Tropentag, September 16-18, 2026, hybrid conference

"Towards multi-functional agro-ecosystems
promoting climate resilient futures"

Application of machine learning and remote sensing for land use and land cover classification in Liberia

Mamadee M Kamara[1], Miroslava Bavorova[2]

[1] *Czech University of Life Sciences Prague (CZU), Department of Economics and Development, Czech Republic*

[2] *Czech University of Life Sciences Prague, Fac. of Tropical Agrisciences - Dept. of Economics and Development, Czech Republic*

Abstract

Reliable land use and land cover (LULC) information provides the foundation for designing multifunctional agroecosystems and strengthening climate-resilient agricultural systems, particularly in tropical countries experiencing rapid environmental change. Liberia, endowed with extensive forest resources and highly diverse landscapes, is undergoing rapid land transformation driven by agricultural expansion, shifting cultivation, timber extraction, and settlement growth. Despite these pressures, spatially explicit, high-resolution LULC datasets remain limited, constraining policymakers, researchers, and development practitioners from designing interventions that balance agricultural productivity, forest conservation, and climate adaptation. This study applies machine learning and multi-temporal remote sensing techniques to classify LULC patterns in Liberia between 2005 and 2025. Using Landsat imagery processed in Google Earth Engine, the workflow incorporates atmospheric correction, cloud masking, and multi-year compositing to address persistent cloud cover common in humid tropical regions. Two supervised machine learning algorithms, Random Forest (RF) and K-Nearest Neighbour (KNN), are employed to classify major land-cover categories, including forest, agriculture, grassland, built-up areas, and water bodies. Training points are collected through Google Earth Engine and randomly split into 70 % for training and 30 % for validation. Classification performance is assessed using established accuracy metrics, including overall accuracy, producer's and user's accuracy, the Kappa coefficient, and F1-scores. The resulting LULC maps will provide a much-needed baseline for understanding landscape trajectories and for supporting strategies that promote multifunctional, climate-resilient agroecosystems. By demonstrating the value of machine learning in data-scarce contexts, the study contributes to improving land governance and strengthening the scientific foundation of climate-smart agricultural planning and forest conservation in Liberia.

Keywords: Agroecosystems, climate-smart agriculture, forest conservation, land use and land cover, machine learning, remote sensing

Contact Address: Mamadee M Kamara, Czech University of Life Sciences Prague (CZU), Department of Economics and Development, Kamycka 1281, 16500 Praha 6, Czech Republic, e-mail: kamara@ftz.czu.cz