

Organically managed cacao agroforestry systems increase soil organic carbon and nitrogen stocks and microbial biomass concentration

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Background & Objectives

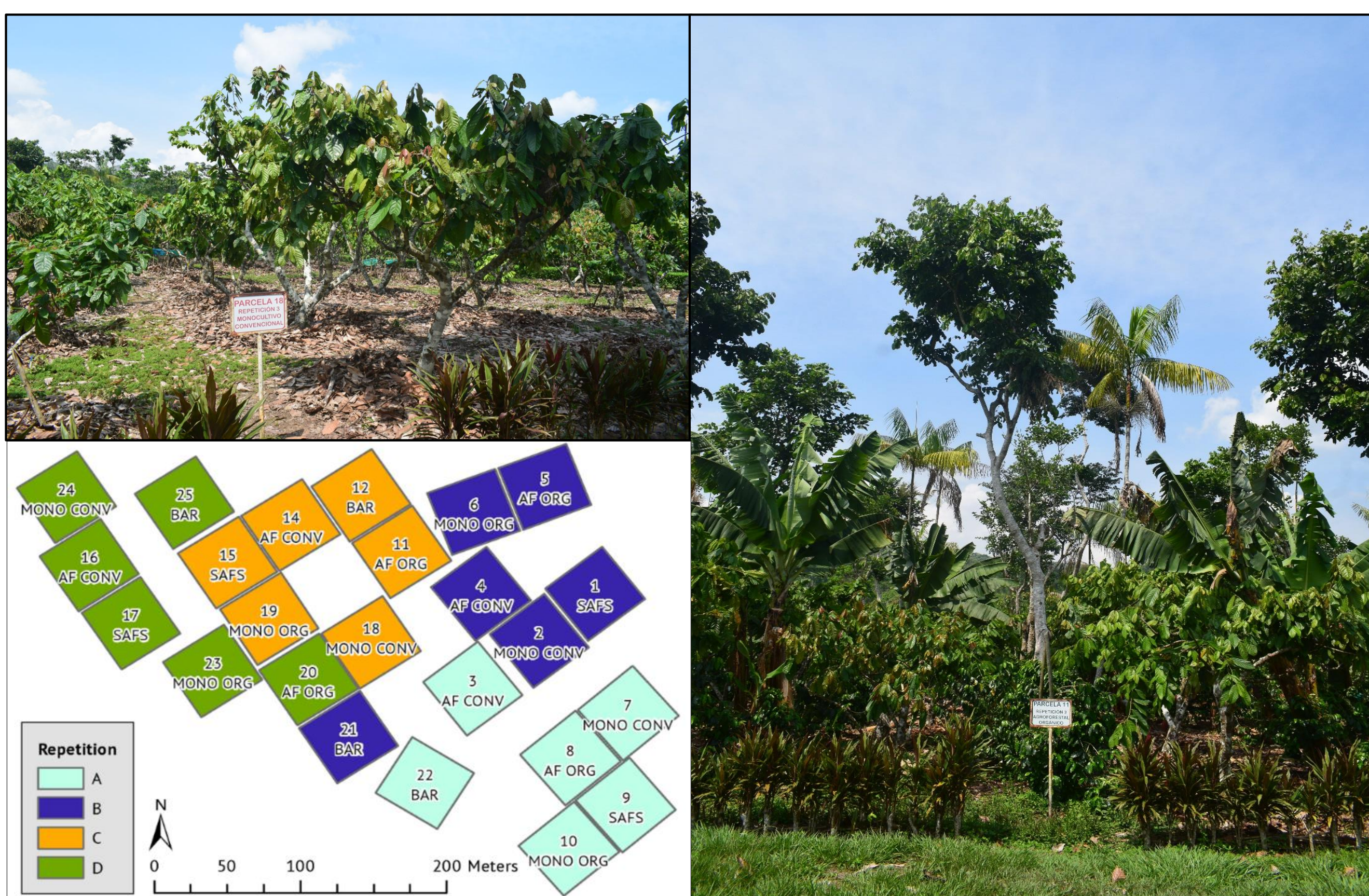
Background

Agroforestry and organic agriculture pursue largely the same goals and methods. The accumulation of biomass to improve soil structure and fertility as a basis for agricultural production and the avoidance of agrochemicals to preserve biodiversity. Nevertheless, there are still many gaps of knowledge about agroforestry systems and organic agriculture, especially about the long-term effects.

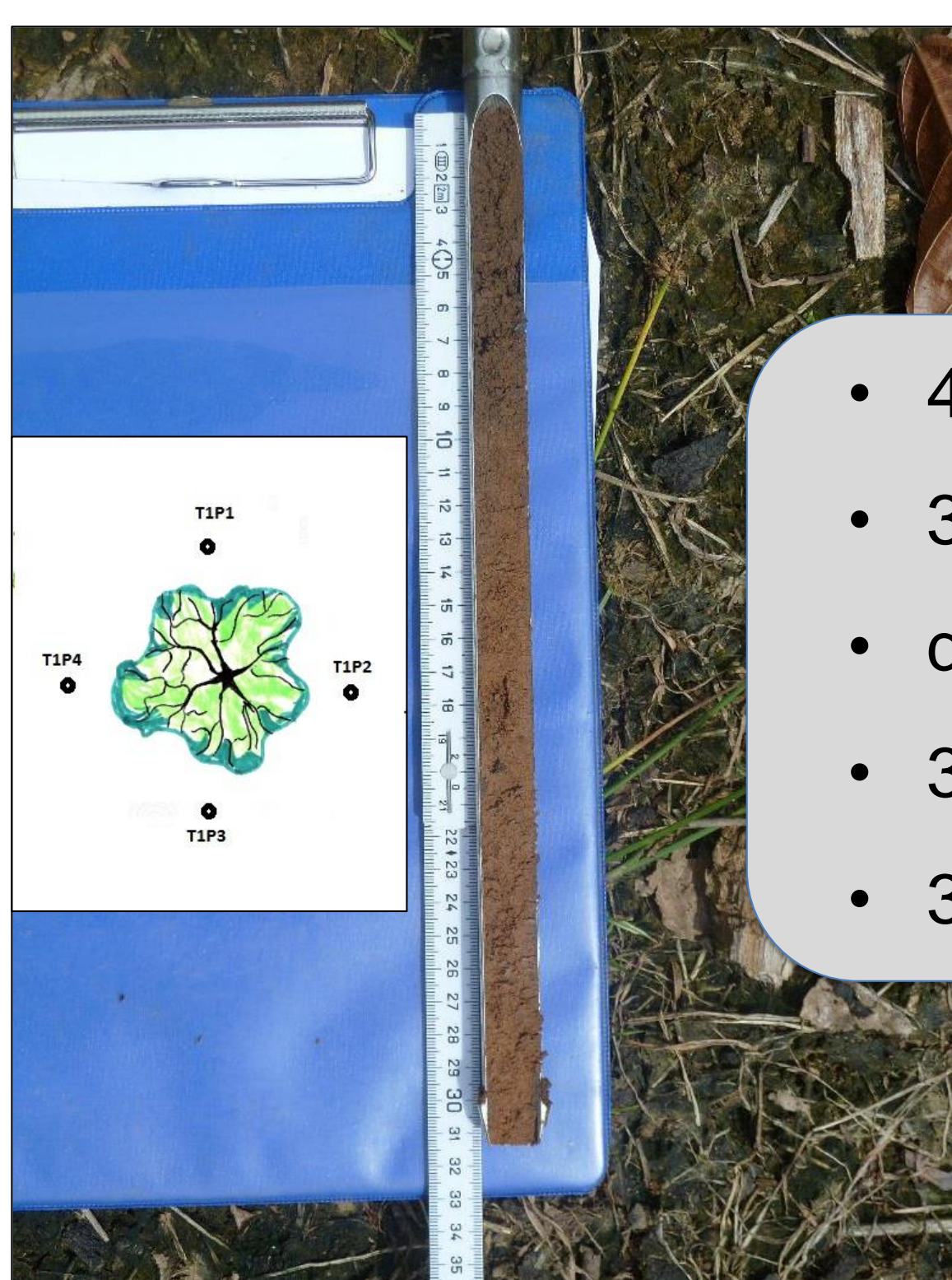
Objectives

In this study, conventional and organically managed cacao monocultures (MCS) and agroforestry systems (AFS) were compared in terms of soil organic carbon (SOC) and nitrogen (N), microbial biomass, and litter decomposition.

Experimental Design & Methods



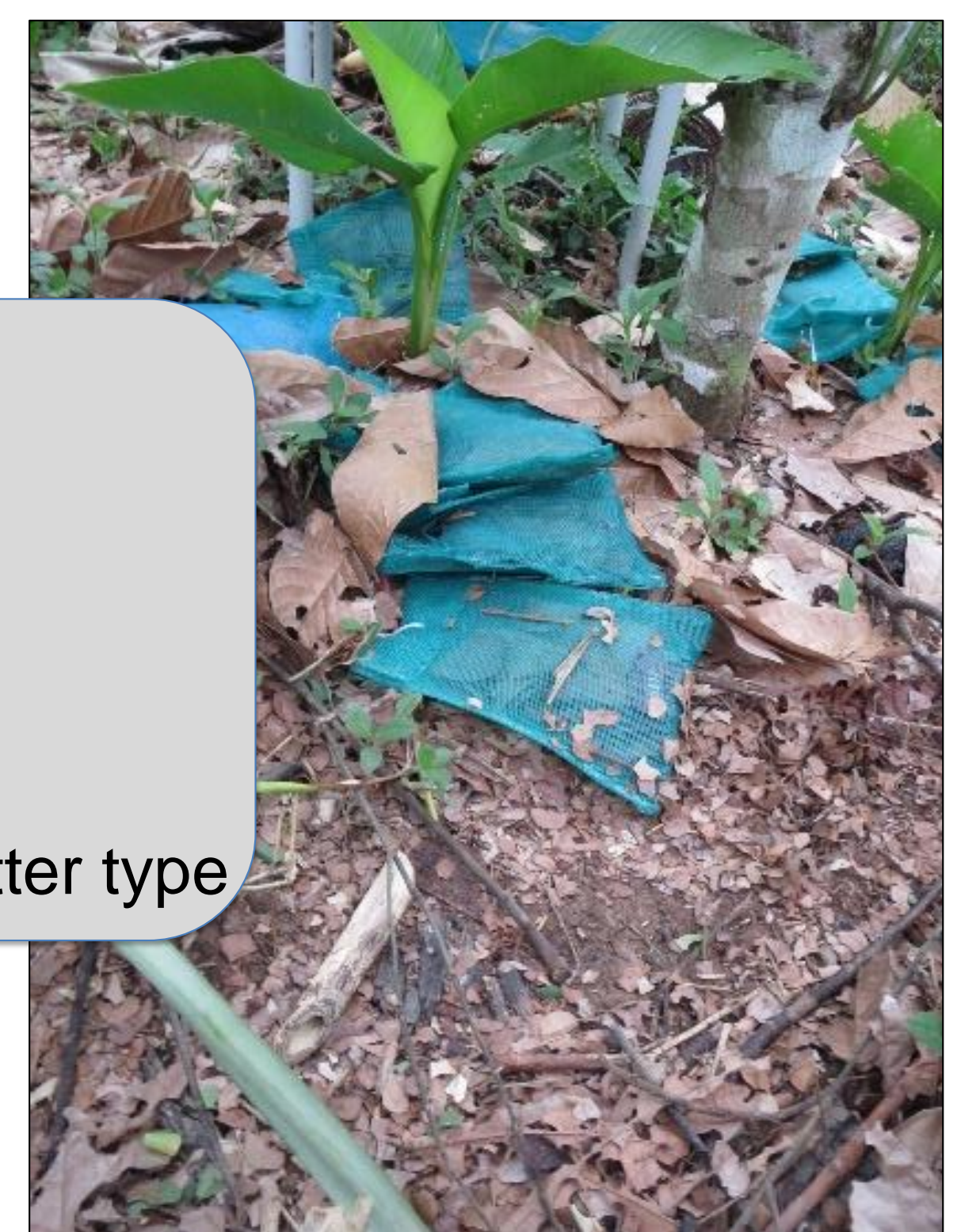
- Comparison of:
 - AFS vs. Monoculture Systems
 - Organic vs. conventional management
 - Plot size: 48 x 48 meters, with a net plot of 24 x 24 meters
 - Stand density: cacao 625 per ha (4 x 4 meters)
 - Pruning of cacao trees three times a year
 - Stand density AFS: 227 trees per ha
 - Single pruning of shade trees at the end of the dry season
 - Organic management: cover crops and application of compost
 - Conventional management: application of fertilizers and herbicides
- More information about the trial at <https://systems-comparison.fibl.org>



- 4 soil samples per tree
- 3 horizons (O, Ah and B)
- distance of 0.5 m
- 3 cacao trees
- 3 Erythrinas in AFS



- 2 types of litter:
 - ❖ Cacao
 - ❖ Erythrina
- 8 times removal
- 320 bags of each litter type



Results & Conclusions

Results

1. Soil organic carbon and nitrogen stocks in the topsoil were significantly higher in organic managed production systems.
2. Microbial biomass in organically managed systems is higher in the topsoil than in conventional production systems.
3. In the soil surface layer microbial nitrogen was four times higher in the organically managed systems than in conventional systems.
4. Organic managed AFS had the highest concentrations of microbial nitrogen.
5. Decomposition rates of leaves showed no differences between the systems.
6. Litter quality influenced decomposition rates. Half-life of cacao leave litter was almost twice of Erythrina leaves.



Conclusions

1. Organically managed cacao agroforestry systems lead to biomass accumulation and to healthier soils.
2. Incorporating leguminous trees into AFS is a source of easily decomposable and Nitrogen-rich litter.
3. Leguminous trees can increase the N - supply
4. Relatively slow decomposed residues of cacao trees help to build up SOC stocks.

Organically managed cacao agroforestry systems should therefore form the basis for production that is not only designed for short-term profit, but also preserves soil ecosystem services in the long-term.