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Research Design, Soil and Biodiversity Baseline for Long-term Farming Systems Comparison of Full Sun and Shaded Agroforestry Cocoa Production under Conventional and Organic Management in Alto Beni, Bolivia

MONIKA SCHNEIDER¹, PATRICIA AMURRIO², JAMES APARICIO^{3,4}, ISABEL GÓMEZ^{3,4}, MIGUEL LIMACHI⁴, JOACHIM MILZ⁵, ULF SCHNEIDEWIND⁶, RENATE SEIDEL⁷, GERMAN TRUJILLO⁸

¹Research Institute of Organic Agriculture (FiBL), Development and Cooperation, Switzerland

²University Mayor San Andres, Institute of Ecology, Bolivia

³National Museum of Natural History, Herpetology, Bolivia

⁴Bolivian Fauna Collection, Universidad Mayor de San Andrés (UMSA), Bolivia

⁵Association of Organic Producers Organisations in Bolivia (AOPEB), Bolivia

⁶Georg-August Universität Göttingen, Landscape Ecology, Germany

⁷National Herbar, Institute of Ecology, Bolivia

⁸Ecotop consulting, Bolivia

Abstract

Cocoa, mainly produced by 5 to 6 millions of smallholder farmers, is considered as one of the most sustainable production system in the humid tropics. Little is known about the sustainability of different cocoa production systems.

A long-term experiment is set up in Alto Beni at 400 m above sea level with a humid winter dry climate, 1'540 mm annual rainfall. The trial assesses the sustainability of five cocoa (*Theobroma cacao*) production systems with the parameters of yield and yield stability, input-output efficiency of nutrients and energy, soil fertility, biodiversity, economic result, climate change mitigation and adaptation. The two-factorial experiment is arranged in a completely randomised block design; the five cocoa treatments, based on local and international practices, are four times repeated. The production systems are differentiated by the diversity of shade canopy and by crops, from mono culture full sun cocoa to an agroforestry cocoa with leguminous species (*Inga edulis*, *Erythrina poeppigiana*) shade canopy, including fruits (e.g. *Euterpe precatoria*, *Theobroma grandiflorum*) and timber (e.g. *Centrolobium ochroxylum*, *Swietenia macrophylla*) species, and a higher diversified agroforestry system based on the natural successions of species. The management of the cocoa is conventional and organic. The five treatments are: mono culture full sun cocoa conventional, mono culture full sun organic, agroforestry conventional, agroforestry organic and successional agroforestry organic. Fallow plots and nearby forests plots are monitored for soil fertility and biodiversity. Field clearing started in 2007 followed by maize (*Zea mays*) crop and end of 2008 the cocoa plots (48 m × 48 m) were established.

The results of the baseline studies concerning soil fertility show good nutrient level for cocoa production; the variance of soil parameters is documented in a soil map. According to the FAO soil classification (2006) the soils are Lixisole and Luvisole with high base saturation.

The biodiversity of above ground fauna and flora highlights the new register of species: *Neopelma sulphureiventer* for the department of La Paz and the serpents *Chironius multi-ventris* for Bolivia and endemic species of amphibians *Oreobates choristolemma* Indicator species for a monitoring are defined.

Keywords: Agroforestry, biodiversity indicators, cocoa, conventional, organic, soil fertility, system comparison