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Tracing Soil Organic Carbon Relocations in a Mixed Land-Use Agricultural Catchment in Northwest Vietnam

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Abstract

Soil relocation (losses/deposition) processes at watershed scale are the key to understand the spatial fate and behaviour of soil organic carbon (SOC), a determinant for soil fertility and regional carbon balance and budget. It is essential to study dynamics of SOC movement and to precisely trace sources of SOC in upland areas at watershed level to adjust existing upland farming systems to more sustainable land use systems.

The primary objective of this study is to test the applicability of a compound-specific stable-isotope (CSSI) approach and CSSI-based mixing models to identify and trace SOC source-and-sink relations in the Chieng Khoi watershed, Son La Province, Vietnam, where severe and accelerated land degradation and soil erosion is currently occurring.

The CSSI approach uses differences in the natural abundance signatures of plant-specific carbonaceous compounds (δ^{13}C) which emerge due to the different photosynthetic fixation pathways, genetic and environmental factors. The compounds of choice to be used as markers are long-chain length fatty acid methyl esters (FAME) originating in upland soils including a range of different crops, as well as natural and secondary forests. These CSSI-biomarkers were traced in the lowland soils (*i.e.* sediment deposition areas, lake sediments) to estimate the dynamics of landscape SOC stocks at watershed level and to assess how land use intensification has changed the spatial and temporal distribution of respective C from uplands to lowlands.

Results have shown that different land uses show different δ^{13}C signatures for identical FAMEs and multi comparison procedures have revealed that a variety of FAME marker with significant discriminatory power exists to describe distinct isotopic fingerprint profiles in source soils for selected sub watersheds. Therefore it was possible to trace the sources of lowland sediments, which improves the understanding of soil erosion and will help to adapt cropping systems which are prone to erosion and thus nutrient losses.

Keywords: Erosion, soil organic carbon, stable isotopes, Vietnam

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