

Agroforestry-based interventions and innovations to address soil nutrition and soil health issues

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Defining Agroforestry

A dynamic, ecologically based, natural resource management system that, through integration of trees on farms and in the agricultural landscape, diversifies and sustains production and builds social institutions.



Tree-Based Soil Health Management Technologies/practices

Short Rotation- Non-coppicing shrubs

- Relay intercropping Fallows (Tephrosia, Pigeon pea, Sesbania)
- Improved Rotational Fallows (Tephrosia, Pigeon pea, Sesbania)

Coppicing Shrubs

- Gliricidia, Leucaena spp. Acaciella

High or Full canopy Species

- *Faidherbia albida* (planted or FMNR)
- Multi-Tree Species (FMNR) ?



Annual soil nutrient depletion in selected Southern African countries

Country	Nutrient depletion (kg ha/yr)		
	N	P	K
Malawi	−48	−7	−37
Mozambique	−23	−4	−19
Zambia	−13	−1	−12
Zimbabwe	−20	−1	−21
Tanzania	−38	−6	−25

Soil Organic Carbon depletion

Maintenance of soil nutrients and health through fertilization

Inorganic fertilisers

Composts

Farmyard manure

Green Manure crops e.g. *Crotalaria mukuna*

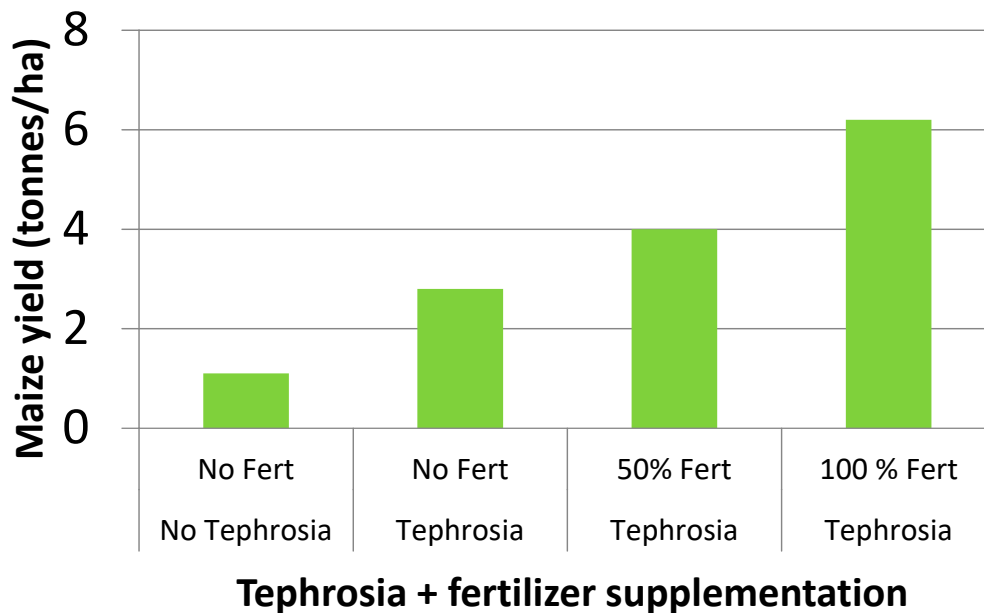
Leguminous fertiliser trees

Fertiliser Trees for enhancing Soil Fertility and Soil health

- Non-coppicing shrubs: e.g. *Sesbania sesban*, Pigeon pea, *Tephrosia*
- Coppicing Trees: e.g. *Gliricidia sepium*, *Leucaena* spp., *Acaciella angustissima*
- Full Canopy Trees: *Faidherbia albida* (musangu)

Improved Relay Fallows
are established annually.

Trees are planted within
2 weeks of planting
maize



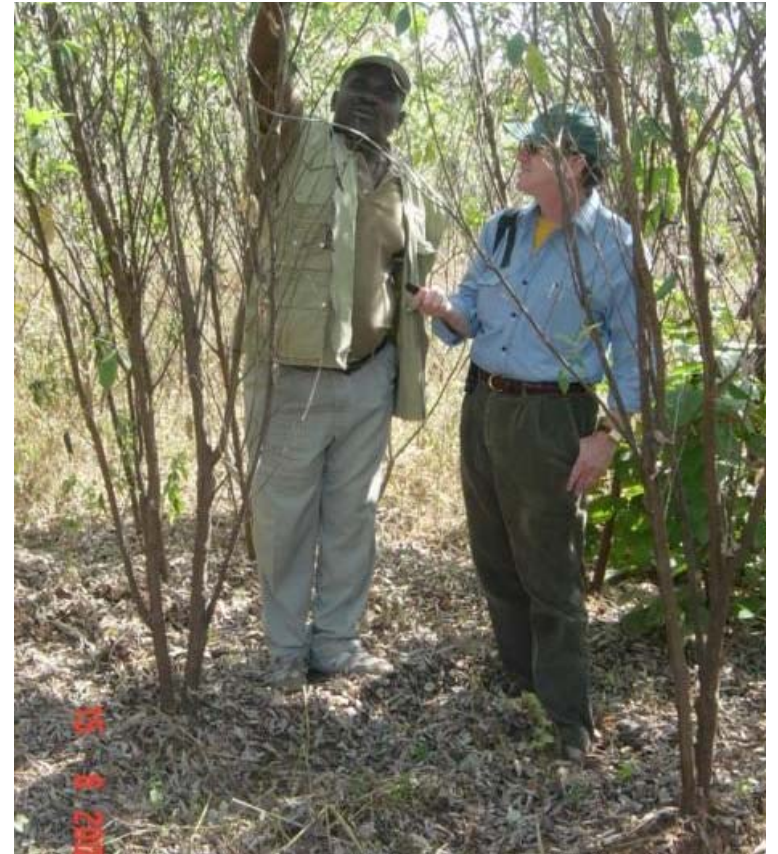


An annual relay
of Sesbania
stand in late
September



An annual relay
fallow of
Tephrosia
following a failed
maize crop in
Kasungu

Improved 2-year
rotational fallows
produce more biomass
(litter & green leaf)



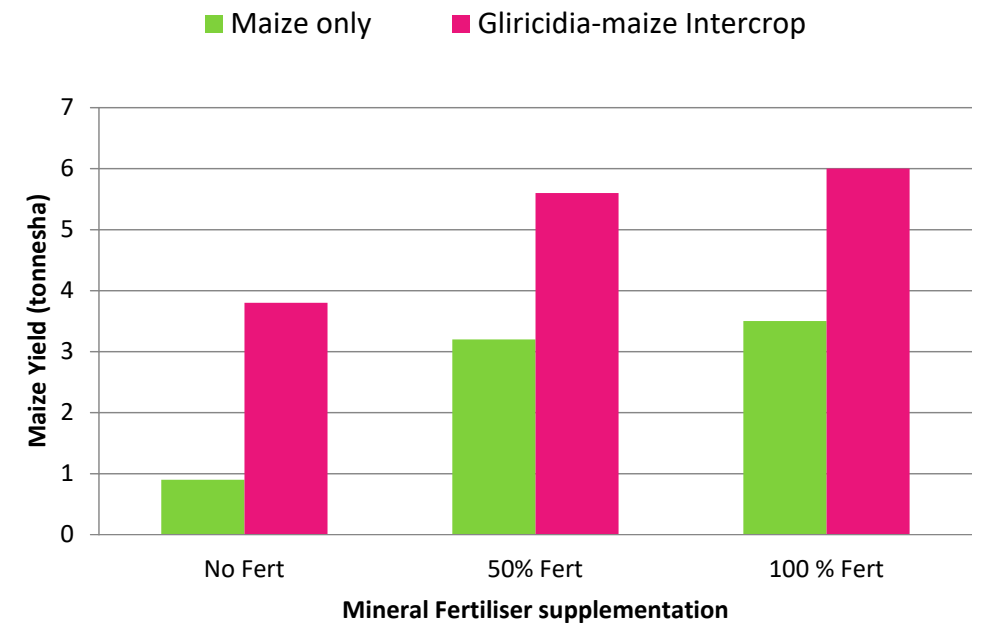
Application is
limited to those
farmers with large
farmlands



Coppicing Shrubs.

- Trees can be intercropped or planted along contour bunds or field boundaries
- Trees can be maintained for up to 15 years





High Canopy Legume fertilizer tree interventions permit mechanization



Soil Rehabilitation Services by Fertiliser trees

- Improvement in soil Nutrient cycling
- Increased soil organic matter
- Improvement in soil biological properties
- Improvement in soil physical properties
- Carbon Sequestration and GHG mitigation

Evidence of changes in soil physical properties from fertiliser trees planted as a fallow compared to continuously cropped sole maize crop

Soil Property	Percentage (from)	Change (to)
Bulk density Mg/m^3	-1.4	-9.2
Aggregate stability (mm)	18.2	36.1
Infiltration rate (mm/hr)	27.6	600
Time to run off (minutes)	40.0	133.3
Drainage (mm)	87.7	990
Penetrometer resistance Mpa)	-9.4	-50
Run off loss (%)	-63.2	-100
Bulk density Mg/m^3	-1.4	-9.2



Source: Sileshi *et al.* (2014)

On-Farm validation



Fig. 6: 2017 Maize yield and yield components data collection process

Observed Challenges with Fertiliser Trees

Variability in green manure yields especially with annual relay fallows

- Site
- Year to Year

Site	2017/18	2018/19
Mzimba	0.5 to 1.1 t/ha	0.9 to 2.3 t/ha
Kasungu	0.7 to 1.5 t/ha	1.0 to 2.0 t/ha

Annual crops and fertilizer trees as organic sources & N fixed on smallholder farms in southern Africa by various legumes

Legume (Organic source)	N fixed (kg/ha)	Leaf biomass (DM) production (kg/ha)
Cowpea (<i>V. unguiculata</i>)	28-47	???
Groundnut (<i>A. hypogaea</i>)	33	656
Pigeon pea (<i>Cajanus cajan</i>)	3-97	2,300
<i>Acacia angustissima</i>	122-210	4,760
<i>Sesbania sesban</i>	84	3,500
<i>Gliricidia sepium</i>	212	2,300
Tephrosia spp	157-280	3,070

Source: Mafongoya *et al.* 2006; Phiri *et al.*, 2013



Thank
You!

