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Impacts of land-use change on organic carbon storage in highly weathered soils of tropical Sub-Sahara Africa

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Land-use change of tropical forests for agricultural production is considered as a major cause for a decline in soil organic carbon (SOC) stocks. However, the extent of the impact of land-use change on SOC storage is highly uncertain, especially for tropical Africa. Interactions with the soil mineral phase can modify such impacts because of high contents of pedogenic Fe- and Al-oxides and clay in these highly weathered soils and their potential for C stabilization. The aim of the current study was to determine land-use change impacts on SOC storage for soils commonly found in tropical Africa. For that purpose 10 pedological similar soils in the Eastern Usambara Mountains (Amani Nature Reserve, NE Tanzania) under contrasting land-uses were sampled down to 100 cm soil depth. Measured SOC stocks were 17.5 kg m^{-2}, 16.8 kg m^{-2}, 16.9 kg m^{-2} and 20.0 kg m^{-2} for forests, tea plantations, croplands and homegarden, respectively. A significant decrease in mean SOC storage of 1.3 kg m^{-2} was detected after changing forests into croplands for the 0-10 cm depth increment. No further significant impact of land-use change on SOC stocks could be detected. All soils have a clay dominated texture and are characterized by high contents in pedogenic oxides. No significant relationship was found between SOC and clay contents for the investigated soils. Statistically significant relationships existed between oxalate-extractable Fe, Al and SOC contents for cropland soils only, although forest soils comprised a wider range of oxalate-extractable Fe concentrations. Probably, a higher variability of fresh OC input in forests may obscure the relation between SOC and pedogenic oxides under forests. In a current follow-up project we focus on factors and specific processes that clay minerals and pedogenic oxides play in controlling SOC stabilization ($i.e.$ the formation of stable mineral-associated organic matter and stable aggregates).