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Cash crop diversity and erosion control across smallholder farms in coastal Ecuador: A spatial assessment

Malena Torres Ulloa[1,2], Vladimir Verner[1], Ramón Espinel[2], Diego Portalanza[3], Eduardo Álava[2], Omar Ruiz Barzola[4], Patrick Van Damme[1]

[1] *Czech University of Life Sciences Prague, Fac. of Tropical AgriSciences, Czech Republic*
[2] *Escuela Superior Politécnica del Litoral, Rural Research Center, Faculty of Social Science, Ecuador*
[3] *Agrarian University of Ecuador, Fac. of Agricultural Sciences, Ecuador*
[4] *Littoral High Polytechnic School, Faculty of Natural Sciences and Mathematics, Ecuador*

Abstract

In Ecuador's coastal region, agriculture is dominated by cash crop monocultures, which are frequently associated with increased soil erosion, particularly when ground cover is limited, or conservation practices are lacking. Within this landscape, family farming systems (FFSs) occupy approximately 50 % of the agricultural area. Despite their significant presence, FFSs have received limited attention in ecosystem service research, particularly regarding their role in regulating erosion (EC), a key function for maintaining soil stability and long-term productivity. This study assessed the relationship between cash crop diversity and the relative provision of EC in cocoa-based FFSs located in Vinces canton, Los Ríos province. The analysis was based on 131 farms managed by members of a local agricultural association. Family farms (FF) were clustered into three types based on variables like hired and family labour, cocoa area, area under other crops and the Shannon diversity index (H'). Non-family farms (Non FF) were grouped as a single category. To estimate EC, satellite imagery from Landsat 9 was processed using the "Collaborative protocol for the evaluation and mapping of ecosystem services and socio-ecological vulnerability for land use planning" (ECOSER), integrating aboveground biomass, NDVI, and slope to quantify erosion regulation potential at farm level. A generalised additive model (GAM) was used to analyse the relationship between crop diversity (H') and EC, incorporating farm type as a categorical predictor. Kruskal-Wallis tests indicated no significant diberences in EC levels among farm types ($p = 0.248$). However, the GAM revealed a significant negative association between crop diversity and EC in Farm Type 2 ($p = 0.038$), with no significant ebects for other groups. The model's low explanatory power (adjusted $R^2 = 0.020$) suggests that crop diversity alone does not adequately account for variation in EC. These results highlight the complexity of ecosystem service provision, suggesting that factors beyond crop diversity, such as management practices or environmental conditions, may influence EC. Further research is needed to explore these factors and improve the understanding of ecosystem services in the region.

Keywords: Agroecosystem, ECOSER, ecosystem services

Contact Address: Malena Torres Ulloa, Czech University of Life Sciences Prague, Fac. of Tropical AgriSciences, Kamýcká 129, 16500 Suchdol, Czech Republic, e-mail: torres_ulloa@ftz.czu.cz