Analysis of Land Surface Temperature, Land Use Land Cover, and Vegetation Indices in Kano

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1. Introduction

Kano, a major city in northern Nigeria, experiences rapid urbanization and environmental changes. Understanding the relationship between Land Surface Temperature (LST), Land Use Land Cover (LULC), vegetation indices, and rainfall is crucial for sustainable urban planning and environmental management. This study analyzes these factors using remote sensing techniques to evaluate their spatial and temporal variations.

2. Study Area

Kano metropolis is located on latitude 12°40′ N and longitude 8°35′ N to 8°45′ E . Kano has a long history of commercial and industrial activities, which attracts millions of people from within and outside Nigeria
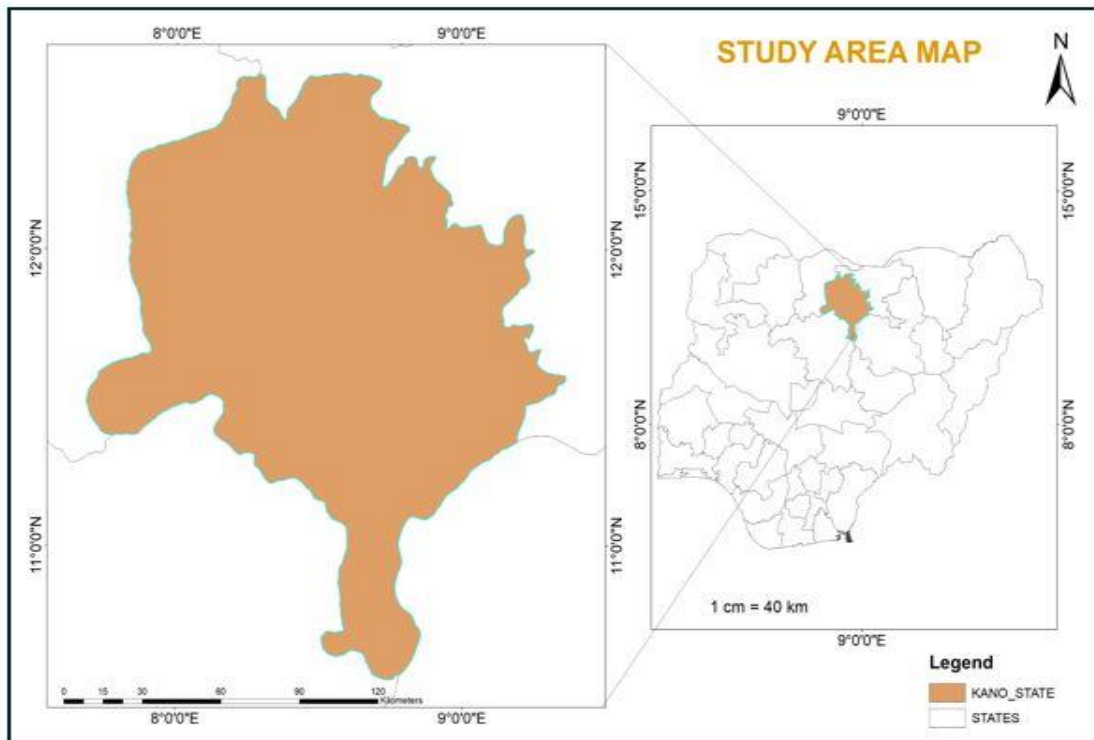
3. Methodology

The study utilizes remote sensing datasets, including:

- LST (Land Surface Temperature) – Extracted from thermal satellite imagery.

- LULC (Land Use Land Cover) – Classified using satellite data to differentiate land cover types.

- NDVI (Normalized Difference Vegetation Index) – Assesses vegetation health and density.

- NDWI (Normalized Difference Water Index) – Detects water bodies and moisture content.

- SAVI (Soil-Adjusted Vegetation Index) – Enhances vegetation signal while reducing soil brightness influence.

- Rainfall Data – Correlates precipitation trends with land surface changes.

Analytical tools such as ERDAS IMAGINE, QGIS, and ArcGIS were used to process and analyze these datasets.

4. Findings

4.1 Land Surface Temperature (LST)

The LST map indicates a significant temperature variation across Kano, with urban areas exhibiting higher temperatures due to the urban heat island effect, while vegetated and water-covered areas show relatively lower temperatures.
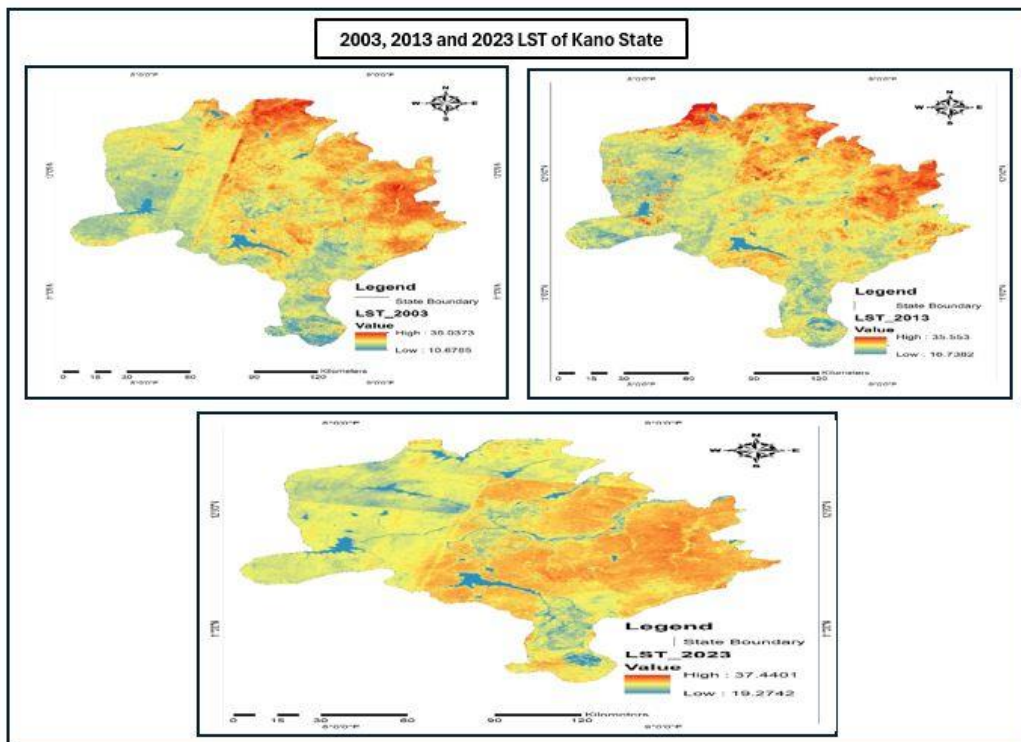
4.2 Land Use Land Cover (LULC)

The LULC classification highlights different land cover types, including urban, agricultural, bare land, and water bodies. Urban expansion has led to a reduction in vegetation and water bodies.
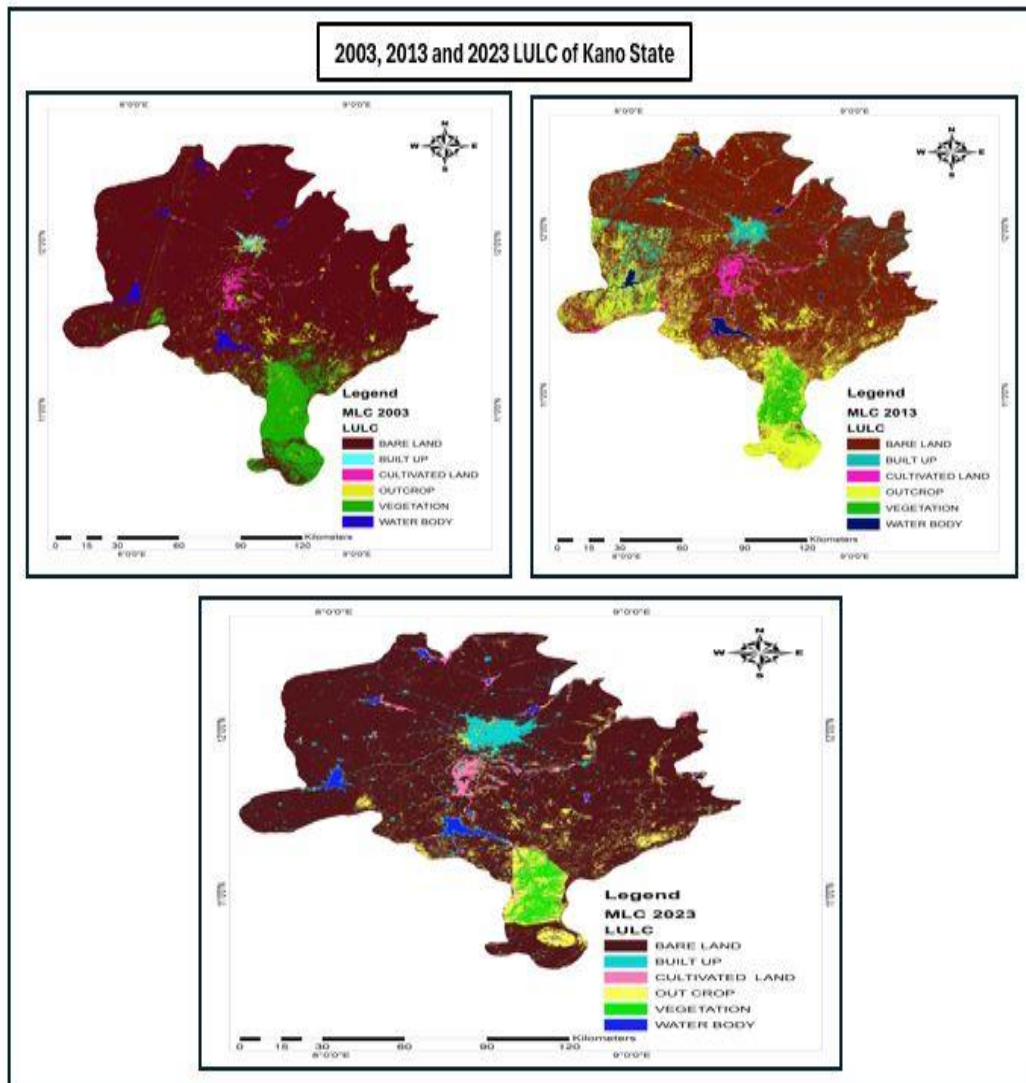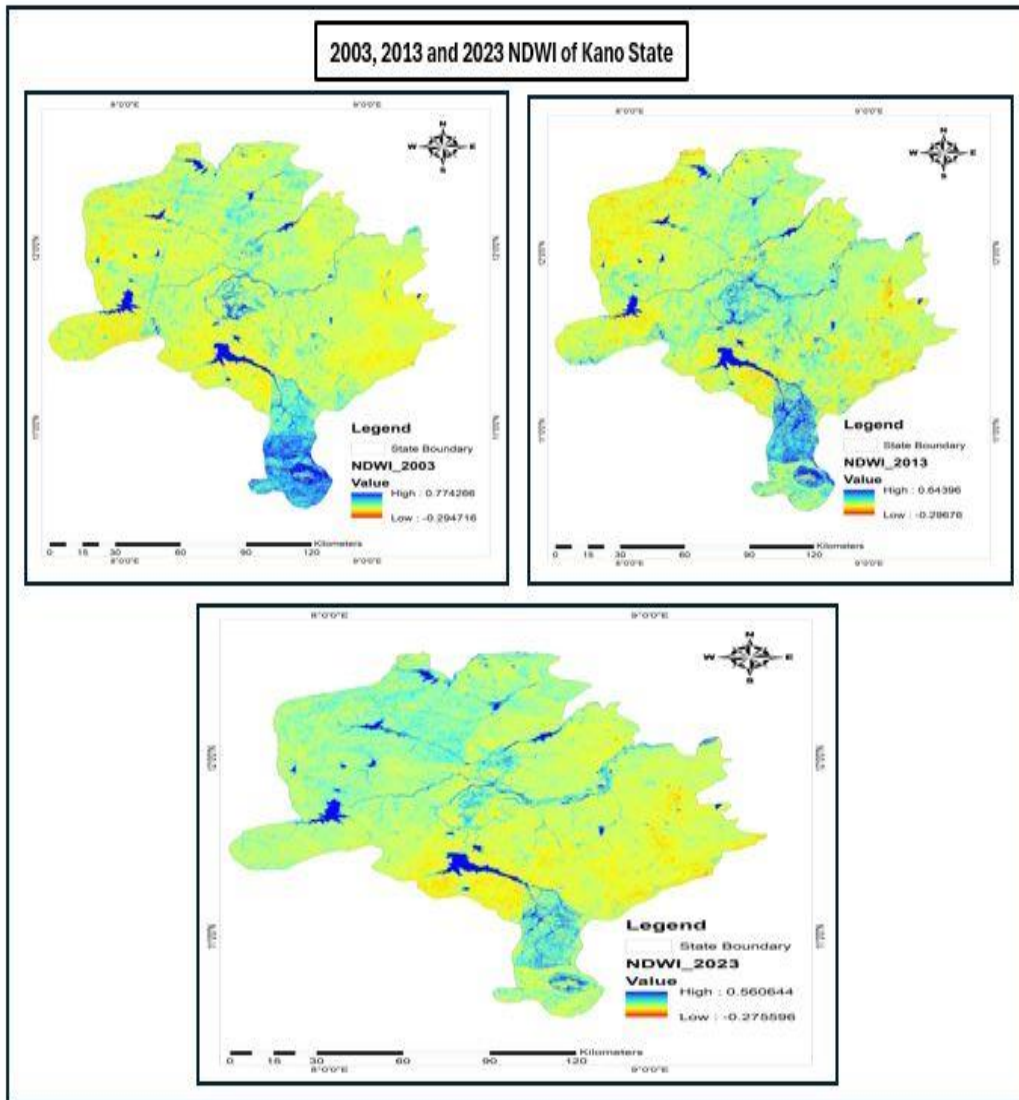
4.3 NDVI Analysis

NDVI values indicate varying vegetation health, with higher values in agricultural and green areas and lower values in built-up and barren lands. The decline in NDVI in some areas suggests deforestation and land degradation.

2003, 2013 and 2023 NDVI of Kano State
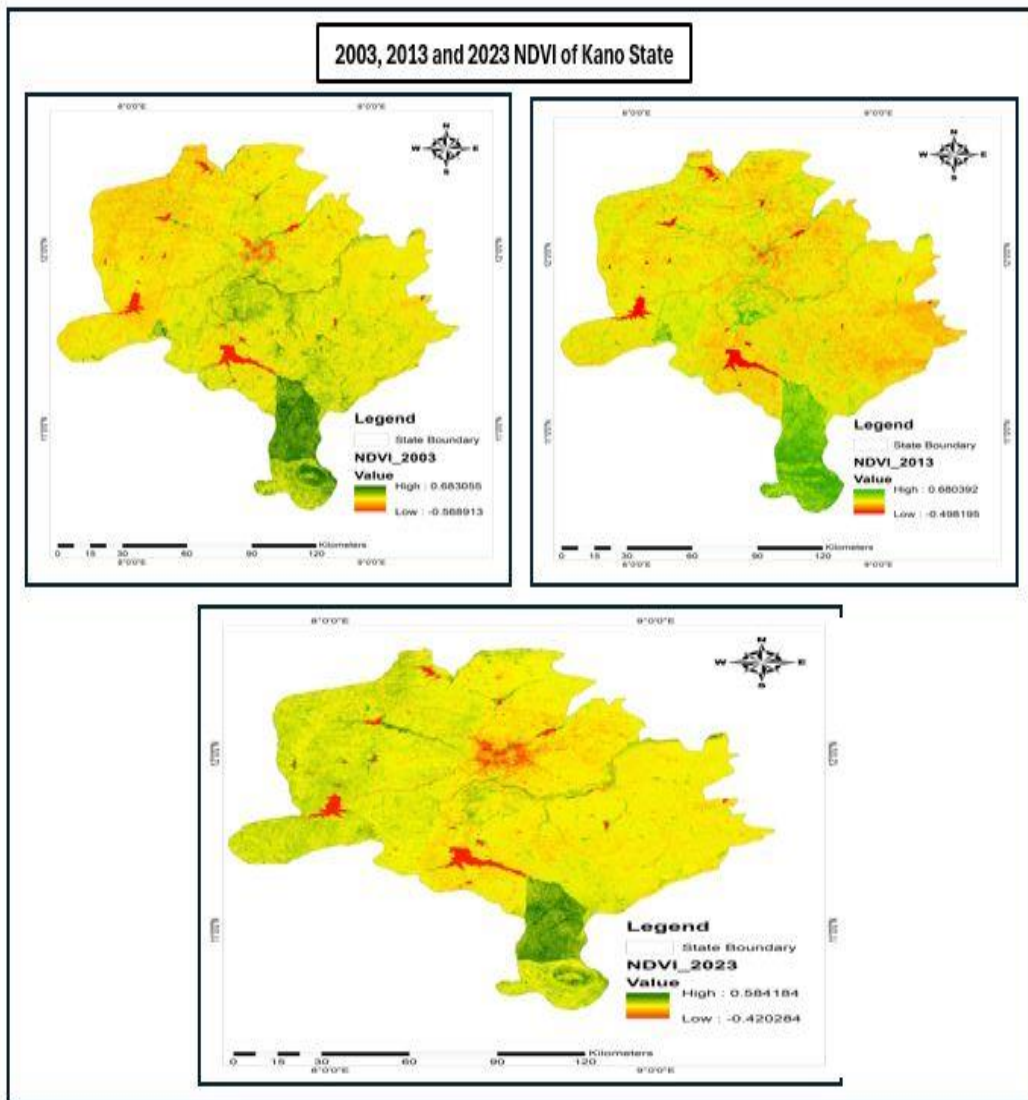
4.4 NDWI Analysis

NDWI results show water bodies and their spatial distribution. A reduction in NDWI values in some areas suggests a decline in surface water availability, possibly due to climate change and human activities.

4.5 SAVI Analysis

SAVI results confirm vegetation presence while minimizing soil brightness effects. This index supports NDVI findings, indicating vegetation stress in some regions.

2003, 2013 and 2023 SAVI of Kano State
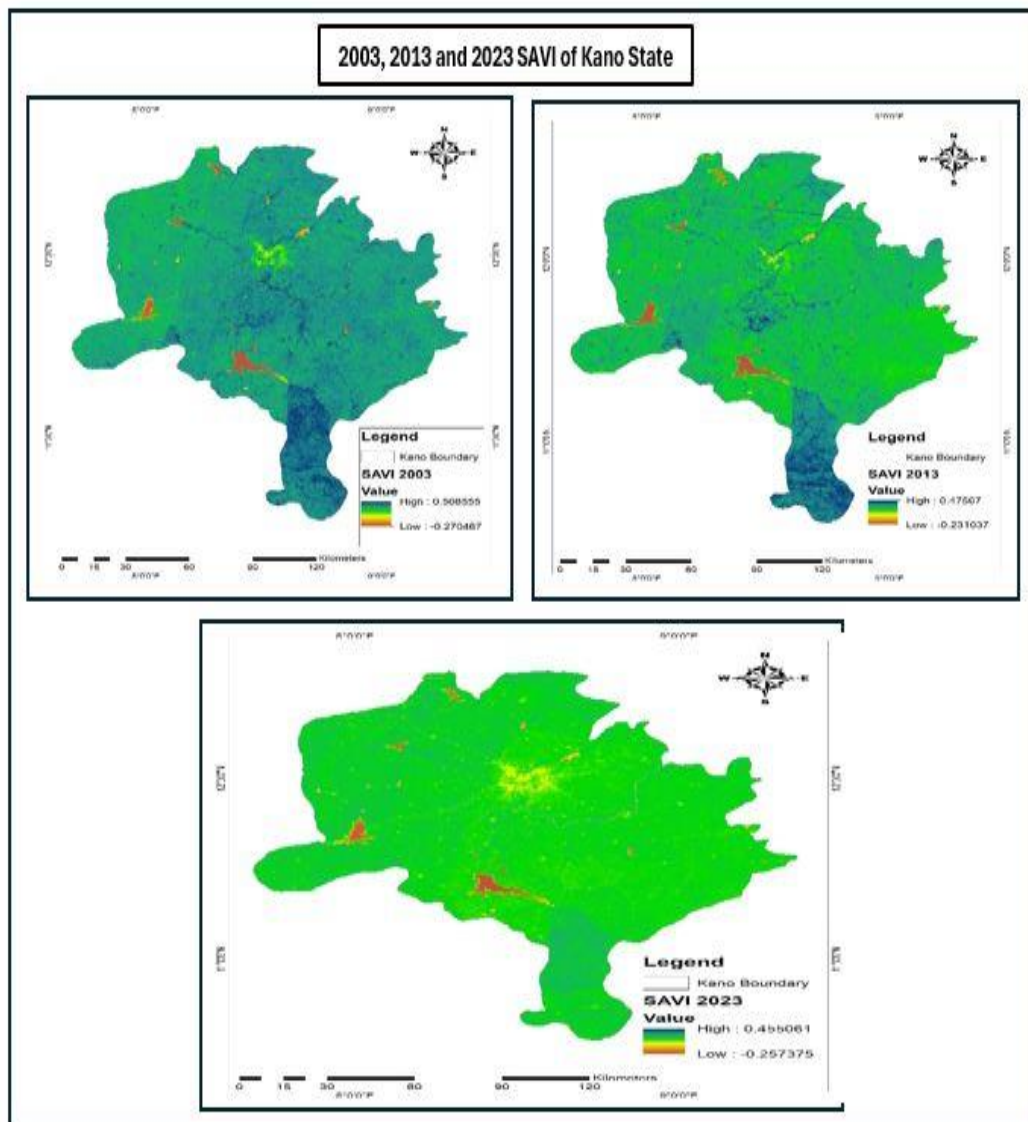
4.6 Rainfall Trends

Rainfall data analysis reveals seasonal precipitation patterns and their correlation with vegetation and land surface changes. Periods of low rainfall coincide with increased land surface temperature and reduced vegetation health.
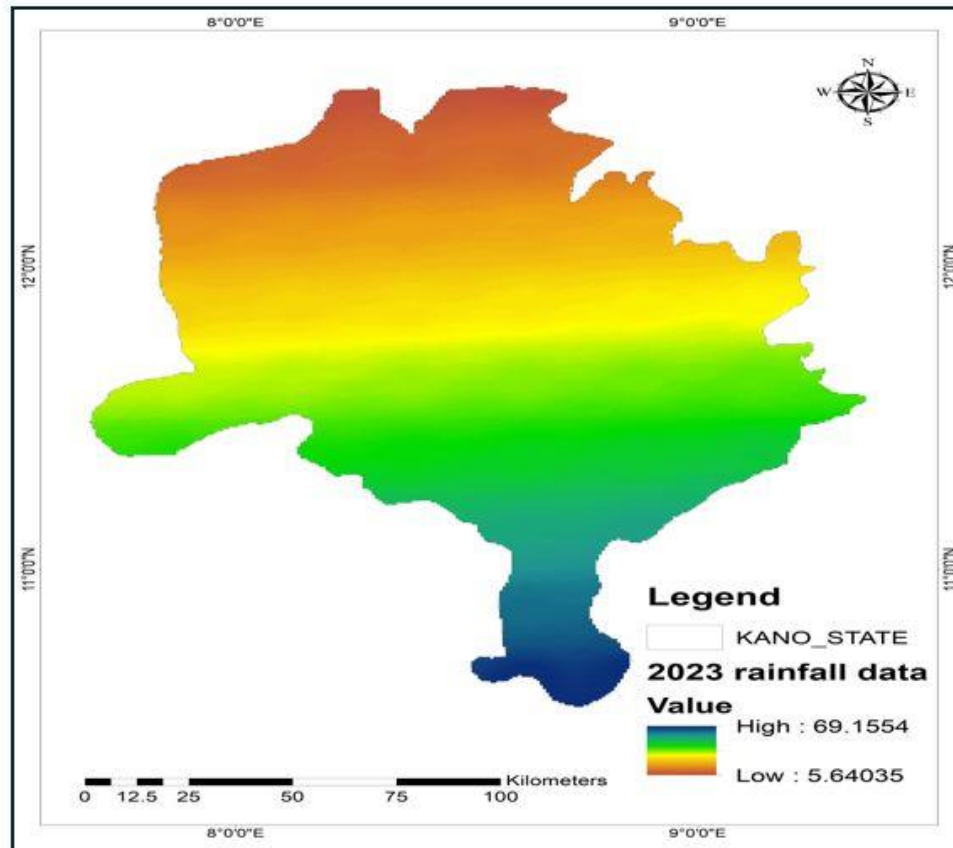
5. Discussion

The findings emphasize the impact of urbanization on land surface temperature and vegetation cover. The decrease in vegetation indices (NDVI, SAVI) and water indices (NDWI) suggests land degradation and declining water resources. The strong correlation between LST and urban expansion indicates the need for sustainable urban planning strategies.

6. Conclusion and Recommendations

This study highlights the importance of monitoring environmental changes in Kano using remote sensing techniques. Key recommendations include:

- Implementation of green infrastructure projects to mitigate urban heat effects.

- Sustainable land use planning to balance urban expansion with environmental conservation.

- Improved water resource management to address declining water availability.

- Continued remote sensing-based monitoring for better decision-making.

This report provides valuable insights into Kano's environmental dynamics and serves as a foundation for further research and policy implementation.