# Agroforestry in Southern Africa- a review

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ASAP-Project (Agroforestry in Southern Africa - new pathways of innovative landuse systems under a changing climate)

*"Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economical interactions between the different components"*

(FAO, 2015)

# Benefits of Agroforestry

Provisions

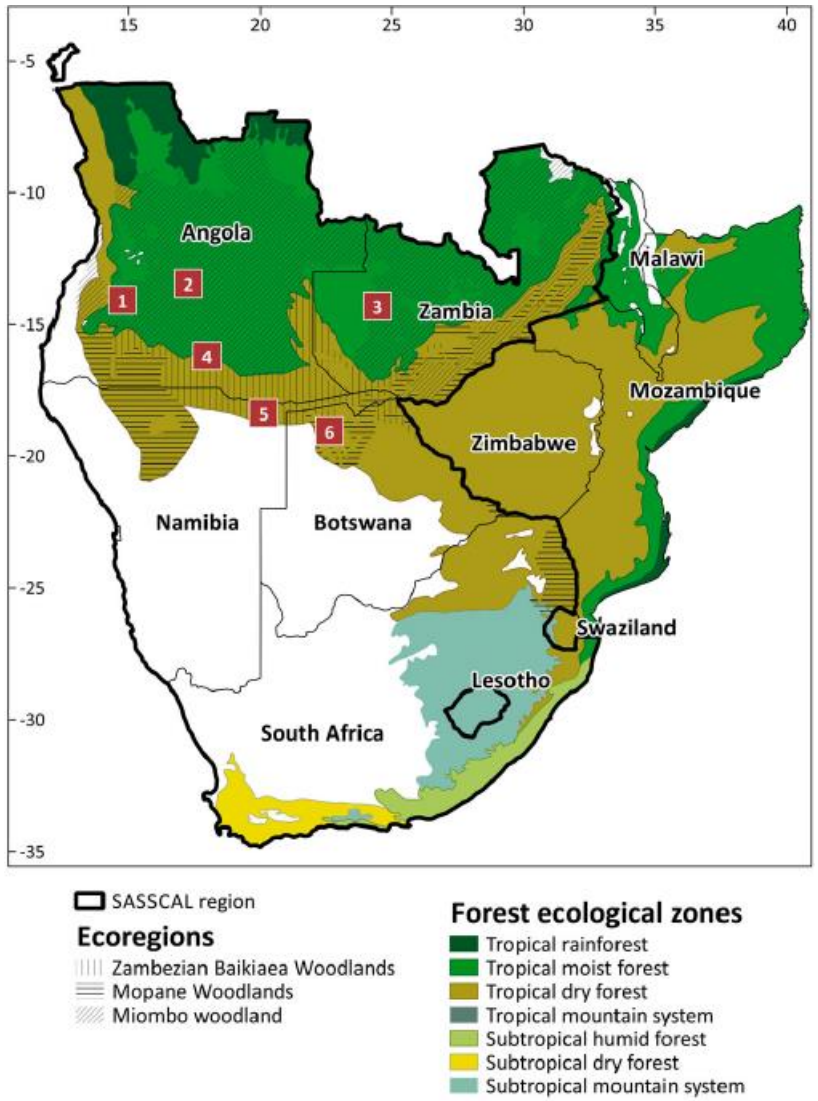
Soil fertility

Erosion control

Carbon sequestration

Nutrient pumping

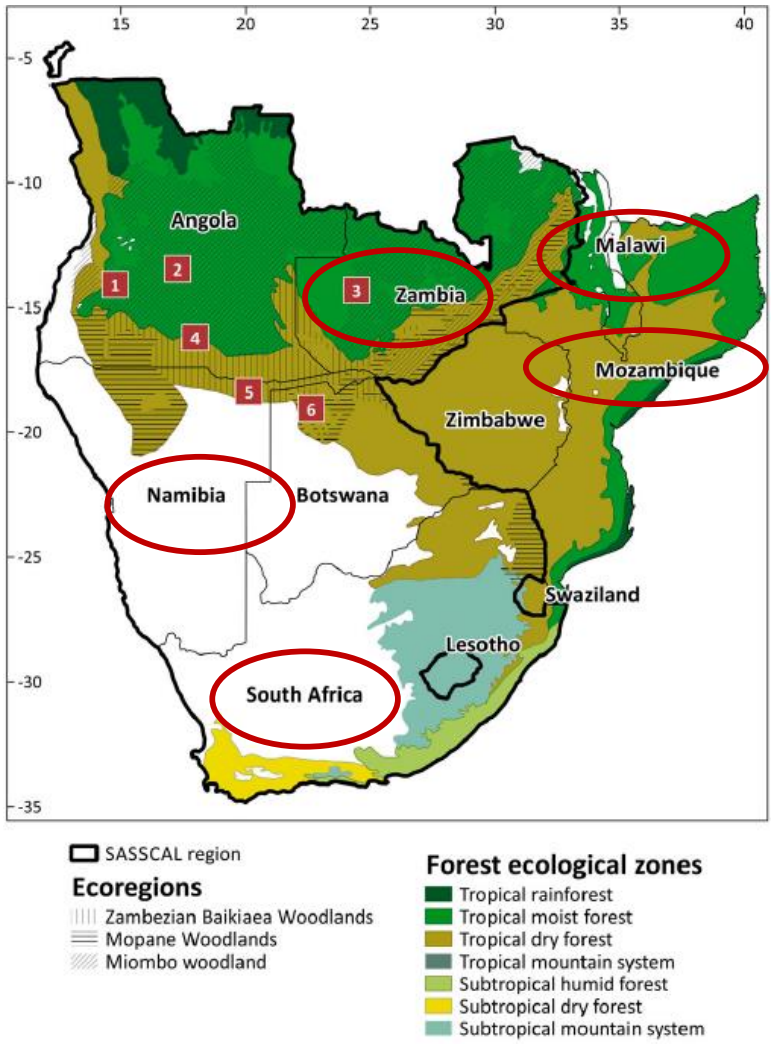
# Southern Africa




(De Cauwer et al. 2018)

- Angola
- Botswana
- Lesotho
- Swaziland
- Zimbabwe
- Malawi
- Mozambique
- Namibia
- South Africa
- Zambia

# Southern Africa




(De Cauwer et al. 2018)

- Malawi
- Mozambique
- Namibia
- South Africa
- Zambia

More than 70 percent of the rural population depends on agriculture for their livelihoods

In the Eastern and Southern parts of Africa, maize is the most important staple and the main source of calorie intake

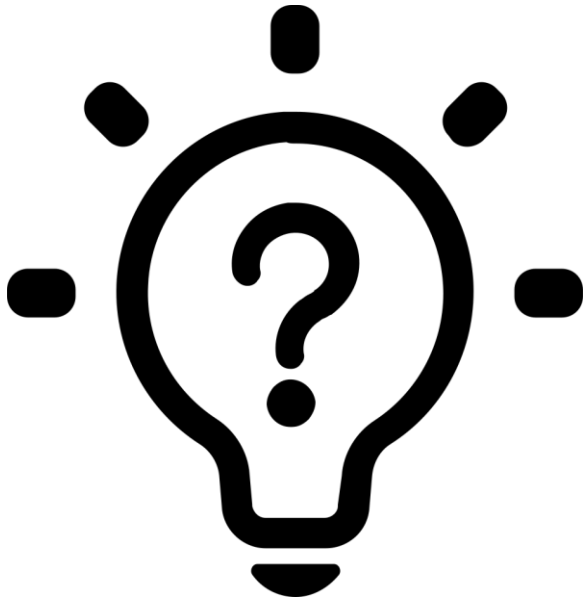
Agricultural households receive up to 20 percent of their income from maize production

In much of sub-Saharan Africa, livestock are critically important to the diets and incomes of the rural poor

***Maize***
***Zea mays***

(Kornher 2018)

# Challenges



**Declining soil fertility**

**High cost of chemical fertilisers**

**Shortages of fodder, fuel wood and poles**

**Environmental degradation in the natural forests**

# Agroforestry

# Innovative initiatives in agroforestry in Southern Africa

- Formal research in agroforestry started in southern Africa- 1987
- International Centre for Research in Agroforestry (ICRAF) launches Southern Africa Regional Agroforestry Programme in partnership with national research systems
- To use agroforestry to mitigate existing problems

# Improved fallows

*Sesbania sesban*

*Tephrosia vogelii*

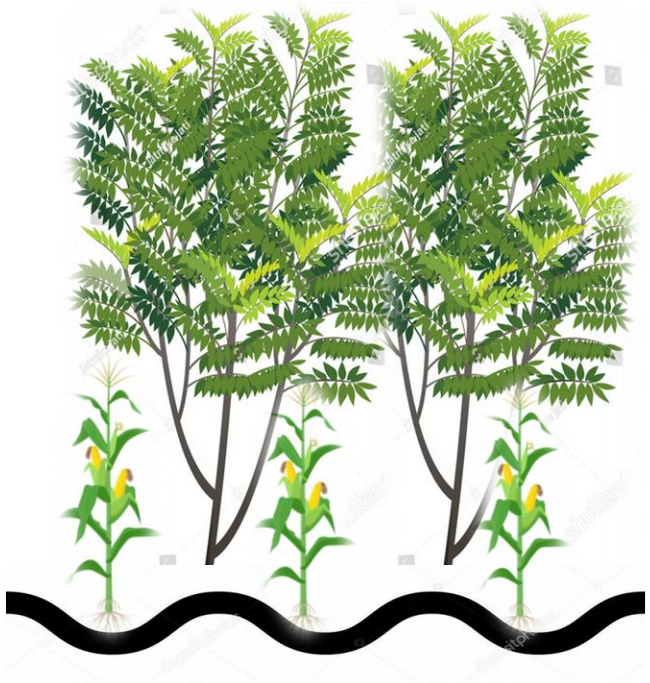
Source: *Flora de Filipinas*

- High nitrogen content and add organic matter to soil
- Produce fuelwood

Atleast one growing season

**Greater food crop yields, representing increased returns to land and labour**

# Mixing coppicing trees and crops



*Gliricidia sepium*

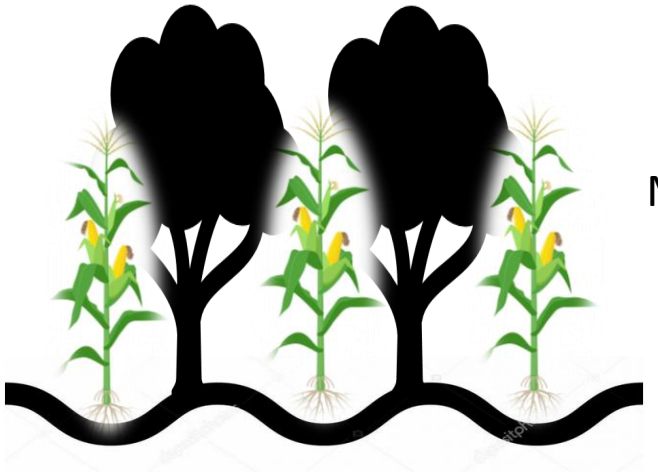
Where land availability is less

Not required to fallow land

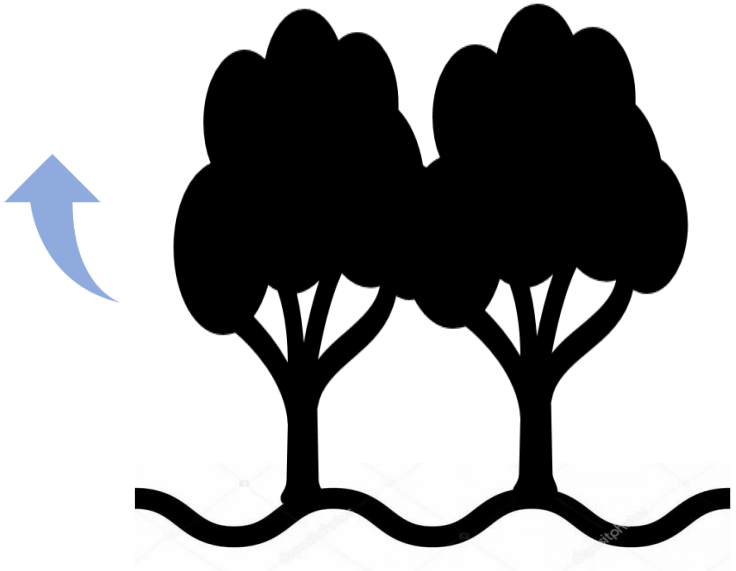
# Annual relay cropping

3-5 week old maize

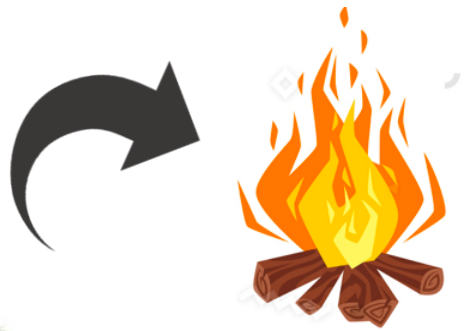
Nitrogen-fixing trees sown



Minimum competition



Post-rainy season



Subsequent rainy season

# Rotational woodlots

Fuelwood

Tobacco curing

Improve soil fertility

Primarily for fuelwood production

Crops grown in rotation with tree species

Australian acacias


*Acacia leptocarpa*

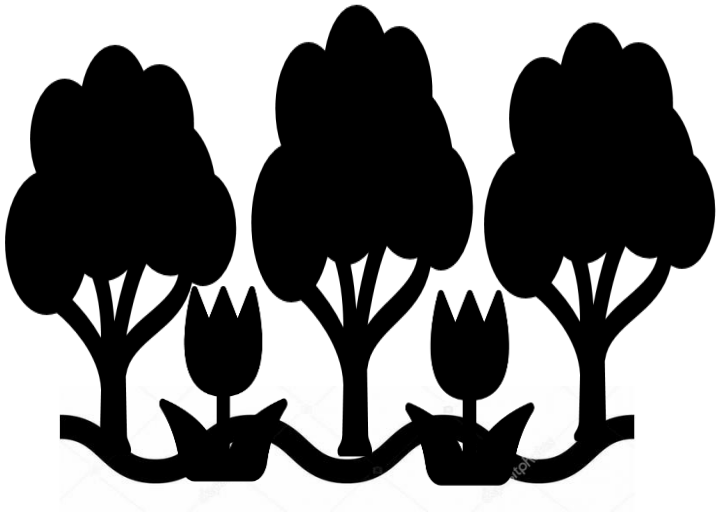

*Acacia crassicarpa*


*Acacia julifera*

Source: worldwidewattle.com

# Biomass transfer

**Miombo woodland**



Unsuitable land for annual crops

# Fodder banks

- 7 to 8 month-long dry season
- Multipurpose protein-rich browse trees
- Targeted to dairy cows and draught-oxen

# Planting indigenous fruit trees

In Malawi and Zambia, as much as 80% rural households had faced severe food shortages, especially during the months of November to January 2001

50% and 26% respectively had adopted fruit trees as a strategy to cope with the famine period in 2001

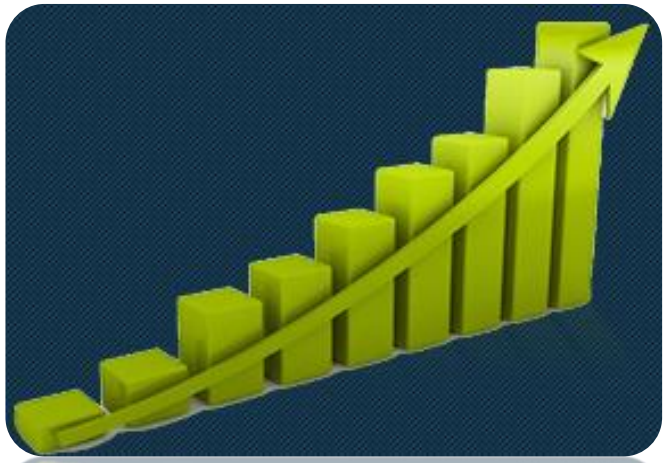
(Akkinifesi et al. 2006)

# Climate change and agroforestry in Southern Africa

- Maximum temperatures are predicted to increase by an average of 2.6 °C across Central to Southern Africa (Cairns et al. 2012)

- Frequency of dry periods is expected to increase, but there is greater uncertainty around precipitation projections (Thornton et al. 2011)

# Climate-Smart Agriculture (CSA)



Sustainably increasing agricultural productivity and income

Adapting and building resilience to climate change

Reducing and/or removing greenhouse gas emissions, where possible

FAO, 2013

# Improved fallows for CSA

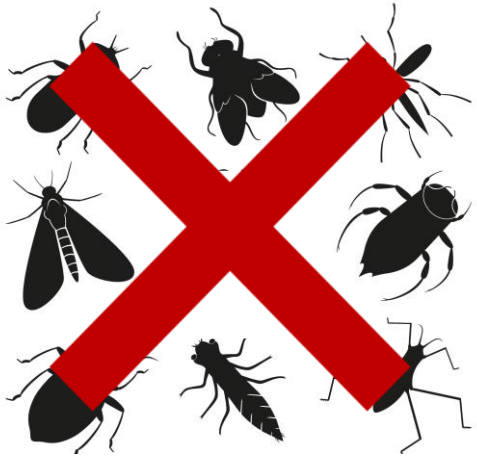
Landscape scale mitigation scheme

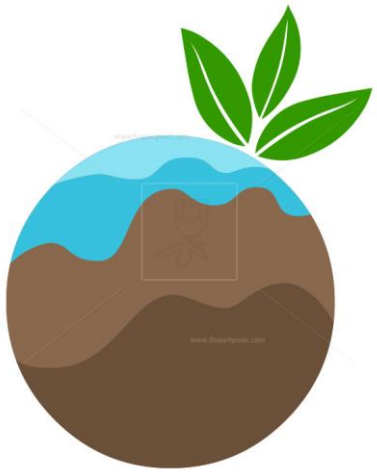
REDD+

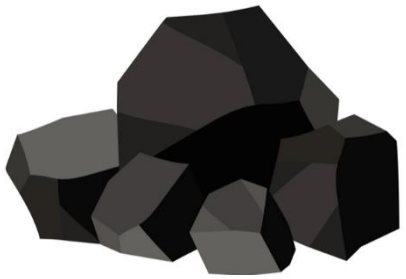
Agriculture, Forestry and Other Land Use (AFOLU)

(Buttoud et al. 2013)

Climate change adaptation



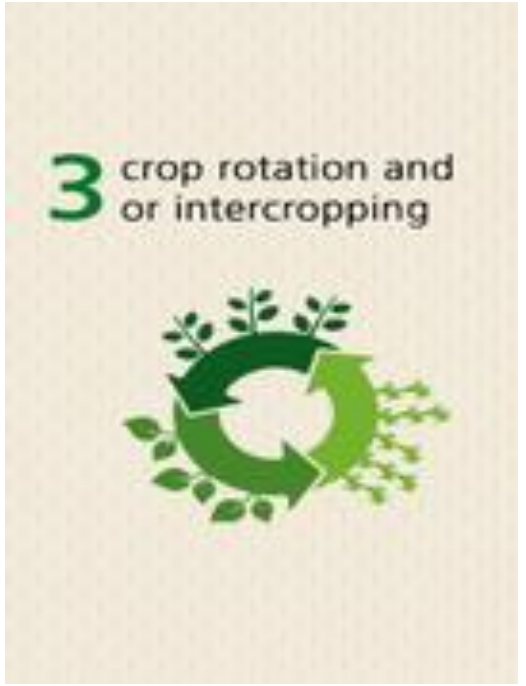


(Partey et al. 2017)

# Conservation Agriculture






(Thierfelder et al. 2018)

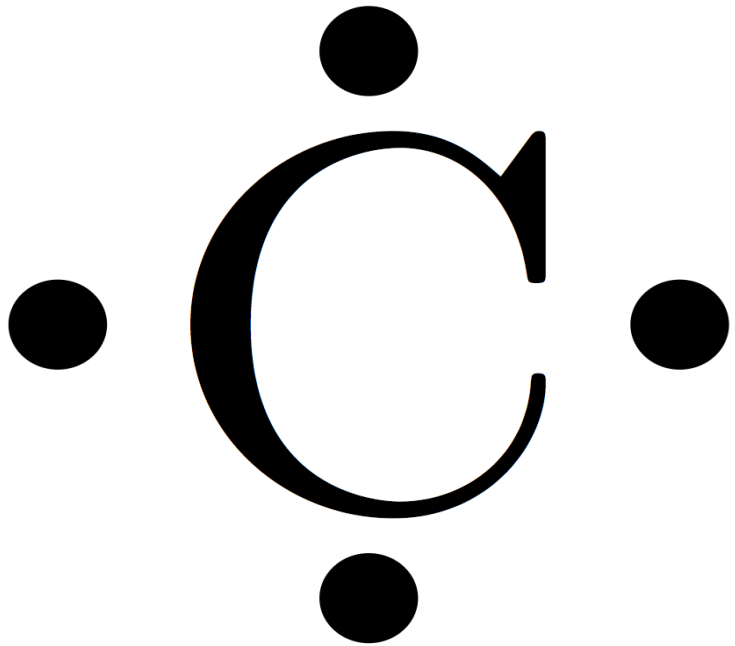
# Conservation Agriculture With Trees (CAWT)

Fertiliser tree

*Faidherbia albida*

*Gliricidia sepium*

(Ajayi & Cataculan, 2012)



# Carbon sequestration in agroforestry systems in Southern Africa

- Agroforestry was a key adaptation strategy to climate change in Sub-Saharan Africa (SSA)

(Quandt et al. 2017)

- Agroforestry mitigates 27±14 t $CO_2$ equivalent/ ha/ year, which is significant to reducing global carbon emissions.

(Kim et al. 2016)

- General agreement that agroforestry system could enhance the sequestration of C

(Nair et al.2009 )

# Improved fallows for Carbon sequestration

**Considering relatively high biomass productivity in agroforestry systems, increased soil C pool could be expected**

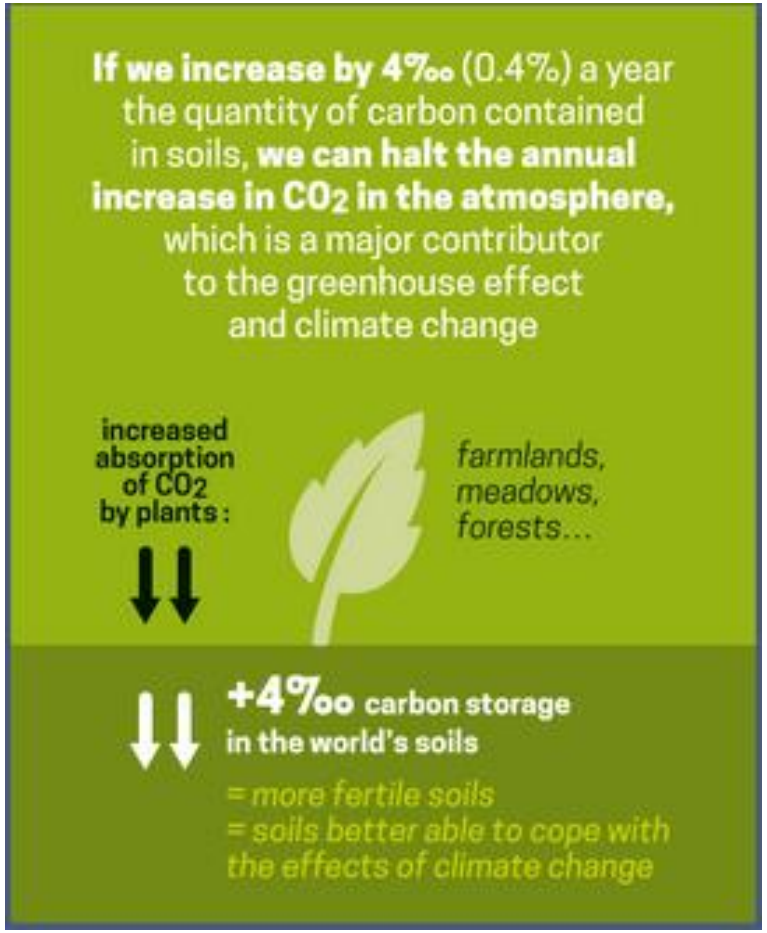
(Partey et al. 2017)

Table 3. Increase in soil organic carbon (SOC) following improved fallows with different species [34].

| Fallow Species | Age (Years) | Country | Soil Type | Sampling Depth (cm) | SOC Increase (Mg ha$^{-1}$) |
|---|---|---|---|---|---|
| *A. auriculiformis* | 5 | Togo | Ferric Acrisol | 0–10 | 3.41 |
| *A. lebbek* | 5 | Togo | Ferric Acrisol | 0–10 | 5.21 |
| *A. indica* | 5 | Togo | Ferric Acrisol | 0–10 | 12.46 |
| *C. cajan* | 1 | Kenya | Deep red loam | 0–30 | 0.73 |
| *C. siamea* | 5 | Togo | Ferric Acrisol | 0–10 | 5.2 |
| *C. grahamiana* | 1.5 | Kenya | Arenosol | 0–20 | 1.69 |
| *C. grahamiana* | 1.5 | Kenya | Ferralsol | 0–20 | 3.6 |
| *C. paulina* | 1.5 | Kenya | Arenosol | 0–20 | 2.15 |
| *C. paulina* | 1.5 | Kenya | Ferralsol | 0–20 | 2.94 |
| *L. leucocephala* | 1 | Kenya | Ferralsol | 0–30 | 8.34 |
| *S. sesban* | 1 | Kenya | Ferralsol | 0–30 | 3.1 |
| *T. candida* | 1.5 | Kenya | Ferralsol | 0–20 | 3.74 |
| *T. vogelii* | 1.5 | Kenya | Ferralsol | 0–20 | 2.58 |

(Partey et al. 2017)

# 4 PER 1000
## CARBON SEQUESTRATION IN SOILS FOR FOOD SECURITY AND THE CLIMATE




Source: 4p1000.org

**Soil Organic Carbon storage rates were significantly higher than 4 parts per thousand per year in fallows and in multistrata agroforestry systems**

(Corbeels et al. 2019)

# Adoption of new agroforestry systems by farmers

Two-year fallow

↓

Maize

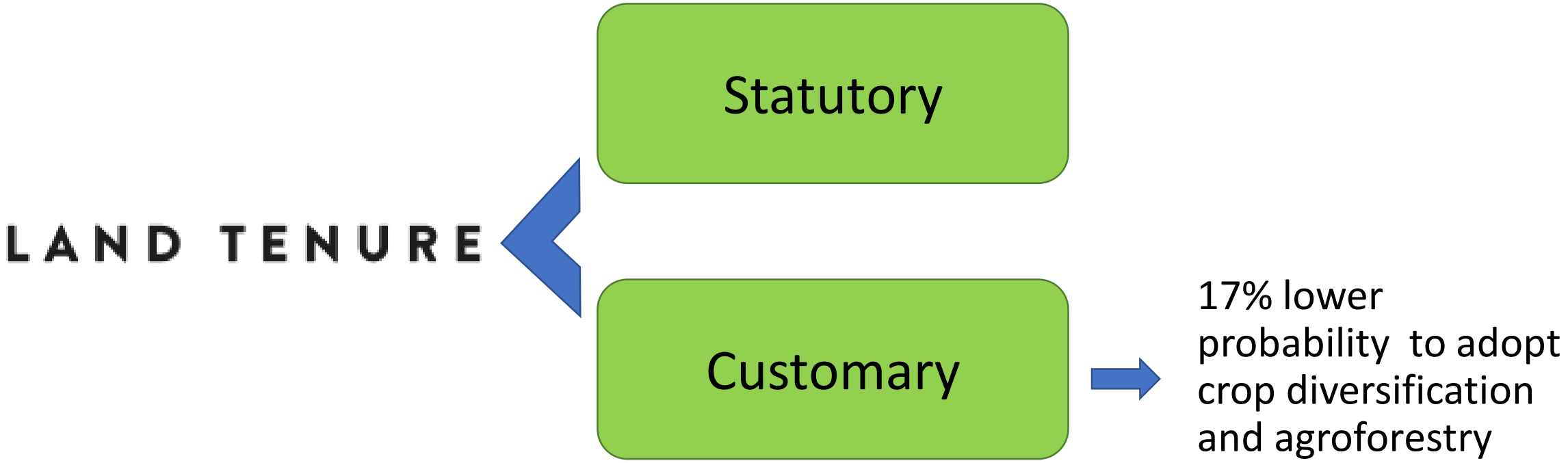
Improved fallow adoption

20,000 farmers

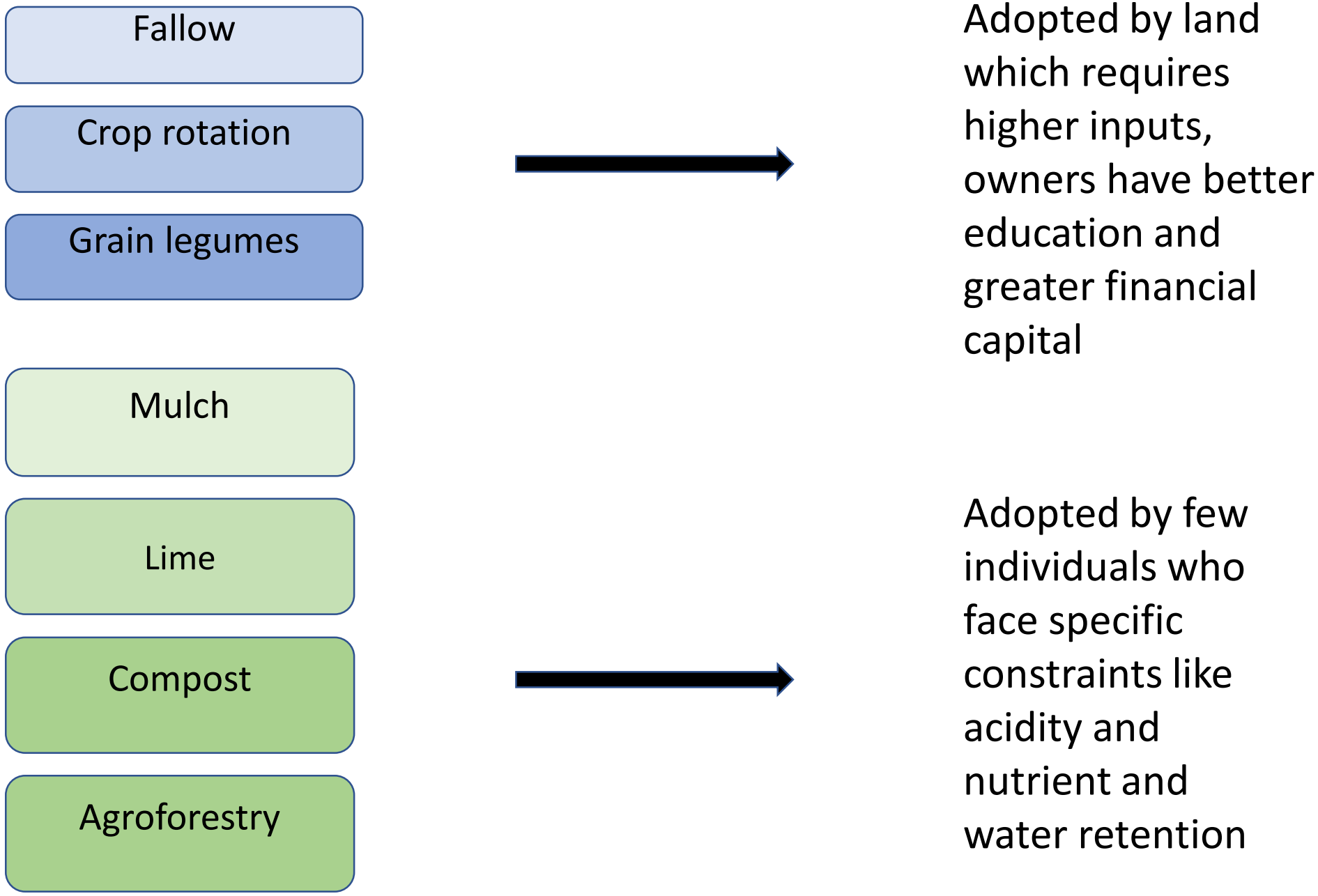
*Sesbania sesban*, *Tephrosia vogelii*, and *Cajanus cajan*

(Partey et al. 2017)

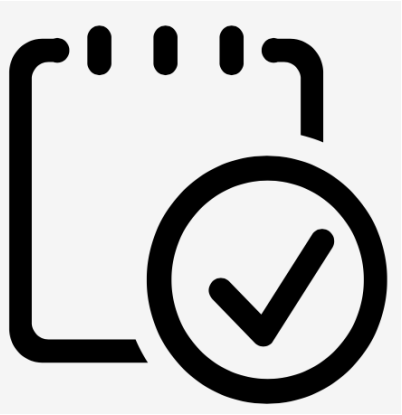
# Zambia




(Nkomoki et al. 2018)




(Mponela et al. 2016)



- Agroforestry in general
- Challenges faced by agriculture sector in Southern Africa
- Innovative initiatives in agroforestry in Southern Africa
- Climate change and agroforestry in Southern Africa
- Carbon sequestration in agroforestry systems in Southern Africa
- Adoption of new agroforestry systems by farmers

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# Thank you

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