

# Stable C isotopes and diffuse reflectance spectra for assessing SOC and soil quality dynamics under land use conversions in Madagascar.

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## Abstract

The impacts of human land use in the highlands of Madagascar are often equated with land degradation and decreasing soil fertility. The practice most often focused on is deforestation through slash-and-burn cultivation (*tavy*), and shifting cultivators are often portrayed as being ignorant, poverty-stricken peasants felling trees for fields and food. However, there is uncertainty whether soil degradation is related to recent *tavy* or earlier forest clearance, and whether some highland areas were ever forested. In this paper we use stable isotopes ( $\delta^{13}\text{C}$ ) and diffuse reflectance spectroscopy (DRS) to study the impacts of deforestation and various other land use changes on ecosystem properties, soil organic carbon (SOC) dynamics and soil quality in the highlands of Madagascar.

Land cover transitions (between  $\text{C}_3$  and  $\text{C}_4$  systems) are defined and quantified in the study area. Historical land use had greater effect on soil organic carbon concentrations than current land use, with cultivated areas previously under  $\text{C}_3$  and  $\text{C}_4$  systems having 37.3 and 14.8 g SOC  $\text{kg}^{-1}$ , respectively. Grasslands previously under  $\text{C}_3$  had approximately 124% more SOC than grasslands previously under  $\text{C}_4$ , while SOC concentrations were 65.3 and 54.9 g  $\text{kg}^{-1}$  under natural forest and in mixed fallow systems, respectively. A soil fertility index was developed for the study area based on diagnostic soil spectra and the results are compared with findings related to SOC dynamics and land use change.

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\* Correct Citations: Shepherd KD, Walsh MG 2004. Diffuse reflectance spectroscopy for rapid soil analysis. In: *Encyclopedia of Soil Science*, edited By Rattan Lal.