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“Filling gaps and removing traps  
for sustainable resource management”

## Reducing Forest Degradation: Energy Self-Sufficiency for Smallholder Farmers via Agroforestry Systems in Semi-Arid Tanzania

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### Abstract

High dependency on firewood to meet households' cooking energy demand is one driver of forest degradation in rural Tanzania. In order to be energy-independent from external firewood sources small-scale farmers may take measures such as on-farm firewood supply as well as the use of energy-efficient cooking to balance domestic firewood consumption. We used the “controlled cooking test” protocol to determine the firewood consumption of three-stone-fire stoves and energy-efficient improved cooking stoves. We assessed the on-farm firewood production potential of *Gliricidia sepium*. In total we analysed 3 blocks with two intercropping treatments each with a plot size of 256 m<sup>2</sup>: maize and *G. sepium* (treatment 1), and maize, pigeonpea and *G. sepium* (treatment 2). The *G. sepium* shrubs were planted in 2014 with a spacing of 4 x 4 m<sup>2</sup>. For treatment 1, maize and *G. sepium* the wood biomass production was 36.7 kg (SD 12.3) in 2018, and 129.7 kg (SD 71.4) per 256 m<sup>2</sup> in 2019. For treatment 2, the wood biomass production was 19.7 kg (SD 1.6) in 2018, and 70.0 kg (SD 15.2) per 256 m<sup>2</sup> in 2019. The extrapolated data showed a firewood production potential of treatment 1 of 1432.7 kg, and of 767.8 kg for treatment 2 in 2018; in 2019 the potential area 5066.1 kg and 2731.8 kg per hectare.

The annual *G. sepium* firewood consumption of a five-head household to meet its cooking energy demand is 1298 kg with improved cooking stoves and 1815 kg with three-stone fire stoves. To determine the firewood self-sufficiency rate, we calculated the ratio of firewood production potential and consumption. In 2018, 88.3 % (treatment 1) and 47.3 % (treatment 2) with improved cooking stoves and 63.1 % (treatment 1) and 33.8 % (treatment 2) with three-stone-fire stoves of households' cooking energy demand could be covered by firewood from intercropped *G. sepium*. In 2019, the on-farm firewood production surpassed the demand: 312.2 % (treatment 1) and 168.4 % (treatment 2) with improved cooking stoves as well as 223.3 % (treatment 1) and 120.4 % (treatment 2) with three-stone-firewood of the households' cooking energy demand could be covered.

**Keywords:** Energy self-sufficiency, *Gliricidia sepium*, improved cooking stoves, on-farm firewood, semi-arid Tanzania, three-stone-fire stoves