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“Development on the margin”

Nuclear Techniques to Investigate Carbon Source/Sink Dynamics between Areas of Land Degradation and Deposition Areas in Local Tropical Watersheds

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Abstract

Innovative technical and progressive approaches are strongly required to adequately trace soil organic carbon (SOC) sink-and-source relationships between areas of critical land degradation and deposition areas. This is particular crucial for mountainous landscapes of northern Vietnam where rapid land use changes are responsible for severe and accelerated land degradation. Consequently, this agricultural intensification in upland areas is leading to rampant water erosion promoting severe losses of SOC and therefore it is of central importance to study such sink-and-source relationships between areas of critical land degradation and also deposition areas in the lowlands.

In this study we use a compound-specific stable-isotope (CSSI) approach to investigate source-and-sink relations of SOC in the Chieng Khoi catchment, Son La Province, Vietnam. The CSSI approach uses natural abundance signatures of plant-specific carbonaceous compounds, such as $\delta^{13}\text{C}$ values in fatty acids (fatty acid methyl ester – FAME) originating in upland soils in the studied tropical catchment including a range of different crops (*e.g.* maize, cassava), as well as natural and secondary forests. These CSSI-biomarkers will be traced in the lowland soils (*i.e.* paddy rice soils, lake sediments) to estimate the dynamics of landscape SOC stocks at catchment level and to assess how land use intensification has changed the spatial and temporal distribution of respective C from uplands to lowlands. So far no attempts have been made to use natural abundance signatures of specific organic compounds (*e.g.*, $\delta^{13}\text{C}$ values in plant-derived fatty acids) in the soil profile to identify soil sources and to apportion their relative contribution from different land use sites in tropical watersheds including a range of farming systems.

In the presented study we discuss primarily the applicability of CSSI analysis and CSSI-based mixing models to identify and trace SOC source-and-sink dynamics in a local tropical watershed on a temporal and spatial scale.

Keywords: Compound specific stable isotopes, fatty acids, soil erosion, soil organic carbon dynamics, Vietnam, watershed

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