Multi-dimensional impacts of tropical forage technologies in Sub-Saharan Africa: A meta-analysis

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Background

- Tropical forage technologies have been disseminated across Sub-Saharan Africa (SSA) and are expected to impact positively on productive, economic and environmental performance of farming systems
- To date, few studies have provided a comprehensive and quantitative overview on multi-dimensional impacts of introducing tropical forage technologies across different agroecologies in SSA

Fig.1: *Brachiaria* grown by a farmer in Tanzania and at Karama research station in Rwanda

Objectives

1. Estimating response ratios of forage technology impacts on soils, crop and livestock production and economic performance
2. Analyzing (controlling) factors influencing effect sizes of treatments

Materials and methods

- A systematic literature search was conducted with Scopus, the largest database of peer-reviewed literature
- Specific search terms were used to extract forage related publications from SSA – only studies with quantitative results and a control treatment were included
- 108 studies with a total of 754 observations were included in the analysis, carried out with R-statistical programming software
- Mean response ratios (treatment over control across all studies) of forage technologies were estimated on various productive, economic and environmental indicators (Table 1)

Results

Impact dimension	Indicator	Unit	Number of studies	Number of observations
Fodder productivity				
	Biomass yield	t/ha	16	216
	Crude Protein	% of DM	25	104
	Metabolizable energy	Mj/kg DM	4	16
Food productivity				
	Grain yield	t/ha	21	193
Livestock productivity				
	Milk production	l/day	19	45
	Dry matter intake	g/kg $BW^{0.75}$		
	Live weight gain	g/day	16	94
Economic viability				
	Net benefit	US$/ha	5	20
	Cost/benefit	US$/ha		
Soils				
	Soil loss	Mg/ha	4	42
	SOC	g/kg	1	6
	Runoff		2	6
Pest/disease control				
	Striga	no.	3	308
	Stemborer	no.	2	26

Table 1: Impact dimensions and their main indicators used in the meta-analysis

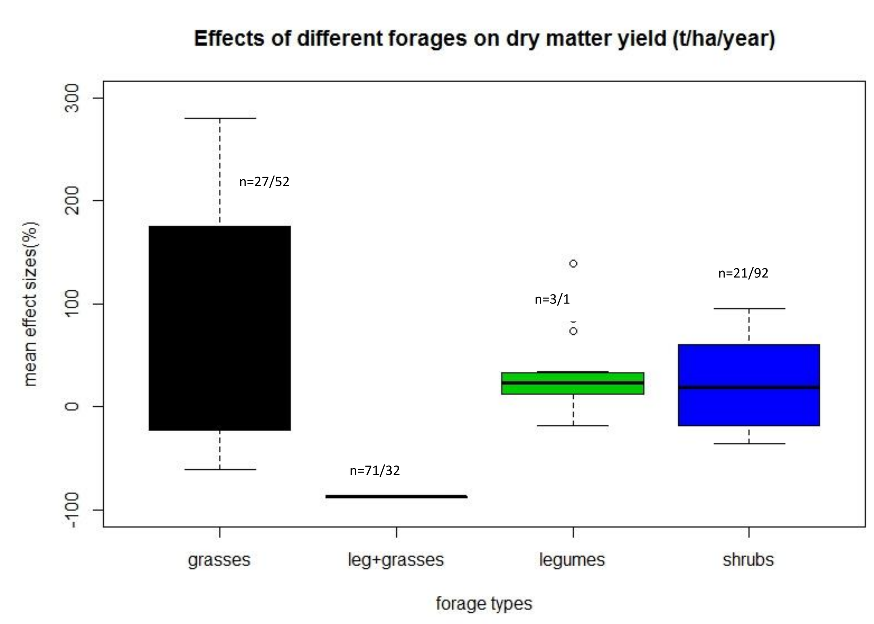

Fig.1: Effects of different types of forages on dry matter yield (t/ha/year)

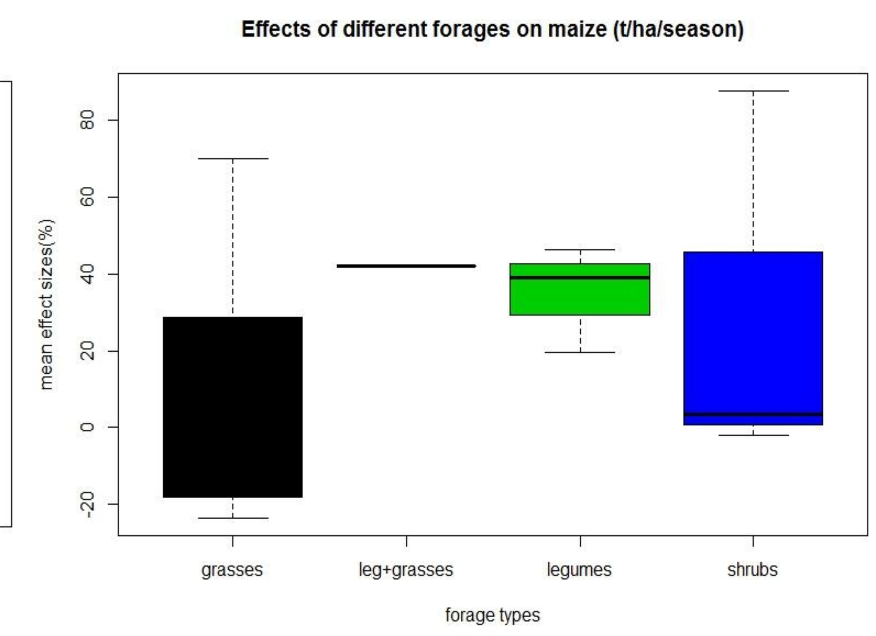

Fig.2: Effects of different types of forages on maize yield (t/ha/season)

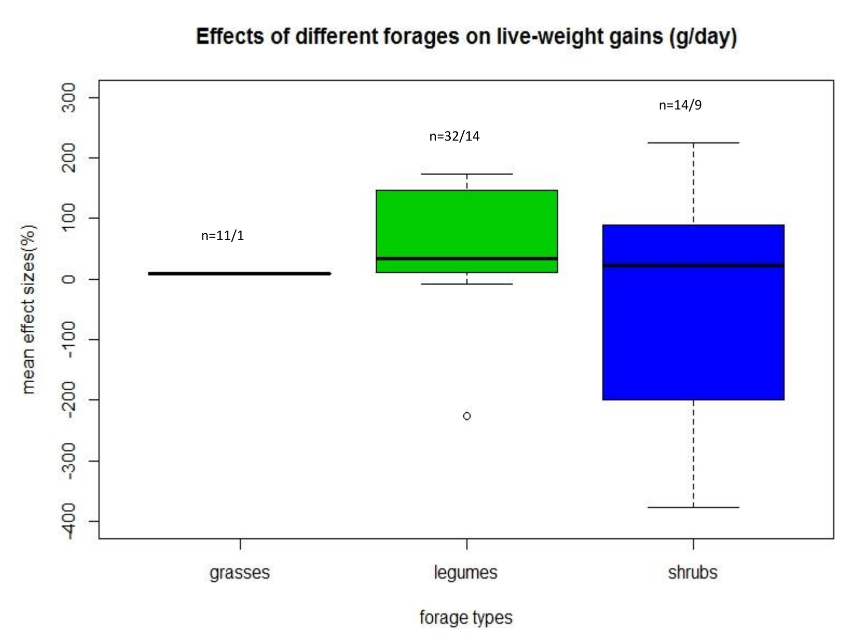

Fig.3: Effects of different types of forages on live-weight gains (g/day)

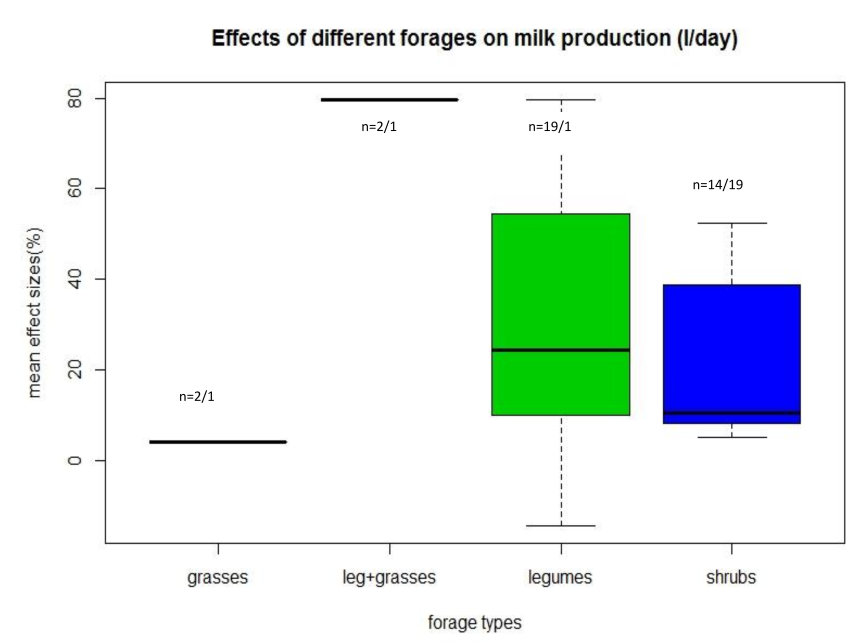

Fig.4: Effects of different types of forages on milk production (l/day)

Discussion and conclusions

- Improved grasses are the most effective in increasing herbage dry matter yield by a mean of 76.41% when compared to the control and leguminous shrubs result in the lowest increase (22.84%).
- Supplementing baseline natural grasses with a mixture of herbaceous legumes and improved grasses results in the highest increase in milk production (79.66%) compared to feeding improved grasses alone (4.05%)
- Livestock feed supplementation with leguminous shrubs results in the highest live-weight gains by 33.43% and improved grasses alone the lowest (9.76%)
- Cultivating leguminous shrubs has the highest effect on soil-loss reduction across all slopes, with the highest soil loss reduction occurring at >30% slope (by 74.36%) compared to improved grasses (by 65.85%).
- Incorporating legumes into cropping systems and feeding regimes resulted in the highest increase in seasonal net benefits (21%) and gross revenue (100%) compared to shrubs (1.55% and 49.19% respectively)

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