

Biodiversity and food production in different cacao production systems

Laura Armengot¹, Kazuya Naoki², Luis Marconi-Ripa², Miguel Limachi³, Renate Seidel², M. Isabel Gómez⁴, Leslie J. Zegada-Herbas², Francisco Saavedra², Indyra Lafuente-Cartagena², Johanna Rüegg², Monika Schneider¹

¹Research Institute for Organic Agriculture FiBL, Switzerland; ²Universidad Mayor de San Andrés (UMSA), Inst. of Ecology, Bolivia; ³National Natural History Museum, Bolivian Fauna Collection, Bolivia; ⁴Bolivian Association for Bird Conservation "Aves Bolivianas", Bolivia

Background

Intensive agriculture is one of the main drivers of biodiversity loss. Agroforestry systems and organic farming have the potential to maintain and promote biodiversity. But it is often argued that it is at the cost of losing productivity

Methodology

In Bolivia, a long-term trial was established in 2008 to evaluate the agronomic, ecological and economic performance of different cacao production systems: monocultures under conventional (CM) and organic management (OM), agroforests under conventional (CA) and organic management (OA) and a highly diverse successional agroforest without external inputs (SA).

Data on yield, birds, herbaceous plants, ants and floral visitors and water use efficiency was collected.

Results

Our results show that agroforestry systems and organic farming support both food production and biodiversity.

Overview of the long-term trial

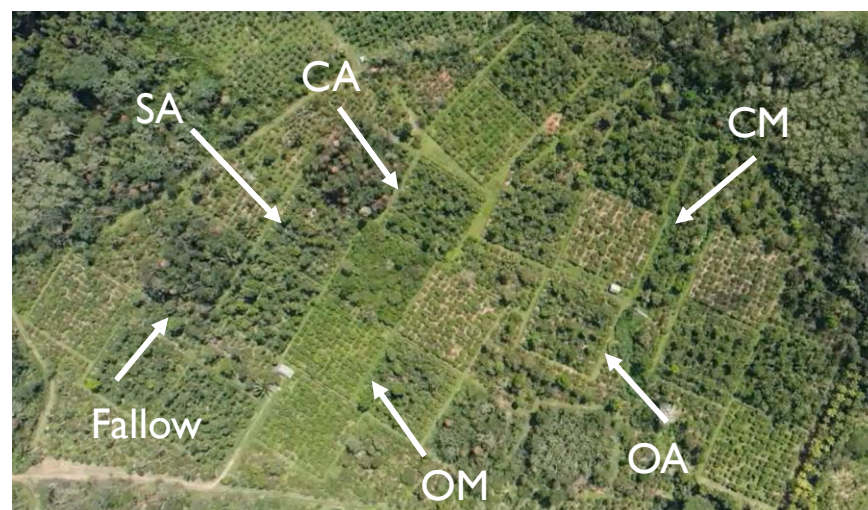


Figure 1: The trial follows a complete randomised design with 4 repetitions. Plots size is 48 x 48 m. Agroforestry systems, in addition to cacao trees, have palms, bananas, timber and fruit trees at a density of about 300 trees ha⁻¹. SA has higher tree and crop diversity (e.g., ginger, curcuma, copoazú) at a density of about 800 trees ha⁻¹. Fallow plots are also included

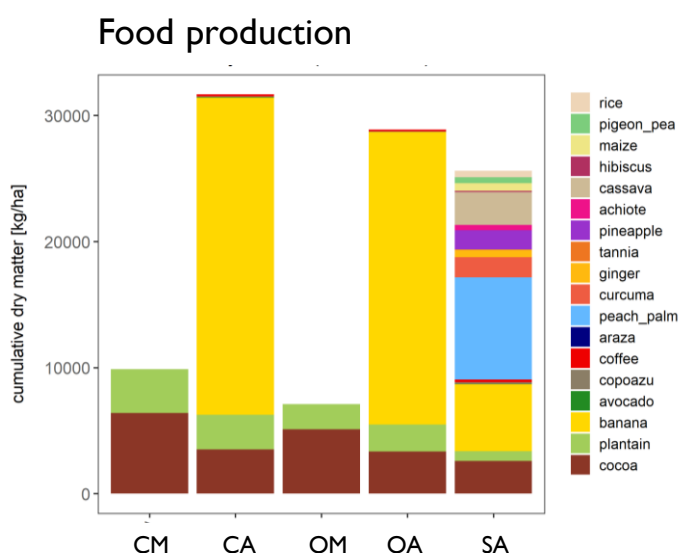


Figure 2. Cumulative dry matter 2009-20219.

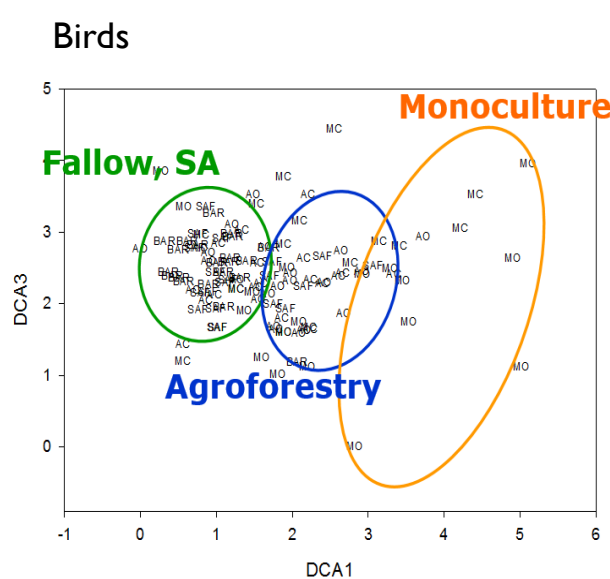


Figure 3. Bird composition.

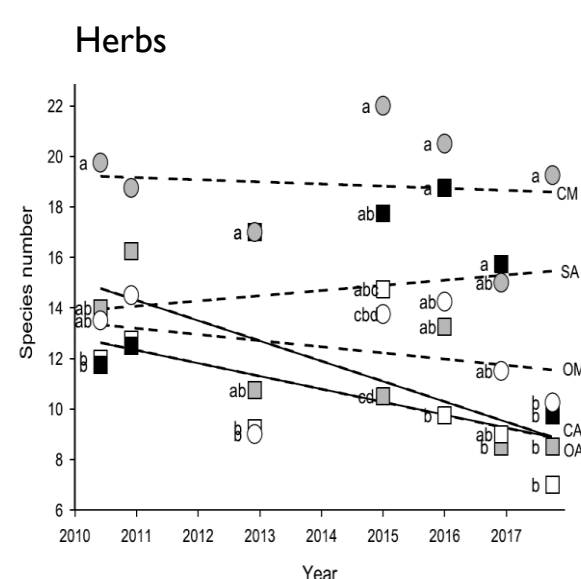


Figure 4. Herb species richness over time

Cacao yield was higher in the monocultures compared to agroforestry systems (Fig 2), but total production was 3-4 times higher in the agroforestry systems. Organic and conventional cacao yields were similar in agroforestry systems, but lower in the OM compared to the CM.

Species richness of birds was higher in the agroforestry systems compared to the monocultures. No differences were found between organic and conventional. Composition also differed between systems, with SA having similar composition as fallow plots (Fig 3).

Species richness of herbs was similar in both the most intensive system (CM) and the less one (SA). Agroforestry systems decline in number of species over time (Fig 4). CM and SA had higher number of new species registered over time, but in CM mainly generalist, exotic and herbicide resistant species while in SA, forest native and endemic species.

Ant species richness did not differ between systems but composition did, which highly changed over the years. Composition of floral visitors differed between systems, with higher abundance of potential cacao pollinators in the agroforestry systems. Agroforestry systems were also more efficient in the use of water, better regulating transpiration through stomatal size and SLA of cacao leaves.