

Mapping and Monitoring Landfill Dynamics in Lagos, Nigeria

Developed a satellite-based approach to map and analyze landfill expansion in Lagos, Nigeria, using Sentinel-2 and Landsat imagery.

Team Members:

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Technologies & Skills Used

Remote Sensing | GIS | QGIS/ArcGIS Pro | Satellite Data Analysis

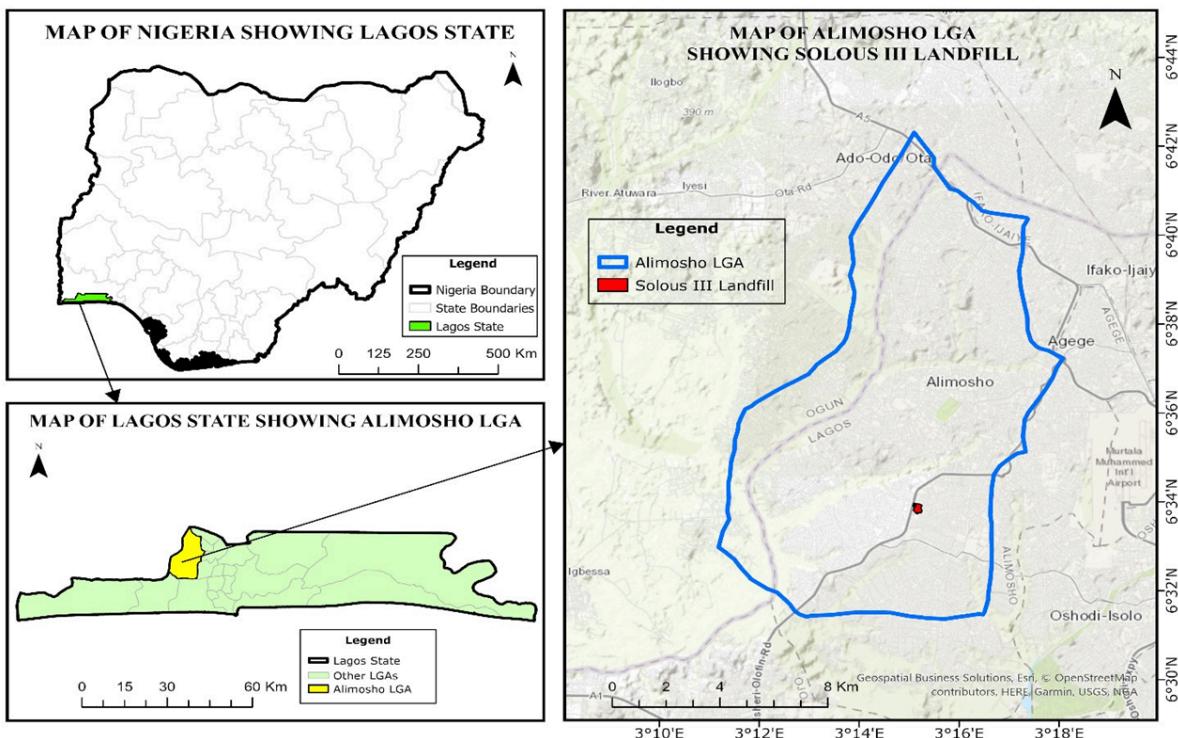
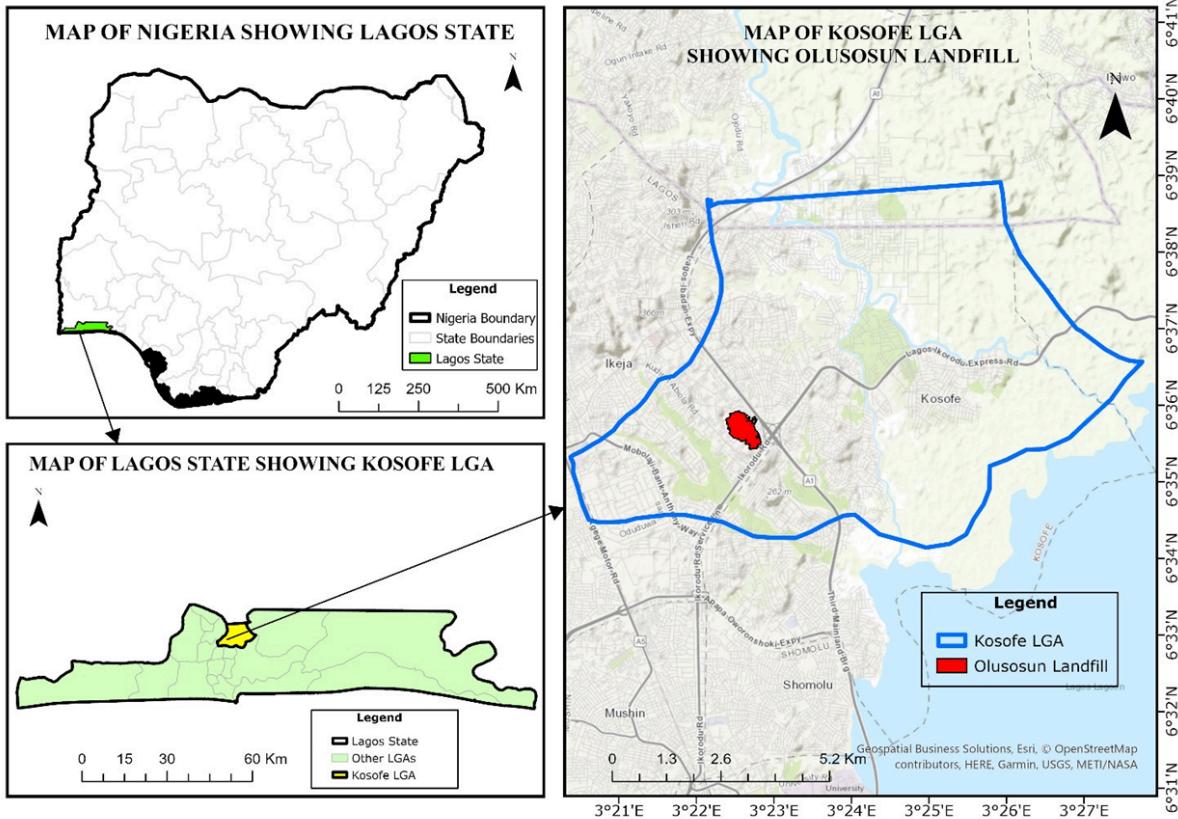
Tools Used: QGIS, ArcGIS, ERDAS IMAGINE, ENVI, Google Earth Engine (GEE)

Data Sources: Sentinel-2, and Landsat 8

Project Overview

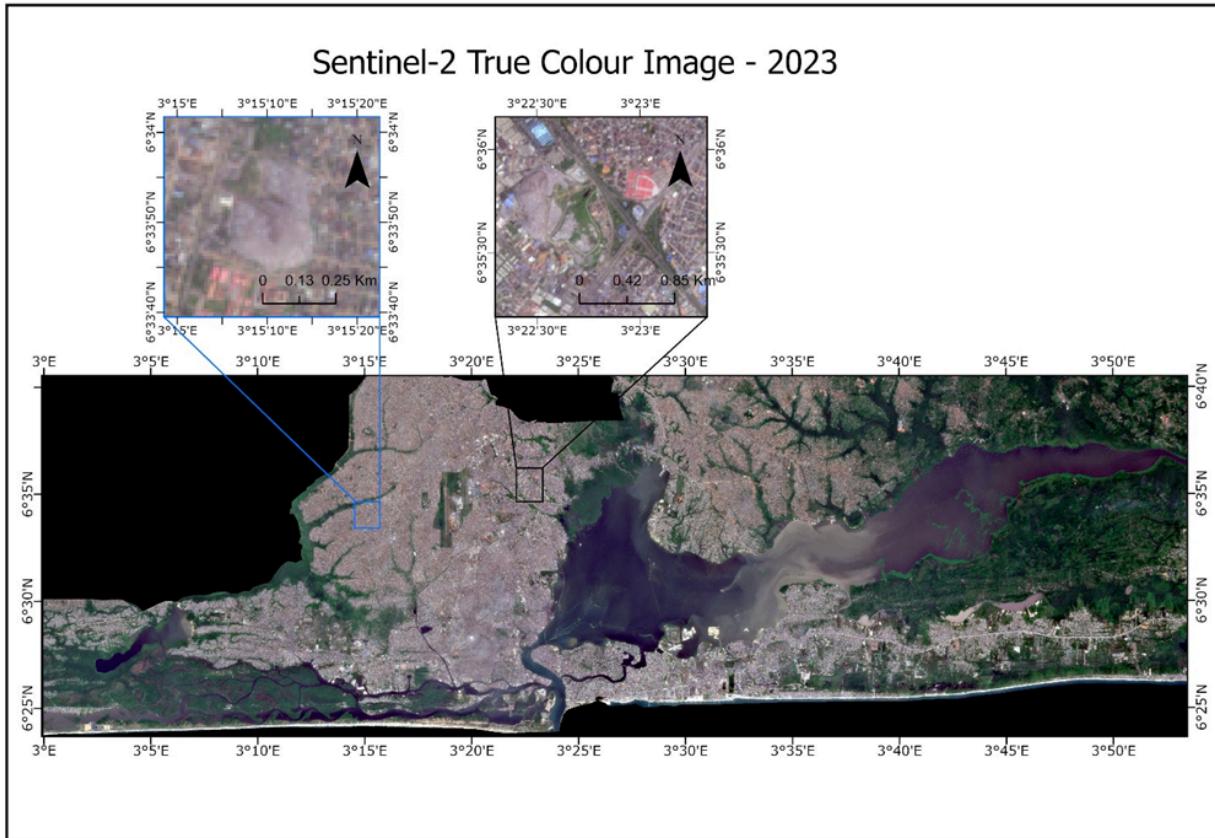
This project focuses on the application of satellite-based remote sensing techniques to map and monitor landfill expansion in Lagos, Nigeria, between 2015 and 2023. Given the city's rapid urbanization and increasing waste generation, effective landfill monitoring is crucial for sustainable urban planning and environmental management. Traditional landfill monitoring techniques are often costly and time-consuming, making remote sensing a valuable alternative for tracking landfill dynamics over time.

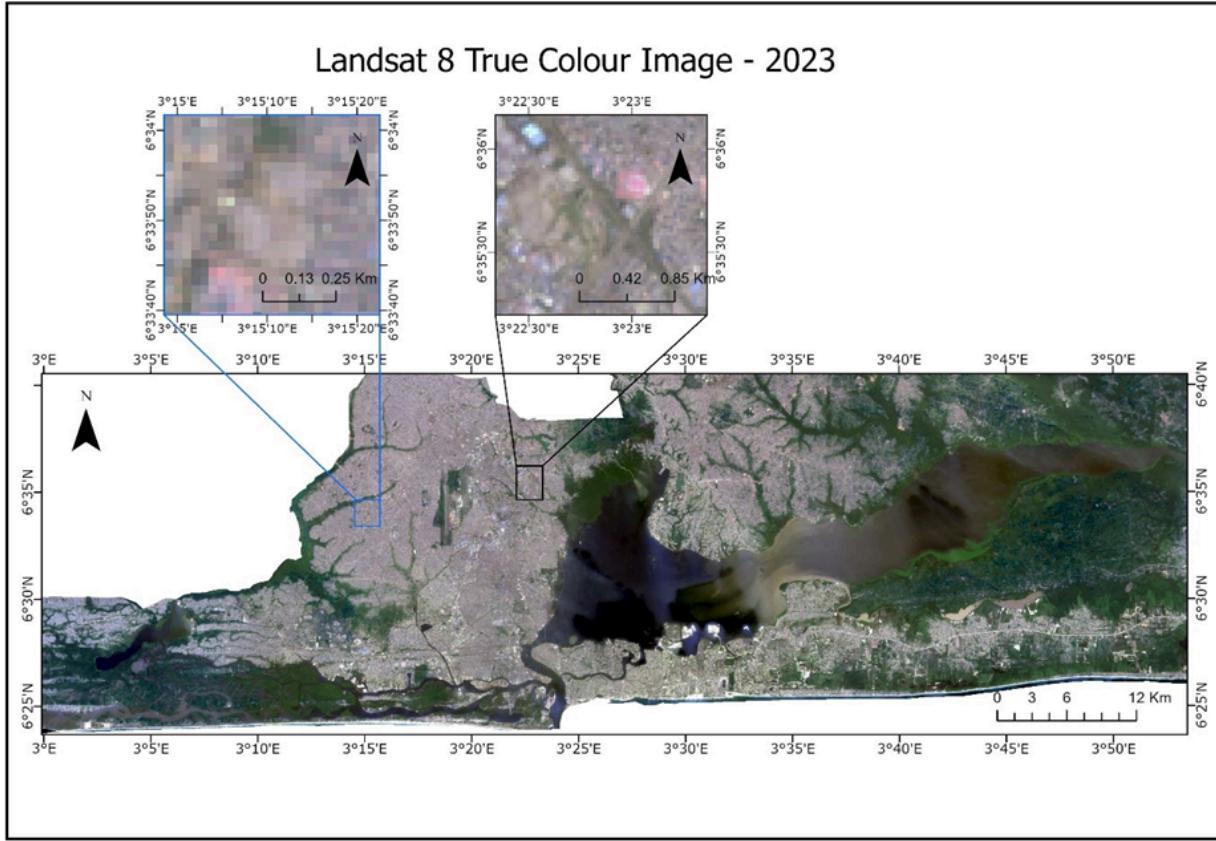
The study leverages Sentinel-2 (10m resolution) and Landsat 8 (30m resolution) satellite imagery, alongside machine learning classification techniques, to analyze the spatial and temporal changes in the Olusosun and Solous III landfill sites, the two largest active landfills in Lagos, Nigeria.



Objectives

- Assess the impact of satellite data resolution on landfill classification accuracy by comparing Sentinel-2 and Landsat 8 imagery.
- Evaluate the performance of multiple classification algorithms, including Maximum Likelihood Classification (MLC), Support Vector Machine (SVM), and Random Forest (RF).
- Improve landfill classification accuracy by integrating spectral indices (NDVI, NDBI, SAVI) and textural features (GLCM-based contrast and entropy).
- Conduct temporal change detection to analyze landfill expansion trends over an eight-year period (2015–2023).

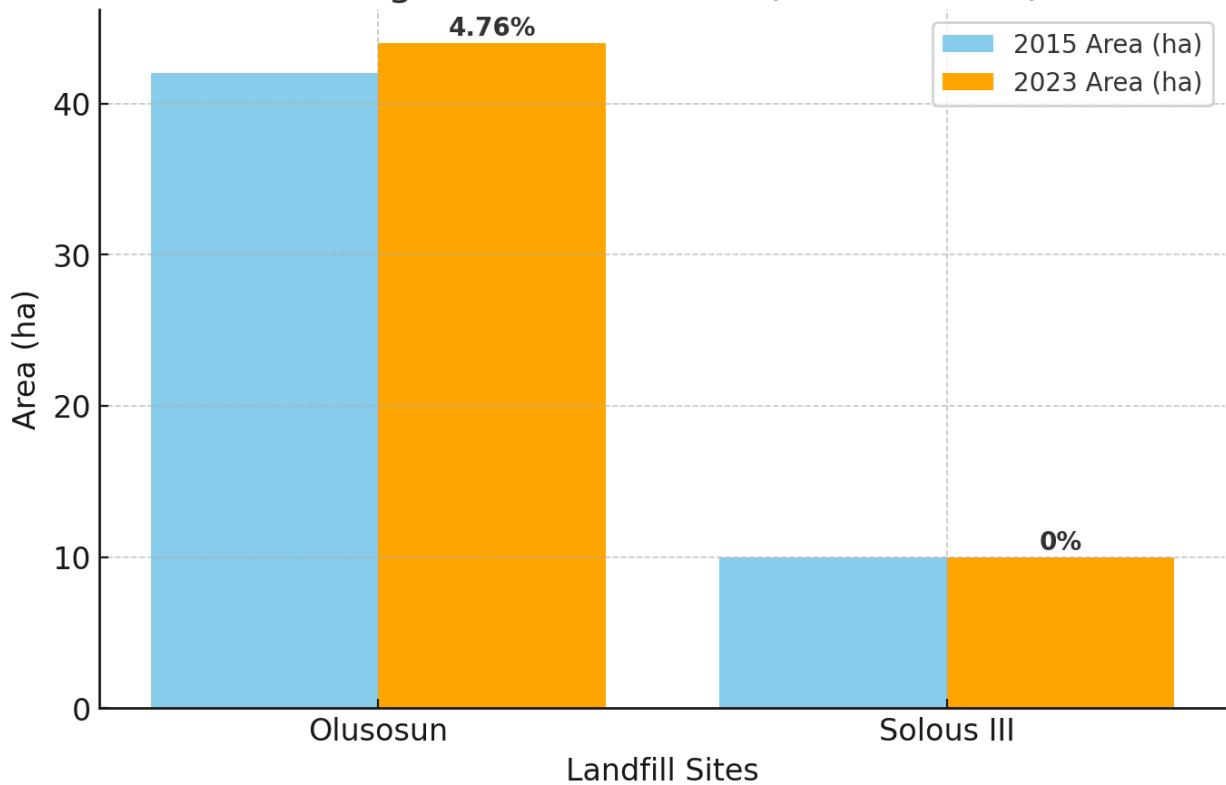




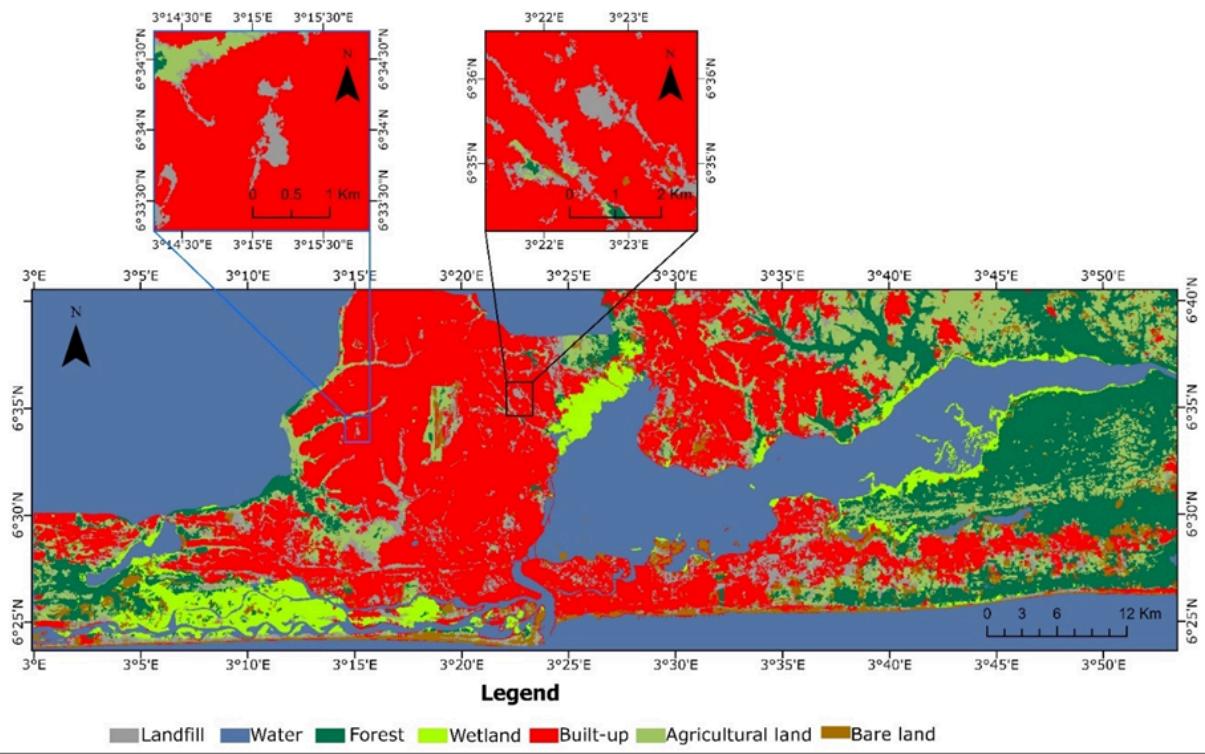
Key Findings

- Sentinel-2 outperformed Landsat 8, achieving the highest overall accuracy (84.57%) and Kappa coefficient (0.82) when classified using the MLC algorithm.
- The integration of spectral indices and textural features significantly improved classification accuracy, increasing the landfill user's accuracy from 76% to 92%.
- Landfill expansion trends:
 - Olusosun landfill expanded by 4.76% over the study period.
 - Solous III showed minimal change, suggesting different operational and regulatory factors influencing expansion.

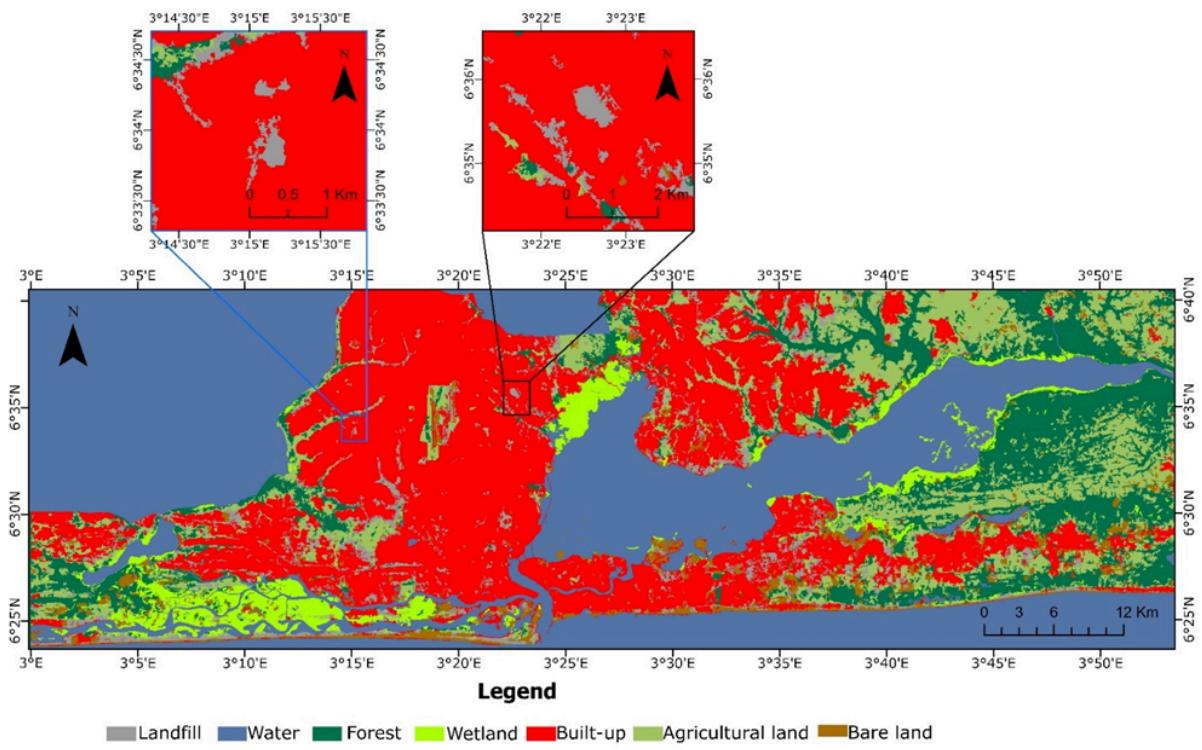
Change in Landfill Area (2015 - 2023)



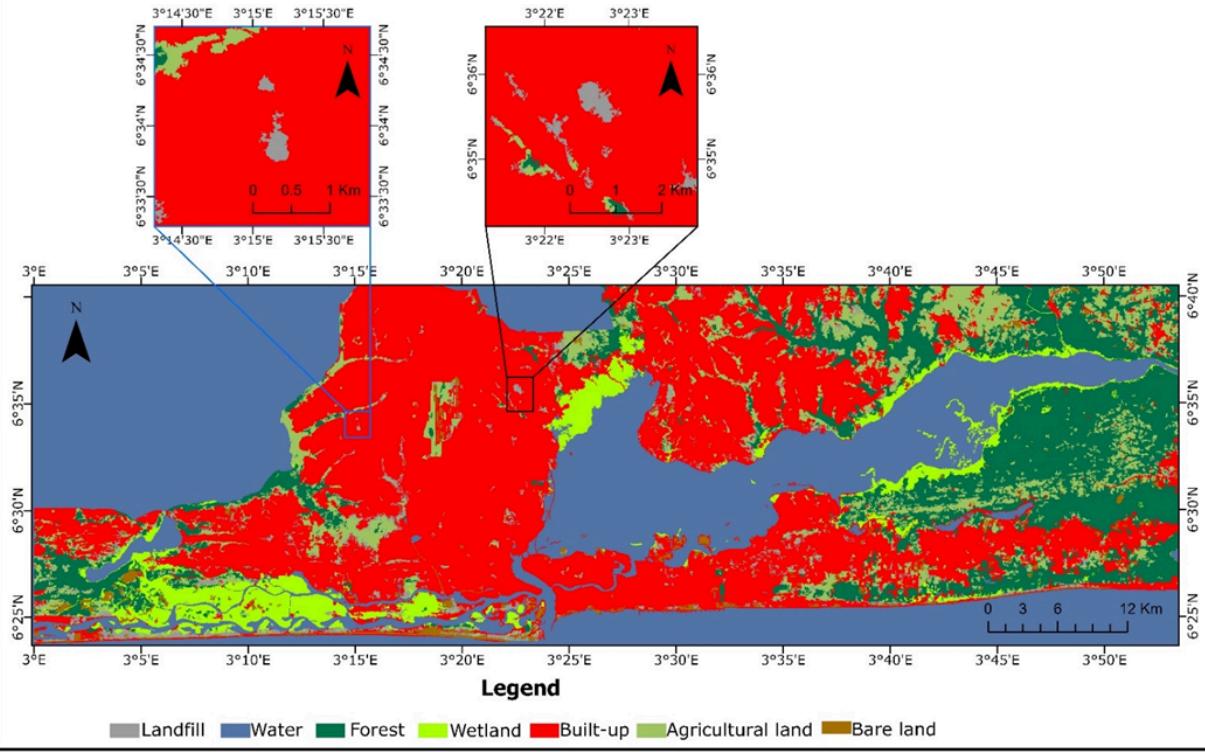
Classified Sentinel Image Using MLC - 2023



Classified Sentinel Image with Indices (MLC) - 2023



Classified Sentinel Image with Indices and Textural Features (MLC) - 2023



Conclusion

This study demonstrates the effectiveness of remote sensing and machine learning in waste management, particularly landfill monitoring, in complex urban environments. The findings highlight the importance of using high-resolution imagery and advanced classification techniques to improve the accuracy of landfill detection.