KATHMANDU UNIVERSITY

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DEPARTMENT OF GEOMATICS ENGINEERING

Final Report on

Preparation of LULC Maps for Three Different Years of Kavre District

GEOM 313

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Date: February 1, 2025

ABSTRACT

Land Use Land Cover (LULC) mapping is essential for understanding landscape transformations and their environmental, social, and economic implications. This study focuses on generating LULC maps for Kavre District, Nepal, for the years 2021, 2023, and 2025 using remote sensing and Geographic Information System (GIS) techniques. The research utilizes satellite imagery from Landsat 8, processed using ArcGIS 10.8, to classify land cover into four categories: Built-up Area, Vegetation, Agricultural Land, and Water Body.

The results indicate significant urban expansion, with built-up areas increasing notably between 2021 and 2025, especially in the northern and central regions. This growth has contributed to a decline in vegetation cover, highlighting the impact of urbanization and land conversion. Agricultural land has shown fluctuating patterns, with some areas experiencing expansion and others being encroached upon by urban development. Water bodies have remained relatively stable in size over the study period.

The study underscores the importance of sustainable land management strategies to balance development and environmental conservation. It recommends proactive urban planning, afforestation programs, and continuous monitoring using remote sensing technologies to mitigate the adverse effects of land-use changes. These findings provide valuable insights for policymakers, planners, and environmental stakeholders aiming to promote sustainable growth in the region.

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1 INTRODUCTION

Land Use Land Cover (LULC) mapping is crucial in understanding the dynamic interactions between human activities and natural environments. It provides essential insights into how land resources are utilized and how these patterns evolve due to socio-economic, environmental, and policy-driven factors. Accurate LULC maps are vital for sustainable land management, environmental monitoring, urban planning, agricultural development, and disaster risk reduction(Anderson et al., 1976).

LULC (Land Use Land Cover) maps are developed using data obtained from satellite imagery, aerial photographs, and ground-based surveys. The process involves the application of advanced Geographic Information Systems (GIS) and image processing software to classify and analyze this data, differentiating various land cover types like forests, water bodies, urban areas, agricultural lands, and barren regions. While land cover classification focuses on the physical features of the landscape, land use classification emphasizes human activities, including residential, industrial, commercial, and recreational purposes. LULC maps serve a wide range of applications across multiple sectors. In urban planning, they help city planners manage land resources efficiently, design infrastructure, and control urban sprawl. For environmental conservation, these maps are essential in tracking deforestation, desertification, and habitat degradation. In agriculture, they support activities like crop monitoring, soil conservation, and irrigation planning. Furthermore, in disaster management, LULC maps are critical for assessing flood risks, predicting wildfires, and conducting climate change studies. They also play a key role in water resource management by providing insights into watershed dynamics and promoting sustainable management of water bodies.

The production of LULC maps is among the most common applications of remote sensing technology. With the decreasing cost and increasing resolution of satellite imagery, both government agencies and private organizations are increasingly relying on these maps for large-scale monitoring of land resource changes. They have become indispensable tools for flood forecasting, urban and rural land-use planning, resource management, and disaster preparedness and response(Treitz & Rogan, 2004).

This report focuses on preparing LULC maps for the Kavrepalanchok (commonly referred to as Kavre) district, situated in the Bagmati Province of central Nepal. Kavre is characterized by diverse topography, ranging from mid-hills to valleys, and is known for its agricultural activities, rapidly growing urban areas, and forested landscapes. The district has experienced significant changes in land use patterns over the past decades due to urban expansion, infrastructural development, and shifts in agricultural practices.

The study covers three distinct periods 2021, 2023, and 2025 allowing for a comparative analysis of LULC changes over a short time. By examining these changes, the report aims to identify trends in land use transformation, such as urban sprawl, deforestation, agricultural intensification, and other anthropogenic impacts. The insights from this analysis are intended to support local authorities, planners, and policymakers in making informed decisions for sustainable development and environmental conservation.

2 OBJECTIVES

The primary objective of this study is to prepare LULC maps for different time periods and study the changes in land use patterns.

The secondary objectives are:

i. To analyze temporal changes in land use and land cover
ii. To assess the impact of land use changes on natural resources and environmental sustainability
iii. To evaluate the effectiveness of remote sensing and GIS tools in LULC mapping

3 METHODOLOGY

3.1 Study Area

For this study, Kavrepalanchok District, commonly known as Kavre, located in Bagmati Province, Nepal, was selected. Geographically, the district spans from approximately 27°20' to 28°45' North latitude and 85°24' to 85°49' East longitude. It covers an area of 1,396 square kilometers. According to the 2021 Nepal census, Kavre has a population of 364,039.

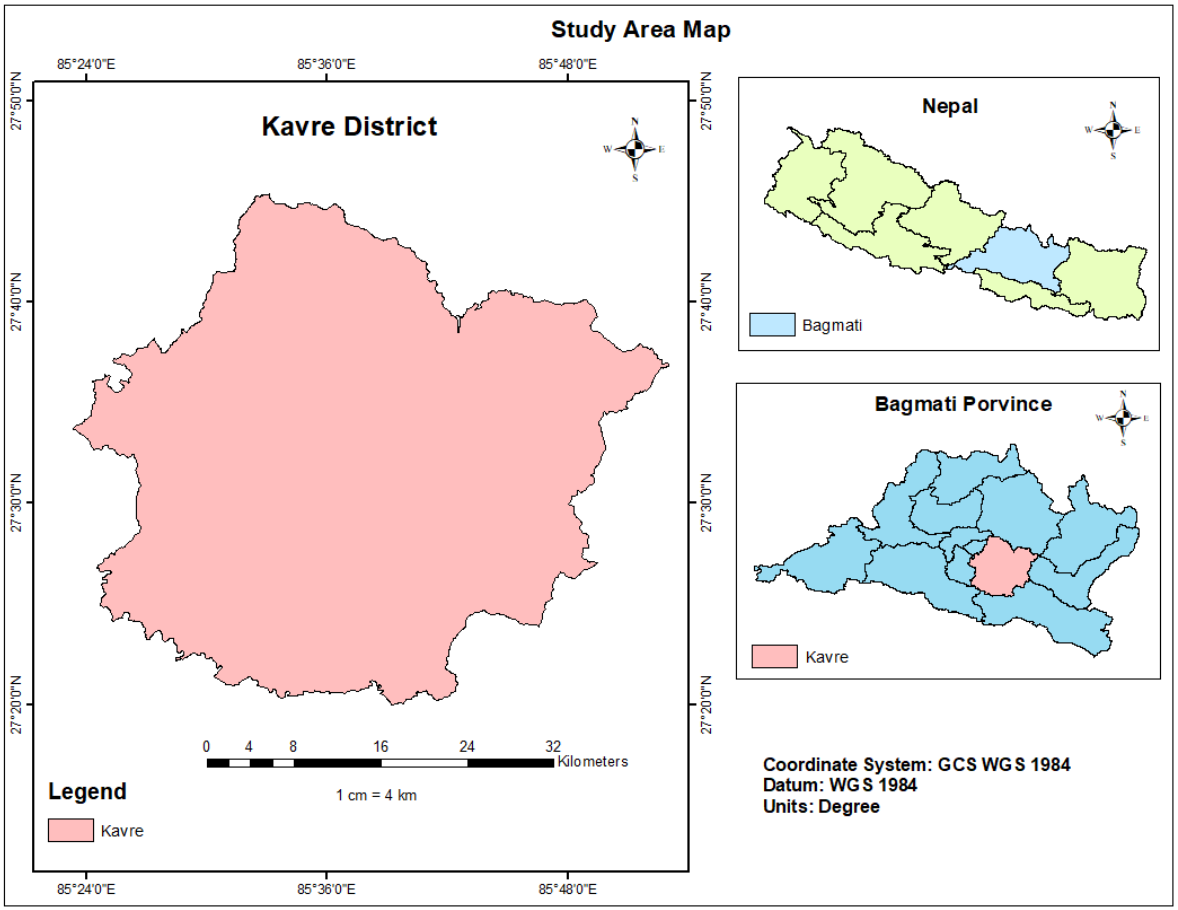

Figure 1: Study Area

3.2 Work Flow

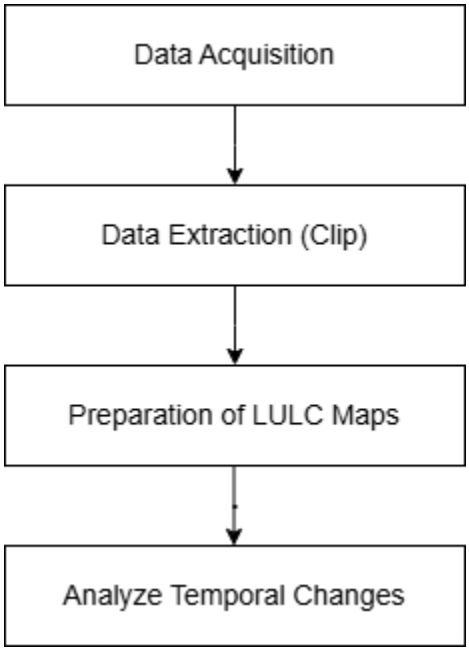

Figure 2: Study work flow

3.3 Data Used

The data for this study was downloaded from USGS Earth Explorer. Satellite images from Landsat 8 was used to create LULC Maps.

3.4 Software Used

ArcGIS 10.8 was used to create LULC maps. The images were first combined to obtain composite bands. Then supervised classification was applied to obtain LULC maps.

4 RESULT

The LULC maps for three different years are obtained as follows:

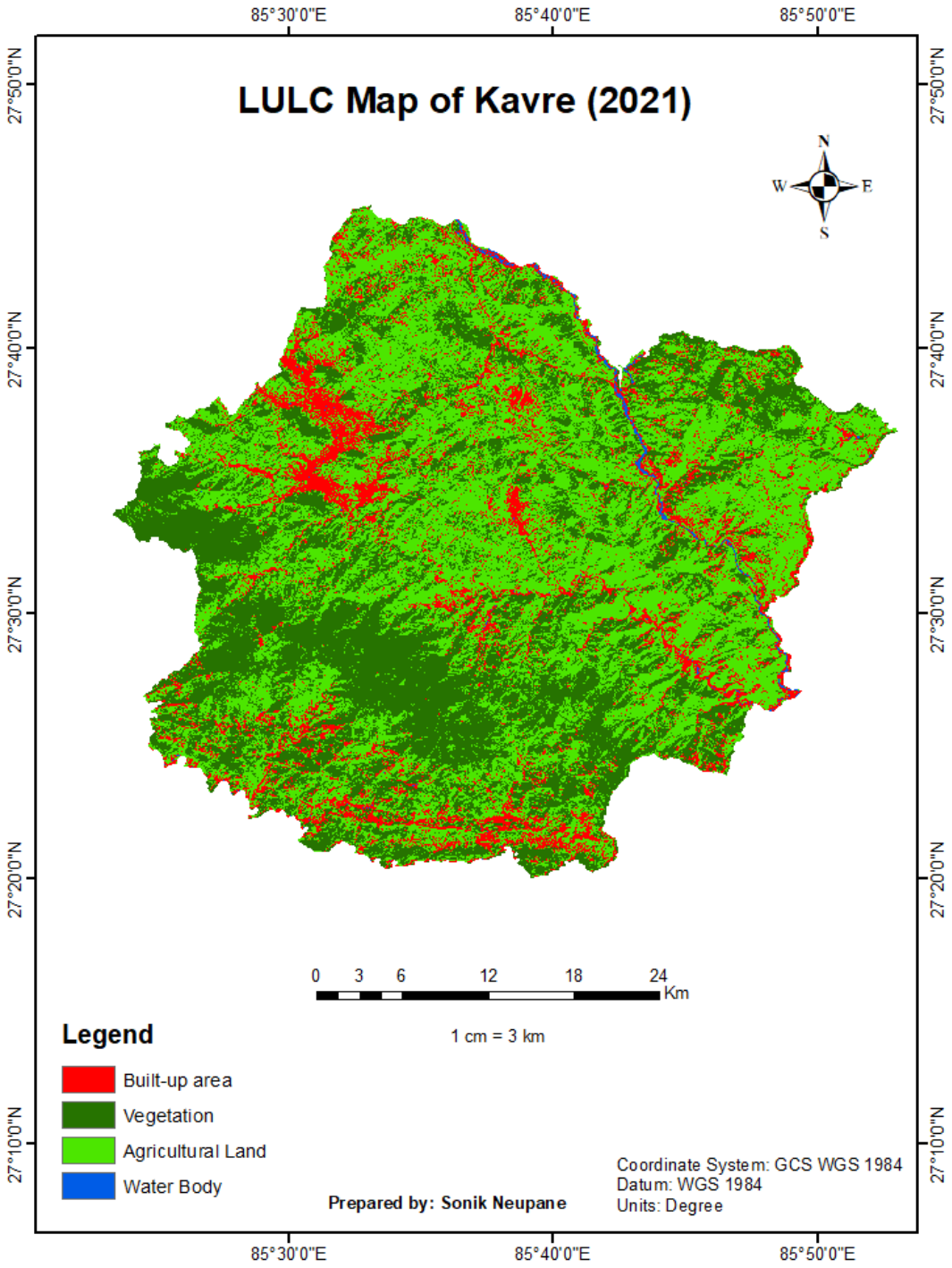

Figure 3: LULC map for 2021

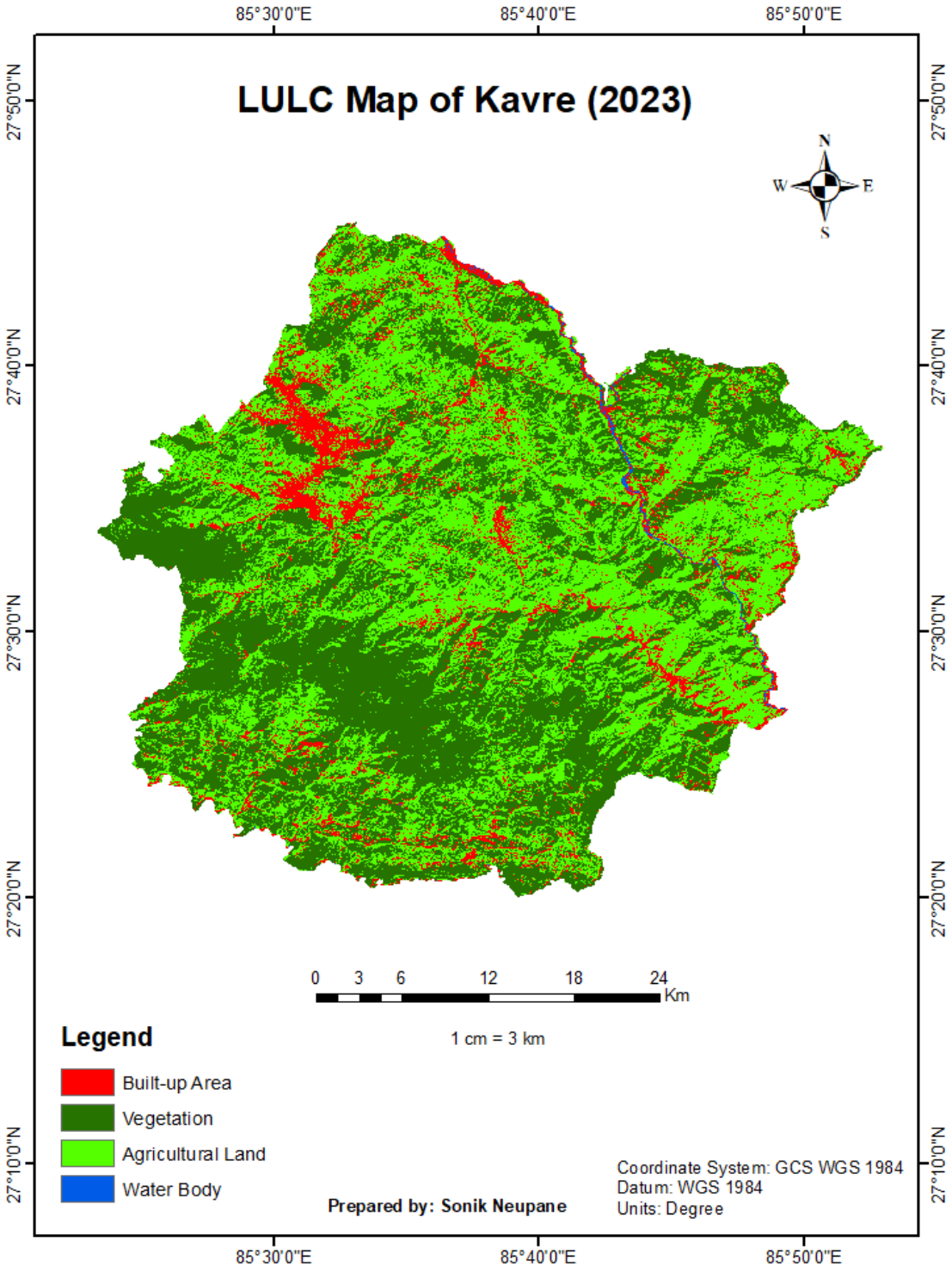

Figure 4: LULC map for 2023

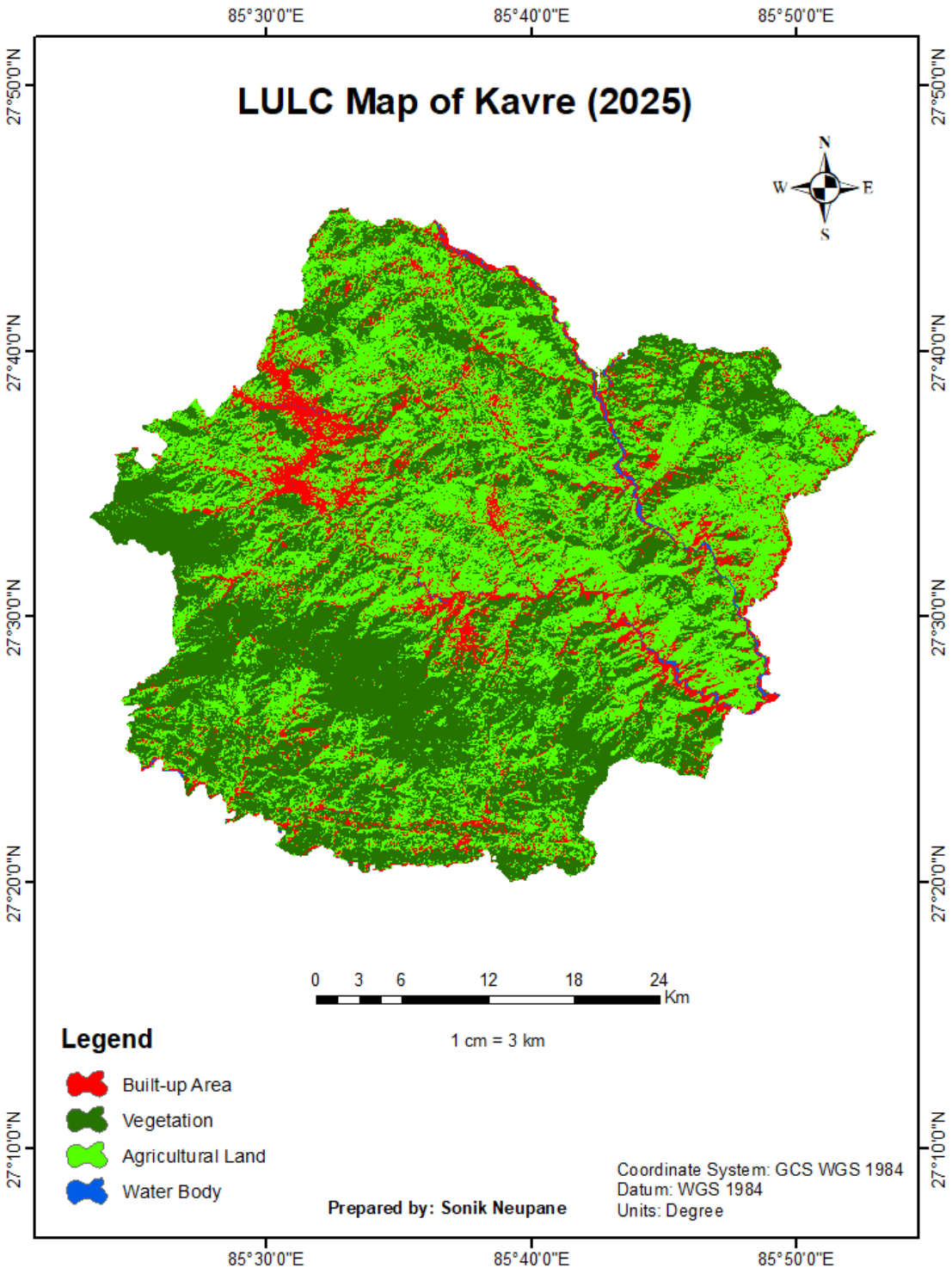

Figure 5: LULC map for 2025

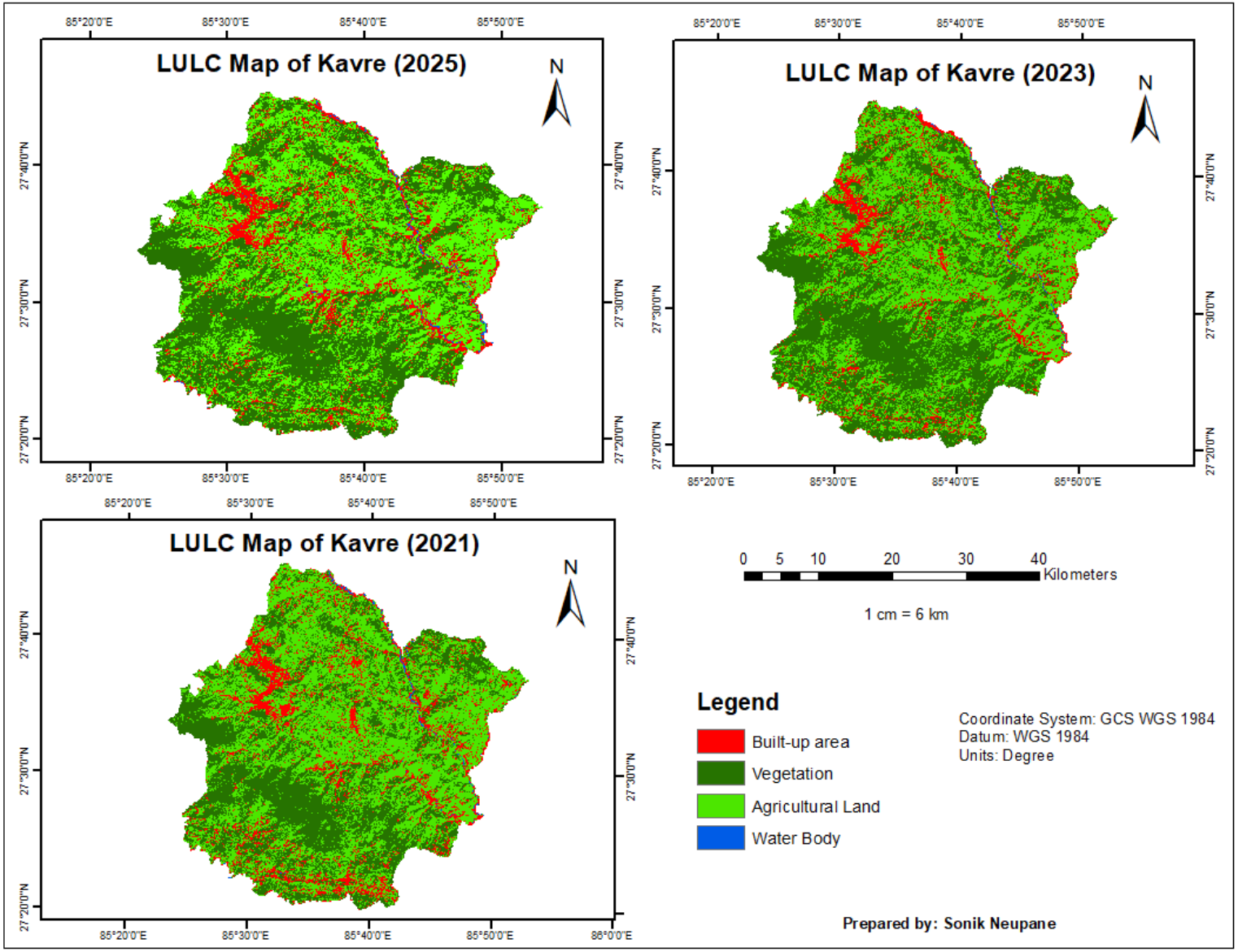

Figure 6: Multiple Static LULC map

The Land Use/Land Cover (LULC) maps of Kavre District for the years 2021, 2023, and 2025 illustrate noticeable changes in land cover over time. These maps were generated using remote sensing techniques and classified into four primary categories: Built-up area, Vegetation, Agricultural Land, and Water Body.

- **Built-up Area (Red)**
  There is a progressive increase in built-up areas from 2021 to 2025. This expansion is particularly evident around urban and semi-urban regions, suggesting rapid urbanization and infrastructure development. Between 2021 and 2023, the built-up areas show moderate growth, while from 2023 to 2025, the growth rate appears to have accelerated, especially in the northern and central regions of the district.
- **Vegetation (Dark Green)**
  The vegetation cover shows a slight but noticeable reduction over the study period. This decline is likely linked to the expansion of built-up areas and agricultural activities. In 2021, dense vegetation covers a significant portion of the district, particularly in the southern and central areas. By 2025, some of these regions have been encroached upon by urban development.
- **Agricultural Land (Light Green)**
  Agricultural land demonstrates both expansion and contraction in different parts of the district. Some areas previously categorized under vegetation appear to have been converted into agricultural land, indicating changes in land use patterns. From 2021 to 2023, agricultural areas appear relatively stable, but by 2025, slight shifts in their distribution can be observed, possibly due to urban encroachment or land-use policy changes.
- **Water Body (Blue)**
  The water bodies remain relatively consistent across the three years, with no significant changes in size or distribution. This stability suggests minimal impact on the district's water resources during the study period.

Overall, the LULC maps highlight significant urban growth in Kavre District between 2021 and 2025, accompanied by a reduction in vegetation cover. These changes underscore the need for sustainable land management practices to balance development and environmental conservation.

5 DISCUSSION

The LULC analysis of Kavre District from 2021 to 2025 reveals significant landscape transformations, primarily driven by urbanization and agricultural expansion. Built-up areas have noticeably increased, particularly in the northern and central regions, reflecting rising population pressures and economic growth but also posing risks of overburdened infrastructure and environmental degradation. Concurrently, vegetation cover has declined, likely due to deforestation and land conversion, raising concerns about biodiversity loss, soil erosion, and increased vulnerability to natural disasters. Agricultural land shows a mixed trend, with expansions into vegetated areas meeting growing food demands, while urban encroachment reduces farmland near settlements. Despite these changes, water bodies have remained relatively stable in surface area, though their quality may warrant further investigation. These shifts highlight the urgent need for sustainable land management policies that balance development with environmental conservation to ensure long-term resilience in the region.

6 CONCLUSION AND RECOMMENDATIONS

The Land Use Land Cover (LULC) analysis of Kavre District from 2021 to 2025 reveals significant transformations in land patterns, driven primarily by urban expansion and a reduction in vegetative cover. The increase in built-up areas highlights rapid urbanization, which has come at the cost of agricultural land and natural vegetation. These changes reflect the district's evolving socio-economic dynamics, including population growth and infrastructural development. While such progress indicates development, it also raises concerns about environmental sustainability, loss of biodiversity, and the potential for increased vulnerability to natural disasters like landslides and floods. This study underscores the critical need to balance development with environmental conservation to ensure sustainable growth in the region.

To mitigate the negative impacts of these LULC changes, it is recommended that comprehensive land use planning be enforced to guide sustainable urban development while conserving natural resources. Policies encouraging sustainable agricultural practices and the protection of green spaces should be prioritized to maintain ecological balance. Reforestation and afforestation initiatives can help restore degraded lands and enhance biodiversity, while strict regulations must be imposed to monitor and control unchecked urban sprawl. Furthermore, continuous monitoring using remote sensing and GIS technologies should be integrated into local governance to track changes and inform proactive policy-making. Community engagement and education programs will also play a vital role in fostering a culture of environmental stewardship and ensuring that local populations actively participate in sustainable land management practices.

7 REFERENCES

Anderson, J. R., Hardy, E. E., Roach, J. T., & Witmer, R. E. (1976). *A land use and land cover classification system for use with remote sensor data* (Professional Paper). https://doi.org/10.3133/pp964

Treitz, P., & Rogan, J. (2004). Remote sensing for mapping and monitoring land-cover and land-use change—an introduction. *Progress in Planning*, *61*(4), 269–279. https://doi.org/10.1016/S0305-9006(03)00064-3