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Maintaining Carbon Stocks and Tree Diversity in Agroforestry Systems in the Sub-Humid Pacific Region in Nicaragua

Pablo Siles[1], Diego Valbuena[1], Rein van der Hoek[1], Orlando Tellez[1], Glenda Bonilla[2], Aracely Castro[3]

[1] *International Center for Tropical Agriculture (CIAT), Nicaragua*
[2] *National Agricultural University, Nicaragua*
[3] *Food and Agriculture Organization of the United Nations, Land and Water Division (NRL), Italy*

Abstract

The seasonally dry tropical forest (SDTF) of Mesoamerica has been highly transformed by deforestation, burning, agriculture expansion and extensive livestock production, causing extensive habitat destruction and fragmentation resulting in soil degradation, biodiversity loss and an overall reduction of other ecosystem services. Silvopastoral systems (SPS) and Quesungual slash-and-mulch agroforestry system (QSMAS) have been promoted to restore key ecosystem services. A study was implemented to: i) quantify the potential impact of different land-use systems in tree diversity and C regulation; and ii) understand potential trade-offs of these two ecosystem services in a SDTF in northern Nicaragua in five major land-uses : SPS, QSMAS, naturalized pastures (NP), slash and burn traditional cropping system (TCS) and secondary forest (SF). In 144 plots (0.1 ha each), we estimated tree composition (dbh >2.5 cm), species richness, diversity (Shannon) and carbon stocks (fractioned in aboveground, litter, dead wood, soil at 20 cm depth). We recorded 2655 trees belonging to 110 species and 45 families. Land-uses differed significantly in terms of abundance, diversity, and floristic composition of tree species. SF was the most diverse land-use, followed by QSMAS and SPS. SF and QSMAS were more similar in composition compared to the others land-uses, Regarding above-ground biomass, SF measured 88 Mg ha^{-1} and QSMAS 33 Mg ha^{-1}, whereas 3 Mg ha^{-1} in TCS. Soil organic C pools were similar between land-uses, with more variability in SF. Total C pools ranged between 102 in SF, 60 in QSMAS, 54 in SPS, 46 in NP and 39 Mg C ha^{-1} in TCS. Soil C accounted from 54 % to 80 % of the total C in SF and QSMAS, whereas up to 96 % in TCS as expected. Results confirmed that QSMAS and SPS can improve both tree diversity conservation and C storage. These synergies can be further enhanced by co-designing with farmers linking better tree diversity and potential use to ensure rural households. The adaptation of these systems could also include farmer incentive mechanisms to restore the multi-functionality of farming systems and rural landscapes in SDTF of Central America.

Keywords: Biodiversity conservation, seasonal dry tropical forest, smallholder agriculture, sub-humid region

Contact Address: Pablo Siles, International Center for Tropical Agriculture (CIAT), Soils, Managua, Nicaragua, e-mail: p.siles@cgiar.org