Tropentag, September 15-17, 2021, hybrid conference

"Towards shifting paradigms in agriculture
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Modelling On-Farm Above-Ground Woody Biomass Production for Smallholder Agroforestry Systems in Semi-Arid Tanzania

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Abstract

Fuelwood is the main source of cooking energy in rural Tanzania; the dependency on fuelwood from off-farm sites is high. Ongoing forest degradation and deforestation negatively affects women and children who are mainly responsible for collecting fuelwood in rural areas.

On-farm produced fuel can reduce or off-set households' need for off-farm fuel without compromising food production at the same time. In semi-arid Tanzania, on-farm above-ground woody biomass production (AGB) of *Gliricidia sepium* (*G. sepium*) and pigeon pea have not been quantified yet. Our aim was to enable farmers to estimate their on-farm fuel production based on dendrometric variables such as root collar diameter assessed 20 cm above the collar (RCD20) and stem height in order to optimise their farm production plans. Using a destructive sampling approach, we assessed 112 *G. sepium* and 80 pigeon pea plants with an age of less than 12 months. We fitted arithmetic (non-linear) and log-transformed (linear) models to estimate AGB from the legumes *G. sepium* and pigeon pea intercropped with maize.

Log-transformed linear models met the assumptions of linear regression using the ordinary least square (OLS) estimator. Findings suggest that RCD20 is the most efficient predictor for AGB production for *G. sepium* and pigeon pea in semi-arid Tanzania. While stem height alone was not a good predictor to estimate ABG fuel biomass production of *G. sepium* (R^2 = 40.6 %) and pigeon pea (R^2 = 83.2 %), RCD20 as a single predictor explained 89.6 % (R^2) of the variation of AGB production of *G. sepium* and 91.4 % (R^2) of pigeon pea. A combination of RCD20 and stem height to predict AGB production was neglected due to multicollinearity of the variables and due to the fact that additional effort is required to assess both RCD20 and stem height.

Using the developed models, smallholder farmers can estimate there on-farm AGB by assessing dendrometric indicators such as RCD20 (and stem height) of *G. sepium* and pigeon pea. On-farm fuel production reduces households' dependency on external fuelwood which might have major socio-economic knock-on effects on rural livelihoods especially with regard to food security.

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Keywords: Agroforestry, Allometric modelling, *Gliricidia sepium*, Intercropping, on-farm fuel production, Pigeon pea, Semi-arid Tanzania