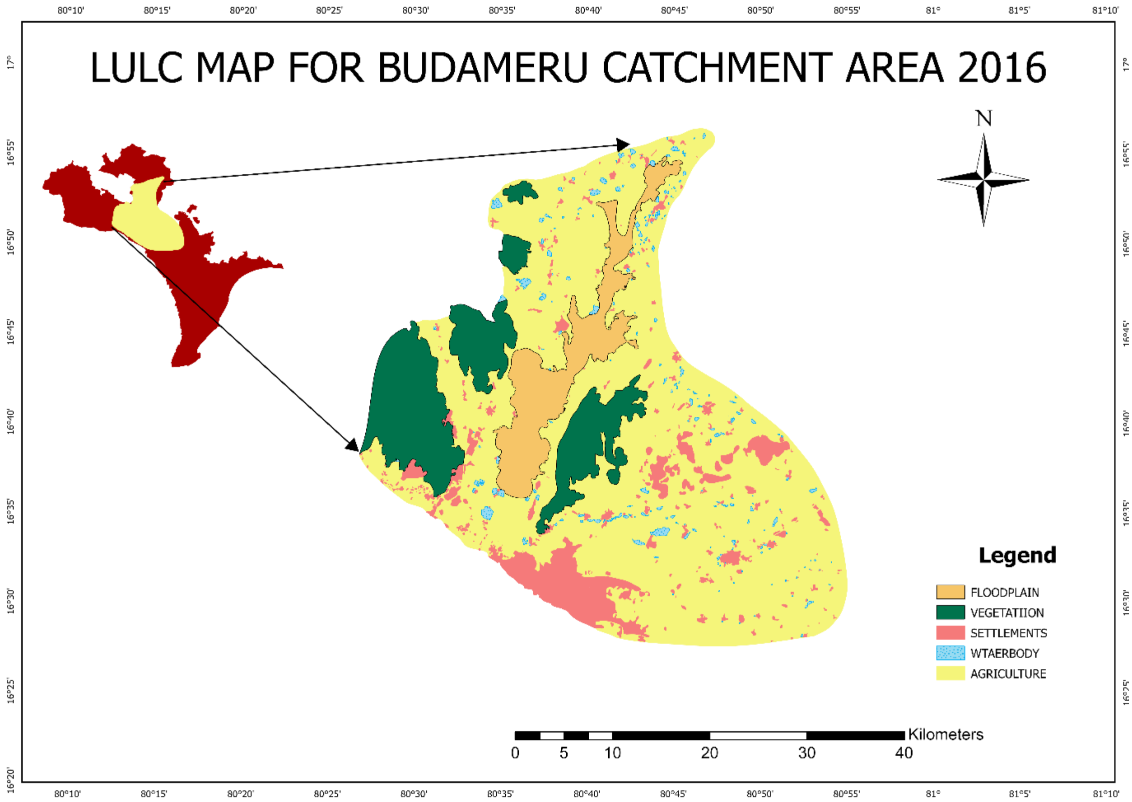

Figure 2: LULC Classification Map for Study Area in 2016

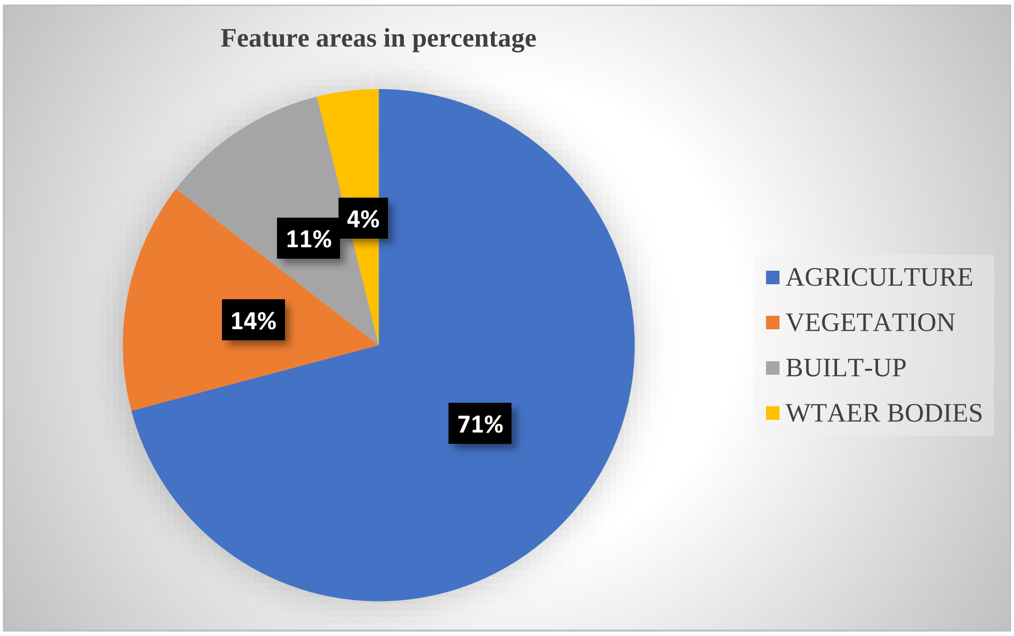

Figure 3: Graphical Representation of LULC Classes for Study Area in 2016

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7The LULC classes are classified as agricultural land, forest, settlements and water bodies in the study area. The areas of the LULC classes in 2025 are as follows: agricultural land is 975.261km², built-up area 165.644km², waterbodies cover 38.223km², vegetation has 221.612km². The LULC Classification Map for the study area (2025) is shown in Figure 4, along with graphical representation of the LULC classes for the study area (2025) in Figure 5.

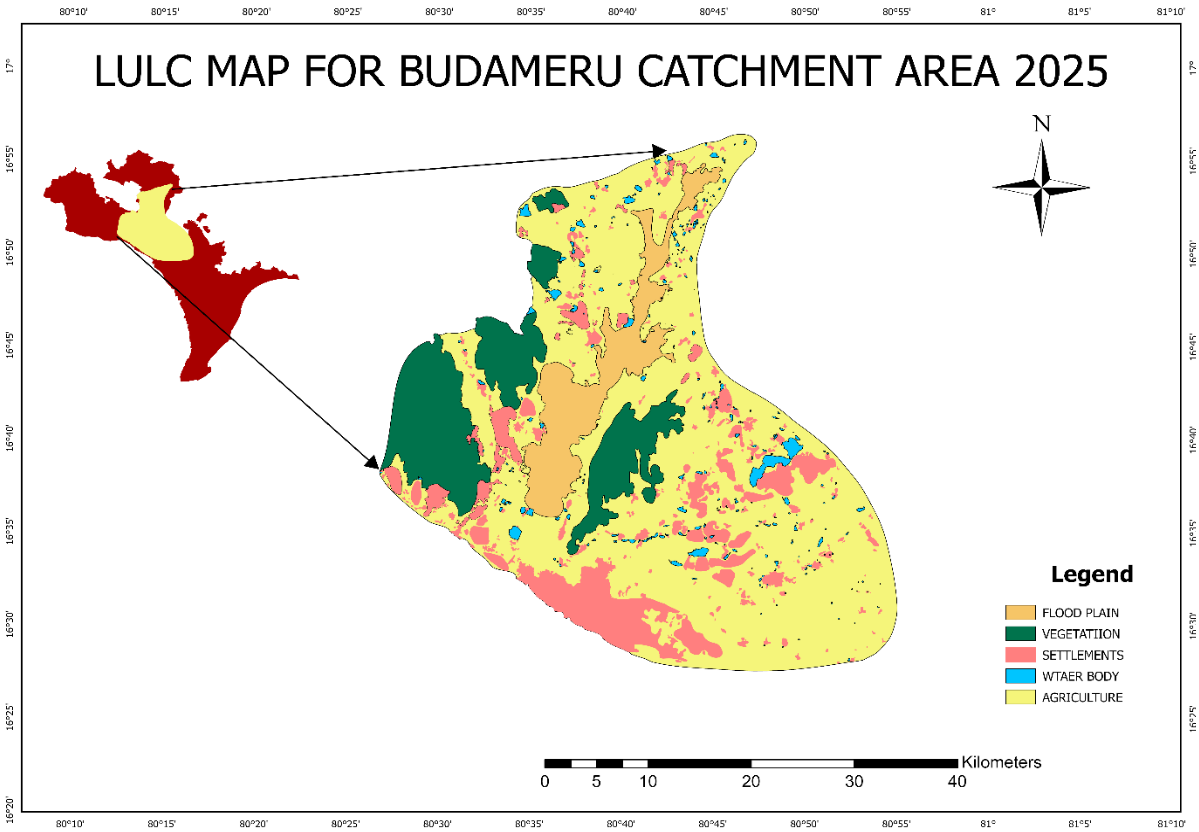

Figure 4: LULC Classification Map for Study Area in 2025

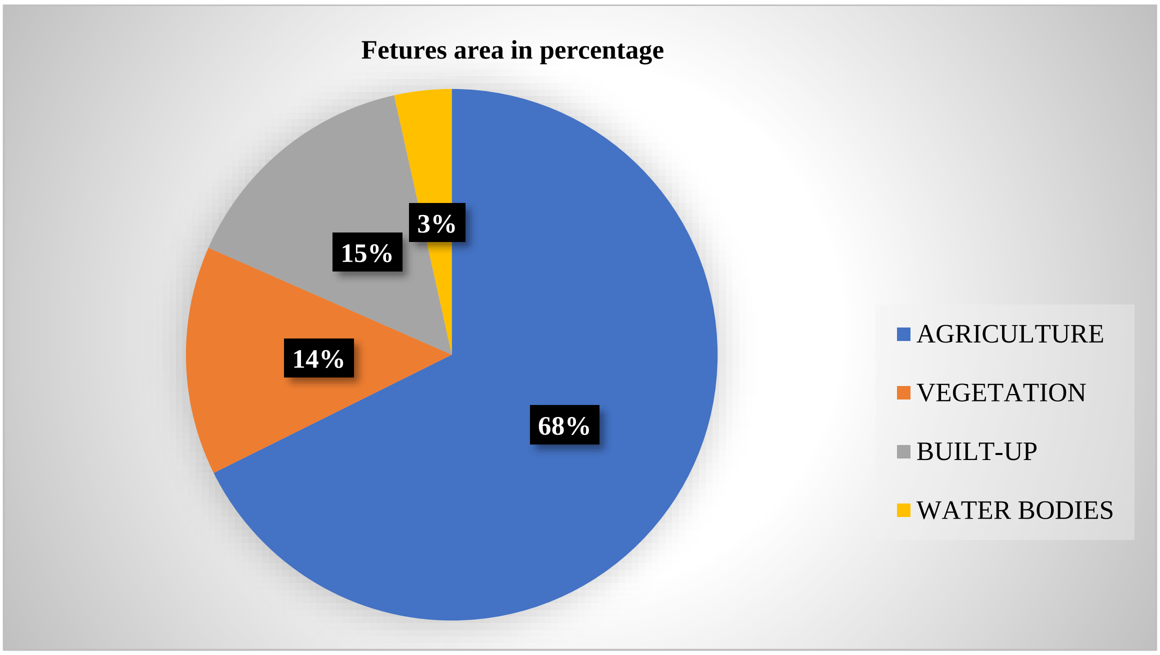

Figure 5: Graphical Representation of LULC Classes for Study Area in 2025

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III.CONCLUSION

LULC Classes occupied areas in 2016 & 2025 in the study area are in Table 3, and the Comparison of LULC classes for the study area is in Figure 6.

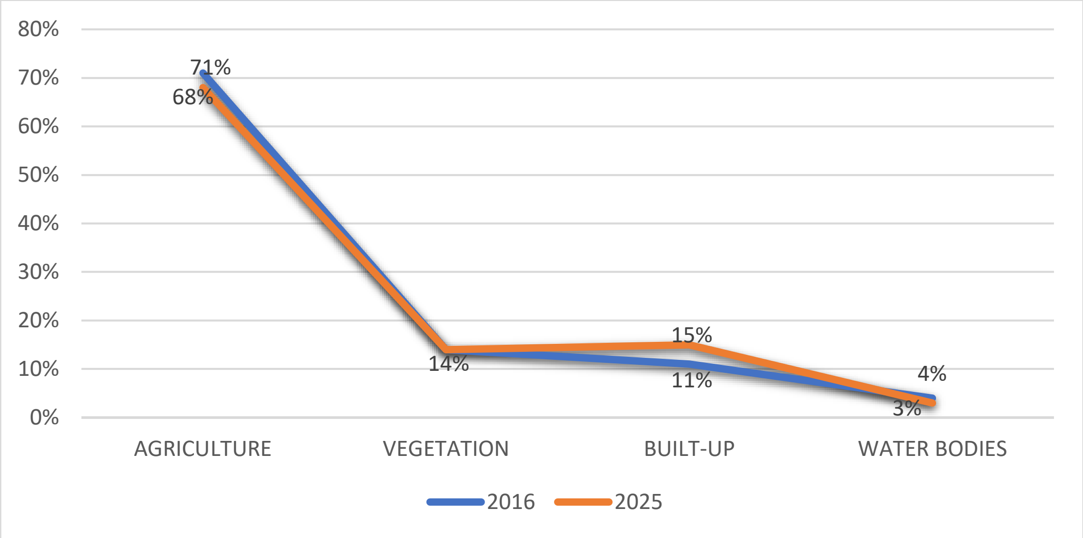

Figure 6: Comparison of LULC Classes for Study Area in 2016 to 2025

Table 3: LULC class occupied areas in 2016 and 2025 in the study area

LULC Classes	AREA (2016) in km^2	AREA (2025) in km^2	% of Variation from 2016 to 2025
Agricultural land	1005.044	975.261	-3.5%
Built-up	133.280	165.644	+4%
Water Bodies	39.060	38.223	-0.5%
Forest	221.749	221.612	-0.09%

The agricultural land accounted for 1005.044 km^2 in 2016 & 975.261 km^2 in 2025 and the waterbodies covers 39.060km^2 in 2016 & 38.223 km^2 in 2025.built-up area is 133.28 km^2 in 2016 & 165.64 km^2 in 2025, and built-up area is increased by 20.36 km^2, the increasing trend shows that built-up areas have increased with the concomitant rise in population in the area. vegetation has 221.74 km^2 & 221.61 km^2 in 2016 and 2025 and it is decreased by 0.16 km^2 from 2016 to 2025. By concluding that the variational changes from 2016 to 2025 the resultant changes of agricultural land declined by 3.5%, built-up area is increased by nearly 4% of the region, water bodies were also encroached slightly by 0.5 %, forest area is decreased by 0.09%. The reliance on LULC mapping by visual interpretation highlights their role in informing urban planning frameworks.

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