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Biomass and Carbon Stocks Related to Ecological Complexity and Tree Diversity in Three Different Cocoa Production Systems

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Abstract

In tropical regions, large forest areas are constantly converted into agriculture contributing with about 17% to global greenhouse gas emissions. Given that tropical areas are most vulnerable to climate change impacts, the need increases to identify and to implement sustainable land use systems that sequester carbon and provide ecosystem services at the same time. Cocoa as a perennial crop which grows well in association with shade trees is one option for vulnerable agricultural areas on tropical rainforest margins. The aim of this research was to compare C-stocks in complex and simple cocoa agroforestry systems and common practice monocultures in Bolivia, and to evaluate the role of local organisations for agricultural diversification. Carbon stocks were then linked to the different types of cropping systems and the related variables age of the plantation, tree and crop diversity and ecological complexity. In 15 plots of 2304 m² each, aboveground and belowground biomass as well as tree and crop diversity was sampled. Then the role of the affiliation to a cocoa cooperative and/or other local organisations for diversity was evaluated by interviewing cocoa farmers with and without affiliation to a local organisation. Results show that C-stocks correlated significantly with the Holdridge-Index for ecological complexity, as well as with tree diversity and with the proportion of shade trees. The results of the interviews indicate that local institutions enhance agricultural diversification and agroforestry by awareness rising, further education, and opening markets for agroforestry products. The integration of ecological and social data allows to conclude that cocoa producers diversify their cocoa plots if provided with agricultural extension services from local organisations, most of all those working with organic certification. This indicates that organic cocoa cultivation, if oriented towards diversified agroforestry, not only contributes to climate change adaptation but also to its mitigation by sequestering more carbon than common practice cocoa plots.

Keywords: Agroforestry, Bolivia, cocoa, cooperatives