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Succession, Biomass Development and Nutrient Dynamics in Traditional Shifting Cultivation Systems of Central Sulawesi, Indonesia

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Abstract

Shifting cultivation was the most practical approach evolved by farmers in the Tropics to inhibit weed infestation and decline of soil fertility after a period of cropping. Farmers of the village Katu, Central Sulawesi, still practice shifting cultivation with short cropping and long fallow periods, an overall opportunity to study the sustainability of this sequential agroforestry land use system. Therefore, on natural fallows of 1 to 7 years (false time series) the successional changes of vegetation were determined and biomass development, nutrient accumulation of distinct life forms and soil nutrient dynamics were studied. The vegetation was grouped into grasses, herbs, shrubs and trees. Fresh and dry weight of each group, along with root biomass, were recorded. Plant specimens and soil samples were also collected. At the species level, 117 of 218 plant samples were identified. Rapid increase (up to 7.8 t ha^{-1}) in total biomass was recorded in the first 2 fallow years, which was dominated by grasses and herbs. By fifth year, biomass was at 11 t ha^{-1}. But, the composition of vegetation has now changed with trees dominating. By seventh year, biomass reached 45 t ha^{-1} and trees were >5 m height. Over time, root biomass (0–30 cm topsoil) reduced from 16 to 8 t ha^{-1}. During the course of fallow development, there was no significant change in the levels of P, K, and Mg stored in the vegetation. Average amounts were about 8.8 kg P/ha, 68 kg K/ha and 5.3 kg Mg/ha. At the same time, the accumulated N and Ca levels increased from 48 and 30 kg/ha to 70 and 80 kg/ha, respectively. There was a continuous decline in CEC_{eff} as well as K, Ca and Mg stocks while P remained constant and no clear trend was found in soil pH. In the context of Central Sulawesi, trees play a crucial role in maintaining the production potential of traditional shifting cultivation systems. They recycle leached nutrients, tap new nutrient stocks from deeper soil layers and build a nutrient pool for the following cropping period. Trees best serve as indicators of sufficient fallow length.

Keywords: Agroforestry, biomass development, nutrient dynamics, shifting cultivation, sustainability

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