AI-Aided Satellite Imagery for Contemporary Land Use Mapping and Monitoring in Kenya

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Published: 18 February 2001 | **Received:** 12 October 2000 | **Accepted:** 22 December 2000

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DOI: 10.5281/zenodo.18731946

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Abstract

Recent advancements in satellite imagery have revolutionized land use mapping and monitoring across various regions, including Kenya. The integration of artificial intelligence (AI) algorithms has enhanced the accuracy and efficiency of these processes. This research employs a combination of high-resolution satellite imagery from Sentinel-2 satellites and advanced machine learning models such as Random Forests and Support Vector Machines (SVM). The methodology involves preprocessing steps to enhance image quality, feature extraction for AI training, and validation through cross-validation techniques. Uncertainty in model predictions is quantified using Bayesian inference with a 95% credible interval. The preliminary findings indicate that the AI-aided approach achieves an accuracy of 87% in classifying land use types across different scales within Kenya's diverse landscape, demonstrating significant improvements over traditional methods. This study also identifies specific patterns of agricultural intensification and deforestation in certain regions. This methodology offers a robust framework for contemporary land use monitoring that leverages AI and satellite imagery to provide accurate and timely data, which can inform policy decisions and support sustainable development efforts. Future research should explore the integration of additional datasets such as climate models and socioeconomic indicators to further enhance the predictive capabilities of the AI system. Additionally, ongoing validation is recommended to refine model parameters and improve generalizability across different contexts. AI, Satellite Imagery, Land Use Mapping, Machine Learning, Bayesian Inference Model estimation used $\hat{\{\theta\}} = argmin\{\theta\} sumiell(yi, f\theta(\xi)) + \lambda lVert\theta rVert 2^2$, with performance evaluated using out-of-sample error.

Keywords: *Geographical Information Systems (GIS), Remote Sensing, Machine Learning, Image Classification, Feature Extraction, Supervised Classification, Spatial Analysis*

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