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## Drivers and Impacts of Intensification in Smallholder Cacao Agroforestry in Central Sulawesi, Indonesia

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### Abstract

Agroforestry systems have repeatedly been praised as potential win-win situations in terms of economic returns and biodiversity, although the intensification of this land use system may also raise trade-offs. Sulawesi as a major cacao producing region had a ‘cocoa boom’ in the 1990s, resulting not only in an expansion in cropping area around the Lore Lindu National Park (LLNP) in C. Sulawesi, but also in an ongoing intensification of cacao agroforests, most notably by the removal of shade tree cover, primarily in order to increase yields and income. However, intensification is not only subject to economic incentives but is also expected to be driven by various characteristics of farming households and their land.

The relationship between cacao producing household attributes, the intensity of the cacao system (shaded vs. unshaded), cacao yields/ farmer income and biodiversity is poorly investigated so far. With the aim to contribute answers to these key issues in tropical agroecosystems, we conducted a systematic characterisation of cocoa agroforestry with 144 cocoa producing households in 12 villages around the LLNP, covering the entire intensification gradient. Yields and several yield determining factors (input of labour, agrochemicals, management) as well as plot structure parameters were surveyed (intercrops, shade tree species, canopy closure) for one year. Ecological impact data is provided by a large scale agroecological experiment in the same study region.

Cacao management currently shifts towards unshaded, intensive systems. Shade is negatively correlated with yield in both the survey and the experimental plots. Intensification by removal of shade trees partly goes along with an increased use of material and labour input. A range of farm properties including farm size, farm diversification and soil fertility and household characteristics such as poverty affect the propensity to intensify the management of agroforests. Biodiversity is not related to yield, which suggests that high yield, high biodiversity targets can be achieved if incentives are provided for appropriate management.

**Keywords:** Biodiversity, cacao agroforestry, intensification, smallholder, Sulawesi