KP04

Knowledge Product 04

CCARDESA

Centre for Coordination of Agricultural Research and Development for Southern Africa

OPTIONS PAPER:

Best Bet Climate Smart Agriculture Options for Rice in SADC

CLIMATE SMART AGRICULTURE

KNOWLEDGE PRODUCTS FOR EXTENSION WORKERS

Customised Information Tool for Agricultural Professionals

Audience: Local Extension Staff

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

Aaron May, 2010

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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 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.

Key Messages:

1. Rice is often referred to as a 'thirsty crop', requiring substantial quantities of water. Increasing variability in the intensity and duration of rainfall has significant negative effects on production in the SADC region, where smallholder rice production is predominantly rain-fed

2. This paper outlines some of your Best Bet climate smart options for rice production in the SADC region

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

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:

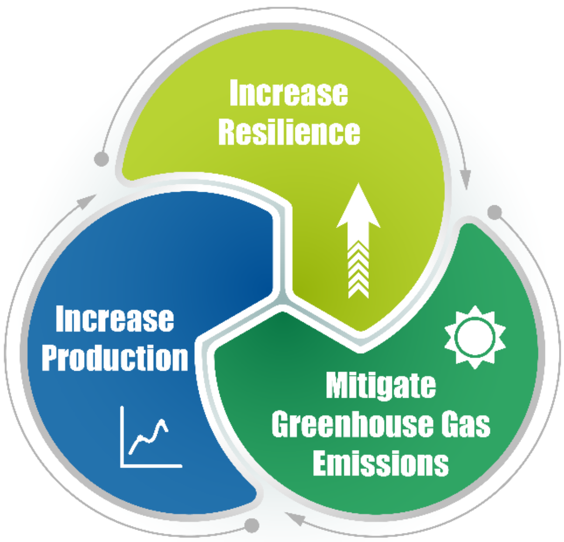
   a. Identifying **best bet** opportunities for agricultural investment

   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.

Entry Points for CSA

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



BEST BET CLIMATE SMART AGRICULTURE OPTIONS FOR RICE IN SADC

This **Options Paper** focuses on some of the **Best Bet Climate Smart practice** and **technology** options for rice 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 & [in draft] Malawi)
- They are widely applicable across the region
- They have high potential to address major constraints to rice production in the region (Table 1).

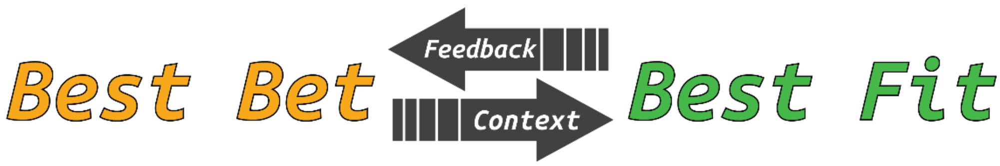


Table 1: Best Bet Options For Addressing Climate Risks To Rice Production with smallholder farmers, as they offer the most potential to reduce production losses.

Best Bet Climate Smart Options For Rice	Risks to rice production
Integrated soil fertility management (ISFM)	Nearly 40% of soils in sub-Saharan Africa (SSA) are already low in nutrient capital reserves; 25% suffer from aluminium toxicity, and 18% have high leaching potential. Average yields from upland areas are about 1 tonne per hectare, with a yield potential of 2.5 – 4 tonnes per hectare.
Water management	The production of rice in East and Southern Africa increased by 57% between 2000 and 2010. About 47% of production is from rain-fed lowlands, and a further 20% from rain-fed uplands. Too much and/or too little rain has a huge impact on rice production – not just through drought stress – but also as wet conditions can delay key management practices, such as planting and weeding.
Improved varieties	Improved short season varieties have been developed to reduce water requirements in upland and lowland areas. However, 5–10 years after their introduction, just 5% of upland rice growing area is planted to these improved varieties.
Pest and disease control	Farmers lose an estimated average of 37% of their rice crop to pests and diseases every year. The most important and prevalent pest species are stem borers, leaf-folders, plant-hoppers, and gall midge. Weeding is a major production cost, with estimates of 50–150 person-days per hectare required for manual weeding.
Post-harvest management	The African Post Harvest Losses Information System lists average annual post-harvest losses for rice across Africa since 2000 as 12.5%.

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CLIMATE HAZARDS TO RICE PRODUCTION

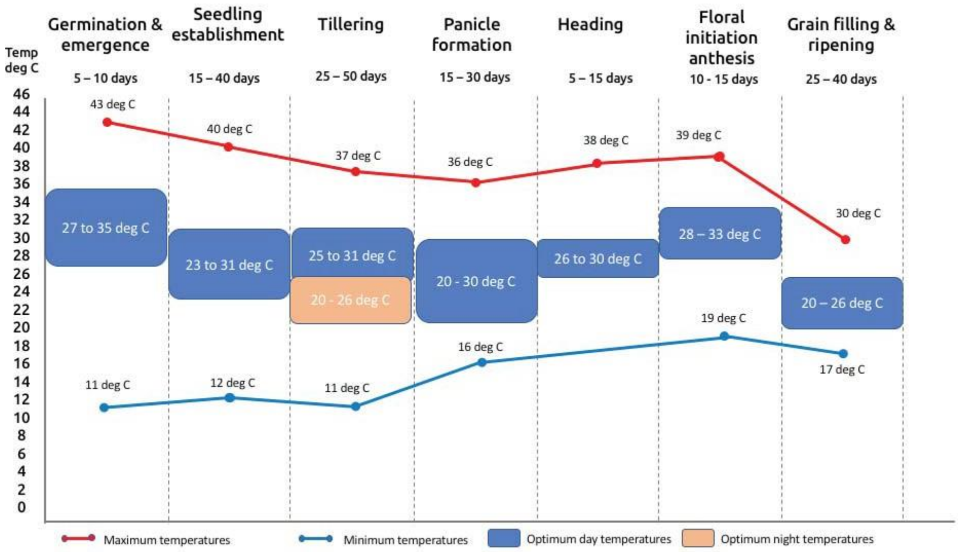
Viable rice production needs a warm, moist climate, with abundant sunshine. An average of 200 mm rainfall per month is needed for lowland rice; 100 mm a month for upland rice.

As most rice production in the SADC region is rain-fed – upland and lowland – rainfall is a critical factor.

Too much and/or too little rain has a huge impact on production – not just through drought stress, but also in delaying key management practices such as planting and weeding.

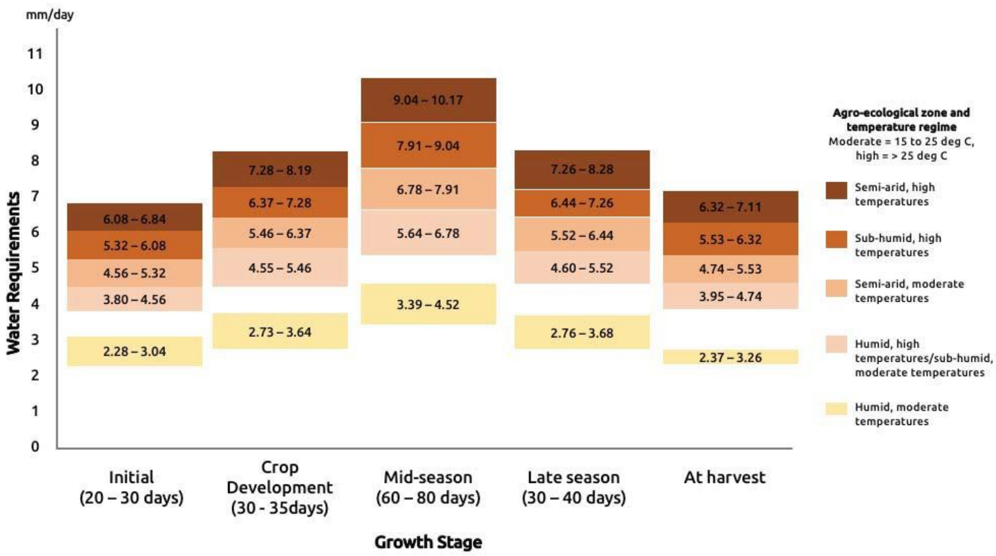
Optimal temperatures range between 20 °C and 30 °C, but rice can tolerate day temperatures up to 40 °C. Rice does better when there is bright sunshine, especially in the 45 days before harvest – when at least 6 hours of sunshine are needed each day. Figures 1 and 2 illustrate the rainfall and temperature requirements for the different growth stages of rice.

Figure 1: Rice (Oryza sativa) temperature requirements by growth stage.



Source: Concern Worldwide, 2017

Figure 2: Upland rice water requirements by growth stage.



Source: Concern Worldwide, 2017

BEST BET OPTIONS FOR ADDRESSING RISKS IN RICE PRODUCTION

Below are five of the **Best Bet Climate Smart Options** for enhancing **Rice Production**.
They 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 seeds (germplasm) – 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 efficient use of fertiliser and organic resources – coupled with other climate smart agronomic practices, 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 the improvement of agronomic practices** on the farm.

This requires **constant testing and assessment** of which climate smart practices/technologies work best for a particular farmer. When promoting ISFM, a **longer-term perspective** should be taken with the farmer. Seemingly small incremental improvements can add up to significant and sustainable increases in production.

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

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 farmers' priorities
   - Are these the same for men and women farmers
4. Understand the farmers' constraints
   - Are these the same for men and women (e.g., labour availability).

See **CCARDESA KPs 6, 9, 11** and **20** for more details on making climate smart decisions on ISFM options for rice. Table 2 illustrates the climate smart credentials of one of the components of ISFM, identified during CSA country profiling in Mozambique. Land-levelling for rice was prioritised as a best bet CSA practice to be promoted.

Table 2: Land-levelling (a component of ISFM) was identified as a priority CSA intervention to be supported/promoted in Mozambique.

CSA practice	Region adoption rate	Predominant farm scale	Impact on CSA Pillars		
			Productivity	Adaptation	Mitigation
Land-levelling (a component of ISFM)	Chokwe <30 % Zambezia <30%	Small & Medium Small & Medium	Increases the yield per unit area. Reduces time and input use, hence reducing production costs	Enhances water-use efficiency. Allows uniform germination and facilitates irrigation process. Can be combined with alternate wetting and Drying (AWD) method	Provides moderate reduction GHG emissions per unit of food produced Increases nutrient-use efficiency, reducing fertiliser applications

Source: CCAFS CSA Country Profile Mozambique

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Water Management

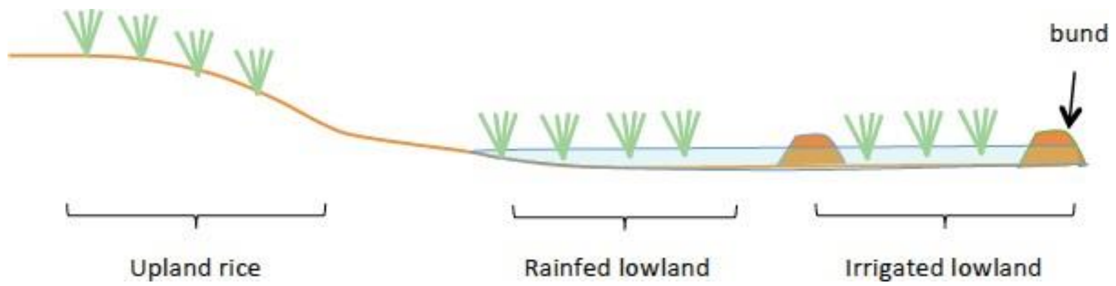
There are three main types of rice production system (Table 3):

- Irrigated lowland
- Rain-fed lowland
- Rain-fed upland.

A fourth system, utilising mangrove swamp-land, represents only 6% of rice growing area in Africa.

Lowland refers to the production technique (rice grown on land that is flooded or irrigated), and **not altitude**.

Table 3: Characteristics of the three different rice production systems prevalent in the SADC region.



	Rain-fed upland	Rain-fed lowland	Irrigated lowland
Estimated % of rice production in Africa	20	47	33
Ecologies where used	Uplands, from low-lying valleys to steep slopes	Swampy, low-lying areas that collect a lot of water	Flood plains, valley bottoms and terraced fields where there is sufficient water and water control infrastructure to allow irrigation
Crops per year and yields	1 crop per year Yields lower and more variable than lowland	1–2 crops per year One rice crop plus other diversified crops Yields lower than irrigated	1–2 crops per year Highest yields
Water	Soil not covered with water for most of growing season	Soil submerged for part of cropping season, depending on rainfall and groundwater	Layer of water is controlled and covers soil for most of growing season Active water management
Key management practices	No puddling or irrigation and soil not intentionally submerged. Seeds broadcast or dibbled in dry soil prior to or during rains	Soils ploughed after onset of rains. Bunds used to contain water, but no active management of water Transplantation of seedlings or direct seeding in dry or puddled fields	Puddling Transplantation or direct seeding Management of water levels throughout cropping season Mechanical weed control

Source: ASHC, Rice Cropping Guide, 2015

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Water management in rice is dependent upon the production system. In irrigated rice, the key is increasing water-use efficiency (WUE) in order to maintain or increase yields.

Safe alternate wetting and drying (SAWD) maintains enough water in the root zone in the soil to ensure plant growth, with no reduction in yield. Where water scarcity does not enable safe alternate wetting and drying, water can be applied at key growth stages to ensure a reduced yield.

Alternate wetting and drying (AWD) is the water management technique used in the System of Rice Intensification (SRI). This system was developed in Madagascar and is an integrated crop management technology, characterised by the following:

- Transplanting 8 to 12-day-old seedlings – very carefully, root tip down
- Transplanting single seedlings
- Spacing the plants widely apart in a square pattern – 25 cm × 25 cm, or wider
- Controlling weeds by weeding with a rotating hoe – aerating the soil
- Applying compost to increase the soil's organic matter content (optional)
- No continuous flooding during the crop growth period – applying small amounts of water regularly, or alternating wet and dry (AWD) field conditions to maintain a mix of aerobic and anaerobic soil conditions. After flowering, a thin layer of water should be kept on the field, although some farmers find alternate wetting and drying of fields throughout the crop cycle to be feasible and even beneficial.

In rain-fed lowland and upland production, water management is often a trade-off between available water and yield reductions.

To make climate smart decisions on water management in upland/lowland rain-fed rice production, many variables need to be considered. These include:

- Understand the soil type and water table
  - Can moisture retention be increased through soil amendments?
- Understand typical rainfall distribution over the growing season
  - Timing of planting to ensure adequate soil moisture and sunshine at critical growth stages
- Determine the main pests and diseases in the growing area
  - This will influence the choice of variety and control options
- Determine labour availability for land preparation, weeding and harvesting
  - Heavy levels of mulch (only appropriate in upland rice) can help retain moisture, but can also significantly reduce labour in weeding
  - Determine what varieties are available on the local market
  - A practical, yet important choice.

See **KP11** for more details on making climate smart decisions on water management options for rice. Table 4 illustrates the climate smart credentials of the system of rice intensification (which includes AWD), identified as a priority CSA option for support during CSA country profiling in Zambia.

Table 4: System of Rice Intensification (includes alternate wetting and drying) was identified as a priority CSA intervention to be supported/promoted in rice production in Zambia.

CSA Practice	Region adoption rate	Predominant farm scale	Impact on CSA Pillars		
			Productivity	Adaptation	Mitigation
System of Rice Intensification	Natural Region 2 – Western Region <30%	Small	Increments in yield due to the higher number of tillers, and better grain quality	Enables larger area for cultivation, even with limited water availability	Reduced methane emission from rice fields. Minimises water use; hence increases water-use efficiency for rice cultivation
	Natural Region 1 – Muchinga <30%	Small			

Source: CCAFS CSA Country Profile Mozambique

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Improved varieties

New varieties of rice are constantly being released across the SADC region and existing ones being tested for their qualties, but there is a significant lag in the uptake of these varieties. New Rice for Africa (NERICA) varieties have been designed specifically for resistance to common pests and diseases in Africa. Five to ten years after their release, uptake of these varieties in West Africa was just 5% of farmers, meaning there is huge untapped potential to narrow the yield gap for rice.

Table 5: Yield gap for rice under different production systems.

Rice system	Current average yields (tonnes per hectare)	Attainable yields with best practices (tonnes per hectare)
Rainfed upload	1	2
Rainfed lowland	2	3 to 4
Irrigated lowland	5	6 to 8

Source: ASHC, Rice Cropping Guide, 2015

It is vital that farmers get access to these new and tested varieties, so 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, flooding or salinity.

Deciding which variety is most suited to your farmers' context is crucial in maximising productivity. To make a climate smart decision on rice variety selection, you should:

1. Understand **soil type and structure**
   - Sandy, free draining soils may not be suitable
   - Is the water table shallow enough that roots may access it directly?
   - Can soil amendments be added to improve moisture retention?
2. Understand **local climatic conditions** and changes over time
   - Timing to ensure rainfall and sunlight during critical growth stages
3. Understand the **farmers' goals**
   - Sale vs consumption?
   - Food security – taste/aroma/colour/shape may be important considerations
4. Assess what **varieties** are currently available, and if others can be made available. A variety should have the following attributes:
   a. Resistance or tolerance to major diseases, insects and/or abiotic stresses (e.g., drought, flood) in the area
   b. The right duration of growth to match the season. Avoid varieties that need to be planted or harvested early or late – relative to other rice fields in the surrounding area to avoid:
   c. Increased attack from pests (e.g., birds during maturation)
   d. Growth problems during times of adverse environmental conditions (e.g., late maturing varieties running out of water)
   e. Consider planting multiple varieties to maintain biodiversity and reduce risk of crop failure
5. Test different varieties under **local conditions** in on-farm trials, and promote the most viable options
   - Testing should always include calculation of gross margins
   - Testing should occur over at least three seasons
6. Continue to test **new varieties as they become available and existing ones for their qualities.**

See **KP09** for a Decision Tool to help you make climate smart decisions when selecting rice varieties. Table 6 illustrates the climate smart credentials of stress-tolerant varieties identified during CSA country profiling in Mozambique, where the use of drought-tolerant varieties was prioritised as a best bet CSA practice to be promoted.

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Table 6: Drought tolerant varieties[1] 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			

[1] This example is for maize, but is equally applicable for rice. Source: CCAFS CSA Country Profile Mozambique

Pest & disease control options

Farmers lose an estimated average of 37% of their rice crop to pests and diseases every year. The most important and widely distributed pest species are stem borers, leaf-folders, plant-hoppers, and gall midge. Weeding is a major production cost, with estimates of 50–150 person-days per hectare required for manual weeding. Continuous monocropping, and other poor pest/disease management practices contribute greatly to this.

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 losses to pests and disease in rice, depending on production type – rain-fed upland, rain-fed lowland, or irrigated:

- **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 rice have built-in resistance to specific pests/diseases
- **Weeding**
    - Weeds themselves are pests, as they compete with rice and steal nutrients that could otherwise be used by the rice plant
    - Weeds can also host pests/diseases, which can then be transferred to the rice plants
- **Flooding** at particular times can break pest life cycles
- **Avoid overuse of nitrogen**, as this can encourage some pests
- **Push–Pull**
    - These systems include plants within the rice plot that 'scare away' insect pests, and others around the edge of the plot that attract (trap) them – keeping them away from the rice
- **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
- **Reduce usage of chemical insecticides**, as these can often kill beneficial 'enemies' of pests:
    - Encourage these beneficial insects (e.g., bees) by planting orange and white flowers on field margins

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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)**.

To make climate smart decisions on which options are best suited to your farmers, you should:

1. Be able to **identify which pests are currently affecting** the farmers' rice crop
2. **Understand the pest life cycle** so that you can recommend control options
3. **Understand the farmers' objectives** in terms of production
   - This may affect investment of time and resource in pest control. Men are often more interested in investing in cash crops than 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 (men, women, youth)
   - Who is responsible for weeding, and what do they think about the costs/benefit 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.

See **CCARDESA KP20** for more details on making **climate smart decisions on pest and disease control options for rice**. Table 7 illustrates the climate smart credentials of crop rotations, which are a key component of any Integrated Pest Management system. This was identified as a priority CSA option for support during CSA country profiling in Tanzania.

Table 7: Crop rotation, a key component of Integrated Pest Management was identified as a priority CSA intervention to be supported/promoted in rice production in Tanzania.

CSA Practice	Region adoption rate	Predominant farm scale	Impact on CSA Pillars		
			Productivity	Adaptation	Mitigation
Crop rotation (Key component of Integrated Pest Management)	Morogoro <30% Shinynga <30%	Small Small	Increases yields due to soil fertility improvement, reduces losses to pests, and increases farm income	Helps in breaking disease cycles and resurgence and build-up of pests Improves on-farm diversification and prevents soil erosion	Reduces the need for nitrogen fertiliser application when leguminous crops are introduced. Maintains and/or improves soil carbon stocks

Source: CCAFSCSACountry Profile Tanzania

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Post-harvest management options

Reducing post harvest losses in rice 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 rice begins when it has 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 8 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 in cereal grains in sub-Saharan Africa are shown in Table 8.

Table 8: Typical post-harvest losses of cereal grains.

Post-harvest stage	Typical percentage loss
Harvesting/field drying	4 to 8
Transport to homestead	2 to 4
Drying	1 to 2
Threshing/shelling	1 to 3
Winnowing	1 to 3
Farm storage	2 to 5
Transport to market	1 to 2
Market storage	2 to 4
Cumulative loss from production	**10 to 23**

Source: WFP,2012

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 **CCARDESA KP13** to help you make climate smart decisions when selecting post-harvest management options for rice.


CIFOR, 2017

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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 the **Best Bet** climate smart CSA options listed have been proven to work; however, that 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 variety of rice 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 breast-fed.

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 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, they 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 the proposed climate smart solutions are feasible, you will have a list of practical options - different practices and technologies will be appropriate at various stages in the rice cropping cycle.

The next step is to pick which option is best suited to meeting 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)**.

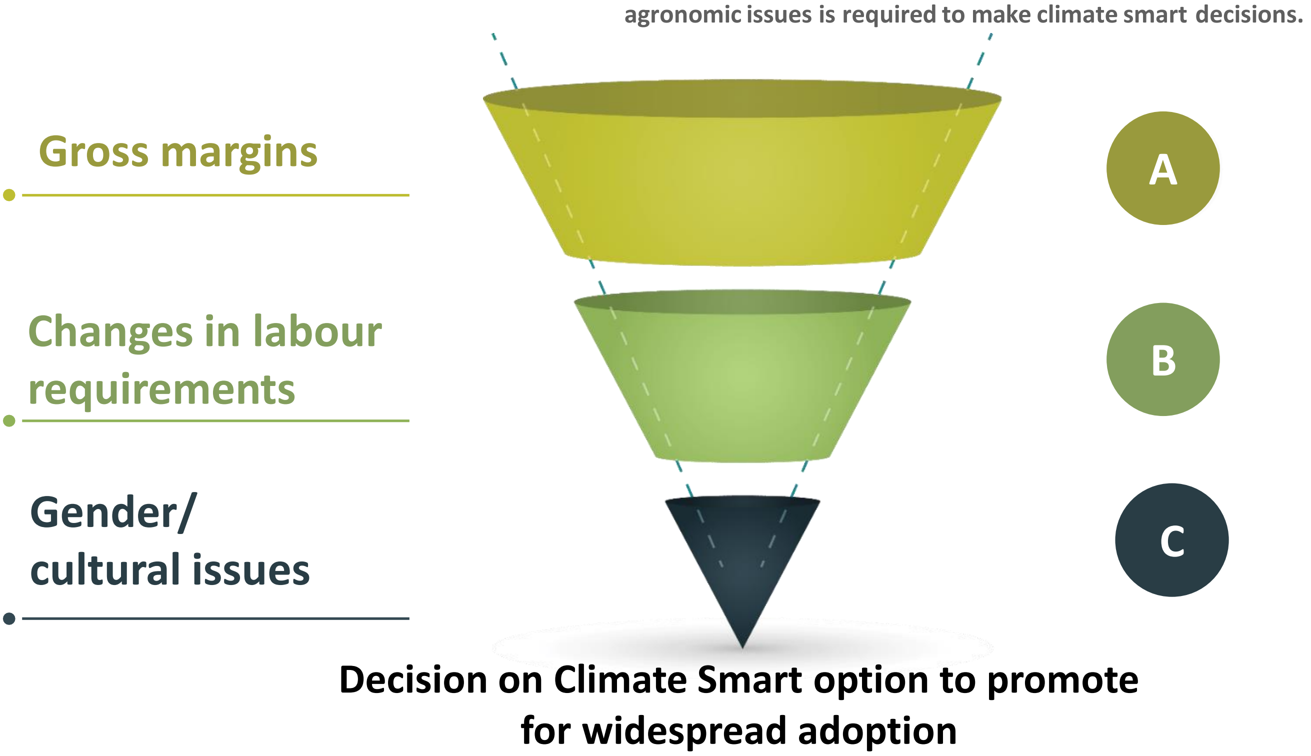
Gross Margins should always be calculated to assess the return on investment as compared to other farm practices. This will result in the most profitable option emerging. Cost of own labour must be included in any gross margin analysis along with all other inputs. A decision on a cultivation practice 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.



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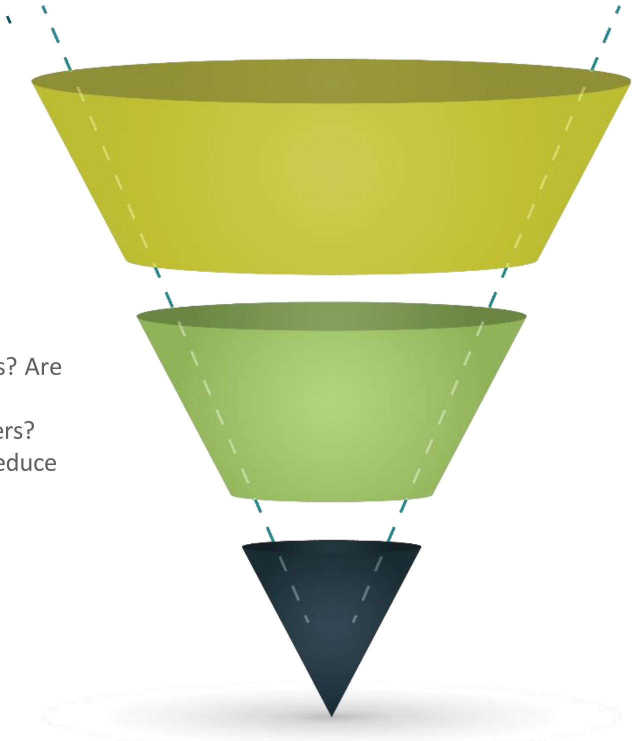
TO SUMMARISE



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.

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.

- **African Soil Health Consortium (ASHC)** – Rice Systems Cropping Guide
  - A practical guide to growing rice. Excellent resource for extension staff in the field
- The Research Programme for **Climate Change Agriculture and Food Security (CCAFS)** – The CSA Guide https://csa.guide/
- **Food and Agriculture Organisation of the United Nations (FAO)** – The Climate Smart Agriculture Sourcebook
- **International Rice Research Institute (IRRI)** - The Rice Knowledge Bank http://www.knowledgebank.irri.org/
  - An outstanding resource for anyone working with rice producers. It provides links to technical guides and videos on all aspects of production. Every extension officer working with rice farmers should have this on their phone

ISFM

- See also **CCARDESA Knowledge Products** 6, 9, 11 & 21 for more detail on specific climate smart practices and technologies included within Integrated Soil Fertility Management for rice
- **ASHC** – Handbook for Integrated Soil Fertility Management
  - An excellent resource for every extension officer

Water Management

- **Africa Rice Centre (WARDA)** – Growing Lowland Rice, a production handbook
  - Useful tool to guide you through all the stages of lowland rice production
- **Africa Rice Centre (WARDA)** – Growing Upland Rice, A production handbook
  - Useful tool to guide you through all the stages of upland rice production
- **IRRI** – Steps to Successful Rice Production (13 Steps)
  - Very basic, but a Good overview of the steps a farmer should follow
- **IRRI** – Water Management in Irrigated Rice: Coping with water scarcity
  - A bit wordy and scientific and also focused on Asia, but a comprehensive guide to water management in irrigated rice that is applicable in most contexts

Improved Varieties

- **New Rice for Africa (NERICA)** – NERICA Rice Crop Management
- Covers all steps of production from land selection to weed control
- **FAO** – Training Manual for Post-Harvest Management and Storage
  - Sections on seed selection and storage are important here

Pest and Disease Control Options

- **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 technical guide to Integrated Pest Management
- **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
- **Plantwise** – Factsheets for farmers
  - 100s of fact sheets 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

Post Harvest Management

- **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 rice and other crops
- **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
- **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.

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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 rice – temperature and rainfall?**
   a. If no, what alternatives are there?

2. **What is the rice 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 rice production are currently being faced by the farmer?**
   a. Are these challenges the same for women and men?
   b. Which jobs are done by men, women and children?

5. **What is the condition of the soil?**
   a. Texture, structure, pH, slope, etc.

6. **What is the current farming system?**
   a. Irrigated lowland, rain-fed lowland or rain-fed upland 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. 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 rice stored? What losses are normally expected in storage?

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