Tropentag, September 10-12, 2025, hybrid conference

"Reconcile land system changes
with planetary health"

Contribution of agroforestry to livelihoods and climate change mitigation in east Africa

Shem Kuyah[1], Catherine Muthuri[2], Wakaba Denis[3], Cory Whitney[4], Caroline Njoki[5]

[1] *Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya*
[2] *Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF),*
[3] *Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF),*
[4] *University of Bonn, Inst. Crop Sci. and Res. Conserv. (INRES) - Horticultural Sci., Germany*
[5] *Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF), Kenya*

Abstract

Agroforestry offers a transformative approach to sustainable intensification by creating multifunctional landscapes that enhance ecological functions, boost productivity, and support rural livelihoods. Its widespread adoption by smallholder farmers, along with its potential to contribute to restoration and climate goals under the Paris Agreement, makes it a promising nature-based solution. However, a systematic understanding of its carbon sequestration potential remains limited, particularly concerning the contribution of different agroforestry practices. In particular, the role of fruit tree integration is often overlooked due to the lack of accurate allometric equations for biomass estimation.

To address these gaps, we conducted a systematic review and an empirical study. A comprehensive search of Web of Science and SCOPUS yielded 185 publications meeting our criteria, including 152 on livelihoods and 43 on carbon sequestration. Results show agroforestry significantly improves household resilience while contributing to carbon storage. Key livelihood benefits reported include fodder (70 studies), food (63), firewood (56), and income (40), offering diversified support, especially during climate shocks. Yet, carbon credit income was rarely mentioned, pointing to policy and scientific gaps in carbon rights, land and tree tenure, and the effects of climate change on tree species distribution. Our review found that East African agroforestry systems store on average 24.2±2.8 Mg C ha ^{1} in biomass and 98.8±12.2 Mg C ha ^{1} in soil. Among practices, homegardens were most multifunctional and carbon-rich (34.3±7.9 Mg C ha ^{1}), followed by perennial tree–crop systems (29.9±12.7) and boundary trees (26.7±14.1).

To complement the review, we developed species-specific allometric equations for avocado (AGB=0.0638×DBH2.5435; n=40) and mango (AGB=0.083×μDPB2.184; n=51) trees and estimated carbon stocks from these major fruit trees in two contrasting Kenyan counties. In Kiambu (subhumid), an inventory with 466 avocado trees yielded 20.6±5.4 Mg ha ^{1} AGB. In Makueni (semi-arid), 230 mango trees contributed 22.3±6.3 Mg ha ^{1} AGB.These findings highlight agroforestry's vital role in carbon storage and climate adaptation. Incorporating fruit trees into carbon initiatives can avoid food security trade-offs while advancing restoration and mitigation goals. Our allometric models support the integration of fruit trees into carbon accounting, reinforcing agroforestry's dual benefits for livelihoods and climate resilience in East Africa.

Contact Address: Shem Kuyah, Jomo Kenyatta University of Agriculture and Technology (JKUAT), 62000, 00200 Nairobi, Kenya, e-mail: kshem@jkuat.ac.ke

Keywords: Allometric equations, Carbon sequestration, Fruit trees, Landscape restoration, Nature-based solutions