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Integrated crop–livestock–tree systems in Africa and Asia: A systematic review of resilient, climate-smart, and multifunctional agro-ecosystems

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Abstract

Integrated crop–livestock–tree (ICLT) systems, also known as agro-silvo-pastoral systems, have been promoted as sustainable land-use strategies capable of addressing the interconnected challenges of food security, environmental degradation, and climate change in smallholder farming systems. However, evidence regarding their ecological, socio-economic, and climate resilience outcomes remains dispersed across disciplines, regions, and production contexts, limiting a comprehensive understanding of their multifunctional performance. This systematic review addresses three key questions: (i) What ecological, socio-economic, and climate resilience outcomes are associated with ICLT systems in Africa and Asia? (ii) How do these outcomes vary across agro-ecological and socio-economic contexts? and (iii) What factors facilitate or constrain the adoption and scaling of ICLT systems? Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, we systematically screened peer-reviewed literature published between 2000 and 2025 and analyzed 186 eligible studies from diverse agro-ecological regions in Africa and Asia. Studies were coded and synthesized using a thematic framework encompassing ecosystem services, farm productivity, livelihood outcomes, climate adaptation, and institutional drivers of adoption. The review reveals that ICLT systems consistently enhance soil fertility, biodiversity conservation, nutrient cycling, and carbon sequestration while improving farm productivity, income diversification, and resilience to climatic shocks. However, the magnitude of these benefits varies considerably across agro-ecological zones and management intensities. A key finding is that socio-economic and institutional factors—including land tenure insecurity, limited access to extension services, inadequate policy support, and high initial investment costs—are more influential in determining adoption than biophysical constraints alone. Furthermore, the review identifies important geographical and thematic research gaps, particularly regarding long-term system performance, trade-offs among ecosystem services, and the integration of climate adaptation metrics into system evaluation. By synthesizing evidence across ecological and socio-economic dimensions, this review provides a more integrated understanding of how ICLT systems contribute to sustainable agricultural intensification and climate resilience. The findings highlight the need for context-specific policies, interdisciplinary research, and inclusive governance mechanisms to support the wider adoption and scaling of multifunctional agro-ecosystems in Africa and Asia.

Keywords: Africa, agroecology, agroforestry, Asia, climate-smart agriculture, mixed farming systems, resilience, sustainable land use

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