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# Integrated Food and Biomass Production Systems for Enhanced Food Security and Environmental Sustainability in Tanzania

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## Abstract

Land degradation, reflected in soil fertility depletion and declined vegetation cover, is still a major biophysical constraint to sustained agricultural productivity in Sub-Saharan Africa (SSA). This problem is aggravated further by high rate of wood extraction for woodfuel (firewood and charcoal) supply, which accounts for 27 % of deforestation in Tanzania. Technologies integrating crops and biomass production with efficient use of woodfuel are critical for intensifying agriculture in SSA to enhance food security and minimise land degradation. Limited information on the socio-economic benefits of this integrated approach affects adoption. We evaluated socio-economic and health benefits of integrating agroforestry and improved cooking stove (ICS) technologies to sustain maize and fuelwood supply in Dodoma, Tanzania. Household fuelwood consumption and socio-economic benefits from improved cooking stove adaptors were determined using the controlled cooking test (CCT) and questionnaire survey. Gas and particulate matter (PM10) emissions were determined using gas analyser and particulate matter sampler, respectively. Three stone fire stove (3STF) was used as a reference for the CCT. Allometric equations were developed to assess wood biomass of trees in shelterbelts, woodlot, Gliricidia-maize intercropping, on contours and farm boundaries. The CCT revealed that, ICS save 50 % of firewood and 40 % of cooking time, leading to 50 % reduction in the firewood budget per meal compared to 3STF. Accordingly, annual firewood consumption and collection time in household adopting ICS were reduced by 67 % and 50 %, respectively. Similar results (56–65 % reduction) were also noted for emissions of PM10 and gases (CO, SOx, NO, and NOx in mg/nm$^3$). Tested agroforestry practices produced 0.5–8 t/ha of wood, which was sufficient to satisfy a 5-member household for 11 and 34 months when using traditional 3STF and ICS respectively. The reduction of firewood budget, time for cooking and fuelwood collection and gas emission reflect economic, health and environmental benefits of ICS technologies. Additional benefits were noted when ICS was linked to on-farm wood production. Apparently on-farm wood supply holds high promise to meet household cooking energy demand when combined

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with ICS. Besides firewood, Gliricidia intercropping produced maize grain yield (1.2 t/ha — 3.2 t/ha), signifying contributions of this integrated approach to sustain food production.

**Keywords:** Agroforestry, Controlled Cooking Test, GHG emissions, Improved Cooking Stoves, Semiarid zones