Changes of Soil Properties and Input-Output Balance of Nutrients in Land-Use Systems Following Rain Forest Conversion in Central Sulawesi, Indonesia

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Abstract

The rainforest area is declining rapidly in Indonesia with its nearly $50\,\%$ of Asia's and $10\,\%$ of the world remaining tropical rainforest. The most important factor for deforestation is agriculture. We wanted to study the sustainability of land-use systems in conversion areas in respect to soil fertility. We studied maize- and cacao/coffee-agroforests which are the main non-irrigated land-use systems of the upland rainforest margin areas of Central Sulawesi. The study objective of this study were:

- To quantify changes of soil properties under maize cultivation and agroforestry compared to natural forest and to measure the effect of the duration of cultivation (chronosequence).
- To measure the input-output balance of nutrients in maize and agroforestry compared to natural forest.

Soils were generally fertile, with high base cation saturation, cation exchange capacity and pH-values. Carbon and nitrogen-stocks were highest in natural forest and lower in maize and agroforestry. In maize both C and N decreased with time, whereas in agroforestry they increased slightly. Maize fields had lost on average approximately $25\,\%$ of the below-ground C-pool compared to natural forest. Soil bulk-density was highest in agroforestry, in maize an increase was observed in time and in agroforestry it remained stable on a high level. In both managed systems Ca-saturation of CEC increased and K-saturation decreased during cultivation. We measured nutrient-input by precipitation, and output by leaching and harvest export on unfertilized maize- and agroforestry-sites. We found low nutrient input through rain, only potassium was imported in considerable amounts. Exports of Mg, Ca was mainly by leaching, whereas N and K was exported mainly by removal of crop harvest. Highest nutrient exports were found in the agroforestry system, maize was intermediate and lowest were found in the forest sites. All systems, including the forest sites, had negative balance of macronutrients, indicating open nutrient cycles on these soils even in natural forests.

Keywords: Chronosequence, land use systems, rain-forest conversion, soil fertility, soil nutrients

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