NARO

Republic of Uganda

Adaptation for Smallholder Agriculture Programme
ASAP
IFAD

IFAD
Investing in rural people

PRELNOR

Cassava

Curriculum and Technical Guide for Farmer Field and Business School Facilitators



2018

© 2018 Ngetta Zonal Agricultural Research and Development Institute (NGEZARDI)

NARO encourages institutions and organizations to translate, reproduce or adopt this publication.

Please send information on the translation, reproduction and adaptation of this publication to:

The Director of Research

Ngetta Zonal Agricultural Research and Development Institute

(NGEZARDI)

P.O Box 52, Lira

Tel: 0473427748 / 0473660052

Email: ngettazardi@yahoo.com

Content

Introduction	2
Importance of cassava	10
Constraints in Cassava production	10
Cassava varieties	11
Site selection	12
Land preparation	12
Seed selection	13
Planting	15
Soil Nutrient Management	18
Weed Management	18
Pest Management	19
Disease Management	23
Harvesting and Post-Harvest	25
Storage	30
Marketing	32
Value Added Cassava Products	33
Profitablitity Analysis for beans	34
Risk and Sensitivity Analysis	36
References	38

ACKNOWLEDGEMENT

This manual is based on training materials developed during the PRELNOR organized write shop meetings. The manual was developed to support Agricultural extension facilitators and Community based facilitators based at parish levels to effectively facilitate farmer learning.

We wish to thank the National Agricultural Research Organization (NARO) led by Nge and AbiZARDI, District Local government staff, Agricultural extension facilitators and breeders of the specific commodities, who were instrumental in the preparation of this manual through technical expertise in the specified commodities, photographs, and in finalization of the text, for which we are grateful. The review of the text by Project Management Unit, DAO's and NARO scientists is also highly appreciated.

The production of the manual is a joint activity between NARO, PRELNOR Project Management Unit (PMU), District Local Government production Staff in the eight project districts of Acholi and Adjumani. The hard work of Otim Godfrey Anyoni, Odama Emmanuel, Alfred Komakech, Walter.O. Anyanga, Lamo Jimmy, Kalule Okello David, Kessime Eunice, Lubadde Geoffrey, Gloria Grace Anguti, Omara Thomas, Kwemoi Daniel and Mercy Namara

in reviewing the publication and the technical editing is highly appreciated.

The support of Kasamba Salim and his team from Real Concepts Ltd in the complex task to provide the illustration and layout for the manual is appreciated.

Finally we acknowledge IFAD and the Ministry of Local Government for funding the development and production of this manual

IEC Materials Consultant : Kasamba Salim
(0783780516, Email: kasambasalim@gmail.com)

CASSAVA



INTRODUCTION

Cassava has been identified as one of the 8 most important staple crops for food security and enhancing household income in northern Uganda. Farmers are getting low yields less than 30% of potential yield due to low access to knowledge and quality planting materials, pest (cassava mealy bugs, green spider mites, white flies among others) and disease infested material(cassava mosaic, cassava brown streak, cassava bacterial blight among others). Planting materials used are either home saved or obtained from the neighbors. NARO has provided disease resistant varieties like NAROCAS 1, NAROCAS 2 and NASE 14. These improved varieties give high yield when appropriate inputs are applied. The seeds of new varieties developed by the plant breeders are usually in small quantities. For the seed to be in sufficient quantity for supply to the general public, it has to undergo multiplication by competent seed multipliers or their agents under a scheme regulated by a certification authority.

This curriculum and manual has been prepared primarily to provide guidelines for improved cassava production and productivity.

TIME (HOURS) THEORY	TIME (HOURS) PRACTICAL	TOPIC	OBJECTIVE	CONTENT	METHOD	MATERIAL
20 min	30 mins	Introduction	• To appreciate importance of cassava production	Importance of cassava	• Brainstorming • Self- discovery • Group discussion	• Demo plot • Flip charts • Markers • Different cassava products
30 mins	45 mins	Record keeping	• To be able to keep proper records	Importance of record keeping	• Brainstorming • Group discussion • Demonstration	• Samples of records
30 mins	45 mins	Constraints in cassava	• To be able to identify production constraints of cassava	Constraints in cassava production	Brain storming Group discussion Field visit	• Flip charts • Markers • Masking tapes • Pens • Note books

15 min	45 mins	Varieties of cassava	• To be able to identify and select different cassava varieties with their attributes	Identification of cassava varieties based on their attributes	• Brainstorming • Practical • Demonstration	• Variety samples • Markers • Masking tapes • Flip charts • Note books • Pens • Photos /video
10 mins	30 mins	Seed selection	• To be able to carry out seed selection in cassava.	Selection of cassava varieties based on their attributes Attributes of good cassava seeds for plantings	• Discovery • Sharing • Practical • Demonstration • Brainstorming	• Cassava fields • Cassava planting materials suitable for planting (age and quality)
10 min	25 mins	Seed rates	• To be able to determine appropriate plant population of cassava.	• Determining seed rates for cassava by plot size	• Brainstorming • Practical • Demonstration	• Demo plot

30 min	1hr	Land preparation	• To be able to prepare land suitable for planting cassava	Different methods of land preparation for cassava	• Brainstorming • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Demo plot • Farm tools • Photos/videos
15 min	40 mins	Crop rotation	• To be able to plan a good crop rotation program for cassava.	Planning crop rotation for cassava	• Discovery • Brainstorming • Practical • Demonstration • Field observation	• Markers • Masking tapes • Flip charts • Note books • Pens • Demo plot
15 mins	1 hr	Planting cassava	• To be able to plant cassava correctly.	Different methods of planting cassava	• Practical • Demonstration • Brainstorming	• Demo plot • Cassava planting materials • Pangas • Hoes • Planting lines • Tape measure

40 mins	1 hr	Soil fertility management and fertilizer requirements for cassava	• To be able to maintain soil fertility in cassava fields. • To be able to identify the best fertilizers for cassava production.	Soil fertility requirements for cassava. Types of fertilizers required in cassava	• Brainstorming • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Demo plot • AESA sheet • Fertilizer samples
30 mins	1 hr	Weed management in cassava	• To be able to correctly and timely control weeds in cassava fields.	Identification of different weeds and weed management strategies in cassava	• Brainstorming • Practical • Demonstration	• Demo plot • Weed species • AESA sheet • Pens • Notebooks • Farm tools
30 mins	1 hr	Disease management in cassava	• To be able to identify the different diseases of cassava, symptoms and different methods of control.	Identification of diseases and management of cassava diseases	• Brainstorming • Practical • Demonstration	• Demo plot • Disease specimens in the field • Disease resistant varieties of cassava • AESA sheets • Pens • Notebooks

20 mins	1 hr	Pest management	• To be able to identify and manage the different pests of cassava.	Identification of cassava pests damages, Management strategies of cassava pests	• Brainstorming • Practical • Demonstration	• Demo plot • Pests specimens of cassava • AESA sheet • Pens • Note books
20 mins	1 hr	Harvesting cassava	• To be able to determine appropriate period for harvesting cassava.	Time of harvesting cassava Harvesting of cassava stems Cassava ratoon crop management	• Brainstorming • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Harvesting tools and materials
11/2 hrs	4 hrs	Post harvest handling	• To be able to carry out postharvest handling activities of cassava.	Post harvest handling methods in cassava	• Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Transport means • Bags

20 mins	1 hr	Drying cassava	• To be able to dry cassava products.	Methods of drying cassava	• Discovery • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Packaging material • Drying yard • Tarpaulins
30 mins	1 hr	Processing cassava tubers	• To be able to process cassava into different products.	Methods of processing cassava	• Discovery • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Packaging materials • Tarpaulins • Cassava chippers
25 mins	30 mins	Packaging	• To be able to package cassava value added products.	Suitable methods of Packaging cassava	• Discovery • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Samples of packaging materials

30 mins	1 hr	Storage	• To be able to store cassava value added products.	Different methods of Storing cassava	• Brainstorming • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Packaging material • Stores • Silos
30 mins	45 mins	Profitability analysis	• To identify different cassava products and their index	Profitability analysis of cassava products	• Brainstorming • Group discussion • Market survey	• Samples of cassava value added products
30 mins	1 hr	Marketing cassava	• To be able to market cassava and its products profitably	Identification of different cassava products and their marketing channels	• Brainstorming • Practical • Demonstration	• Markers • Masking tapes • Flip charts • Note books • Pens • Transport • Bags

Summary Information on Cassava Production Technologies

Importance of cassava

- Source of food and food security
- Income generation
- Confectionery
- Industrial alcohol
- Pharmaceutical industry/coating tablets
- Fodder; protein supplement in livestock and poultry feed (cake).
- Cover crop

Constraints in Cassava production

Poor agronomic practices for example; site identification and land preparation, variety selection, weed management, stem multiplication and storage

- Pests
- Diseases
- Climatic changes
- Declining soil fertility
- Post - harvest losses
- Accessing quality seeds/planting materials

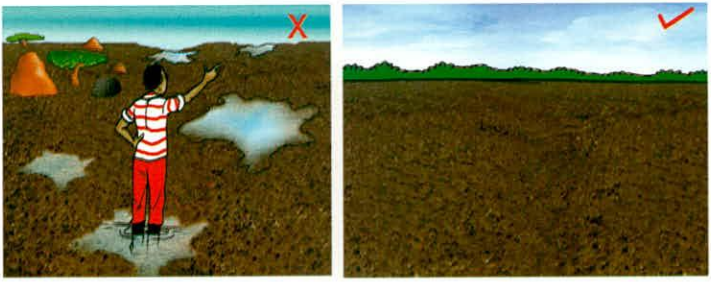
Cassava varieties

	Brief Attributes			
	NASE 19	**NASE 14**	**NAROCAS 1**	**NAROCAS 2**
Leaf appearance	Similar to NASE 14.			
Stem and inner stem appearance	Similar to NASE 14. (Difference is tuber shape)			
Plant height	100- 180 cm	Branching height: low	Branching height: low	Branching height: High
Yield	12 -16 tons/acre	10 -14 tons/acre	12 -18 tons /acre	10 -14 tons /acre
Maturity	12 months	12 months	12 months	12 months
	Brief attributes			
	Similar to NASE 14.	• Shoot tip color: purplish red • Outer root color: light brown • Petiole color: red • Stem color: grey	• Shoot tip color: greenish • Petiole color: green • Stem color: grey • Outer root color: light brown	• Shoot tip color: green • Outer root color: brown • Petiole color: green • Stem color: grey

Site Selection

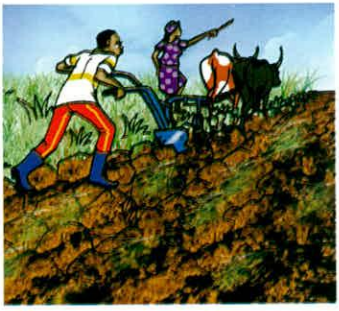
The crop grows best on medium to light, well –drained soil with enough rainfall.

- Avoid waterlogged areas and stony land.

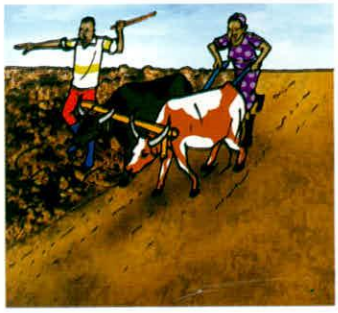


Land Preparation

- Good land preparation is essential for a good stand and root development.
- It requires deep soil for better root development
- Very fine seed bed is not recommended.
- First and second ploughing will give a good yield



1st ploughing



2nd ploughing

Rotation

- Since it does not take a lot of nutrients from the soil, it can be the last crop in the rotation.

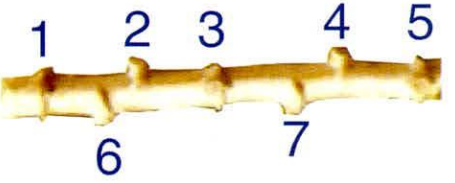
Seed Selection

Look for varieties with:

- Healthy cuttings (avoid plants with pests and diseases)
- Middle brown skinned portions
- High dry matter content
- Varieties with good mealiness
- That bulk early for example, NASE 14 and NASE19
- Good ground storability for example, NAROCAS 1

Desirable stems

- Use cuttings with about 5 - 8 nodes to increase sprouting chances.
- Small cuttings lose viability and moisture very easily and that may affect sprouting ability and establishment.



Health of stems

- Stems from healthy plants should be used.
- Diseased stems sprout poorly.
- Farmers should know symptoms of CBSD and CMD in order to select clean planting materials
- Use a sharp panga to avoid cracking and bruises on stems.



- Avoid bruised stems, as bruises can be entry points for pathogens.



Seed Rate

Use a seed rate of 6- 7 bags /acre (4000 cuttings per acre), each bag should have on average 666 cuttings.

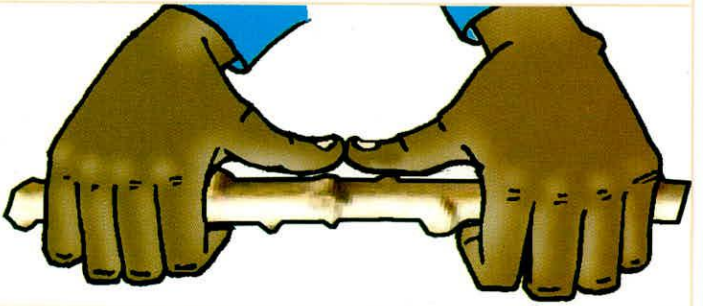
Planting

Over-mature and tender stems give poor germination



Stake length of 25- 30 cm, with 5 – 8 nodes is recommended.

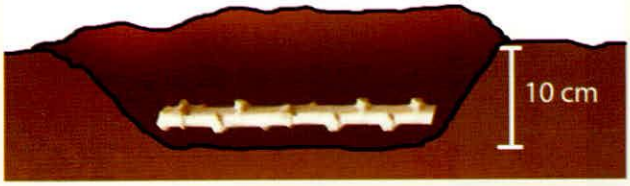




Horizontal planting of stems is a common practice and deeper planting is recommended for sandy soils and shallow planting for moist and heavy soils.

a) Horizontal

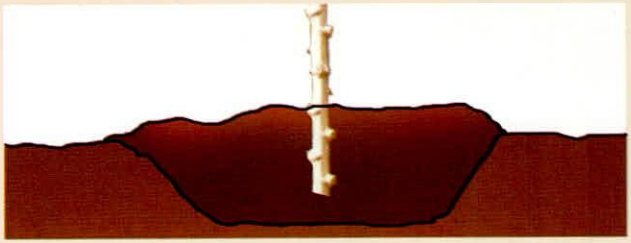
- Storage roots develop more closely to the surface.
- More likely to be exposed and attacked by rodent and birds.
- Several weak stems develop from the cuttings.



10 - 15 cm deep Horizontal planting

b) Vertical

- Storage roots develop deeper in the soil
- Roots develop more closer
- Difficult to harvest
- Best in sandy soils

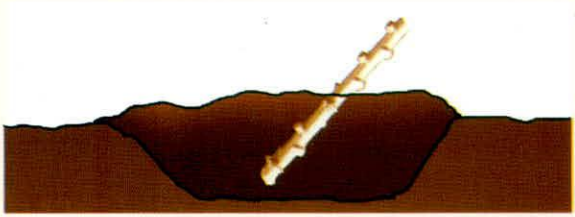


$\frac{2}{3}$ of the stem in soil for vertical planting

c) Slanting

This method is recommended in areas with termite infestation.

- When planting using the slanting method, the nodes should be facing upwards not downwards. No sprouting shall occur if the nodes face downwards.

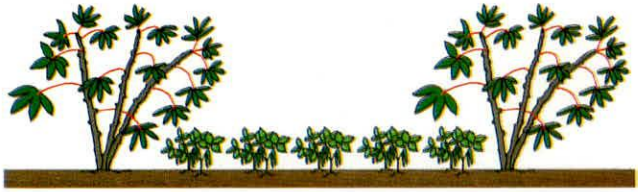


Plant at the onset of each rainy season for proper root establishment.

Spacing



1 x 1m



1 m x 1.5 m

Considerations for intercropping

- Branching habit of the cassava variety and the component crop
- The characteristics of intercrop
- Working space (for weeding, harvesting etc.)

Soil Nutrient Management

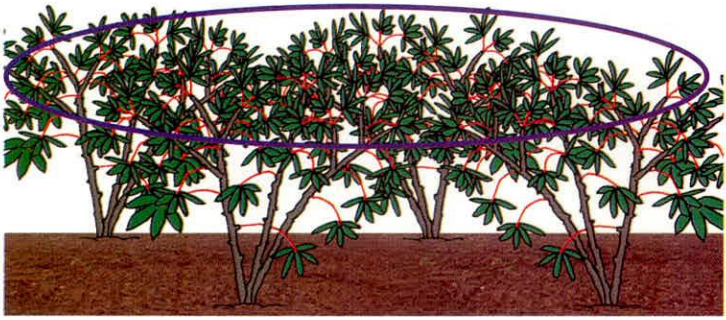
Use of N (Nitrogen) fertilizers is not encouraged as it boosts too much vegetative growth at the expense of the root tubers development.

Weed Management



- By intercropping with legumes
- Weed control begins from proper seed bed preparation
- 1st weeding at 2 weeks after emergence
- 2nd and 3rd weeding at appropriate time using appropriate method

- Mechanical - using a hand hoe
- Weeding is necessary every 3- 4 weeks until 3 months after planting
- Afterwards the canopy may cover the soil and weeding is less necessary
- Early branching varieties develop canopies which reduce weed growth

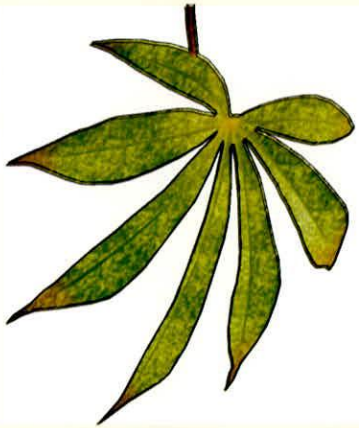


Pest Management

Major pests of cassava are cassava green mite, cassava mealy bug, cassava scales

Pest	Symptom	Control
Cassava green mite • Causes yellow chlorotic leaf spots on the upper leaf surface.	• White " pin-pricks" on the leaf • Reduced leaf size • "Candle sticks" or drying of tips.	• Plant at onset of rains • Plant tolerant varieties Like NASE 14 and NAROCAS 1 • Biological control is recommended like predatory mite.

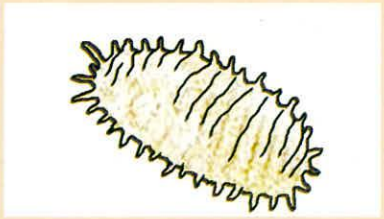






Cassava mealy bug

- Occurs on cassava leaves, shoots, petioles and stems



- Reduced internodes
- Stem distortion
- Drying of leaves
- Bunchy tops



- Plant at onset of rains
- Plant resistant varieties e.g NASE 14.
- Disinfect planting materials with furadan



Cassava scales





- The use of insecticide is recommended



White flies



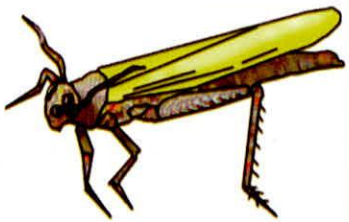
- Black molds on shoots



- Plant resistant varieties e.g NASE 14, among others.
- Plant at the onset of rain
- Spray systemic insecticides (eg. Dimethoate)



Elegant grass-hopper



- Detopped plants
- Whole plant eaten leaving hard wood
- Debarked stem
- Defoliation



- Spray with Dieldrin or fenitrothion



Disease Management

Disease	Symptom	Control
Cassava Mosaic	• Leaf wrinkling • Stunted young plants • Reduction in size of leaflets • Leaf chlorosis 	• Plant tolerant varieties e.g. NASE 14, NASE 18, NASE 19, NAROCAS 1 and NAROCAS 2. NAROCAS 1 may show symptom but recovers from CMD. • Use clean planting material • Rogue out infected plants • Do not plant in fields previously infected • Awareness campaign 

Cassava Bacterial Blight

- Drying of leaves from the tip



- Plant resistant varieties eg. NASE 14, NASE 18, NASE 19, NAROCAS 1 and NAROCAS 2
- Use clean planting material
- Rogue out infected plants



Cassava Brown Streak Disease

- Yellowing of older leaves
- Yellow patching of leaves



- Plant tolerant varieties e.g. NASE 14, NASE 18, NASE 19, NAROCAS 1 and NAROCAS 2
- Rogue out infected plants
- Do not plant in fields previously infected

- Dark brown "streaks" or lesions on the stem
- The "streaks" appear as scratch-like wounds in some varieties (below)



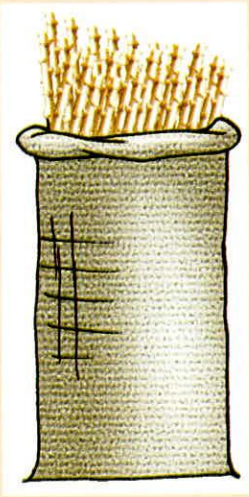
- Corky brown rot in tubers:



- Root constriction (string of bead - like appearance) :



- Awareness campaign
- Use clean planting material



Adopted from the cassava seed quality management manual, First edition, 2015, National Crops Resources Institute-Uganda.

Harvesting and Post – Harvest

- Harvesting cassava roots is usually done by hand; it is easy if the soil is sandy or during the rainy season.



- In heavier soils or during the dry season, harvesting usually requires digging around the roots to free them and lifting the plant.



- Avoid damaging the root tubers during and after harvest



- Keep fresh tubers under shade or in soil if their use is extended to a period exceeding one day



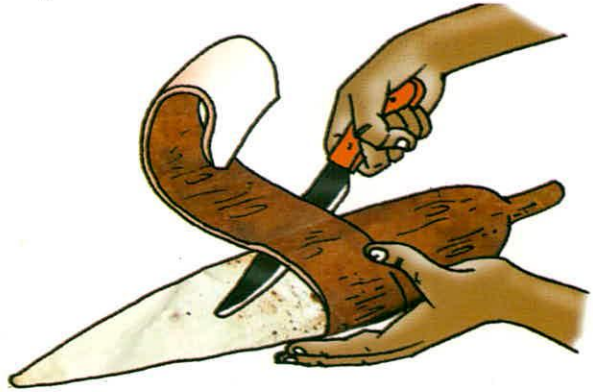
- Process bitter cassava varieties using manual power graters, chippers/slicers or hydraulic press



Preparing cassava for drying

- Cassava should be peeled, washed, chipped or sliced before drying

Peeling

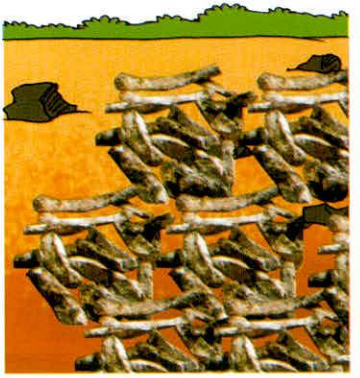


Washing



Drying cassava

Peeled cassava should be dried on tarpaulins or plastic sheets



Poorly dried cassava



Proper drying of cassava

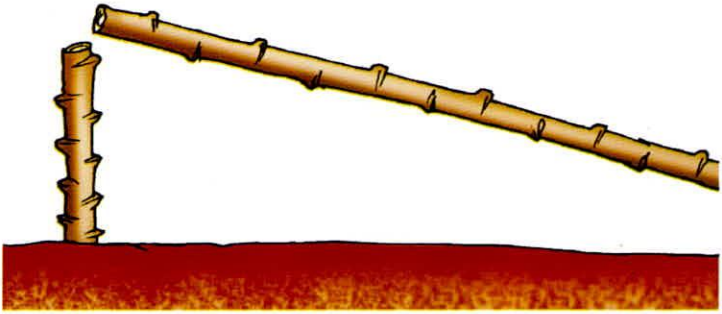
- Dry in a clean dryer, drying racks or biomass dryers or clean surface free of soil



- Shelf- life of cassava is prolonged by processing it into bakery and confectionery products

Ratoon Crop Management

- Harvest stems at 15 cm from the ground level



- Allow the sprouts to grow and remove the excess sprouts leaving only four vigorous ones to grow



- Control weeds, pests and diseases in the ratoon.
- Ratoons are ready for planting after 8 months.

Storage

- Fresh cassava can be stored using the pit, and waxing



Pit

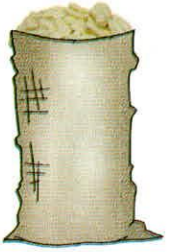


Unwaxed cassava



Waxed cassava

- Dry cassava may be stored in gunny bags, granaries or silos
- Other Storage technologies include cement brick silo, basket woven granaries, drum and hermetic storage.



Gunny bags,



Hermetic storage



Basket woven granaries

- Store in cool, dry and hygienic place

Marketing



- Conduct market survey to establish the market requirements in terms of quality, quantity, seasonality and Price.
- It is important for farmers to have linkage to market information and they should practice bulk marketing and value addition.



- Encourage contract farming with cassava processors.
- Promote local seed business



Recommended packing in a labeled bag



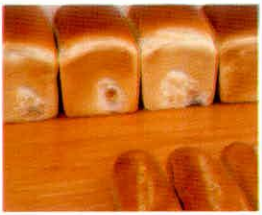
Monitoring and certification of seeds

Value Added Cassava Products





Cassava Crisps

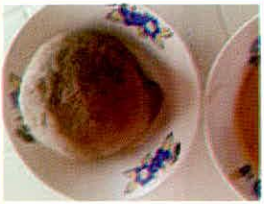


Cassava baked bread

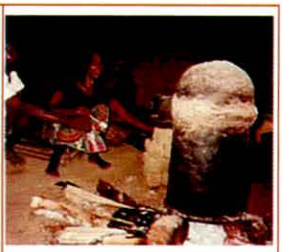




Cassava flour



Cassava mingled bread

		
Isombe (Greens of cassava leaves)	*Industrial Brew*	*Local Brew*

Profitability Analysis for Cassava

Gross

Example: Gross margin for cassava per acre

Assumptions: yield of cassava = 12 tons and market price = 500/- per kg

Item	Unit	Quantity	Unit cost	Total
Cost of input				
Seeds /planting material	Bags	7	30,000	210,000
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				313,000
Labour costs				
Land preparation x2	Man- day	2 x10	5,000	100,000
Planting	Man- day	5	10,000	50,000
Weeding	Man- day	3 x 10	5,000	150,000
Harvesting	Man - day	2 x 5	10,000	100,000
Drying	Man- day	10	5,000	50,000
Packaging	Man- day	20	2,000	40,000
Total labour cost				490,000
Cost of labour and input				800,000
Gross Margin				5,200,000

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

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

$= \frac{800{,}000}{16{,}000}$

= 50/-

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

= 500 — 50

= 450/-

Implication: a farmer is getting a profit of shs 450/- per kg produced

Risk and Sensitivity Analysis

Risk analysis for cassava enterprise

Scenario 1: A decrease in yield of cassava to 9,000kg per acre and a rise in market price to shs 600 a kg.

Expected Revenue	Cassava	1 acre × 9,000	600	5,400,000
Total Cost				800,000
Gross Margin				**4,600,000**

Scenario 2: An increase in yield of to 12,200 kg/acre and a fall in price to shs 400 per kg

Expected Revenue	Cassava	1 acre × 12,200	400	4,880,000
Total Cost				800,000
Gross Margin				**4,080,000**

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.

References

- Bishaw,Z.,Niane, A.A, Van Gasten,A.J.G,(2006). *Technical guidelines for quality seed production.*
- ICARDA,Aleppo,Syria,23pp.CIAT Handbook 1 page 2
- FAO,AHP (2002).*Anti- hunger Programme, reducing hunger through agriculture and rural development and wider access to food*, FAO, Rome. Harry Van Den Burg and Nina De Roo.2013: Seed Entrepreneurship Manual. Season 1.3, page 16- 17
- IITA, (2000); *Disease Control in Cassava Farms*; IPM Guide for extension agents
- IITA (2000); *starting a Cassava Farm*; IPM Guide for extension agents
- NARO, 2001. *Agriculture in Uganda*. Vol 2 crops
- NARO, (2009).*Crop Production Handbook*
- MAAIF, (2009) *Crop Production Handbook*,
- Rielyet al.(1999): *Food security indicators and framework for use in the monitoring and evaluation of food aid programs*
- World Bank (1986).*Poverty and Hunger: issues and options for food security in developing countries.*
- Washington, DC

CONTACT:
Ngetta Zonal Agricultural Research and Development Institute
THE DIRECTOR OF RESEARCH
P.O Box 52, Lira
Tel: 0473427748 / 0473660052
Email: ngettazardi@yahoo.com