KP20
Knowledge Product 20

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

DECISION TOOL:
Climate Smart Pest & Disease Control for 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)

Rice | Decision Point | Gender | Youth | Climate Smart | Practice


CIFOR, 2017

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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/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?

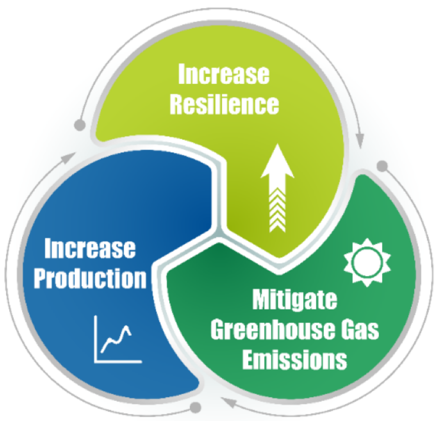
1. CSA places greater emphasis on **hazard and vulnerability assessments** and **emphasizes weather forecasting** (short term) and **climate scenario modelling** (long term) in the decision-making process for new agricultural interventions.
2. CSA promotes the **scaling up of approaches** that achieve **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. To make climate smart decisions on pest & disease control options for rice, you need to consider:
   a. The farming system
   b. The current status of the soil
   c. The pests and diseases prevalent in the area
   d. Female and male farmers' priorities
2. Climate smart pest & disease control options for rice include:
   a. Integrated Soil Fertility Management (ISFM)
   b. Mulching
   c. Crop rotations and green manure
   d. Land preparation
   e. Variety and/or seed selection
   f. Planting techniques and timing
   g. Considerations during growth stage
   h. Integrated pest management (IPM).

Entry points for CSA

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



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CLIMATE SMART PEST & DISEASE CONTROL FOR RICE

Climate change is now creating favorable conditions for animal and plant pests and diseases in new areas, as well as changing the way they are transmitted – affecting the distribution and prevalence of pests and diseases in rice production systems. The average global temperature increases, and atmospheric CO_2 concentration increases affect the growth and cultivation of different crops, including rice. Changing disease scenarios affect the reproduction, spread and severity of many plant pathogens, thus posing a threat to food security. Any changes in rainfall, temperature and relative humidity can readily contaminate foods like groundnuts, wheat, maize, rice and coffee, with fungi that produce potentially fatal mycotoxins.

Climate change has been observed to reduce the resistance against certain diseases of rice, including stem rust, blast (*Pyricularia oryzae*) and sheath blight (*Rhizoctonia solani*).

This **Decision Tool** aims to help field-level extension staff make **climate smart decisions** on which pest and disease control 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. Reference to technical guides relevant to the practices and technologies outlined are included at the end of the tool.

The tool focuses on some of the **Best Bet Climate Smart Pest & Disease Control Options** for rice production in the Southern African Development Community (SADC) region. These are just some of the many options available. In many cases, multiple options might be selected.

They are listed in no order and have been selected as best bet for the following reasons:

- 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 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** individual farmer's needs.

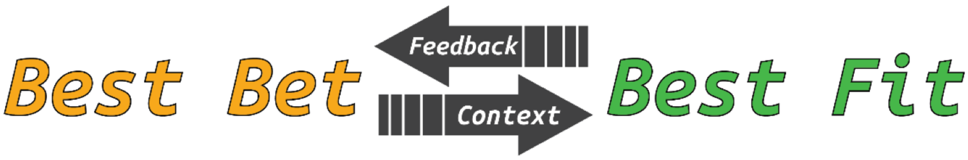


Table 1: Best Bet Climate Smart Pest & Disease Control Options For Rice that have potential across the SADC region.

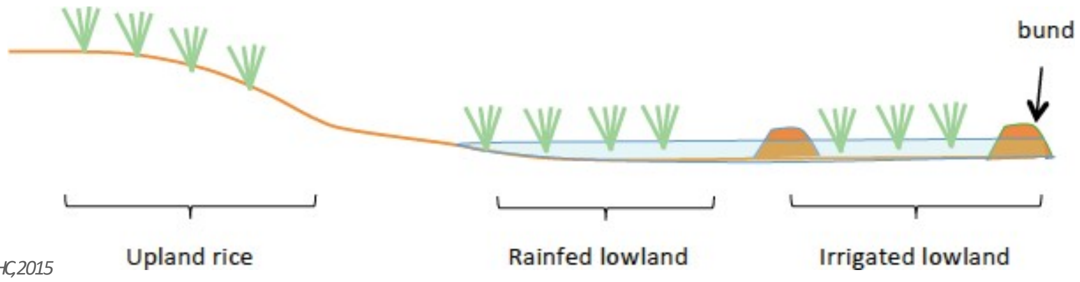
Climate Smart Pest And Disease Management Option	What is it?	3 Pillars of CSA		
		Increase production	Resilience/ adaptation	Mitigate GHG emissions if possible
Integrated Soil Fertility Management (ISFM)	A holistic approach to soil fertility management that includes seed selection, cultivation practices, cropping systems and soil amendments	Improves soil structure Increases soil fertility Ensures higher germination rates and plant vigour	Aims at sustainable intensification; increasing resilience through more predictable production	Maximises the amount of carbon retained in the soil and aims to maintain this in the long term
Climate-smart pest management (CSPM)	Is an interdisciplinary approach aiming to increase resilience of farms and landscapes to changing pest threats, mitigate greenhouse gas emissions and contribute to food security	Reduced inputs and incidences of pests increased productivity per unit area	Enhances ecosystem services and builds resilience of farms and landscapes to changing pest threats	Can reduce emissions arising from chemical pesticides and helps lock carbon in the soil
Crop rotation and green manure	Growing different crops in rotation. Planting a crop that adds biomass and/or nitrogen to the soil	Increases soil fertility Suppresses weeds and keeps away soil pests, thus promoting plant growth and vigour	Breaks pest and disease cycles Reduce the amount of the pest population and other pathogens present in the soil that survive year-to-year. Rotating to non-host crops prevents the build up of large populations of pathogens	Can help lock more carbon in soil
Land preparation/ mulching	Using clean equipment, minimum till, mulching and flooding, encouraging beneficial insects and reducing seed entry into field	Reduced incidence of pests and disease, including weeds	Reduced potential for cross-contamination Increased biodiversity	Minimum till can help lock carbon in the soil; mulching reduces soil exposure and helps lock CO_2 in soil
Variety and seed selection	Selecting resistant varieties suitable to local conditions Selecting only quality seeds	Increased production due to higher germination and less incidence of disease	More predictable yields	Possible reduced requirements for chemical pesticides and herbicides
Planting techniques and timing	Direct seeding and transplanting Planting on time Spacing	Planting on time and along with neighbours can reduce losses from individual fields	Using regular plant spacing enables easier weeding in early growth stages and ensures a complete canopy later, reducing the need to weed	N/A
Options during growth stage	Avoiding applying too much nitrogen Limiting use of pesticides Seeding	Increased yields due to lower incidence of weeds, pests and diseases	Sustainable and limited use of pesticides helps maintain biodiversity	Reduced fertiliser use

WHICH CLIMATE SMART PEST & DISEASE CONTROL OPTION IS BEST SUITED TO YOUR FARMERS?

There are many climate smart options that can minimise losses due to pests and disease in rice. While some are the same for all three of the common rice production systems in the SADC region, others are specific to certain production systems – rainfed upland, rainfed lowland or irrigated.

Figure 1 and Table 2 illustrate the differences between the three most common rice production systems in SADC.

Figure 1: Ecologies where rice is grown.



Source: ASHC, 2015

Table 2: Characteristics of the three most common rice production systems in SADC.

	Rainfed upland rice	Rainfed lowland rice	Irrigated lowland rice
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	One crop per year Yields lower and more variable than lowland	One to two crops per year One rice crop plus other diversified crop Yields lower than irrigated	One to two 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 the growing season. Active water management
Main factors impacting yields	High risk of drought Subsistence farming – low use of inputs	Competition from weeds and risk of drought reduces yields	Reduced risk of crop failure gives farmers confidence to use inputs
Current average yields (tonnes per hectare)	1	2	5
Attainable yields with application of good management practices (tonnes per hectare)	2	3–4	6–8
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: Adapted from African Soil Health Consortium (ASHC), 2015

Understanding the context will assist you and your clients/farmers in making climate smart pest & disease control decisions. The **Decision Tree** below illustrates possible decision pathways for climate smart pest & disease control options. This model places emphasis on variety selection as a key component of integrated pest management.

DECISION POINT

Understand context

What pests and diseases are common in the area?
What is the soil like? Could the farmer observe changes over the past decade that can be related to climate change?

Problem	Weed control	Insect pests	Diseases
Variety/seed selection	Weed-resistant varieties (e.g., *Striga*)	Insect-resistant varieties	Disease-resistant varieties
Possible Climate Smart Pest & Disease Control Options	Land preparation/ mulching/flooding/ timing of fertiliser/ green manure/ rotation	Climate-smart pest management/ Clean equipment between seasons/ plant with neighbours/ encourage pest enemies	Clean equipment/ manage pests/crop rotations

KNOW YOUR SOIL

Healthy soil equals healthy plants, and healthy plants are much more likely to survive pest and disease attacks.

Rice can be grown in a wide range of soil types; soils with good water retention capacities are best. Clay soils with high organic matter content are ideal, but soils with high silt contents are also suitable. Sandy soils are not ideal for rice production. They tend to dry out quickly.

Rice performs well in soils with a near neutral pH (6–7).

- The pH value is most important in upland rice. Here, if it is too low (i.e. too acidic) there is a risk of aluminium toxicity and low phosphorus availability (phosphorus is essential to promote good root growth and tillering)
- In rainfed lowland rice, iron toxicity is a major problem, which limits yields. Iron toxicity occurs in acidic soils and can be managed by applying lime and growing iron-tolerant rice varieties, amongst other techniques
- In irrigated lowland rice systems, where soils are submerged for extended periods, pH is not usually a problem.

Climate Smart options for improving soil fertility are detailed in **CCARDESA KP06 – Climate Smart Soil Amendment Options for Sorghum and Maize**[1]:

- Organic matter – compost, manure, etc.
- Green manure
- Biochar
- Organic and inorganic inputs (compost/manure and fertiliser).

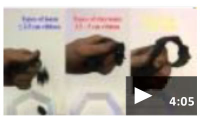
[1] The focus is on maize and sorghum, but most of the practices covered are also applicable for rice.

If you are unsure what type of soil you have, there are lots of videos to help you...

How to test your soil - texture (sand, silt, clay composition)

Central West Local Land Services

June 22, 2014



Soil texture by feel

UCDavisIPO

Sep 1, 2010

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Integrated Soil Fertility Management practices should always be applied. The aim of this approach is to continuously improve practices on the farm, based on experience gained as well as current and new information.

KNOW WHAT PESTS AND DISEASES ARE PREVALENT IN YOUR AREA

Farmers lose an estimated average of 37% of their rice crop to pests and diseases every year. There are many different types of insects, weeds, diseases and other pests that can affect rice, and identifying them is not always easy.

For example, there are over 100 different insects that can attack rice, but only about 20 of these insects cause economic damage to the crop. It is important to know exactly which pest and/or disease is attacking a crop before deciding on whether it is worth investing extra resources to control it.

If you are not sure what the main pests and diseases in the target area are, the first thing you need to do is find out. This can be done by asking a colleague or working with the farmers themselves to identify pests and diseases. Fields should be visited regularly during the season so that any new infestations can be identified. There are several tools available to help you in identifying the various pests and diseases of rice.

The *Rice Doctor* is a particularly useful mobile app that you can download onto a smartphone, but it is currently only available in English	The *Plantwise Factsheet Library* allows you to search for factsheets on various pests and diseases in multiple languages	The International Rice Research Institute (IRRI) has an excellent resource called the Rice Knowledge Bank, which contains information on all the main pests and diseases as well as helpful photos and factsheets
Rice Doctor LucidMobile Free	**Plantwise Factsheet Library** CABI Free	

All of the above tools include resources on how to prevent and directly control various pests and diseases. Decisions on climate smart pest and disease control in rice focus on prevention and need to be made at each stage in the cropping calendar[2]. All of these decisions will depend on:

- Available labour and who does what (men, women and/or youth)
- The farming system (cereal, livestock, rainfed, irrigated, etc.)
- Socioeconomic factors – access and availability of inputs, marketability, level of risk aversion
- Cultural factors – what are my neighbours doing? Taste, aroma, etc.

[2] Climate Smart Post Harvest Management options are covered in a separate KP – #13

TIP

See CCARDESA **KP04 on Best Bet Climate Smart Agriculture Options for Rice in SADC** for a checklist of questions to help you understand the local context.

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BEST BET PEST & DISEASE CONTROL OPTIONS FOR RICE PRODUCTION

Five climate smart pest & disease control options for rice follow. They are listed in no order. All are broadly applicable across the SADC region. In many instances a combination of these options will give optimum results in terms of production, resilience and GHG mitigation. 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.

FALLOW PERIOD

In rainfed upland and rainfed lowland rice systems, the fallow period may last until the next annual cycle (single cropping). In irrigated lowland production the farmer may be able to grow two or even three crops per year, giving a very short fallow period. What the farmer does during the fallow period can have a positive or negative effect on pest and disease control. In terms of weeds, fields should always be kept weed free to avoid weeds reseeding. This can also reduce the number of weeds available to act as hosts for diseases.

TIP One year of weeds = seven years of seeds!

The farmer has several climate smart options during the fallow period. Their choices will be influenced by available labour, their farming system (rainfed/irrigated, with or without livestock, etc.) and socioeconomic and cultural factors. It is important that you understand all of these issues in order to propose the most climate smart solution.

- **Mulching** – a thick layer of mulch that completely blocks sunlight from reaching the soil will control most weeds. Regular inspections and 'rogueing' of any weeds that do pop up will maintain a weed-free field. Mulching can be a good option if there is not enough residual moisture to grow a second crop (rotation), or if the farmer does not have available labour to grow a second crop
  - The mulch has the added benefit of improving soil structure and moisture retention by adding organic matter. Healthy soil gives stronger plants that are better able to resist pests and diseases
  - Heavy mulch layers may not be possible due to the need to feed plant residues to livestock, or due to the extra labour required in gathering enough mulch material
  - When mulching with crop residues, it is important to be careful not to use infected plant material that may host a pest or disease from the previous year. Some diseases and pests can carry over to a new crop and some do not. If in doubt, remove the plant material and either feed it to livestock, compost it, or burn it

- **Crop rotation and green manure/cover crops** – Growing a different crop to break disease and pest cycles and increase soil fertility. This crop can also potentially be used for animal fodder or as a food or cash crop by the farmer, depending on their local circumstances. These crops can maintain soil cover and out-compete weeds
  - This is a good option if there is enough residual moisture in the soil
  - Crops that can be planted after harvest include nitrogen fixing crops like *Sesbania, Azolla,* and other legumes such as mung bean and cowpea. If you are trying to maintain a hardpan to reduce water requirements, be sure to select plants with shallow roots that will not break this pan
  - In rainfed upland systems, soil moisture will likely be the limiting factor – so select drought-tolerant or short-season crops. In rainfed lowland systems, residual moisture may well be enough, and farmers may choose to grow high-value crops such as vegetables. Choices in irrigated systems will depend on available water sources. Second and third rice crops may be an option, but rotations are recommended to break pest & disease cycles.

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LAND PREPARATION

A well-prepared field helps control weeds and can also help break pest and disease cycles. It also ensures good plant establishment.

- **Clean equipment** – This should be done to ensure no cross-contamination occurs between fields and/or seasons

- **Minimum till** – This may be an option, especially in rainfed lowland upland systems. By not turning over the soil, weed seeds remain on the soil surface rather than being buried; however, dormant weed seeds may remain inactive with high mortality rates. This can help to increase soil microbial and invertebrate activity, which can combat pests
- Soil moisture and temperature are affected by tillage systems, potentially affecting weed and crop germination conditions. Crop residues left on the soil surface in reduced tillage systems could allow for new developments in the biological control of weeds. Reduced tillage systems generally have less run-off, which reduces herbicide losses and minimizes environmental contamination
  - Rainfed lowland systems are often found in areas with seasonal flooding. This results in high levels of vegetation, and the best way of incorporating this in the soil is ploughing, so minimum till is not always desirable/possible

- **Flooding** – In irrigated systems, flooding is a very effective method for controlling weeds and many pests as they cannot complete their lifecycles in flooded systems. However, this practice requires high volumes of water so should only be practised where water availability is not an issue
  - Remember to consider downstream users when planning water usage
  - Periodic flooding can be used to 'flush out' irrigation canals. Many irrigation systems work on an overflow system whereby water flows through one field to get to the next. This can spread pests and diseases. Ideally, each field should have its own irrigation channel. If this is not possible, it may be an option to install filters (fine mesh or hessian sacks) at levees or overflows to limit the transfer of pests from one field to another. These can then be manually cleaned

- **Encourage beneficial insects** – Planting white and yellow flower plants on bunds (or allowing them to grow) can attract naturally beneficial insects such as bees – among other pollinators – some of which are predators of many pest species

- **Reduce weed entry into field** – Keep irrigation channels and field bunds free of weeds to prevent weed seeds or vegetative parts entering the fields.

VARIETY AND SEED SELECTION

If weeds, pests or diseases are prevalent in the area, you can assess if resistant varieties are available locally and if these are accessible to your farmers. For seed to be accessible it should be:

- Affordable

- Practical for farmers
  - Some varieties may have been bred for resistance to specific pests and diseases but may also be very short. Most smallholders use a sickle to harvest their rice and such shorter varieties make this task much harder. While yields may be higher, farmers may decide the extra work is not worth it

- In packets that suit the average farm sizes

Other issues to consider when choosing the right variety with your farmers are listed in Table 3. Resistant varieties are only appropriate if they possess the other qualities that are important to farmers, processors and consumers. It is important to consider the views of both men and women, as well as value- chain actors (if growing for market) before selecting a new variety. Table 3 highlights the main considerations when making decisions on which variety of rice to plant. Pest and/or disease resistance are just two factors that need to be considered and weighed up against lots of other factors, before a framer decides what best suits their situation.

Table 3: Different factors to be considered when selecting which variety or rice to plant.

Variety considerations	A variety should have:
	• Good quality grain (especially cooking characteristics, colour, shape, taste and aroma, head rice recovery) that should meet a farmer's expectation in the context of its marketability or consumption
	  ◦ Considering male and female points of view
	• Adequacy of yield potential and stability over seasons
	• Resistance or tolerance to the major diseases, insects and/or stresses (e.g., drought, flood)
	  ◦ 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 increased attack from pests (e.g., birds during maturation) or growth problems during times of adverse environmental conditions (e.g., late maturing varieties running out of water)
	• Adequate tillering capacity to shade out weeds and produce a sufficient number of tillers for optimum yields
	• Resistance to lodging under normal farmer management
	• Availability in the local market and affordability to farmers
	  ◦ Gender in particular should always be considered in terms of availability and access to seed varieties. Women in single-headed households may not have the same access to markets as men or single parent as compared to two parent households

Management considerations	• Production system – rainfed upland, rainfed lowland or irrigated • Suitability of the variety to the method of crop establishment and farmer management practices – e.g., some varieties are more suited to direct seeding than others • Use of 'good' seed to maximise yields • Availability of seed in sufficient amounts to meet local demand • Plant variety mixes in regions to maintain biodiversity and slow the spread of pests and the breakdown of varietal resistance
Evaluating new varieties	• A variety should be tested over at least 3 seasons in farmers' fields to ensure suitability in terms of stability of yield and resistance to local pests and adaptation to local conditions • New varieties evaluated with respect to crop management that are similar to farmers' practice. For example, if farmers apply very little fertiliser, new varieties should not be evaluated under very high levels of fertilisation. If farmers direct-seed, evaluation should not be done under transplanted conditions • Farmers consulted to ensure variety suitability before promoting a new variety • Grain quality, market demand and price need to be acceptable • Testing new varieties in parts of fields to reduce risk • Consideration of men's and women's views during evaluation of new varieties, as well as youth views, depending on who in the household performs what management tasks.

Seed selection: Preference should be to obtain certified seed each year, as this will have high germination rates and will produce vigorous rice seedlings. If farmers cannot afford certified seed or it is unavailable, the next best option is 'good ' seed purchased from other farmers who have grown it, especially for seed. If this is not available or affordable, farmers can select the best of their own rice as seed for the following crop. When selecting rice for seed for the following year you should:

- **Rogue off-types** (by plant height, appearance, flowering time, etc.) and poor, diseased or insect damaged plants or plants with discoloured panicles at maximum tillering and flowering
- **Winnowing** – Harvested seed includes seed of varying sizes and non-seed matter (e.g., weeds and trash). Full plump (heavier) seed can be selected by winnowing with natural wind or an electric fan (see photo below):
  - Pour seed slowly from a height of 1 m – 1.5 m
  - Repeat winnowing if necessary. Select heavier seed closer to the side from which the wind blows. This procedure will also remove lighter weed seed and non-seed matter
- **Storage** – After harvest, clean seed and select full and uniform seed. Dry seed to 12%–14% moisture content. Store the seed in sealed airtight containers until ready for planting (seed is good for up to one year if stored properly). Seed in non-airtight containers absorbs moisture and loses viability over time.

Planting multiple varieties with different resistance is an option but, varieties with the same total growing period should be selected if this is to be practised. Otherwise, losses of ripe seed can be incurred while other varieties are still not ready for harvest. Varieties should also be of similar height to make harvesting easier.

PLANTING

Rice is most susceptible to pest attack in its early growth stages (10 days for transplanted, 21-days for direct seeded). The number of plants established, and its seedling vigour, will affect the competitiveness of the crop against weeds and determine the final yield potential

- **Direct seeding** – Prime the seeds to ensure uniform and vigorous growth (Soak seeds for 4–8 hrs and re-dry prior to sowing. Seeds must be sown within 1–2 days after priming)
- **Transplanting** – Check seedlings for signs of pests or diseases before transplanting. Ensure any weeds in the seedbed are not transplanted with the seedlings. Do not transplant weak or discoloured seedlings if possible
- **Timing** – Planting at the same time (or within a two-week window) as the neighbouring fields, can help to minimise insect, disease, bird, and rat pressure on individual fields
- **Plant in rows** – Planting in rows with even spacing will make weeding much easier. It will also ensure an even canopy, which will help to control weeds.

OPTIONS DURING GROWTH STAGES

Farmers should inspect their rice fields daily for the presence of pests, diseases, and/or nutrient deficiencies. Plants that are not healthy will be more susceptible to attack from pests and diseases. Many male farmers migrate for seasonal labour during the growing season, and women are left to manage the crop. A good understanding of who does what tasks during the growing season is essential so that options selected are appropriate

- **Fertiliser application** – High nitrogen can increase susceptibility to certain pests and diseases. That is why specific fertiliser recommendations are very important
  - Being able to recognise the various nutrient deficiencies is equally important so that the correct soil amendments can be applied. The tools mentioned earlier can help with this
- **Use of pesticides** – Overuse and misuse of pesticide is common among farmers and can lead to pest outbreaks. Natural insect enemies of the rice pests are also killed when pesticides are applied, and this can lead to an outbreak of other rice insect pests
  - Generally, a rice crop can recover from early damage without affecting yield. Pesticides should not be applied within the first 40 days of planting
  - Pesticides may not be affordable or accessible, and farmers may not be trained in their use. They are also usually only economically viable if pest infestations are high. Neem is a commonly available plant that can be ground up and mixed with water and applied as an effective biological control mechanism for some pests
- **Weeding** – Wait until weeds are one to two weeks old and are big enough to pull out of the ground so you do not leave roots behind. Remove and destroy
  - Hand weeding is required until the canopy closes
  - Do not let weeds go to seed
  - If weeding is done correctly, the labour required should decrease year-on-year
  - Weeding is laborious and is often done by women and children. Selecting climate smart options during fallow and planting stages that reduce the incidence of weeds will help reduce this burden.

INTEGRATED PEST MANAGEMENT (IPM)

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**. See also **CCARDESA KP19 – Climate Smart Pest & Disease Control in Sorghum and Maize**, as many of the principles outlined are applicable for rice production, especially upland rainfed production.

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TO SUMMARISE

To make climate smart decisions on options best suited to your farmers:

- Know your soil and the rice production system
- Be able to identify which pests are currently affecting the farmers' rice crop
- Understand the pest lifecycle so you can recommend control options
- 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
- Understand the farmers' ability to access/use inputs such as organic/inorganic pesticides/herbicides/insecticides
- Understand who does what and when in the crop calendar
  - Who is responsible for weeding and what do they think about the costs/benefit of weed control options?
- Assess the potential and actual benefits of any options recommended/implemented
  - Labour should always be included in analysis of gross margins.

STEP 1: Understand the context

- What pests and diseases are prevalent, and understand their lifecycles
- Effects of climate change on pests and disease prevalence
- Soil type
- Production system

STEP 2: What are the farmer objectives?

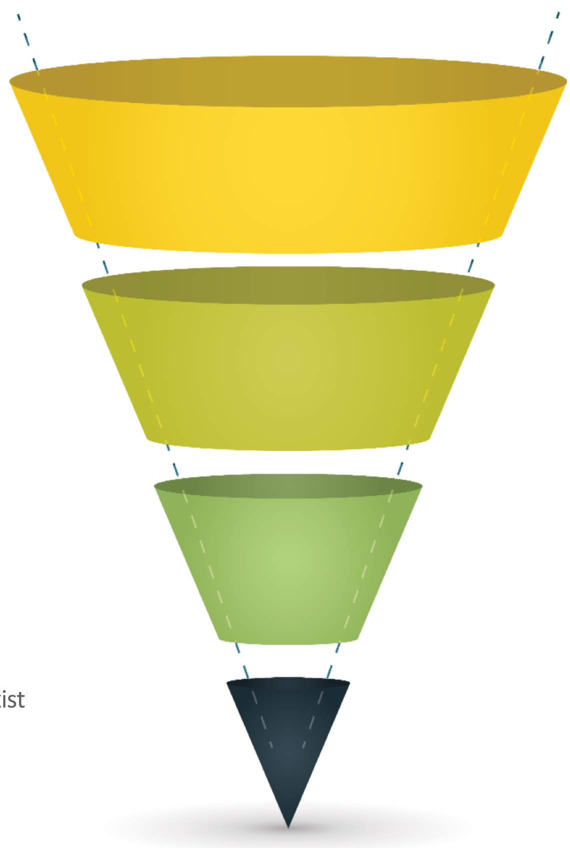
- Consumption or market
- Taste, colour, aroma, etc.

STEP 3: Know the local context

- Availability & accessibility of different varieties
- Farmer needs and priorities
- Availability of labour; who does what?

STEP 4: Cost benefit analysis

- Which option of pest and disease control is financially viable?
- What existing, effective Indigenous knowledge practices of control exist
- Consider alternatives.



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.

- The CCARDESA Knowledge Hub – KPs 6, 7, 8, 9, 10, 13 and 19
- **Africa Rice Centre (WARDA)** – Growing Lowland Rice: A production handbook.
  - Useful tool to guide you through all the stages of lowland rice production
- **African Soil Health Consortium (ASHC)** – Rice Cropping Guide
  - Excellent resource for any Extension Officer working with rice farmers. Chapter 6 is especially relevant to pest and disease control
- **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 really useful guide to identifying and controlling the main pests and diseases of the most important food crops. Every Extension Officer should download a copy
- **International Rice Research Institute (IRRI)** – Steps to Successful Rice Production (13 Steps)
  - Basic, but a good overview of the steps a farmer should follow
- **IRRI** – Water Management in Irrigated Rice: Coping with Water Scarcity
  - Rather scientific and focused on Asia, but a comprehensive guide to water management in irrigated rice that is applicable in most contexts
- **IRRI** – The Rice Knowledge Bank **http://www.knowledgebank.irri.org/**
  - This is an outstanding resource for anyone working with rice producers. Links to technical guides and videos on all aspects of production. Every extension officer working with rice farmers should have this on their phone
- **IRRI** – Illustrated Guide to Integrated Pest management in Rice in Tropical Asia.
  - An older resource (1986). Covers all you need to know and more. Focus is on tropical Asia, but most of the principles are transferable to the SADC context. Some of the content may be out of date
- **IRRI** – Friends of the Rice Farmer, Helpful Insects, Spiders and Pathogens
  - Published in 1987 and focused in the Philippines, but a useful guide nonetheless
- **New Rice for Africa (NERICA)** – NERICA Rice Crop Management
  - Covers all steps of production, from land selection to weed control.

Citation: CCARDESA and GIZ 2019. Knowledge Product 20: Climate Smart Pest and Disease Control for Rice. CCARDESA Secretariat, Gaborone, Botswana.