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# Losses of soil carbon by converting tropical forest to plantations: Erosion and decomposition estimated by $\delta^{13}C$

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## Abstract

© 2015 The Authors. Indonesia lost more tropical forest than all of Brazil in 2012, mainly driven by the rubber, oil palm, and timber industries. Nonetheless, the effects of converting forest to oil palm and rubber plantations on soil organic carbon (SOC) stocks remain unclear. We analyzed SOC losses after lowland rainforest conversion to oil palm, intensive rubber, and extensive rubber plantations in Jambi Province on Sumatra Island. The focus was on two processes: (1) erosion and (2) decomposition of soil organic matter. Carbon contents in the Ah horizon under oil palm and rubber plantations were strongly reduced up to 70% and 62%, respectively. The decrease was lower under extensive rubber plantations (41%). On average, converting forest to plantations led to a loss of 10 Mg C $ha^{-1}$ after about 15 years of conversion. The C content in the subsoil was similar under the forest and the plantations. We therefore assumed that a shift to higher $\delta^{13}C$ values in plantation subsoil corresponds to the losses from the upper soil layer by erosion. Erosion was estimated by comparing the $\delta^{13}C$ profiles in the soils under forest and under plantations. The estimated erosion was the strongest in oil palm (35 ± 8 cm) and rubber (33 ± 10 cm) plantations. The $^{13}C$ enrichment of SOC used as a proxy of its turnover indicates a decrease of SOC decomposition rate in the Ah horizon under oil palm plantations after forest conversion. Nonetheless, based on the lack of C input from litter, we expect further losses of SOC in oil palm plantations, which are a less sustainable land use compared to rubber plantations. We conclude that $\delta^{13}C$ depth profiles may be a powerful tool to disentangle soil erosion and SOC mineralization after the conversion of natural ecosystems conversion to intensive plantations when soils show gradual increase of $\delta^{13}C$ values with depth.

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## Keywords

Carbon sequestration, Deforestation, Erosion assessment, Land degradation, Organic matter decomposition, Soil organic matter, Subsoil, $\delta^{13}C$ depth profile