KP12
Knowledge Product 12

CCARDESA
Centre for Coordination of Agricultural Research and Development for Southern Africa

DECISION TOOL:
Climate Smart Agroforestry Options for Maize, Sorghum & Rice

CLIMATE SMART AGRICULTURE
KNOWLEDGE PRODUCTS FOR EXTENSION WORKERS
Customised Information Tools for Agricultural Professionals

Audience: Local Level Extension Staff (Government, NGO/Civil Society, Private Sector)

Maize Sorghum Rice Decision Point Gender Youth Climate Smart Practice


CCAFS, 2014

german cooperation
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Implemented by:
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WHAT IS CLIMATE SMART AGRICULTURE (CSA)?

CSA comprises three interlinked pillars, which need to be addressed to achieve the overall goals of food security and sustainable development:

1. **Productivity:** Sustainably increase productivity and incomes from agriculture, without negative impacts on the environment
2. **Resilience:** Reduce exposure of farmers to short-term risks, while building capacity to adapt and prosper in the face of shocks and longer-term stresses (resilience). Attention is given to protecting ecosystem services, maintaining productivity and our ability to adapt to climate changes
3. **Mitigation:** Wherever and whenever possible, CSA should help to reduce and/or remove greenhouse gas (GHG) emissions. This implies that we reduce emissions for each unit of agricultural product (e.g., through decreasing use of fossil fuel, improving agricultural productivity and increasing vegetation cover).

CSA = Sustainable Agriculture + Resilience – Emissions.

How is CSA Different?

1. CSA places greater emphasis on **hazard and vulnerability assessments** and **emphasises weather forecasting** (short term) and **climate scenario modelling** (long term) in the decision-making process for new agricultural interventions
2. CSA promotes the **scaling up of approaches** that achieve **triple wins** (increase **production**, increase **resilience** and [if possible] **mitigate GHG emissions**), while at the same time **reducing poverty** and **enhancing ecosystem services**
3. CSA promotes a systematic approach to:
    a. Identifying **best bet** opportunities for agricultural investment
    b. Contextualising **best bet** options to make them **best fit** their specific context through learning and feedback loops
    c. Ensuring the **enabling environment** is in place so that farmers (and other stakeholders) can invest in CSA practices and technologies to catalyse adoption.

Key Messages:

1. Given the multiple medium and long-term benefits of trees and shrubs within any farming system, **agroforestry is always a climate smart option**
2. Climate smart agroforestry options for maize, rice and sorghum include:
    - Boundary, live fence & hedge planting
    - Farmer-managed natural regeneration
    - Intercropping with trees
3. Keeping existing and (re-)planting additional trees and shrubs has multiple benefits – among these:
    - Increases carbon sequestration
    - Diversifies and increases production as timber, fruit, nuts, vegetables, medicinal plants, building materials etc. can be harvested short term and long term
    - Increases biodiversity
    - Retains water and reduces evaporation
    - Reduces soil erosion
    - Increases biomass and soil fertility
    - Can help with pest control.

Entry Points for CSA

- CSA practices and technologies
- CSA systems approaches
- Enabling environments for CSA.

CLIMATE SMART AGROFORESTRY OPTIONS FOR MAIZE, SORGHUM & RICE

This **Decision Tool** aims to help field-level extension staff make **climate smart decisions** on which agroforestry option best suits their farmers' context. This tool is not designed as a technical guide to implementation. It is designed to assist extension staff in making climate smart decisions on improvements to their farming systems with their clients/farmers. Reference to technical guides relevant to the practices/technologies outlined are included at the end of the tool. The tool focuses on some of the **Best Bet Climate Smart Agroforestry Options** for rice, maize, and sorghum production in the Southern African Development Community (SADC) region. These are just some of the many options available. They are listed in no specific order and have been selected as best bet because:

- They are climate smart (see Table 1)
- They are applicable in multiple agro-ecological zones across the region
- They have high potential to address major constraints to rice, maize, and sorghum production in the region (Table 1).

These are best bet options. An understanding of the local context and farmers' priorities is required in order to make these options **Best Fit** to individual farmer's needs.

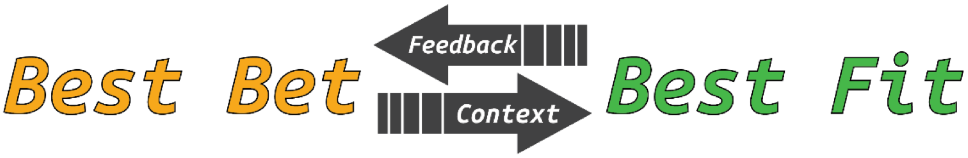

Table 1: Best Bet Climate Smart Agroforestry Options for Rice, Sorghum and Maize that have potential to address climate risks across the SADC region.

Climate Smart Agroforestry Practice Option	What is it?	3 Pillars of CSA		
		Increase production	Resilience/ adaptation	Mitigate GHG emissions if possible
Boundary, live fence and hedge planting	Planting trees and/or shrubs around the edges of fields, farms, gardens and homesteads	Increases availability of tree and shrub products (nuts, fruit, timber etc.) and biomass, which improves soil fertility and thus production	Reduces erosion of soil and evaporation. Increases water retention and infiltration. Diversifies income sources. Improves yield stability	Locks more carbon in plants and in the soil
Farmer managed natural regeneration	Protecting, (re-)planting and managing trees and shrubs that are growing naturally on the farm	Increases availability of biomass, which improves soil fertility and thus production. The trees/ shrubs can be a source of income and reduce costs	Reduces erosion of soil and evaporation. Increases water retention and infiltration. Diversifies income sources. Improves yield stability	Locks more carbon in plants and the soil
Intercropping with trees	Different planting systems that include trees and shrubs within the main crop of maize, sorghum or rice	Increase and diversify production from increased biomass and additional products (timber, nuts, fruit, etc.). Nitrogen fixation increases yields	Diversified income sources. Increased stability and predictability of production. Improved soil structure and protection from erosion. Better water retention and infiltration	Locks more carbon in plants and in the soil

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Incorporating and maintaining selected trees and shrubs into the farming system has many potential benefits. They are to:

- Provide timber for construction, handicraft and fuel
- Produce nuts, fruit, bark and leaves for medicine, fodder, consumption or sale, and thus increase income/reduce costs
- Increase biomass and soil organic matter which improves soil fertility
- Function as windbreaks and thus reduce soil erosion, evaporation and damage
- Provide shade which reduces heat stress on crops and soil, and reduces evaporation of water
- Fix nitrogen (and other nutrients) and thus increase productivity
- Enhance water infiltration and retain and regulate water
- Protect bunds and stabilise contour lines, which decreases soil erosion and enhances soil fertility
- Can be used to demarcate land
- Increase carbon storage
- Increase biodiversity, strengthen the resilience of the ecosystem overall, and maintain ecosystem services.

WHICH CLIMATE SMART AGROFORESTRY OPTION IS BEST SUITED TO YOUR FARMER(S)?

Given the multiple potential medium and long-term benefits of trees and shrubs within any farming system, **agroforestry is always a climate smart option**. To make climate smart decisions on which agroforestry practice is best suited to your farmers, you need to work with them to understand the local context. To be effective, this needs to start at the **community and the watershed level**.

TIP

Climate Smart Agroforestry options should be considered as a component of an **Integrated Soil Fertility Management** approach.

THE COMMUNITY/ WATERSHED CONTEXT

The Decision Point below outlines the steps required to make climate smart decisions on which agroforestry option is best suited to your farmers' needs.

DECISION POINT

Understand broader context	**Climate hazard map and historical analysis ofcommunity/watershed**
Priority areas	**Degraded soils/wind erosion/water erosion/crop stress**
Land ownership	**Individuallly owned/leased/community owned**
Land use	**Crops/livestock/fallow/combination**

Determine land use

The first step when engaging with a farming community on potential agroforestry measures should be to **determine the area and boundaries of the community and the watershed** under their control. If farms are larger or community members are widely dispersed, it may only be possible to work with individual or small groups of farmers.

A map is a useful starting point. It can be drawn by the community from scratch, or a large print of an existing map can be organized. Engage with community members, including male and female farmers and land owners, and **jointly identify boundaries** and within these identify and draw:

- **The different land uses:** Arable land, pastures, wood lots, urban areas or homesteads, homestead gardens, commercial and industrial areas, major transport routes, boreholes, ponds, rivers and streams
- **Key infrastructure** such as markets, agro-dealers, abattoirs, veterinary services, nurseries and sources of energy (solar panels, diesel pumps, grid connection etc. needed for agricultural production) and water
- **Areas where farmers might see issues** such as environmental contamination or degradation, caused for example by over-grazing, littering or excessive use of chemical pesticides and fertilisers.

The facilitator should **keep in mind the land use throughout the year**, whether or not crop rotation is being practised and whether livestock is integrated into the farming system. In the context of agroforestry, it is furthermore important to encourage community members to not only focus on the main crops and pastures, but also on the use of forests, trees and shrubs for different purposes.

Climate risk mapping

Based on the land use map which reflects the current land uses and practices, the next step is to discuss observed and potential future climate risks with your farmers, and to draw an additional climate risk layer on the land use map (use the same map or create a new layer with transparent paper).

- This process should be participatory. Women, men and youth perceptions of hazards must be taken into account
- The assessment needs to consider observed and expected trends in rainfall, temperatures and wind, as well as extremes such as droughts, flooding or cyclones
- Before engaging with the farmers on this topic, seek information on past and future trends at your local Met and Disaster Management Office, and note expected changes and suggested measures over the next number of years
- Older generations of farmers, especially , have gathered many years of experience on past weather conditions. It is worthwhile to capture their observations before providing scientific inputs
- The following questions can be discussed:
  - »What changes in rainfall, temperatures and extreme events did farmers experience over the past 30, 20 and 10 years?
  - »Do they observe changes in seasons such as delays, shorter or longer wet seasons, or changed fruiting seasons?
  - »Now you provide inputs on what is expected in future in terms of rainfall intensity and duration, and temperature – especially in the growing season.
- A **crop calendar** should be included, focusing on **climatic stresses** on the maize, sorghum and rice crops – e.g., wilting, lodging, flooding, etc.

Identifying priority areas

The land use and the climate risk mapping processes will identify which areas within the watershed and community are most at risk from the following influences:

- Over-use of natural resources
- Environmental degradation and contamination, including degraded soils and water sources
- Wind and water erosion
- Areas where crops are suffering from heat and moisture stress, droughts, flooding and/or cyclone damage.

The joint mapping and discussion will also help you in identifying areas of high value to communities in terms of ensuring ecosystem services, such as access to water and agricultural or harvesting produce.

Every farmer can practise agroforestry, but targeting priority farmers and locations will help to ensure that the most at-risk locations/farmers are addressed first.

Your role is to facilitate the decisions on priority areas by the farmers themselves, and **not to tell the farmer where the priority areas are**.

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Determine land ownership

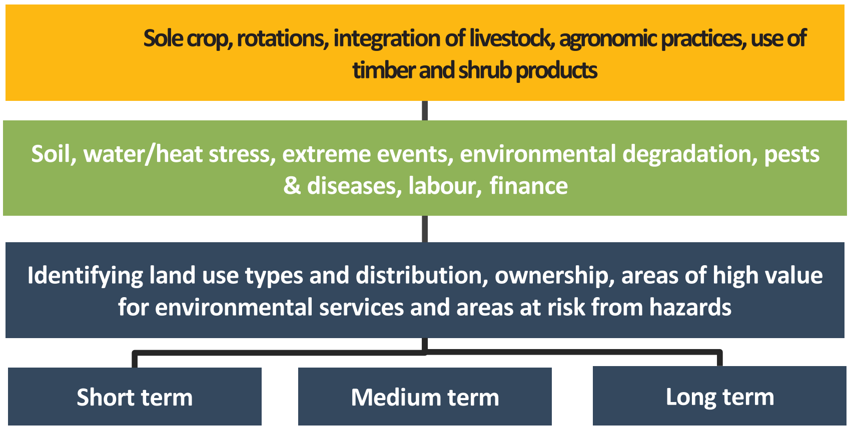
Returns on investment in agroforestry can be evident in as little as a year, but full benefits will likely not be evident for several years or even decades after the initial investment is made.

- Identifying who owns the land is critical in designing agroforestry options.
  - Discussing how land is transferred from one generation to the next is important. Whether the system is matriarchal or patriarchal may have an influence on the investments male and female farmers make
  - Farmers who own land may be willing to invest in its long-term productivity. Those leasing land or practising sharecropping may be less likely to invest.
  - Younger farmers may be more willing to adopt longer-term agroforestry practices, as they will likely be around to reap the benefits.
  - Combinations of agroforestry measures that have longer and shorter term benefits should be considered.

The next stage is to gain a holistic understanding of the current farming system and farmers' priorities – see Decision Point, below. Trees can have multiple benefits, so understanding the entire farming system is important in selecting the agroforestry practices that best meet the farmer's needs.

PRIORITIES

DECISION POINT



Understand the farming system

Sole crop, rotations, integration of livestock, agronomic practices, use of timber and shrub products

Constraints to production

Soil, water/heat stress, extreme events, environmental degradation, pests & diseases, labour, finance

Land use

Identifying land use types and distribution, ownership, areas of high value for environmental services and areas at risk from hazards

Short term

Medium term

Long term

Understanding the farming system

Farming systems are complex. To understand them properly, you should spend time in the field with your farmers at various times of year considering, among others, the following factors:

- **Agronomic practices**
  - When is labour required, and who performs each of the management practices for crops, livestock, trees and shrubs?
  - Is rotation or intercropping practised in the maize, sorghum and/or rice plot, and if so, what crops are used?
  - What land preparation practices are used?
  - Is farming mechanised?
  - Is rice grown under a rainfed upland, rainfed lowland or irrigated system?
  - How are weeds, pests and diseases controlled?
  - Are fertilizers, manure and/or compost added, and in what amounts?
  - Are cover crops and/or mulches applied?

- **Livestock integration** into the cropping system?
  - What type of livestock, and how many?
  - How are livestock fed throughout the year?
    - »Communal grazing on crop residues, or farmers' own animals and fields?
    - »Are there competing uses for crop residues?

- It is important when considering agroforestry that the multiple uses of trees and shrubs are considered, as this may affect the availability of labour to carry out crop management. For example, women/children may need to commute to collect firewood. If trees were available closer, this might free up time to spend on weeding and thus increase production.

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Constraints to production

To make climate smart decisions on which agroforestry options might suit best in a maize, sorghum and/or rice growing system, the next step is to understand what the existing constraints to production are. At the individual farm level, you should consider the following:

- **Soil** – **physical and chemical properties:**
  - What is the soil texture?
  - What is the pH?
  - Are there signs of nutrient deficiencies in crops?
  - How much organic matter and/or macro organisms are there in the soil?
    - »Where are these sourced?
  - How much moisture is in the soil?
    - »This should be assessed at various times of the year
  - Does the soil form a crust in the dry season and/or is there a hardpan below the 'plough' layer?

- Does the maize, sorghum and/or rice crop suffer from heat, water or other **stresses**?

- What **pests and diseases** are prevalent in the area, and what are the control options for these?
  - For example, *Striga* (witchweed) is inhibited by *Gliricidia sepium*. Intercropping *Gliricidia* might be an option for managing *Striga*

- **Labour constraints:**
  - Which crop management functions do men, women and children perform, and when?
  - Is the farming household labour constrained – is it a single parent household?
  - Is labour available to manage agroforestry practices (sowing, planting, coppicing, pruning, pollarding, cutting and carrying, etc.) and will this affect other crop management tasks, household chores or school attendance?

- **Financial resources:**
  - If the household is labour constrained, can it afford day labourers?
  - Are resources available to establish a tree nursery?
  - Will the potential returns be greater than the initial investment, and what are the time frames?

Farmer priorities

Farmers' priorities can broadly be split into three categories:

- Short term – addressing constraints to production for the following season, for example:
  - Fodder production for livestock
  - Biomass for mulching
  - Live fence poles

- Medium term – addressing constraints to production over the next 2 –5 years, for example:
  - Increase soil organic matter to improve moisture retention
  - Use coppiced or pruned branches for fuel
  - Improve soil fertility by fixing more nitrogen into the soil
  - Planting fruit trees
  - Reduce erosion
  - Protect bunds in rice fields

- Long term – The need to farm sustainably over a longer time period. Examples might be:
  - Planting or protecting *Faidherbia albida* in sorghum and maize plots – can take 20 years before benefits are fully realised
  - Farmer-managed natural regeneration (FMNR, see further below) and/or boundary planting to protect against soil erosion on sloping land
  - Planting trees for fruit or nut production
  - Planting trees with the aim of using the timber in construction, or selling it.

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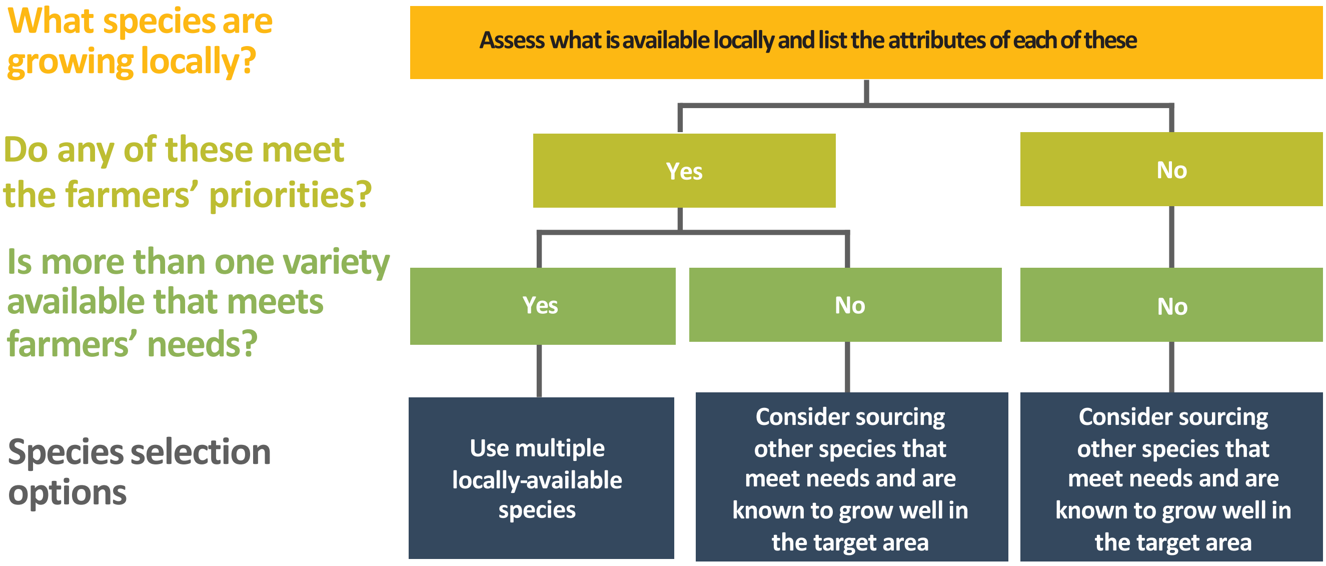
SPECIES SELECTION

If you do not match the ecological and socio-economic conditions of the species and the planting site, the impact of tree and shrub planting may be very limited. Species selection is very similar to the selection of crop varieties: both farmers' needs, and the ecological conditions of the planting site need to be considered. The Decision Point below depicts a decision tree to assist you in making climate smart decisions on species selection.

DECISION POINT



The preference should always be for species that are already well established in the target area. Only if species that do meet farmers' priorities are not available locally, the option of sourcing from outside should be considered. Some native species might be well known by farmers over generations for multiple uses. Other species may have very desirable characteristics, but it might be difficult to source seeds and/or they may not be familiar to farmers. Great care should be taken when introducing any new species to an area, as there may be unintended consequences.

Consider to check with your local Forestry or Environment Office.

Always start at a small scale when introducing new species. Once you know the farmer's priorities and have matched a species (or preferably several species) to his or her objectives, you can work with them to select the most appropriate climate smart agroforestry practice to test. Because agroforestry options often focus on the medium to long term, it is important that the above steps are followed before making recommendations.

TIP

There are a range of databases on agroforestry available that can help you identify suitable trees, such as the AgroforesTree Database from *World Agroforestry (ICRAF)* – for additional resources, see the last page of this KP.


UNEP, 2009

BEST BET AGROFORESTRY OPTIONS FOR ADDRESSING CLIMATE RISKS IN RICE, MAIZE AND SORGHUM PRODUCTION

Below are three climate smart agroforestry options for rice, sorghum and maize. They are listed in no particular order. All are broadly applicable across the SADC region. While these are best bet options, they are not universally applicable. CSA is context specific and each of these options will need to be tested under local conditions and adapted to make it **Best Fit** the local context.

BOUNDARY, LIVE FENCE AND HEDGE PLANTING

Boundary planting: Growing trees on farm boundaries is a very common practice used to demarcate land holdings, and can provide additional benefits in breaking the wind, shading, and provision of fuelwood. One issue to consider is potential conflict between neighbours.

Examples: Certain species, e.g., *Cordia abyssinica* and *Croton megalocarpus*, have traditionally been used as boundary markers. Grevillea is a very popular tree. Trees with a short lifespan, e.g., *Sesbania* spp. and *Acrocarpus fraxinifolius*, are less suitable unless they are combined with more permanent trees. Competitive trees such as eucalypts, pines and *Acacia mearnsii* should be avoided. Many other non-competitive trees are suitable. Non-commercial fruit trees, e.g., *Syzygium cuminii, Vitex* spp. and *Annona* spp. can also be suggested.

Live fences and hedges: Live fences can be established all around the farm (Figure 1), but are most common around the homestead. Live fences and hedges can be a useful means of confining livestock or restricting livestock movement. This practice is relevant for most farming systems, but careful analysis is required in irrigated farming systems and most arid areas.

Examples: *Acacia brevispica, Acacia nilotica, Acacia tortilis, Agave sisalana, Albizia amara, Balanites spp., Caesalpinia decapetala, Calliandra calothyrsus, Carissa edulis, Croton dichogamus, Croton megalocarpus, Cupressus lusitanica, Casuarina spp., Dovyalis caffra, Euphorbia tirucalli, Gliricidia sepiunt, Morus alba, Lantana camara, Parkinsonia aculeata, Pithecellobium dulce, Prosopis* spp., *Psidium guajava, Thevetia peruviana* and *Ziziphus* spp.

Note: Choice of AF trees should be biased towards trees with easily degradable leaves.

Figure 1: Trees planted along the fence in a farm (top), and a live fence under establishment (bottom).

Source: ICRAF, 2014

Biophysical requirements

The suggested tree species are broadly applicable, as they have the following temperature, rainfall and soil requirements:

Temperature: Boundary, live fence and hedge planting can be implemented in a wide range of temperatures from 10 °C to higher than 30 °C

Rainfall: Boundary and hedge planting can be established in places that receive annual rainfall as low as 350 mm to above 2,000 mm each year

Soil type: Trees planted in this practice can grow in a wide range of soil types, including poor soils.

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FARMER MANAGED NATURAL REGENERATION

Farmer Managed Natural Regeneration (FMNR) is a quick, affordable and easy-to-replicate way of restoring and improving agricultural, forested and pasture lands. FMNR promotes the systematic regrowth of existing trees and shrubs, or from naturally occurring seeds. It can be used wherever there are living tree stumps with the ability to coppice (re-sprout), or seeds in the soil that will germinate.

Adoption of FMNR is closely related to the number of mature trees on the plot. This suggests that farmers with higher numbers of mature trees may see the benefits of trees more clearly.

Biophysical requirements

Altitude: FMNR works best and gives faster results in high altitude areas from 1,000 m to 2,600 m above sea level. It is most suitable and best applicable in the lowlands.

Temperature: Commonly practised in higher-temperature regions with a daily temperature range of 10 – 35 °C. Annual crops' tolerance of hot and/or dry spells is improved by trees' steady provision of soil organic matter, mulching material and shade. Trees help increase water infiltration into soil, reduce soil evapotranspiration and reduce soil temperature.

Rainfall: The trees regenerate faster in areas with average annual rainfall between 400 mm and 1,600 mm, but suitably practised in areas with low rainfall amounts where tree planting is a challenge; the practice is not limited to the drylands, as its effects are felt faster in the high rainfall areas.

Soil: Works well in different soil types with varying textures and drainage conditions. Preferable soil type is also dependent on the types of trees being regenerated.

Christian Thierfelder, CIMMYT, 2017

INTERCROPPING

There are two basic types of intercropping with trees:

- Alley cropping or alley farming, and
- Intercropping with leguminous shrubs or trees.

Alley cropping and alley farming

Alley cropping is a production system in which trees and shrubs (preferably fast-growing leguminous species) are established in hedgerows on arable cropland, with crops cultivated in the alleys between the hedgerows.

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Alley farming (Figure 2) is essentially an extension of the alley cropping system that includes livestock by feeding a portion of the hedgerow biomass to animals.

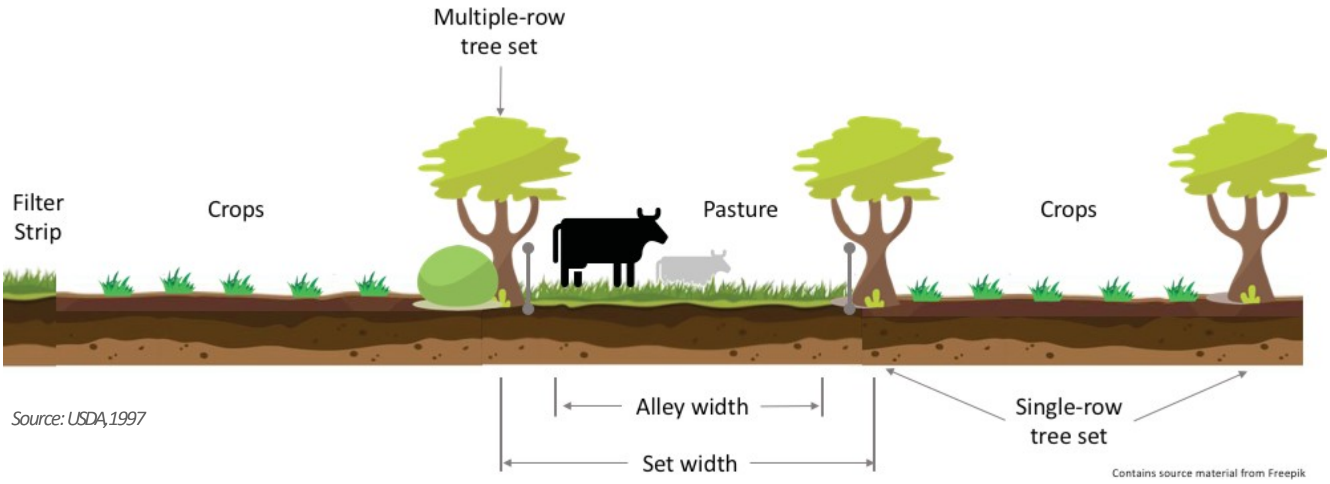
The two systems are therefore similar, except that hedgerow management differs as it includes animal feed production. The underlying scientific principle of the alley-cropping and farming practices is that by continually retaining fast-growing, preferably nitrogen fixing trees and shrubs on crop-producing fields, their soil-improving attributes (such as recycling nutrients and controlling erosion on sloping land) will create soil conditions like those in the fallow phase of shifting cultivation. Some benefits of alley cropping are:

- It is a low-input farming system
- It can reduce competition from weeds
- It can help conserve soil by reducing physio-chemical soil degradation and the decline of soil organic matter
- It is particularly suited to mechanised farming, as trees are planted in rows.

If alley cropping and alley farming are not soundly managed, the hedgerows will compete with crops for soil water, which often limits crop productivity.

Slower maturing trees can also be planted, depending on farmer preferences. These may be leguminous (*Faidherbia albida*) or for fruit, timber and fodder production. Larger trees provide shade to the maize, rice or sorghum crop, but it must be managed to ensure that this does not have a negative effect on crop production – such as competition for nutrients, water and sun. A population of about 100 mature trees per hectare is optimal (10 m x 10 m spacing), but larger populations can be planted initially and thinned as they grow.

Figure 2: Alley width depends on purpose, tree canopy, crop sensitivity, crop rotation, crop or forage grown.



Source: USDA,1997

Biophysical requirements

Altitude: Intercropping can perform well in a wide range of altitudes from <200 m to 2,050 m (or more) above sea level.

Amount of rainfall: 350 mm to 1,800 mm annually with rainfall events ranging from 37–210 days per year. Intercropping has also been successful in a bimodal rainfall pattern with short dry seasons between the rainy periods.

Temperature: Intercropping has shown success in areas with a mean monthly temperature range of 13 °C to more than 30 °C.

Humid zone: Alley farming or alley cropping can do well in a wide range of humid zones from sub-humid to relatively high humidity conditions as well as the forest–savanna transitional zone.

Soil requirement: The practice thrives in a wide range of soils that favour robust establishment of alley tree and shrub species, as well as agricultural crops planted therein.

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Intercropping with leguminous shrubs and trees

This practice replaces herbaceous crops with woody species in an intercropped planting system (see **KP07 – Climate Smart Planting System Options**). It combines the two climate smart agriculture practices of intercropping and continuous ground cover. Intercropping with leguminous shrubs and trees can be a solution in systems where additional biomass is required to serve as fodder or mulch, and/or to suppress weeds (Figure 3). Growing leguminous trees or shrubs can:

- Help improve soil fertility through the fixation of atmospheric nitrogen:
  - With appropriate selection of tree species and good management, this can substantially reduce the requirement for inorganic fertilisers

- Add organic matter to the soil from pruning material and leaf litter:
  - This enables better soil moisture retention and increases fertiliser efficiency

- Reduce soil temperatures:
  - Pruning materials used as mulch also reduce the soil temperature, thereby enabling a better build-up of soil fauna that helps crop productivity.

The integration of **tested trees** into farming practices (agroforestry) has the potential to sustain land productivity, in addition to providing useful tree products such as firewood, fruit and fodder.

Figure 3: Intercropped maize with *Gliricidia sepium*.

Source: ICRAF

Biophysical requirements

Altitude: Intercropping with leguminous shrubs and trees thrives in a wide range of altitudes from 350 m to >1,700 m above sea level.

Rainfall requirement: The trees integrated with crops require a mean annual rainfall of 300 – 1,500 mm for successful establishment and productivity.

Temperature: Mean monthly temperatures of between 11 °C and 33 °C.

Soil type: Wide range of soil types with sandy, clay and loamy being the common ones.

FORECASTING AND ANALYSIS

It is important to have an idea of whether a new farming practice will be profitable (before introduction), and to monitor the development over the course of time. The likely benefits of a new practice are calculated based on estimated data, while actual benefits are based on real data collected once the new farming practice has been introduced.

Smart decisions are made when useful information is available. There are many variables to consider when choosing which tree species will be most suitable, and which climate smart agroforestry option will be most suited to individual farmers. Not all these variables will be related or limited to increased production on the farm. Many, if not most trees have significant social and/or cultural functions that may go well beyond increasing production or improving the soil:

- Their use for shade for meetings, farm labourers or livestock
- Use during festivals and celebrations
- Medicinal properties, etc.

This makes it complex to accurately assess which species and/or practice is best, especially given that implementing climate smart agroforestry options can take anything from one year to decades to see actual results.

When selecting a climate smart agroforestry option (or combination of options), it is vital to understand the management practices required (e.g., pruning, see Figure 4). The initial cost of climate smart agroforestry options may well be small, but the management costs in terms of labour may be extensive, especially for intercropped systems. A clear analysis of who will manage the trees and when is required before making decisions. Men's and women's roles and capacities in tree management, as well as in regular crop management practices, must be considered.

You should also sit with your farmers before the season starts to develop a seasonal calendar and forecast of what labour and inputs are required at various stages during the season. Be sure to tease out who is doing the labour when and for how long, so that nothing is missed. Accurate data on labour and input costs should be collected throughout the year and compared to the forecast. This allows an assessment of performance against targets, as well as an analysis of gross margins at the end of the year. The gross margin is the return the farmer makes on his or her investment (money & labour). This will help the farmer to more accurately plan and forecast for the following seasons. Discussions on gross margins are crucial in helping farmers make improvements (climate smart decisions) on their farms.

Figure 4: Tree pruning for fodder and firewood, and to reduce negative shading effect on a rice system.

Source: ICRAF,2017

TIP

While gross margins are an important tool for assessing profitability, trees have many benefits that go beyond soil improvement and crop yields. Gross margins may be less useful when assessing medium and long-term climate smart agroforestry options.

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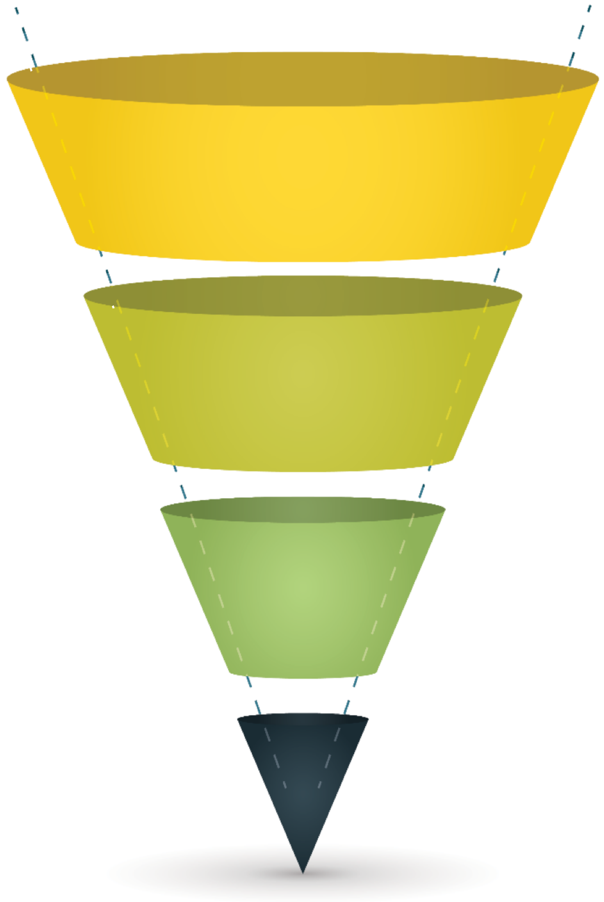
TO SUMMARISE



STEP 1: Understand the broader context: community/watershed

- Determine land use
- Climate risk mapping
- ID priority areas
- Determine land ownership

STEP 2: Define farmers' priorities

- Understand the farming system(s)
- ID constraints to production
- ID short/medium/long-term priorities

STEP 3: Select the right species

- ID what is available locally?
- Cross-check with farmers' priorities
- Are other options available?

STEP 4: Select climate smart agroforestry option

- Consider combinations of options
- Assess labour requirements
- Collect data and reflect on possible improvements.

WHERE CAN I FIND MORE INFORMATION?

The following resources, which were used as reference for the development of this Knowledge Product, provide valuable additional reading on this subject. Please also refer to the CCARDESA website (www.ccardesa.org), the full series of Knowledge Products, and associated Technical Briefs.

- CCARDESA Knowledge Hub
- Access Agriculture
  - Hundreds of videos on lots of topics in multiple languages are available on this site. These are suitable to show directly to farmers or to learn yourself. If you sign up you can also access downloadable technical guides
- **FAO/ICRAF** – Agroforestry in Rice Production Systems in South East Asia: A Practical Guide
  - Focus is on South East Asia so the tree species are different and the rice production system is predominantly irrigated lowland, but the principles are applicable in the SADC region also
- Find trees that might be suitable for your ecological conditions:
  - **ICRAF** – AgroforesTree Database
  - **CABI**'s Forestry Compendium
- **ICRAF** – Technical Brief: Farmer Managed Natural Regeneration
  - This is a short, simple guide, clearly explaining farmer-managed natural regeneration
- **ICRAF** – *Gliricidia* – Maize Intercropping System: An Extension Trainer's Guide
- **ICRAF** – Conservation Agriculture with Trees: Principles and Practice. A Simplified Guide for Extension Staff and Farmers
- **ICRAF** – Tree Seeds for Farmers
  - This is an excellent resource to help you select tree seeds most suited to your farmers and how to propagate these if necessary. Commercial and on farm nurseries are included
- **World Agroforestry Centre (ICRAF)** – Agroforestry Guidance Tool
  - This is a detailed technical resource on all the different agroforestry practices. Well worth having the link on your phone for use in the field.

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