NARO

Republic of Uganda

Adaptation for Smallholder Agriculture Programme
ASAP
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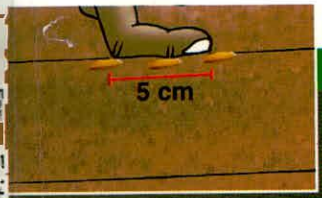
Investing in rural people

PRELNOR

Rice

Curriculum and Technical Guide for Farmer Field and Business School Facilitators

















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RICE

INTRODUCTION

Rice is an important food crop with high commercial value along its value chain in Uganda. Over 80% of rice produced is marketed outside the production areas at competitive prices when compared with other crop commodities. Production is mainly under rainfed upland, rainfed lowland and irrigated production conditions. Currently, Uganda produces up to 320,000MT of rice annually which is equivalent to import substitution of about 104M USD per year (FAO, 2015). The sector targets to produce 680,000 MT by 2020 and generate at least US$73 million worth of exports (UBOS, 2015). Northern and Eastern parts of the country produce 90% of the total rice produced in the country with the north producing 23%. The northern parts produce mainly upland rice and the area is largely suitable for upland rice production based on agro-climatic parameters and potential for expansion (Ojara et al 2017). The potential for upland rice production in Northern Uganda is undermined by several constraints. These constraints include biotic (pests and diseases) and abiotic (unfavourable environment) factors.

CONTENTS OF THE CURRICULUM

The curriculum consists of training modules divided into units indicating the topics, objectives, contents, methods of delivery and training materials required. A time schedule is allocated for each topic to enable the facilitator to plan appropriately for each session.

Course content

TIME (HOURS)		TOPIC	OBJECTIVE	CONTENT	METHOD	MATERIAL
THEORY	PRACTICAL					
30 min	1 hr	Introduction	To appreciate production of upland rice	• Importance of rice production	• Select farmers and they give success stories. • Demonstration	• Flip chart • Masking tape • Markers • Pens • Note books • Pictorial charts
30 mins	45 mins	Record keeping	To be able to keep proper records	• Importance of record keeping	• Brainstorming • Group discussion • Demonstration	• Samples of records
15 min	45 mins	Constraints in rice production	To be able to identify constraints in rice production	• Production constraints in rice production	• Brainstorming Group discussion • Provide information on additional constraints and include pictures and samples for practical sessions	• Flip chart • Markers • Pens • Notebooks

10 min	**15 min**	Varieties of rice	To be able to identify different rice varieties with their attributes	• Identification of rice varieties and their attributes	• Practical • Demonstration • Brainstorming • Farmers varieties to be mentioned as well as the flagship varieties	• Rice seed samples of different varieties • Markers • Masking tapes • Flip charts • Note books • Pens
20 mins	20 mins	Seed selection	To be able to select good seeds of rice for planting. Variety name, germination test, source of seed sorting practicals	• Attributes/ characteristics of good rice seeds for plantings	• Brainstorming Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Demo plot

20 mins	40 mins	Germination testing	To be able to test the seeds for viability	• Methods of germination testing e.g floatation test Germination (viability)test • Identification of off types by washing coated seeds	• Brainstorming Practical • Demonstration	• Seed samples for testing • Seed testing kit • Bucket of water
20 mins	20 mins	Seed rates	• To be able to interpret seed rate in relation to plot size.	• Determining seed rates for rice by plot size	• Brainstorm • Practical • Demonstration	• Demo plot • Seed sample
15 min	**15min**	Site selection	• To be able to select suitable sites for planting rice	• Selection of suitable sites for upland rice production • Selection of site for lowland rice should also be mentioned	• Sharing • Practical • Demonstration	• Demo plot • Markers • Masking tapes • Flip charts • Note books • Pens

30 min	**1hr**	Land preparation	• To be able to prepare land suitable for planting rice	• Different methods of land preparation for rice • Lowland • Upland • Rain fed lowland	• Brainstorming Practical • Demonstration	• Demo plot • Markers • Masking tapes • Flip charts • Note books • Pens • Handtools • Tractor • Ox plough
15 min	**40 mins**	Crop rotation	• To be able to design crop rotation for rice.	• Planning crop rotation for rice	• Brainstorm • Practical • Demonstration	• Demo plot • Flip charts • Markers • Note books • Pens
15 mins	**25 mins**	Spacing	• To be able to determine optimum spacing for rice.	• Determining plant population of rice	• Brainstorming Practical • Demonstration • Selfdiscovery	• Markers • Masking tapes • Flip charts • Note books • Pens • Demo plot

20 mins	**20 mins**	Planting and planting depth	• To be able to plant rice using different methods.	• Methods for planting rice • Dibbling • Drilling	• Brainstorming Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books Pens • Demo plot • Planting ropes • Line markers • Planting rake
15 mins	**15 mins**	Planting depth	• To be able to determine appropriate depth of planting rice.	• Adjusting the planter/ planting rake depth according to field conditions.	• Brainstorming Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Demo plot • Planting rake

15 mins	**20 mins**	Gap filling and thinning	• To be able to determine appropriate time of gap filling rice.	• Appropriate time of refilling missing hills in rice	• Practical • Demonstration	• Demo plot • Small nursery bed besides mother garden • Rice seeds • Markers • Masking tapes • Flip charts • Note books • Pens • AESA sheet
45 mins	**1 hr**	Soil fertility maintenance and fertilizer requirements and application for rice	• To be able to determine soil fertility requirements for rice. • To be able to identify different types of fertilizers suitable for planting rice	• Soil fertility requirements for rice • Integrated Nutrient Management in rice • Types of fertilizers required in rice • Rate of application • Methods of application • Time of application	• Brainstorming Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Demo plot • Fertilizer samples required in rice production • AESA sheet

30 mins	**1 hr**	Weed management	• To be able to identify and manage weeds using different methods.	• Methods of weed management in rice	• Brainstorming Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Demo plot • Selective herbicides for rice • AESA sheet
30 mins	**1 hr**	Disease management	• To be able to identify and manage diseases using different methods.	• Identification of rice diseases • Methods of disease management in rice	• Brainstorming Practical • Demonstration	• Demo plot • Fungicides • Sprayer • AESA sheet • Pens • Notebooks

20 mins	**1 hr**	Pest management	• To be able to identify and manage pests of rice.	• Identification of rice pests • Damages done by rice pests • Methods of pest management in rice	• Brainstorming Practical • Demonstration	• Demo plot • Different pests specimens in rice fields • Markers • tapes • Flip charts • Note books • Pens • AESA sheet • Scarecrows
20 mins	**1 hr**	Harvesting rice	• To be able to determine the maturity period of harvesting rice.	• Time of harvesting rice by straw colour, Maturity of spikelet (85%) of panicle, • Methods of harvesting rice	• Brainstorming Practical • Demonstrations	• Demo plot • Serrated sickles • Markers • Masking tapes • Flip charts • Note books • Pens
15 mins	**30 mins**	Post-harvest handling	• To be able to handle rice after harvesting.	• Postharvest handling methods in rice	• Brainstorming • Practical • Demonstration	• Demo plot • Tarpaulins • Transport

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15 mins	**30 mins**	Post-harvest handling	• To be able to handle rice after harvesting.	• Postharvest handling methods in rice	• Brainstorming • Practical • Demonstration	• Demo plot • Tarpaulins • Transport

20 mins	**1 hr**	Drying rice	• To be able to determine the appropriate moisture content for rice.	• Methods of drying rice e.g open air drying • Determination of moisture content	• Practical • Demonstration	• Demo plot • Clean drying floor • Tarpaulins • Moisture • Salt • Bottle
30 mins	**1 hr**	Threshing rice	• To be able to thresh rice appropriately.	• Methods of threshing rice	• Brainstorming • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Rice thresher
25 mins	**30 mins**	Packaging	• To be able to package rice appropriately.	• Suitable methods of packaging rice	• Brainstorming • Practical • Demonstration	• Samples of packaging materials

30 mins	**1 hr**	Storage	• To be able to store rice appropriately.	• Different methods of storing rice	• Brainstorming • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens
30 mins	**1 hr**	Marketing rice	• To be able to market rice profitably	• Marketing rice • Profitability analysis for rice	• Brainstorm • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens

SUMMARY INFORMATION ON UPLAND RICE PRODUCTION TECHNOLOGIES

Importance of rice

- Source of food and food security
- Fodder (husk, silage)
- Green manure and cover crop
- Income

Challenges in rice production

- Pests and diseases
- Climatic changes
- Declining soil fertility
- Knowledge gaps in production
- Post -harvest losses
- Access to quality seeds

Rice varieties

	Rice variety				
Year of release	2002	2013	2013	2013	2013
Variety Name	NERICA 4 	NamChe 1 	NamChe 2 	NamChe 3 	NamChe 5 
Yield Kg/ha	3510	3800	4300	4550	5800
Milling percentage	63.9	66.2	68.7	72.7	71.4
Culm length (cm)	66	64	66	66	60
Duration from germination to harvest (days)	115	110	127	125	120
Aroma profile when cooked	non aromatic	weak aroma	non aromatic	non aromatic	Mild aromatic
Resistance/ tolerance to diseases	Highly tolerant to rice blast	Highly tolerant to rice blast	Highly tolerant to rice blast	Highly tolerant to rice blast	Highly tolerant to rice blast

1000 grain weight (gram)	30	29	28	24	26
Other attributes	• Awning: Absent; • Flag leaf large but long • Leaf blade colour light green; • Panicle: long and compact • Milled grain: Very white • Medium • Drought tolerant • Performs well in very poor soil	• Awning: Absent; Flag leaf large but long; Leaf blade colour light green; Panicle: long and compact Milled grain: Very white • Early maturity • Drought tolerant • Performs well in very poor soil	• Awning: Absent; • Flag leaf large but long; • Leaf blade colour light green; • Panicle: long and spreading (scattered) • Milled grain: Glossy white • Least breakage when milled • Drought tolerant • Most resistant to diseases	• Awning: Absent • Flag leaf large but short • Leaf blade colour light green • Panicle: long and compact • Milled grain: white • Drought tolerant	• Awning: Absent • Flag leaf large but short • Leaf blade colour light green • Panicle: long and compact • Milled grain: white • Drought tolerant

SITE SELECTION (UPLAND RICE)

- The best soils are deep well drained sandy loams or loamy sandy soils and moist throughout the growing season, and with reasonable fertility levels

LAND PREPARATION

- Prepare land 3-4 weeks before planting so as to kill weeds and allow decomposition
- Early land preparation allows you to plant timely at the onset of rains
- Rice performs well in a well- drained, well aerated soils with high organic matter and nutrient content
- A very fine seed bed necessary for planting rice



Recommended



Not recommended

- Use the hand hoe or oxen for opening land

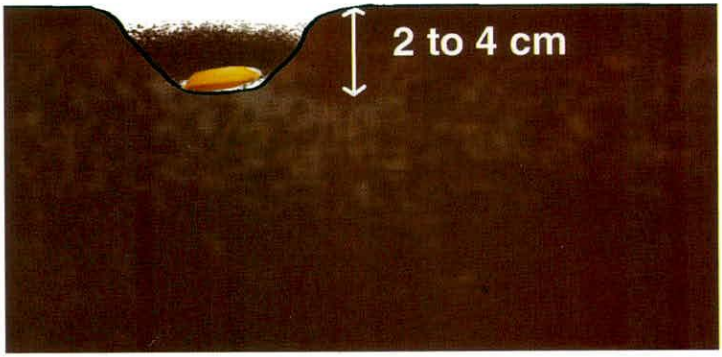
SEED SELECTION

- Use rice seed of the same variety

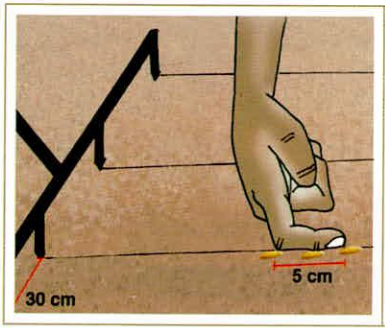
- Source seed from stockist recommended by your agricultural officers.
- Use the floating technique to separate filled grains from empty grains.
- Use rice seed that is of uniform size, free from other varieties, weeds /other crop seeds and inert materials
- Rice seed should not be diseased, cracked or shriveled to allow for proper germination
- Rice is a self- pollinated crop. No loss in vigor can result due to in-breeding, therefore, you can multiply your own seed

PLANTING AND PLANTING DEPTH

- Rice requires a lot of water so plant at the onset of rains
- Plant good quality rice with high germination of over 80%.



- Plant rice at 2-4 cm deep. The depth of planting should be uniform to allow uniform plant germination and growth.
- Plant rice in line at spacing of (30 x 2) cm (drilling).





- Using the above spacing you will require 20 kg per acre.





SEED RATE

- Seed rate of 20 kg/acre.
- If large scale production is the target, intercropping is not encouraged.
- Where there is no germination, gap filling can be done 15-20 days after planting.
- A small nursery bed can be established near the main garden for gap filling.
- Rice seeds can only lose viability after 11 months of proper storage. Therefore you are advised to plant seeds of less than one year.

- NERICA 4 and other upland varieties have short dormancy period of 4-7 days; and therefore can be planted more than once in a year if there is reliable rainfall.

FERTILIZER REQUIREMENT AND APPLICATION

Methods of application



Spraying (Micro nutrients zn, B, mgso4)



Top dressing (Briquette fertilizers, N)



Basal appllication, DAP (Broadcasting uniformly)

SOIL NUTRIENT MANAGEMENT

- Rice should be rotated with other crops to conserve soil fertility
- Composited organic matter such as rice straw and animal manure can be added to the soil to supplement soil fertility
- In upland rice, when using chemical fertilizers, the application rates are guided by soil analysis, yield potential of target variety and target yield. To produce 1 tone of rice per hectare requires 15-20 kg of N, 2-3 kg of P and 15-20 kg of K. Zinc and sulfur are important micro nutrients which if lacking in soil affect yield. If rice straw is incorporated back to the field, you need 3-5 kg of K per tone of rice. Apply P by basal application at planting, use split application to apply UREA 14 days after planting, apply K at panicle initiation or booting stage.
- Effects of higher fertilizer dosage include lodging, susceptibility pest/disease & development of ineffective tillers
- In case of K deficient soil apply 25kgs/acre of muriate of potash (0-0-60). Apply 10kg/acre Basal and 15kg/acre at early panicle initiation (booting) Apply fertilizer immediately after weeding when soil is moist.

WEED MANAGEMENT

- Do first weeding at 3 weeks and second weeding at 6 weeks after germination.
- Third weeding at 9 weeks after planting
- Weeding should be done using the hand hoe or hand removal before weeds flower.



Weeding at 3 weeks

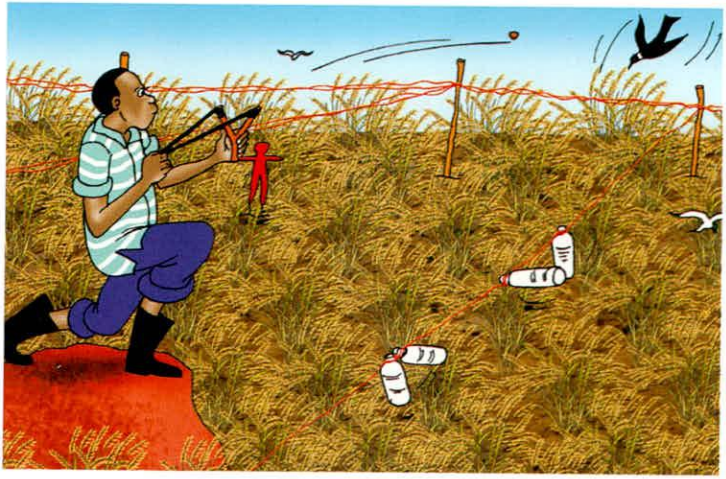


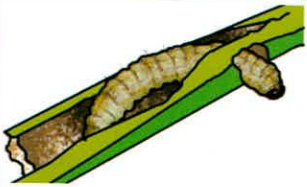
Hand weeding to remove weeds

- Do not weed rice when it has already flowered since this causes flower abortion leading to low yield.

PESTS MANAGEMENT

- The most important pests are; insects, birds and rodents of rice include: stem borer, termites, stink bugs and gall midge.



	
Stem borer	*Stink bugs*

How to control rice pests

- Destroy crop residues after harvest and alternate host.
- Timely planting and harvest is important

- Destroy contaminated plant residues or debris left in the field after harvest.

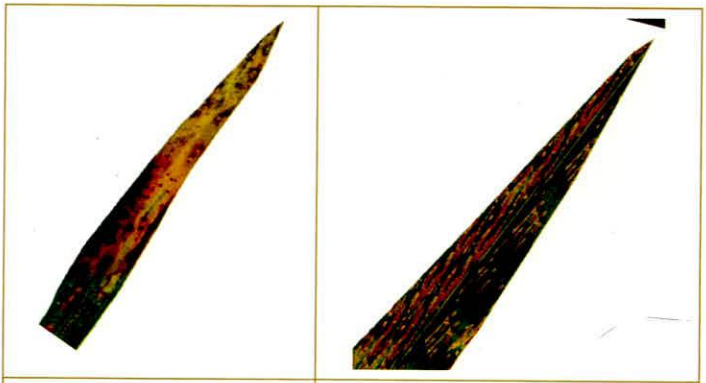


- Practice crop rotation to reduce build up of pests and diseases.
- Harvest at right time to eliminate storage pest infestation.
- In storage: inspect, remove infested stock, practice store hygiene.

The most common and severe disease of rice is rice blast and bacterial leaf streak

- It attacks rice leaves, nodes and floral parts, particularly the basal part of the panicle.





Rice blast disease

Bacterial leaf streak disease in rice 2

Damage, symptoms and part of plant attacked

How to manage rice diseases

- Use tolerant varieties against important diseases like rice blast, rice yellow mottle virus. These include: NERICA 4, NERICA 10, NAMCHE 1, 2,3,4 and 5
- Practice field sanitation and crop rotation.
- Apply fungicidal sprays like Carbendazin 80 WP

HARVESTING AND POST HARVEST HANDLING TECHNIQUES

- Milling quality is heavily dependent on harvest and post-harvest stages, timing, methods and techniques of harvesting.
- Rice generally takes 30 days from Heading to Maturity
- Harvest when 20% of panicle is at Hard dough stage and 80% straw coloured.
- Harvest at moisture content of (20 -22%)

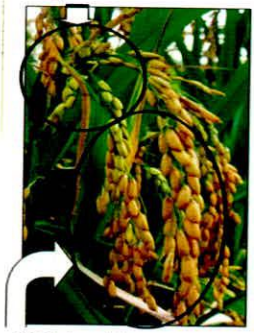


- Harvest rice at the right time.

Key observable indicators for right time to harvest rice:

- 80-85% of the grains have hardened and ripened (yellow)
- Grain MC is between 20-26%
- Grain is white and hard after removing the husk.

Grains in the hard-dough stage



80 % of panicles are straw-colored

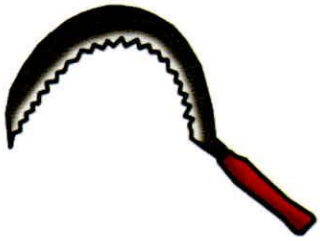


A ready-to-harvest field



A not ready-to-harvest field

- Tools used to harvest rice include;



Sickles



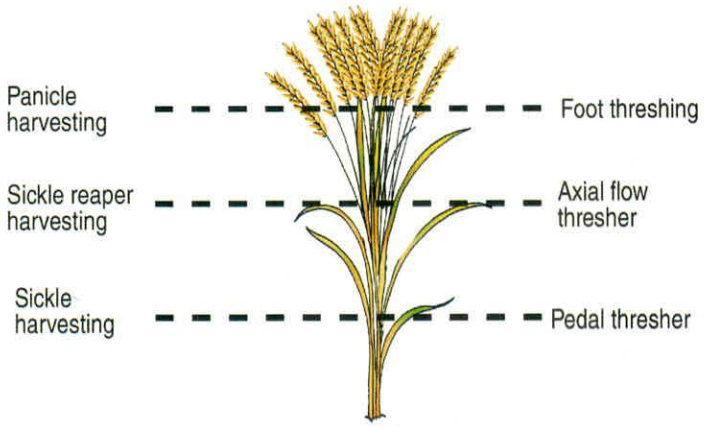
Reaper



Combine harvester

How to harvest

- Start harvesting rice after drying of morning dew or reduction of moisture after rainfall.
- In water logged fields, open channels to drain water from the paddy field about 2 weeks before harvesting if applicable.
- Length of cut straw depends on threshing method.



Care and handling of harvested Paddy

1. During harvesting, Place cut straws on tarpaulin to minimize grain losses.





Spreading straws in the field during cutting is not good as it results into grain losses.





2. Spread harvested paddy on the tarpaulin.



3. Do not pile harvested rice in large mounds.

   This increases heat build-up causing cracking in the paddy and mold growth.



4. Thresh harvested paddy Immediately

(4hrs after harvesting)

Where to thresh Paddy?

It should be done on:

- Tarpaulin
- Concrete floor
- Hard rock

Avoid threshing on bare ground. This contaminates paddy with Sand/Impurities.



Threshing of Rice

- Separating paddy from the rice straw.



Recommended methods of threshing rice

a) Beating with sticks or against a log



Beating with sticks creates losses by leaving many rice grains among straws.



b) Using a threshing machine

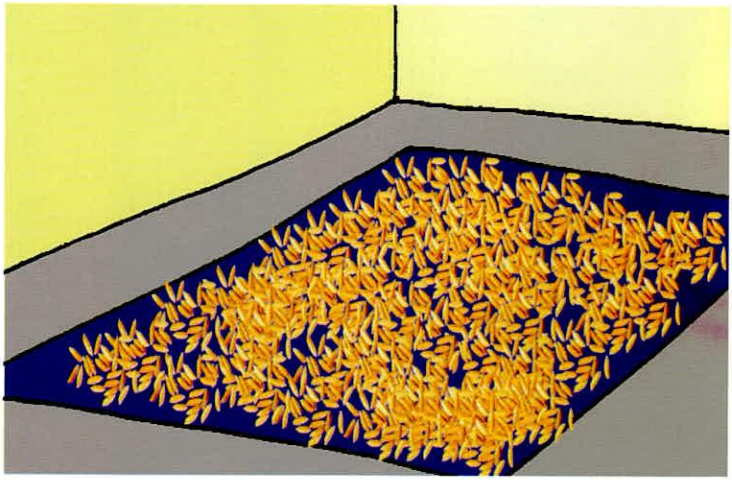
- Capacity 400-500kg/hr
- Threshes faster than hand





Handling of threshed Paddy

- Threshed paddy should be dried immediately.
- If this is not possible, take it into the store and spread it on tarpaulin or concrete floor to allow escape of heat.



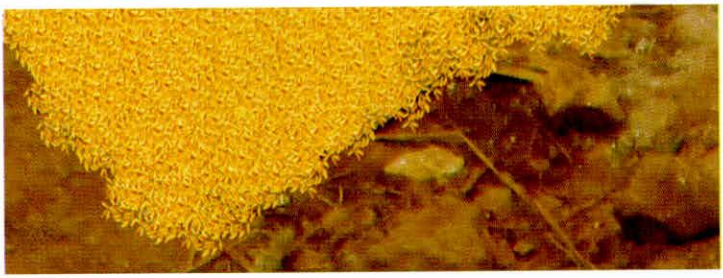
Take it into the store and spread it on tarpaulin

- Do not keep threshed paddy on a heap or in a sack for even a day as this results in heat build- up causing paddy to rot, germinate and crack during milling.

Drying of Paddy

When to dry rice

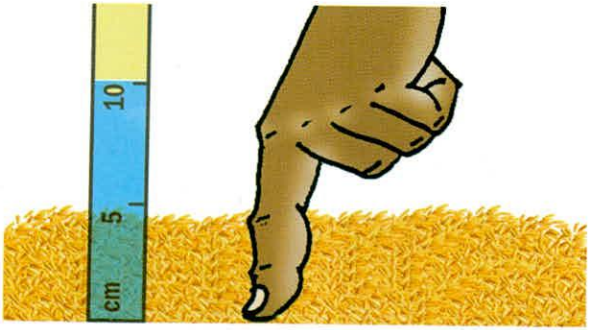
- Paddy is usually harvested and threshed when still wet, MC 22 – 26%.
- If not dried, heat builds up and rice grains start rotting.
- Drying is done to reduce paddy Moisture Content to 12 -11% for safe storage and milling. High moisture content encourages growth of mould that releases poisonous materials called aflatoxin to the grain. Aflatoxins cause cancer.
- Badly dried rice directly affects quality of milled rice.



- Poor drying also affects seed viability.

How to dry rice

- Rice is dried mainly using direct sun heat.
- Dry paddy immediately after threshing.
- Dry on tarpaulin, mats or concrete floor.
- Drying of rice should be done slowly (2-3 hours per day or 1-3 days) until 12-14% prior to storage.
- The rice should be 4-5 thick and should be turned over 30- 60 minutes to allow for uniform drying



- Turn the grain using special or improvised rakes after every 1 hour.





Using an electric drier to dry rice

- Dry the paddy at 75mm for 2days, 4 hours per day to control the drying rate.





- On 3rd day add other tarpaulins and spread paddy to a small thickness of 25mm.
- Keep turning the grain using a rake after every one hour.
- Take the paddy to shade or inside the store to cool.
- While in store, spread and leave top open to allow escape of heat.
- Repeat the process until moisture content drops to 12-13% for paddy for milling and 10 – 11% for seed.

Handling of paddy during and after drying



- Avoid drying on bare ground.
- Avoid turning rice using dirty/ soiled feet or gumboots.
- Keep off birds and animals to avoid droppings.
- Do not mix varieties or other grains while drying the rice.
- Clean the rice before storage.
- Avoid dried paddy coming into contact with rain and water as this causes serious cracking of paddy.

VALUE ADDED PRODUCTS FOR RICE



Grains boiled



Packed rice



Samosas



Rice balls



Rice cakes



Rice flour



Rice chapati



Bread

MARKETING

- Conduct market survey to establish the market requirements in terms of quality, quantity, seasonality, price
- Providing market information and linkages
- Promotion of bulk marketing
- Encourage contract farming
- Promotion of local seed business.



PROFITABILITY ANALYSIS FOR RICE

Gross Margin Analysis of Rice per acre

Example:

Assumptions: yield of rice = 600 kg/acre and market price = 2,500 per/kg

Item	Unit	Qty	Unit cost	Total
Cost of input				
Seeds	Kg	20	4,000	80,000
Tools (hoes)	Pieces	5	8,000	40,000
Tools (pangas)	Pieces	2	3,000	6,000
Pesticides	Litres	5	10,000	50,000
Bags	Pieces	7	1,000	7,000
Total input cost				**183,000**
Labour costs				
Land preparation x2	Man-day	2 x10	5,000	100,000
Planting	Man-day	4	10,000	40,000
Weeding x2	Man-day	2 x 10	5,000	100,000
Scaring birds	Man -day	10	7,000	70,000
Harvesting	Man -day	2 x 5	7,000	70,000
Drying	Man-day	2	5,000	10,000
Threshing	Man-day	20	5,000	60,000
Packaging	Man -day	7	2,000	16,000
Total labour cost				466,000
Cost of labour and input				649,000
Gross Margin				**851,000**

Note: Production cost per unit (kg) $= \frac{\text{Total cost}}{\text{Total output (yield)}}$

$= \frac{649000}{600}$

= 1,081.6/-

Profit margin per kg = sale price per unit – production cost per unit

= shs 2,500 – 1,081.6

= 1,418.4/=

Implication: a farmer is getting a profit of shs 1,418.4/- per kg produced

RISK AND SENSITIVITY ANALYSIS

Risk analysis for Rice Enterprise

Scenario 1: A decrease in yield of rice to 550 kg/acre and a rise in market price to shs 2,600 /kg

Parameter	Product	Quantity (kg)	Marketing Price (Sh.)	Total (Sh.)
Expected Revenue	Rice	1 acre × 550	2,600	1,430,000
Total Cost				649,000
Gross Margin				**781,000**

Scenario 2: An increase in yield of rice to 620 kg/acre and a fall in price to shs 2,200/kg

Parameter	Product	Quantity (kg)	Marketing Price (Sh.)	Total (Sh.)
Expected Revenue	Rice	1 acre × 620	2,200 per kilo	1,364,000
Total Cost				649,000
Gross Margin				**715,000**

Note: a) In scenario 1 above, the decrease in yield accompanied by a rise in price will not significantly affect profitability of the enterprise

b) **Under scenario 2:** A fall in market price will drastically reduce profitability of the enterprise.

A fall in market price has a far reaching effect on gross margin than a fall in yield.

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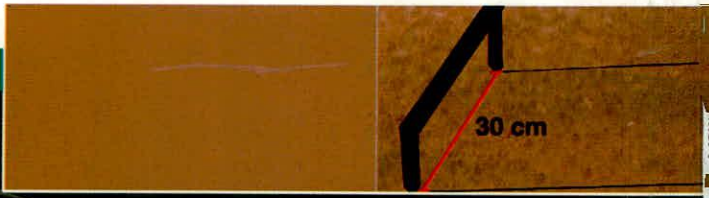

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