



Tropentag, September 16-18, 2015, Berlin, Germany

“Management of land use systems for enhanced food security:
conflicts, controversies and resolutions”

Shade-Tree Diversification in Cacao Agro-Forests: A More Sustainable Model?

ARIANI WARTENBERG¹, WILMA BLASER¹, JAMES ROSHETKO², MEINE VAN NOORDWIJK², JOHAN SIX¹

¹*ETH Zurich, Dept. of Environmental System Science, Switzerland*

²*World Agroforestry Centre (ICRAF), Indonesia*

Abstract

Sulawesi is still home to some of Indonesia's remaining tropical forests, but this is quickly changing due to the expansion of logging activities, cash-crop cultivation, and the degradation of converted areas via unsustainable management practices. Indonesia is one of the world's leading producers of cocoa, and in Southeast Sulawesi, cocoa is currently the principal crop. Declining yields in existing plantations, which can be attributed to high pest and disease incidence, climate change, depleted soils, and ageing trees, might lead to increased deforestation if established systems cannot support sustained or even increased production. It is thus imperative to improve the sustainability of existing cocoa cultivation systems in the region. Diverse cocoa agro-forests are considered to contribute to general ecosystem health. However, while the beneficial effects of trees in cocoa systems are widely stated, data on the magnitude of these effects, and how they ultimately translate into effects on yields, is scarce and often controversial.

In our study, we assessed the impacts of smallholder management decisions on soil fertility across a shade-tree diversity gradient. We quantified the effects of shade-tree diversity, plot age, and fertilisation intensity on ecosystem functioning by measuring yields, soil nutrient pools, soil aggregation, pH and water holding capacity (WHC), and microbial community structure and diversity.

We found no significant effect of shade-tree diversity or fertilisation levels on soil carbon/nitrogen pools, pH and WHC, or yields. Increased shade-tree presence negatively impacted total soil phosphorus pools. We observed significantly higher soil aggregation and SOM content in macro-aggregate fractions, as well as higher microbial diversity and total biomass, in secondary forests as compared to managed cocoa-based systems. Total microbial biomass was significantly higher in older plots.

These initial results suggest that in Sulawesi, shade-tree diversification may not have the clear benefits for soil fertility and yields generally associated with diverse agroforestry systems. Still, trees may have beneficial effects on other ecosystem services such as biodiversity conservation or pest and disease control. Further research is needed to investigate this. It is also likely that other factors such as pest occurrence or microclimate may have more direct effects on yields and productivity.

Keywords: Cocoa, Indonesia, shade-tree diversification, smallholder agro-forestry, soil fertility