The potential for tree/crop systems (agroforestry) in building resilient production systems for southern Africa

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Introduction

- The agricultural sector in southern Africa will need to undergo transformation for it to be able to produce adequate food growing population
- Big challenges especially in the smallholder sub-sector include:
  - Soil fertility depletion
  - Lack of access to investment resources and improved technologies
  - Climate change and variability

Introduction (cont..)

- Global climate models predict that temperatures will increase in Southern Africa by 0.6-1.4 degrees Celsius by 2030.
- Rainfall pattern changes predicted- increased intra-seasonal rainfall variation, increased frequency of droughts and floods
- Crop yields in the region are predicted to suffer as a result, with maize yields predicted to fall by 30 percent and wheat by 15 percent, in the absence of adaptation measures (Lobell, *et al.* 2008).

Introduction (cont..)

- Climate smart agriculture (CSA) has been suggested as an approach to agricultural development that can increase in production in the face of resource constraints, environmental degradation and climate change
- Climate smart agriculture focuses on practices and approaches that achieve the following simultaneously:
  - Increase yields
  - Reduce vulnerability to climate change,
  - Reduces green house gases (GHGs) emissions
- Agroforestry is widely recognised as being “climate smart”

Introduction (cont..)

- Climate smart agriculture is not just limited to farming practices
- It encompasses interventions in areas of:
  - Policies
  - Institutions development,
  - Investment decisions,
  - Rural finance and credit,
  - Infrastructure development,
  - Input and output market stimulation
  - Development of collaborative frameworks that support generation of innovations, and adoption by farmers.
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Agroforestry systems as Climate Smart Agriculture Practices (cont.)

- ***Tephrosia* species**
- Used as an annual relay intercropped with maize or used in improved fallows
- Improves soil fertility
  - Fixes nitrogen
  - Produces large quantities of nitrogen rich leaf foliage, improves soil carbon
- Improves water and nutrient efficiency

Agroforestry systems as Climate Smart Agriculture Practices (cont.)

- Grown as annual relay intercrop or improved fallows
  - Deliver significant benefits in a relatively short period – within 2 seasons
- Other species that can be used in such systems are Pigeon pea (*Cajanus canjan*), *Sesbania sesban*
- **Benefits**
- Increased agricultural production
  - Increase in maize yield of 1.3-1.6 tonnes per hectare over unfertilized, monocropped maize
  - Increased farm profits
  - Increased food security
- Stabilises crop yields – higher water holding capacity (Sileshi et al 2012)

Agroforestry systems for soil fertility management (cont.)

- ***Gliricidia sepium***
- Used in permanent tree intercrop
- Enhances soil fertility
  - Fixes nitrogen
  - Coppices prolifically and produces high volumes of nitrogen rich foliage, improves soil carbon
- Improves water and nutrient efficiency

Agroforestry systems as Climate Smart Agriculture Practices (cont.)

Financial profitability for maize production under fertiliser tree/shrub agroforestry systems (5 year cycle)

Production system	Net Profit (US$/ha)	Benefit cost ratio	Return to Labour (US$/ person day)
No fertiliser	130	2.01	1.10
With fertiliser applied (non-subsidised)	499	2.65	3.20
With fertiliser (subsidised)	349	1.77	2.53
Gliricidia (2 year fallow and 3 year maize)	269	2.91	2.51
Sesbania (2 year fallow and 3 years maize)	309	3.13	2.49

- ***Discount rate of 30%***
- **Ajayi et al (2006)**

Agroforestry systems as Climate Smart Agriculture Practices (cont.)

Table 2. Estimates of emissions mitigation potential of some agroforestry systems in selected sites in Malawi (t CO2e per hectare) per year and over a 20 year horizon

District		Total (t CO_2e ha^{-1})	Annual (t CO_2e ha^{-1} $year^{-1}$)
Karonga	Gliricidia-maize	40.5	2.0
Mzimba	Gliricidia-maize	69.9	3.5
Machinga	Gliricidia-maize	33.7	1.7
Zomba	Gliricidia-maize	34.7	1.7
Mulanje	Gliricidia-maize	31.1	1.6
Mzimba	Tephrosia-maize relay	69.9	3.5
Kasungu	Tephrosia-maize relay	69.4	3.5
Mchinji	Tephrosia-maize relay	72.2	3.6

Agroforestry systems as Climate Smart Agriculture Practices (cont.)

- ***Faidherbia albida***
- Used in permanent tree intercrop
- Improves soil fertility
  - Fixes nitrogen in the soil
  - Leaf foliage is nitrogen rich, easy to incorporate into the soil

Agroforestry systems as Climate Smart Agriculture Practices (cont.)

- *Faidherbia* can be used at different scales

Agroforestry systems as Climate Smart Agriculture Practices (cont.)

- Improves water and nutrient efficiency
- Increases yield – on average 300% over unfertilised maize monoculture (Akinnifesi *et al.* 2006; Garrity, *et al.* 2010)
  - Increased farm profits
  - Increased food security
- Stabilises crop yields – higher water holding capacity, microclimate from shading to reduce heat stress (Sileshi et al 2012)
- Sequesters carbon - 28.7 to 87.3 tonnes C e/ha (below and above ground) (Takimoto *et al* 2007)

Agroforestry systems as Climate Smart Agriculture Practices (cont.)

leucena

- **Species used for fodder banks – *Calliandra, Leucena***
- **Increased provides affordable high quality feed**
- **Increased milk production**
- **Increases profitability and income**
- **Reduces green house gas emissions**

Agroforestry systems as Climate Smart Agriculture Practices (cont..)

- Integration of fruits on crop lands
  - Improves nutrition
  - Provides additional income
  - Trees sequester carbon

Domestication and commercialization of indigenous fruits

Domestication

1. Product development
2. Business development
3. Marketing

Agroforestry systems as Climate Smart Agriculture Practices (cont..)

- Agroforestry has been short to deliver on the three pillars of CSA, but why are many farmers who can potentially benefit not adopting it?
- **Challenges:**
- Lack of knowledge and skills
- Lack of access to quality tree seed and seedlings
- Lack of supportive policy and institutional environment (land tenure, extension services, credit, poorly functioning markets)

Agroforestry systems as Climate Smart Agriculture Practices (cont..)

- **Way forward**
- Capacity building of farmers and extension officers
- Innovative extension approaches – lead farmer agro-advisors, capacitating and incentivising agro-dealers to provide advisory services
- Taking a value chain approach to climate smart agriculture (looking at the supply and demand side)
- Improving access to climate finance – capacitating farmers on bio-carbon projects development, framing carbon finance with element of development fund, simplifying monitoring, reporting verification procedures
- Enhancing production and income benefits, as carbon payments alone are not likely to provide adequate incentives


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