KP02
Knowledge Product 02

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

OPTIONS PAPER:

Best Bet Climate Smart Agriculture Options for Maize in SADC

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

Audience: Local ExtensionStaff

Maize | Options Paper | Gender | Youth | Climate Smart | Practice | Technology

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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. **Adaptation:** Reduce exposure of farmers to short-term climate risks, while building capacity to adapt and prosper in the face of climate 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).

Key Messages:

1. Maize production is particularly sensitive to **increases in temperature** (both air and soil) and more **erratic rainfall**.
   The potential impact of these hazards changes during the different growth stages

2. This paper outlines some of your 'best bet' climate smart options for maize production in the SADC region

3. CSA is context specific – **Best Bet** options should take account of the farmer's own context and priorities and be adapted to become '**Best Fit**' CSA solutions.

CSA = Sustainable Agriculture + Resilience – Emissions.

How is CSA Different?

1. CSA places greater emphasis on **climate risks 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:

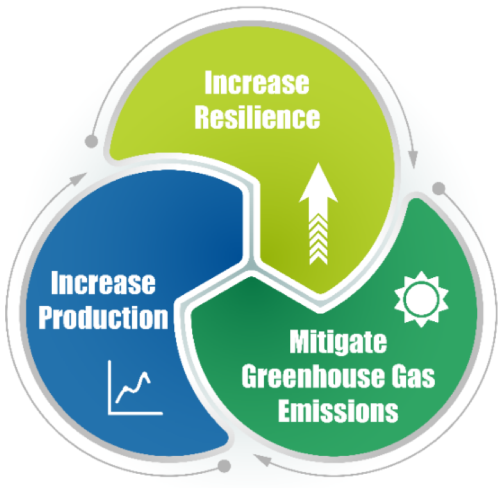
   a. Identifying **best bet** opportunities for agricultural investment

   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.

Entry Points for CSA

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



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BEST BET CLIMATE SMART AGRICULTURE OPTIONS FOR MAIZE IN SADC

This **Options Paper** focuses on some of the **Best Bet Climate Smart practices** and **technology** options for Maize production in the Southern African Development Community (SADC) region. These are just some of the many options available. They are listed in no particular order, and have been selected as best bet because:

- Each of them has been identified as a priority CSA option in the **CSA country profiles** completed so far for the SADC region (Mozambique, Zambia, Tanzania & Malawi)
- They are widely applicable across the region
- They have high potential to address major constraints to maize production in the region (Table 1).

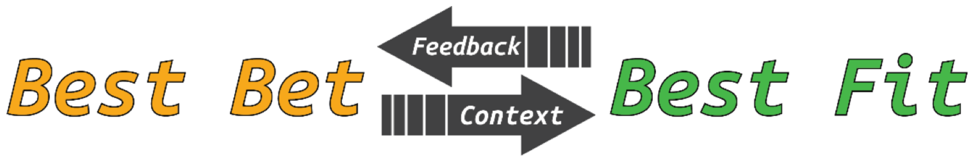


Table 1: Best Bet options for addressing climate risks to maize production with smallholder farmers, as they offer the most potential to reduce production losses.

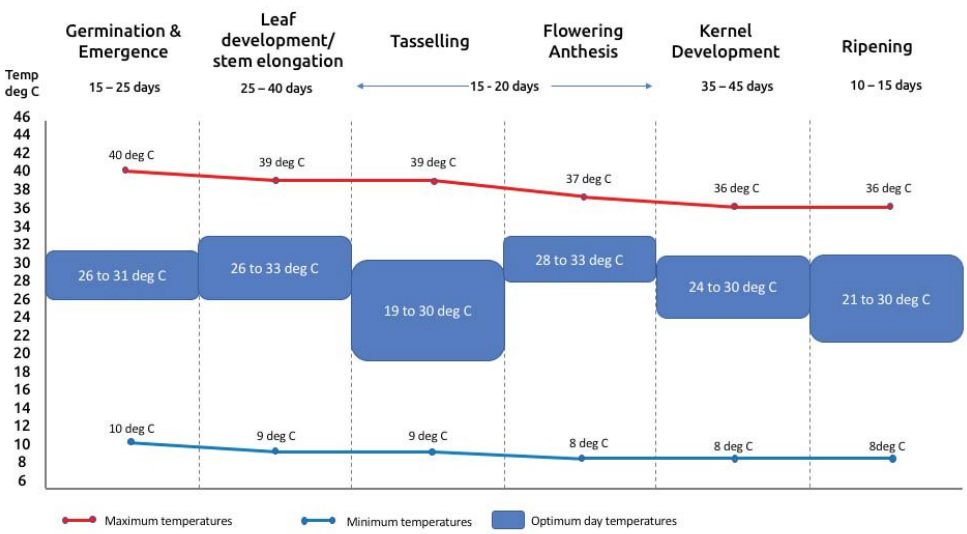
Best Bet Climate Smart Option For Maize	Risk to maize production
Integrated Soil Fertility Management (ISFM)	Nearly 40% of soils in sub-Saharan Africa are already low in nutrient capital reserves, 25% suffer from aluminium toxicity, and 18% have high leaching potential
Improved varieties	40% of Africa's maize-growing areas face occasional drought stress, resulting in yield losses of 10%–25%. Around 25% of the maize crop suffers from frequent drought, with losses of up to half the harvest Maize occupies approximately 24% of farmland in Africa, and the average yield is around 2 tonnes/hectare/year
Planting system options	Due to climate change, maize yields in Africa have already declined by 3.8% since the 1980s, and further declines of 5%–10% are expected by 2050 It is predicted that 30% of current maize-growing areas in sub-Saharan Africa will no longer be able to grow maize by 2100
Pest and disease control	Stem borers alone are estimated to cause anything from 15%–100% annual yield losses in maize ***Striga***, a parasitic weed, has already infested 40 million hectares of land in sub-Saharan Africa, resulting in yield losses of 20%–80%. The seeds of this weed remain viable and dormant in the soil for at least 10 years, and up to 20 years.
Post-harvest management	The **African Post Harvest Losses Information System (APHLIS)** lists average annual losses for maize across Africa as 17.89% since 2000.

CLIMATE HAZARDS TO MAIZE PRODUCTION

Maize production is particularly sensitive to **increases in temperature** (both air and soil) and more **erratic rainfall**. The potential impact of these hazards changes during the different growth stages.

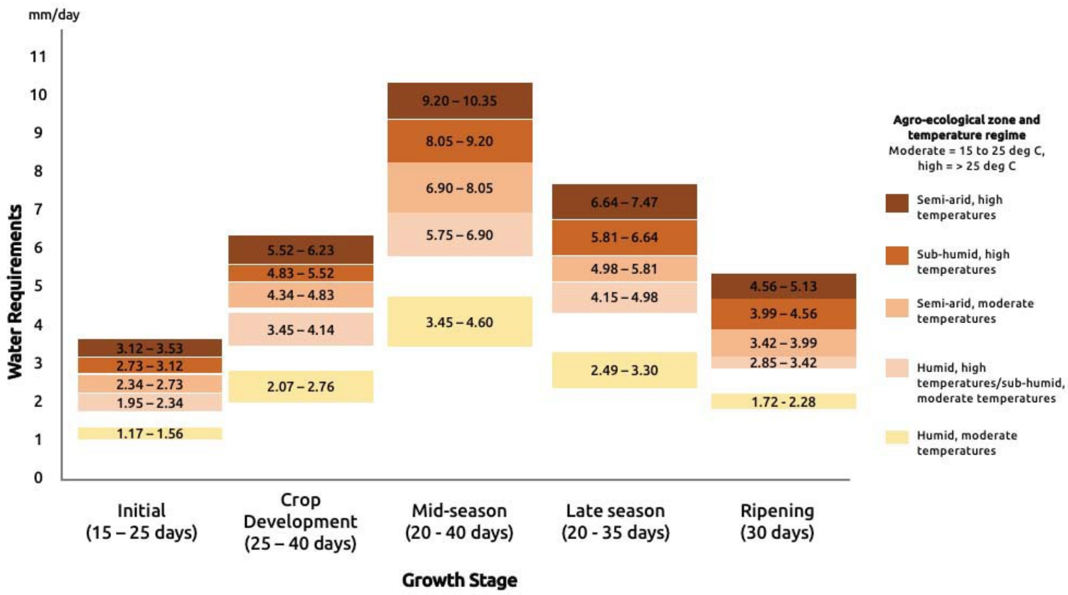
Figures 1 and 2 illustrate the rainfall and temperature requirements for the different growth stages of maize in the sub-tropics. New stress tolerant varieties are constantly being developed, which may expand these ranges.

Figure 1: Maize temperature requirements by growth stage.



Source: Concern Worldwide, 2017

Figure 2: Maize water requirements by growth stage in the tropics and sub-tropics.



Source: Concern Worldwide, 2017

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BEST BET OPTIONS FOR ADDRESSING RISKS IN MAIZE PRODUCTION

Below are five of the best bet climate smart options for maize production. These are covered in more detail in a series of **Decision Tools** developed by CCARDESA for field-level extension staff.

Integrated Soil Fertility Management (ISFM)

ISFM is a set of soil fertility management practices:

- The use of fertiliser
- Organic inputs
- Improved germplasm (seeds) adapted to local conditions
- Cropping systems (rotations/intercropping/fallows, etc.)
- Water management (irrigation, moisture retention, etc.)
- Cultivation practices (minimum till, sub-soiling, pit planting, etc.).

ISFM aims for the **efficient use of fertiliser and organic resources**, coupled with other climate smart agronomic practices in maize production – such as planting improved varieties with appropriate spacing and timing and good control of weeds, insect pests and diseases. Good crop growth is associated with an **extensive** and **vigorous root system** capable of efficient uptake of soil nutrients and water.

To achieve the highest levels of efficiency in terms of productivity, ISFM entails **continuous decision-making** for improvement of agronomic practices for maize.

This requires **constant testing** and **assessment** of **which climate smart practice/technology works best** for a particular farmer. When promoting ISFM, a longer-term perspective should be taken with the farmer.

Small incremental improvements can add up to significant and sustainable increases in maize production over several years. Key decision points for climate smart ISFM selection include the following:

1. Understanding soil type and structure
2. Understanding local climatic conditions and changes over time
   - Assess probability of adequate rains in the coming season
3. Understand the farmer's priorities
   - Are these the same for men and women farmers?
4. Understand the farmer's constraints
   - Are these the same for men and women e.g., labour availability?

See **KPs 06, 07, 08, 09, 12 and 21** for more details on making climate smart decisions on ISFM options for maize. Table 2 illustrates the climate smart credentials of ISFM identified during CSA country profiling in Tanzania. ISFM for maize production was prioritised as a best bet CSA practice to be promoted.

Table 2: ISFM for maize was identified as a priority intervention to be supported/promoted in Tanzania.

CSA Practice	Region Adoption Rate	Predominant Farm Scale	Impact on CSA Pillars		
			Productivity	Adaptation	Mitigation
Integrated Soil Fertility Management	Bahi 30% Songea 30% to 60%	Small to Medium Medium	Improves yield per unit area, hence increasing household incomes	Promotes soil and water conservation, hence less use of inputs such as fertilisers. Reduces incidence of soil-borne pests and diseases	Increases above and below-ground carbon storage. Reduces the need for synthetic fertilisers and related GHG emissions

Source: CCAFS CSA Country Profile Tanzania, 2012

Improved varieties

New varieties of maize are constantly being released across the SADC region and existing varieties being tested for their quality. Improved varieties of maize have been adopted by 55% of farmers in Southern Africa, but the average age of the cultivars being used is 15-years for hybrid and 13-years for **open-pollinated varieties**. There has been an explosion in the release of new cultivars over the past 20-years, but few are widely used. This means that there is **untapped potential in the market**. It is vital that farmers gain access to new varieties so that they can make decisions on which ones might be best suited to their conditions.

Improved varieties generally aim to include pest/disease resistance, with increased tolerance of drought, heat, or salinity. Some varieties aim to increase tolerance to both heat and drought. Drought-tolerant varieties are often faster maturing and yield less grain.

Deciding which variety is most suited to your farmers' context is crucial to maximise productivity.

Key decision points for climate smart variety selection include the following:

1. Understand soil type and structure
2. Understand local climatic conditions and changes over time
   - In the long term, maize may no longer be a viable crop in the target area
3. Understand farmer goals
   - Sale vs consumption
   - Food security – taste/colour may be an important consideration
4. Assess what varieties are currently available and if others can be made available
   - Do men and women have equal access to improved varieties?
5. Test different varieties under local conditions in on-farm trials, and promote the most viable options
   - Testing should always include a calculation of gross margins
6. Continue to test new varieties as they become available and existing varieties for their qualities.

See KP09 for a Decision Tool to help you make climate smart decisions when selecting maize varieties.

Table 3 illustrates the climate smart credentials of stress-tolerant varieties identified during CSA country profiling in Mozambique where the use of drought tolerant varieties of maize was prioritised as a best bet CSA practice to be promoted.

Table 3: Drought tolerant maize varieties were identified as a priority intervention to be supported/promoted in Mozambique.

CSA Practice	Region adoption rate	Predominant farm scale	Impact on CSA Pillars: Productivity	Adaptation	Mitigation
Use of drought-resistant varieties	Nampala: 30% to 60%	Small	Improves yield per unit area – especially during dry periods – hence income for farmers	Enhances water-use efficiency. Increases resilience to moisture stress and other climate shocks	Provides moderate reduction of GHG emissions per unit of food produced
	Inhambane >60%	Small			

Source: CCAFS CSA Country Profile Mozambique

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Planting system options

There are multiple climate smart cropping options available to choose from, including the following:

- Crop Rotation – almost always **includes at least one legume**
  - Changes in the order or **sequence** of crops in a rotation
  - Changes of the **types** of crops in the rotation
- **Intercropping** with legumes
- **Diversity**
  - **Cultivars** – multiple maize varieties in the same plot
  - **Crops** – grow more types of crops in the plot
  - **Rotation** – increase the number of crops in the rotation.

Which combination of crops to grow, and in which spatial arrangement, requires:

1. **Understanding local soil** (texture, fertility), slope, area available and climatic (rainfall, temperature) conditions
2. **Current agronomic practices**, who is engaged in them, and when:
   a. Cultivation/land preparation/sowing
   b. Weeding/pest control
   c. Harvesting
3. An **understanding of the variety of maize** available/ preferred, and the farmer's production goals
   a. Short, medium or long term/yellow or white
   b. Pest/disease resistance
   c. Target tonnes per hectare
   d. Consumption, sale or market access
   e. Men's and women's preferences
4. **Understanding of farmers' goals** for non-maize crop(s), recognising farmers may have multiple goals:
   a. Are men's and women's goals the same?
   b. Cover crops/biomass production
   c. Pest/disease control
   d. Animal/human consumption
   e. Cash crop(s)
   f. Soil fertility management (nutrient availability, moisture retention)
5. **Understanding of legume types** available/desired, and what the main purpose is (legumes are almost always included in climate smart cropping options):
   a. Grain legume – consumption/sale, organic matter
   b. Fodder Legume – animal feed, organic matter
   c. Tree legume – fodder, wood, organic matter
6. Understanding of the **physical attributes of the non-maize crop(s)** to be introduced in the system
   a. Root depth and plant spacing required
   b. Height at maturity and canopy spread
   c. Recommended plant spacing on different soil types
7. **Cost/benefit analysis** of option(s) tested.

See KP07 for a Decision Tool to help you make **climate** smart decisions when selecting planting systems for maize. Table 4 (over) illustrates the climate smart credentials of crop associations identified during CSA country profiling in Mozambique. The use of crop associations in maize production was prioritised as a best bet CSA practice to be promoted.

Table 4: Crop association for maize was identified as a priority intervention to be supported/promoted in Mozambique.

CSA Practice	Region adoption rate	Predominant farm scale	Impact on CSA Pillars		
			Productivity	Adaptation	Mitigation
Crop association	Central zone <30%	Small to Medium	Increases total production and productivity per unit of land Harvests of multiple crops increase income and food security	Reduces the risk of total crop failure during unfavourable climatic conditions – due to a diversified production system	Improves soil structure, increases above-ground biomass, and when leguminous species are used reduces nitrogen-based fertilisers and related GHG emissions

Source: CCAFS CSA Country Profile Mozambique

Pest & disease control options

Crop losses in African countries due to pests and diseases are estimated at 49% of the expected total crop yield each year (CABI, 2018)[1], driven by continuous monocropping (mainly of maize), and poor pest/disease management practices.

Off-the-shelf pesticides, herbicides and insecticides can be effective control options, but are often not viable for smallholder farmers due to cost and availability. Men and women may also not have the same access to these inputs and/or to the information required to use them correctly (e.g., women's literacy rates are consistently lower than men across the region, meaning they are less likely to be able to read and understand instructions that come with the product). They can also have negative environmental effects, especially if not used correctly. Organic pesticides made from locally-available ingredients can also be used.
There are many climate smart options that can help minimise the losses due to pests and disease in maize:

- **Crop rotations/intercropping/crop diversity**
  - Planting different crops, or varieties of the same crop in rotation or on the same plot, reduces risk and can break pest and disease cycles

- **Resistant varieties**
  - Many varieties of maize have built-in resistance to specific pests/diseases

- **Weeding**
  - Weeds themselves are pests, as they compete with maize and steal nutrients that could otherwise be used by the maize plant
  - Weeds can also host pests/diseases, which can then be transferred to the maize plants

- **Push–Pull**
  - These systems include plants within the maize plot that 'scare away' insect pests, and others around the edge of the plot that attract (trap) them, keeping them away from the maize

- **Dealing with infected plant material**
  - Depending on the type of pest/disease, it may be necessary to remove infected plant material and feed it to animals, burn it or compost it.

[1] This figure includes post-harvest losses.

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Different practices can be used together to maximise benefits, and **no one solution works in every situation**. Combining pest management practices is known as **Integrated Pest Management (IPM)**.

Make climate smart decisions on which options are best suited to your farmers:

1. Be able to identify which pests are currently affecting the farmers' maize crop
2. Understand the pest life cycle so you can recommend control options
3. Understand farmers' objectives in terms of production
   - This may affect investment of time and resources in pest control. Men are often more interested in investing in cash crops. Women may be more interested in food crops
4. Understand the farmers' ability to access/use inputs such as organic/inorganic pesticides/herbicides/insecticides
5. Understand who does what and when in the crop calendar
   - Who is responsible for weeding?
   - What do they think about the costs/benefits of weed control options?
6. Assess the potential and actual benefits of any options recommended/implemented
   - Labour should always be included in an analysis of gross margins or agronomic efficiency.

See **CCARDESA KP19 for a Decision Tool** to help you make climate smart decisions when selecting pest and disease control options for maize. Table 5 illustrates the climate smart credentials of integrated pest and disease control options identified during CSA country profiling in Zambia.

Table 5: Integrated Pest Management (IPM) was identified as a priority intervention to be supported/promoted in Zambia.

CSA Practice	Region adoption rate	Predominant farm scale	Impact on CSA Pillars		
			Productivity	Adaptation	Mitigation
Integrated pest and diseases management	Natural Region 2a <30% Natural Region 1 <30%	Small Small	Ensures crop production and quality, hence increasing potential income	Reduces crop losses from pests and diseases, even when crops are under moisture stress conditions	Reduces GHG emissions by reducing use of synthetic pesticides

Source: CCAFS CSA Country Profile Zambia

Post-harvest management options

Reducing post-harvest losses in maize can be a more resource-efficient way of increasing grain availability – rather than expanding production – as it may not rely on increased use of agricultural inputs such as land, labour, and fertiliser.

Addressing post-harvest losses may be a more viable alternative for labour-constrained households than trying to increase production.

Post-harvest losses of cereal grains commence when they have reached physiological maturity in the field. This is followed by a chain of post-harvest activities, from the field to the consumer. This chain has at least eight links from harvest to marketplace. At each link, there are usually some dry matter weight losses when grain is scattered or spilt, or due to grain becoming rotten or consumed by pests. The typical magnitudes of such losses are shown in Table 6.

When making decisions on which post-harvest handling & storage options to advise farmers to adopt, the following steps should be followed:

1. Understand the principles of good management for each stage (harvesting, transport, drying, sorting, protecting and storing)
2. Understand the current farming practices to identify how they can be improved
3. Be able to recognise better quality grain
4. Understand the farmers' priorities and constraints to select the most appropriate climate smart solution for their situation.

See the **CCARDESA KP13 Decision Tool** to help you make climate smart decisions when selecting post-harvest management options for maize.

Table 6: Typical post-harvest losses.

Crop	Maize	Maize	Sorghum	Millet
Scale of farming	**Small**	**Large**	**Small**	**Small**
Harvesting/field/drying	6.4	3.8	4.6	3.5
Platform drying	4	3.5	–	–
Threshing	1.3	2.3	3.6	2.0
Winnowing	–	–	–	0
Transport to farm	2.4	1.9	2.2	2.5
Farm storage	5.3	2.3	2.5	1.1
Transport to market	1.7	1	1	1
Market storage	2.7	2.7	2.7	2.7
Cumulative % weight loss	**21.6**	**16.3**	**15.5**	**12.2**

Source: APHLIS, 2013

FEASIBILITY ANALYSIS

Before you can decide which options are best suited for your farmers/clients, you need to assess if they are feasible in the local context. All of the 'best bet' climate smart CSA options listed have been proven to work. But, this does not mean that they are suitable for every farmer.

It is **vital to understand how different solutions might impact men, women, and youth differently**. For example, a recommendation to plant a new drought-tolerant seed variety that is available five kilometres away in a farm supply store might be a simple solution for an adult male farmer with access to transport, but might not be suitable for a single female-headed household with a small child that is still being breastfed. If malnutrition is an issue, are their available drought tolerant seed varieties that are biofortified and/or is there potential for intercropping?

Farmers' priorities will also **change with the time of year**. During the growing season, they may be more concerned with pest and disease control, but potential climate smart solutions to this problem may start with the choice of varieties and the cultivation practices, which happen much earlier in the season. It is vital to understand the problems faced throughout the agricultural calendar.

A **checklist** of questions to help guide you in understanding the farmer's context is provided at the end of this knowledge product.

1 What do farmers need/ demand?

- Are the demands of male and female farmers the same?
- To develop effective **climate smart** solutions, the demand must address an identified need

2 Is the proposed solution accessible?

- Is the solution equally accessible to men and women?
- Is the technology locally available (e.g., improved seed)?
- Will the practice require extensive training or changes to existing practices?

3 Labour requirements

- If the solution requires increases in labour, who will do this (men/women/children) and do they have the time to do this?

HOW TO CHOOSE THE BEST BET CLIMATE SMART OPTIONS FOR YOUR FARMER(S)

Once you have worked with your farmer(s) to determine if proposed climate smart solutions are feasible, you will have a list of practical options – different practices will be appropriate at various stages in the maize cropping cycle.

The next step is to pick which option is best suited to meet the demands of the farmer(s).

Trials should be established with the farmers to test feasible solutions, to see which are the most effective. These can be done with individual farmers, with lead farmers, or through **farmer field schools (FFS)**.

Gross margins should always be calculated to assess the return on investment. This will result in the most profitable option emerging. Cost of own labour must be included in any **gross margin analysis**, along with all other inputs. A decision on a cultivation practice might have positive or negative effects on labour/input requirements later in the growing cycle.

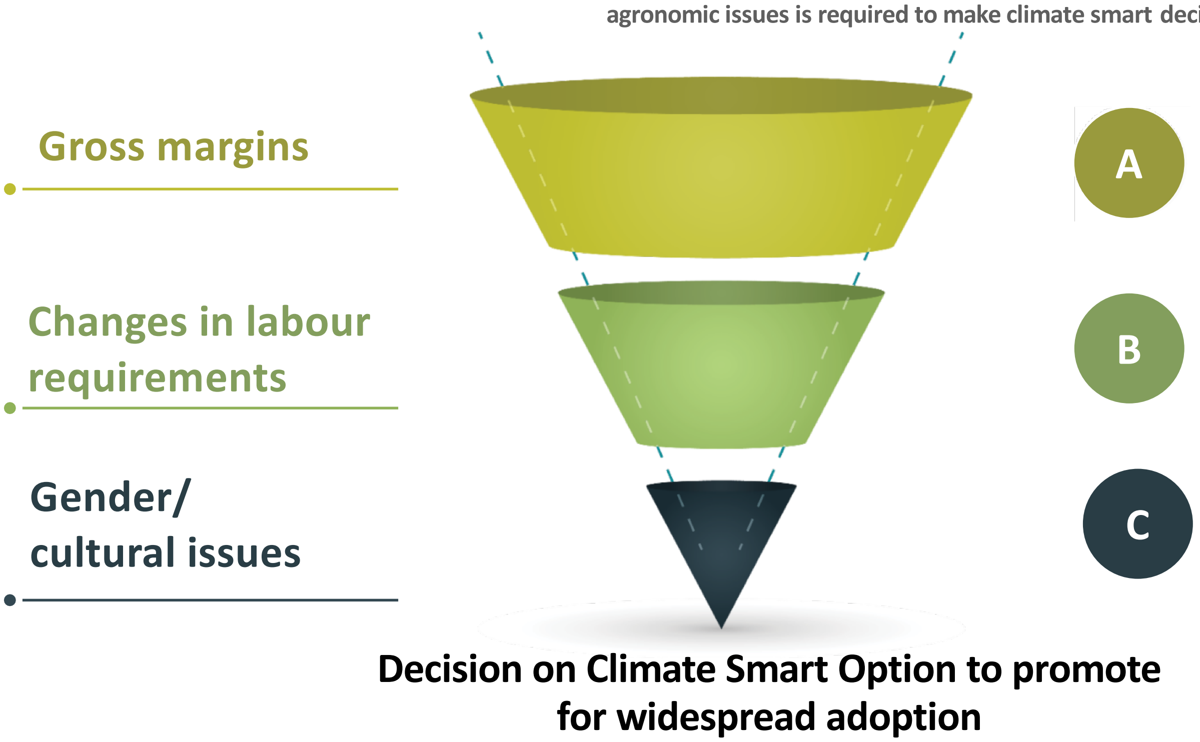
It is important to understand who does what and when within the whole growing cycle and to assess input costs all the way through the season, even if the solution being tested is in relation to a different cultivation practice.

Gross margins, labour requirements, gender and cultural issues as well as multiple other context-specific issues need to be understood, and trade-offs made when deciding which CSA practice/technology is the best fit for a particular farmer (Figure 3).

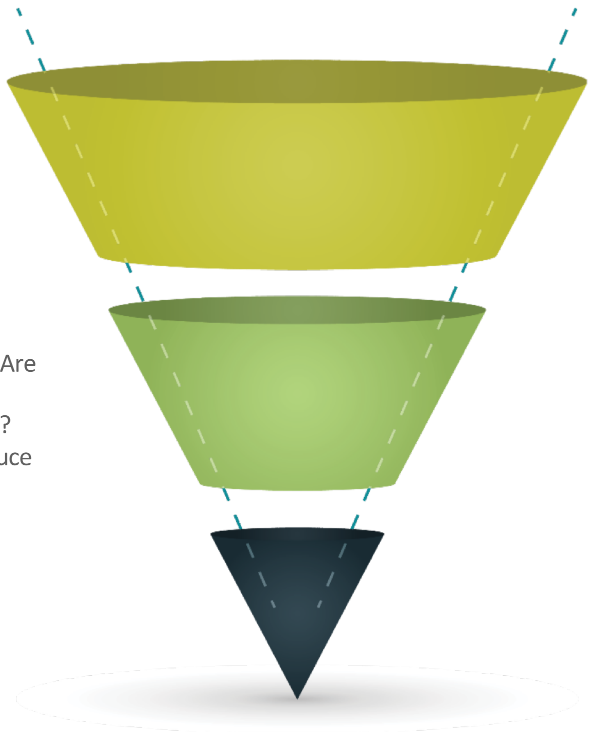
TIP

Remember, when establishing farmer trials – keep all other variables except the one you are testing (seed type, time of planting, weeding, etc.) – the exact same.

Figure 3: A deep understanding of the context and the interplay between multiple social, environmental, and agronomic issues is required to make climate smart decisions.



TO SUMMARISE



STEP 1: Identify options

- What is the current situation
- What happens if nothing is done?
- What is the potential if climate smart options are introduced?

STEP 2: Analyse feasibility

- What is being demanded by farmers? What are their requirements? Are requirements of men and women the same?
- Is the technology/practice, available/accessible to the target farmers?
- Will the proposed climate smart practice/technology increase or reduce labour requirements?

STEP 3: Select option

- Test different options with farmers
- Assess cost effectiveness using gross margins analysis
- Assess any gender/cultural constraints.

CIAT, 2016

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. Translations of this Knowledge Product to French and Portuguese was achieved using machine translation tools, and the results were checked by an accredited translator.

- **CCARDESA website** www.ccardesa.org
- **The Research Programme on Climate Change Agriculture and Food Security (CCAFS) – The CSA Guide** (**https://csa.guide/**) Tsedeke Abate, Monica Fisher, Tahirou Abdoulaye, Girma T. Kassie, Rodney Lunduka, Paswel Marenya and Woinishet Asnake: Agriculture and Food Security, 2017. Characteristics of maize cultivars in Africa: How modern are they and how many do smallholder farmers grow? DOI 10.1186/s40066-017-0108-6
- **FAO** – **The Climate Smart Agriculture Sourcebook**

Integrated Soil Fertility Management

See also **CCARDESA Knowledge Products** 7, 8, 9, 10, 12, 16 & 19 for more detail on specific climate smart practices and technologies included within **Integrated Soil Fertility Management.**

- **African Soil Health Consortium (ASHC)** –Handbook for Integrated Soil Fertility Management
- An excellent resource for every extension officer
- **ASHC** – Maize-Legume Cropping Systems
  - A practical guide to growing maize and legumes. Excellent resource for extension staff in the field

Improved varieties

- **FAO** – Training Manual for Improving Grain Post-Harvest Management and Handling
  - Sections on seed selection and storage are important here
- **International Maize and Wheat Improvement Center (CIMMYT)/International Institute for Tropical Agriculture (IITA)** – Drought Tolerant Maize for Africa – **http://dtma.cimmyt.org/**
  - Access the different varieties that have been released over the past number of years, and for useful contacts

Planting system options

- **FAO** – Green manure cover crops and crop rotation in conservation agriculture on small farms: Integrated Crop management Vol 12, 2010
  - Focused on Paraguay and quite scientific in places, but covers all the principles behind the practices
- **FAO/TECA** – Cover crop species with a special focus on legumes
- **FAO/TECA** – Crop Rotation in Conservation Agriculture

Pest and disease control options

- **Plantwise** – Factsheets for farmers. **www.plantwise.org**
  - 100s of factsheets available. Each one dedicated to a specific pest/disease. You will need to be able to identify the problem so you can find the correct factsheet, supported by a mobile App. Excellent resources

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- **Technical Centre for Agricultural and Rural Cooperation (CTA)** – Practical Guide Series 2: How to Control Striga and Stemborer in Maize
  - A short, practical guide comparing different and joint control measures for both pests
- **FAO** – Integrated Management of the Fall Armyworm on Maize; A guide for farmer field schools in Africa.
  - An excellent resource for any extension officer faced with existing/potential outbreaks of fall armyworm. Many of the principles in this manual can be used to control other pests. A valuable resource for all extension workers
- **ASHC** – Maize-Legume Cropping Systems
  - A practical guide to growing maize and legumes. An excellent resource for extension staff in the field
- **ASHC** – Crop Pests and Diseases; A manual of the most important pests and diseases of the major food crops grown by smallholder farmers in Africa
  - A useful guide to identifying and controlling the main pests and diseases of the most important food crops. Every Extension Officer should download a copy
- **Croplife International** – Trainee Manual; Introduction to Integrated Pest Management
  - A comprehensive guide to Integrated Pest Management; but quite verbose, and with few diagrams
- **Global Alliance for Climate Smart Agriculture (GACSA)** – Climate Smart Pest Management; Implementation Guidance for Policymakers and Investors
  - Targeted towards policy makers, not field staff. Worth reading to get the bigger picture

Post-harvest management

- **World Food Programme**, University of Greenwich, NRI - Training Manual for Improving Grain Postharvest Handling and Storage
  - An excellent resource for extension staff. Covers every aspect of post-harvest management in detail, while still being very user-friendly.
  - Also includes posters that can be customised by adding text in the local language
- **Natural Resources Institute's** (NRI's) Postharvest Loss Reduction Centre – https://postharvest.nri.org/
  - This website has lots of practical resources on managing post-harvest losses. Its 'Granary Selector Tool' is a useful guide for extension staff
- **African Post harvest Loss Information System** (APHLIS) (managed by NRI) – Loss Assessment Manual
  - Detailed guidelines on how to collect and analyse data on post-harvest losses at each link in the post-harvest chain
- **FAO Information on Postharvest Operations** (INPhO)
  - Details on post-harvest management practices for maize, sorghum, rice and other crops
- **GIZ** – Rapid Loss Appraisal Tool (RLAT): For Agribusiness Value Chains – A user guide for Maize
  - A useful guide to assist practitioners in designing and implementing an assessment of where in the value chain losses are most significant, measuring these, and designing interventions to address these.

ANNEX A: CHECKLIST OF QUESTIONS TO HELP UNDERSTAND THE LOCAL CONTEXT

Understanding the farmer's context and the challenges they face is key to coming up with climate smart solutions to their problems. Different people within the household will often perform different tasks, and thus a problem faced by a male farmer (e.g., in land preparation) might not be understood or mentioned by his wife/children (who might face different challenges in weeding), or vice versa.

The questions below are a good starting point for understanding the farming system and the problems within it:

1. **Is this location suitable for maize – temperature and rainfall?**
    a. If no, what alternatives are there?
2. **What is the maize being used for (sale/ consumption/both, etc.) and what varieties are available locally?**
    a. What variety do they use and why? Who decides on this?
    b. How much is required?
3. **What other inputs are used, and are these available and accessible?**
    a. Is access/availability of these inputs different for men and women?
4. **What challenges to maize production are currently being faced by the farmer?**
    a. Are these challenges the same for women and men?
    b. You need to understand which jobs are done by men, women and children – to ensure the different problems faced during different tasks are addressed
    c. Does the farmer have any problems in accessing agricultural inputs (fertiliser, manure, pesticides, seed, labour) and are these problems different for men and women?
5. **What is the condition of the soil?**
    a. Texture, structure, pH, slope, etc.
6. **What is the current farming system?**
    a. Irrigated or rain-fed production?
    b. How and when is land prepared, and who prepares it?
    c. Does the farm have a mixed cropping system and/or are animals integrated in the system?
    d. Where does the seed come from?
    e. How is the seed planted, and who plants it?
    f. Is compost/manure applied, at what rate, and by whom?
    g. Is fertiliser used? What type, when, how, and by whom?
    h. If irrigated, how is water managed?
    i. How are weeds/pests managed, and by whom?
    j. How is harvesting done, and by whom? (timing/ drying/grading, etc.)
    k. How and where is the maize stored? What losses are normally expected in storage?

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