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SIZE-DENSITY AND ISOTOPIC FRACTIONATION OF SOIL ORGANIC MATTER AFTER FOREST CONVERSION

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1. ABSTRACT

The ability to understand soil organic matter dynamics in forest-derived soils is essential in the search for more intensively managed and environmentally sound and sustainable practices. Evaluation of sustainability of newly developed systems requires sensitive methods that allow an early detection of changes in soil fertility before degradation becomes apparent.

Soil samples from under different humid tropical land use systems were obtained from intact as well as recently converted forests, under I) rubber/rice systems and Imperata grassland in Sitiung, Indonesia, and under ii) *Peltophorum dasyrachis* and *Gliricidia sepium* woodlots, *Imperata* grassland and sugarcane plantations at Lampung, Indonesia. Soil was sieved and the 0.15 - 2 mm size fraction was then separated by density (<1.13, 1.13-1.3, > 1.3 g cm^{-3}). The fraction dry weights suggested that land use systems without burning, soil cultivation and intensive weeding can maintain soil organic matter close to forest levels, but in frequently burnt Imperata grasslands stocks are depleted.

The origin of soil organic matter from rainforest and crops was determined by $\delta^{13}C$ methodology for a forest - sugarcane conversion series in Lampung, as well as a pure *Brachiaria humidicola* pasture and a *B. humidicola-Desmodium ovalifolium* mixture after rainforest clearing in Bahia, Brazil. Results showed that rainforest plant species at both sites were mainly C_3 plants differing in ^{13}C content with the C_4 sugarcane and grass pasture, and thus allowed identification of the soil-C origin from the two groups. Loss of rainforest-C after clearing amounted to around 50% under both sugarcane and pastures nine and eight years after rainforest clearing respectively. The contribution of crops to the buildup of new soil organic matter was higher in the pasture systems than under sugarcane presumably due to burning activities and associated loss of organic matter inputs in the sugarcane system.

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2. INTRODUCTION

When forests are converted into agricultural use, either temporary or permanent, the forest soil provides a rich heritage for the new crops or trees, both by its structure (including 'old tree root channels' VAN NOORDWIJK *et al.*, 1991), chemical content (especially when the litter layer and biomass were turned into ash) and organic matter content. Decline of soil organic matter content is widely seen as a major factor in the decrease of soil fertility and crop yields after forests are converted for agricultural use. The total organic C content of the soil (C_{org}), however, is not a very sensitive indicator of initial changes. Development of improved soil management practices would be easier if more sensitive indicators were available. A number of fractionation methods have been developed for soil organic matter in the past decade. Here we will focus on two of them, one based on size/density fractionation (MEIJBOOM et al., 1995) and one based on the $^{12}C/^{13}C$ isotope ratio (CERRI et al., 1985).

A variety of models are in use for describing soil organic matter turnover by dividing the total C_{org} content into pools with different turnover times. Most of these models involve a small active pool with a short turnover time and one or more pools of greater size and slower turnover rates. Methods to measure the active pool (mainly microbial biomass and byproducts) have been successfully established, but