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"Solidarity in a competing world — fair use of resources"

Indicators for Carbon Cycling in Four Different Cacao Production Systems in Bolivia

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Abstract

Carbon loss of tropical forests by land use change can be reduced by locally adapted agroforestry (AF) systems. Cacao AF systems have higher above- and below-ground biomass in comparison to monoculture systems. The opportunity to increase and sequester organic carbon depends on the composition of shade trees and system management.

A cacao long-term field trial in Bolivia by The Research Institute of Organic Agriculture (FiBL) is arranged in a block design with system and management as factors. The systems are agroforestry (cacao under shade trees) and monoculture (cacao under full sun). The management is divided into organic and conventional. In the organic managed plots compost is applied. While inorganic fertilisers are used in the conventional management.

Litterfall was sampled monthly using 0.25 m^2 circular litter traps. Monthly means were summed up to gain the annual litterfall for each plot. Litter decomposition of cacao and *Erythrina* leaves was measured by litterbags with a mesh size of 1.0 mm, which were placed onto the litter layer. The decomposition experiment was performed for a period of 10 months. Soil samples for microbial biomass were taken down to a depth of 25 cm.

The annual litterfall (1.3 to 2.3 Mg C ha^{-1}) was highest in conventional agroforestry systems. Cacao litter decomposed slower than legume tree litter, but there was no difference between system or management. Microbial carbon and nitrogen contents were mainly affected in uppermost layers by management with lowest values in conventional monoculture. Soil taken nearby legume shadow trees showed especially higher microbial nitrogen values. This effect tended to extent down to the B-layer.

Overall, the study showed that due to higher biomass in shade trees in agroforestry system the total carbon re-accumulation was highest in the initial phase. While soil organic carbon was highest in organic management. Over time, the balance between litterfall and decomposition will decide about changing carbon stocks in the soil compartment.

Keywords: Biomass, carbon stocks, leaf mass residuals, litter fall, microbial biomass, *Theobroma cacao*

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