

EFFECTS OF DIFFERENT AGRICULTURE SYSTEMS ON SOIL QUALITY IN NORTHERN LIMÓN PROVINCE, COSTA RICA

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Conversion of native rainforest ecosystems in Costa Rica's Limón Province to banana and pineapple monoculture has led to reductions in biodiversity and soil quality. Agroforestry management of cacao (*Theobroma cacao*) is an alternative system that may maintain the agricultural livelihood of the region while more closely mimicking native ecosystems. This study compared physical, biological and chemical soil quality indicators of a cacao plantation under organic agroforestry management with nearby banana, pineapple, and pasture systems; a native forest nearby served as a control. Conventional vs. organic cacao management was also compared. Cacao had a lower bulk density than the banana and pineapple monocultures, but greater than the forest ($P < 0.05$). The cacao also hosted a greater number and mass of earthworms than banana and pineapple ($P < 0.05$), but similar to forest and pasture. Standing litter crop was greater in cacao than forest and banana ($P = 0.0014$), but litterfall over one month was greater in forest than the cacao ($P = 0.0019$). The forest and pineapple ecosystems had the lowest pH, cation exchange capacity, and exchangeable nutrient cations, while cacao had the highest ($P < 0.05$). Total nutrient levels of P and N were slightly higher in the banana, pineapple and pasture than in the cacao, but this is probably related to addition of chemical fertilizer and manure from cattle grazing. The forest and cacao also had greater %C, which is directly related to the amount of soil organic matter, than the other ecosystems ($P \leq 0.0001$). Overall, the cacao had more favorable physical, biological and chemical soil characteristics than the banana and pineapple monocultures, while trends were less conclusive compared to the pastureland. No significant differences were noted between organic and conventional cacao systems. While organic cacao was inferior to native forest in some soil characteristics such as bulk density and organic carbon, its soil quality did best mimic that of the native forest. This supports the cultivation of cacao as a desirable alternative to banana and pineapple monoculture.