

Sensing landscape level change in soil fertility following deforestation and conversion in the highlands of Madagascar using Vis-NIR spectroscopy

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Abstract

Research data on soil quality are scarce in Madagascar, despite the island's widely recognized problems of soil and environmental degradation. One of the major constraints to properly assessing current status, trends and processes of soil degradation is the high level of costs involved when using conventional soil analytical methods. Previous studies have demonstrated that visible-near-infrared (Vis-NIR) reflectance spectroscopy may permit rapid and cost effective analysis of tropical soils that could provide new opportunities for farmers, land managers, local authorities and researchers in assessing and managing soil quality. This study tested the potential of Vis-NIR soil spectral libraries for predicting and mapping soil properties in the eastern highlands of Madagascar. Stable calibration models were developed for several key soil properties. Cross-validated r^2 values were soil organic carbon (SOC), 0.94; total nitrogen (TN), 0.96; and cation exchange capacity (CEC), 0.80. A spectral soil fertility index (SFI) was developed based on ten commonly used agronomic indicators of soil fertility. SFI varied significantly with current and historic land use. The index was successfully calibrated to both soil reflectance measured in the laboratory ($p = 0.003$) and Landsat TM reflectance ($p = 0.003$), which permitted mapping of the index.

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