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Sweet as Chocolate: Stabilisation of Ecosystem Services by Production of Cocoa in high-shade Agroforestry Systems in Central Sulawesi (Indonesia)

JAN BARKMANN, EVA MARIA SCHNEIDER, STEFAN SCHWARZE

Georg-August-Universität Göttingen, Department of Agricultural Economics and Rural Development, Germany

Abstract

Indonesia is a leading international cocoa producer. Within Indonesia, cacao agroforestry expansion is concentrated in the province Central Sulawesi including the region around Lore Lindu National Park (LLNP), where cacao area rose from zero (1979) to 17,984 ha (2001) and where new plots are partly established within LLNP. Additionally, an intensification syndrome with reduced and less diverse shading tree cover, and with increased fertiliser and pesticide application spreads in the region. These developments threaten remaining core ecosystems of the global Wallacea biodiversity ‘hotspot’.

Based on data from 289 representative households in 12 villages of the LLNP region with 201 cacao plots, we economically compared extensive and medium intensified cacao agroforestry plots (average shading 70%; 31% of regional cacao agroforestry area) with more intensively managed plots (average shading 30%; 69% of area). Based on results from several coordinated ecological studies in the region, a shading reduction from 70% to 40% and below reduces total species richness of terrestrial herbs by $\frac{1}{2}$, and nearly eliminates forest herbs. Also canopy ants and wasps substantially decline, and parasitism of herbivorous insects is likely to be reduced by $\frac{1}{2}$. For extremely low and zero-shading situations, much more dramatic results have been documented previously.

On average, more extensive plots yielded 347 US\$ ha⁻¹yr⁻¹ gross margin, more intensive plots 546 US\$ ha⁻¹yr⁻¹. Second order stochastic dominance analysis reveals that - because of price and yield risks - more intensive agroforestry is not generally superior, however. Accounting for these risks, an additional gross margin of 160 US\$ ha⁻¹yr⁻¹ (0.39 US\$ kg⁻¹) would be sufficient to revert to high-shading agroforestry systems. Considering international price premiums for “fair trade” organic cocoa of up to >0.40 US\$ kg⁻¹, these results indicate a market-based potential for high-shading cocoa production that stabilises the provisioning of several ecosystem services and forest species habitat.

A certification scheme for “biodiversity-friendly” cocoa production has to guarantee production outside LLNP to avoid additional incentives for forest encroachment. In addition to external audits, effective monitoring and enforcement, a village-centred approach may be required as village headmen are regularly the decisive authority in local land access issues.

Keywords: Agroforestry, biodiversity, certification, cocoa, deforestation, economic incentives, ecosystem services, national park

Contact Address: Jan Barkmann, Georg-August-Universität Göttingen, Department of Agricultural Economics and Rural Development, Platz der Göttinger Sieben 5, D-37073 Göttingen, Germany, e-mail: jbarkma@gwdg.de