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Title

Promoting biodiversity conservation and economic sustainability in the cocoa sector

Abstract

Sustainable production of cocoa (*Theobroma cacao*) remains a major challenge in tropical regions, where its production is associated with the loss of tropical forests, biodiversity and associated ecosystem services, but employs a large share of the poor. Agroforestry systems and certification schemes have been proposed as strategies to promote sustainability in the cocoa supply chain. However, the ongoing trend of widespread management intensification in cocoa agroforestry systems, which involves the removal and reduction of shade trees as attempts to increase local crop productivity, is compromising their biodiversity conservation value. Addressing this challenge requires an interdisciplinary perspective, but evidence that combines environmental and economic insights is limited. This research project aims to better understand the environmental and economic impacts of increased intensification of cocoa production for the conservation value of cocoa agroforestry and its economic profitability for smallholders, with a focus on cocoa cultivation in the region of Southern Bahia, Brazil. To meet this goal, we will use an interdisciplinary approach that combines farm-household interviews among 300 households and farm-level biodiversity assessment surveys among a sub-sample of 30 cocoa agroforestry farms.

First, we will analyse the environmental and economic trade-offs and synergies between biodiversity conservation and cocoa productivity along a shade-tree management gradient. To address this objective, we will assess the extent to which shade-tree management affects the persistence of an endemic primate species of conservation concern, the golden-headed lion tamarin (GHLT; *Leontopithecus chrysomelas*), and the larger mammal community. Playback surveys will be used to assess GHLT presence while camera traps will be used to determine large- and medium-sized mammal presence. Vegetation surveys will be conducted to determine the vegetation structural complexity and quantify vegetation variables affected by management intensification practices. In addition, we will use quantitative structured questionnaires to collect economic data and determine the variation in cocoa productivity and farmer's income among cocoa agroforestry farms with different management intensities. We expect that management intensification in agroforestry systems likely leads to a gradual decline in its conservation value, reducing its use by species of conservation concern while increasing its use by generalist mammals. In contrast, increased intensification in cacao agroforestry systems is expected to increase crop productivity and thereby farmers' income.

Secondly, we will evaluate the effectiveness of cocoa certification standards for enhancing biodiversity conservation and smallholders' livelihoods. We will focus on Sul da Bahia Geographic Indication (GI) that aims to promote regional economic development and shade cocoa agroforest preservation. We will investigate the ecological and economic impacts of GI certification in certified and non-certified farms using propensity score matching. Positive livelihood outcomes for certified cocoa farmers are expected to be more likely than environmental benefits, given the limited ecological criteria outlined in the GI certification standards.

Finally, we aim to deliver recommendations for improving the sustainable management of cocoa agroforestry systems and strengthening GI certification standards to benefit biodiversity conservation while ensuring farmers' profits.