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Agronomic and economic performance of agroforestry and full-sun monoculture systems in a newly established cacao plantation in Alto Beni, Bolivia

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Over the last decades the global demand for cacao (*Theobroma cacao* L.) has drastically increased. The cultivated area has been expanded in tropical forest areas and production has been intensified by replacing traditional agroforestry systems with full-sun monocultures at high-input levels. This has led to a loss of biodiversity in tropical areas. Monocultures are commonly reported to be more productive than agroforestry systems, but the latter can help to conserve biodiversity and ecosystem services by resembling natural forest. However, the farmers' adoption of one or another production system strongly depends on their economic feasibility.

In this study we compare the agronomic and economic performance of four different cacao production systems, i.e. agroforestry and full-sun monocultures under organic and conventional management during the first five years of a newly established field trial. Cacao and by-crops (plantain/banana) yields, costs, revenues, and labour demand were registered, and the gross margin and return to labour, i.e. the return per working day, were estimated for each system.

Cacao yields were higher in the monocultures compared with the agroforestry systems. No differences were found between organic and conventional management in the agroforestry systems, but higher yields were obtained under conventional management in the monocultures.

The sales of by-crops of the agroforestry systems economically overcompensated for the difference in cacao yield between agroforestry and monoculture systems, which highlights the role of by-crops to the contribution to farmer's income during the establishment phase. The costs were lower in the agroforestry systems due to lower fertilization rate applied and less weeding. Overall, the return to labour was almost the double in the agroforestry systems.

In conclusion, agroforestry systems have the potential of both improving farmer's income at the establishment phase of the plantations and biodiversity in cacao production regions.

Keywords: cacao plantation, by-crops, economic analysis, agroforestry systems