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Roots of resilience: exploring the impact of agroforestry on food security in western rwanda

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Abstract

The world is challenged to meet the food demand of a growing population, especially in developing countries. Consequently, food insecurity remains a reality for 757 million people (FAO et al. 2024). Sub-Saharan Africa remains amongst the most food insecure regions in the world, with 20.4% of the population showing prevalence of undernourishment (FAO et al. 2024). In this region, rising population pressure has forced farmers to shorten fallow periods or practice continuous cropping, even on hillslopes, accelerating erosion, depleting soil organic matter, and causing nutrient loss without adequate replenishment.

While interventions often focus on raising agricultural productivity, the role of landscape diversity remains underexplored. Agroforestry, defined as the integration of trees into farming systems, is proposed as a low-input, sustainable solution to enhance food production and ecosystem resilience. However, empirical evidence on its mechanisms and impacts on household food security is limited, especially regarding diverse pathways of influence and the role of tree species composition.

This study investigates how agroforestry affects food security among smallholder farmers in Western Rwanda, using cross-sectional data from 598 households across four districts. We analyse four key pathways: (1) direct consumption, (2) agroecological, (3) income, and (4) energy provision. Unlike previous research, we explicitly consider the diversity of tree species to assess its role in mediating these pathways.

Preliminary findings suggest that agroforestry contributes to food security through multiple, interconnected channels. Direct consumption of tree-based foods and income from tree products emerge as significant predictors of improved household nutrition, while agroecological and energy pathways show context-dependent effects. Notably, tree species diversity enhances ecosystem services, supporting both crop production and dietary diversity.

These results underscore the importance of tailored agroforestry interventions that account for local ecological and socio-economic contexts.

Keywords: Agroforestry systems, ecosystem services, food security, rural development , smallholder livelihoods