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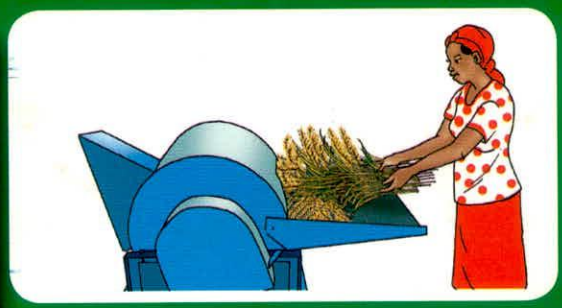
NGETTA ZONAL AGRICULTURAL RESEARCH AND DEVELOPMENT INSTITUTE
NGEZARDI

Catalogue for

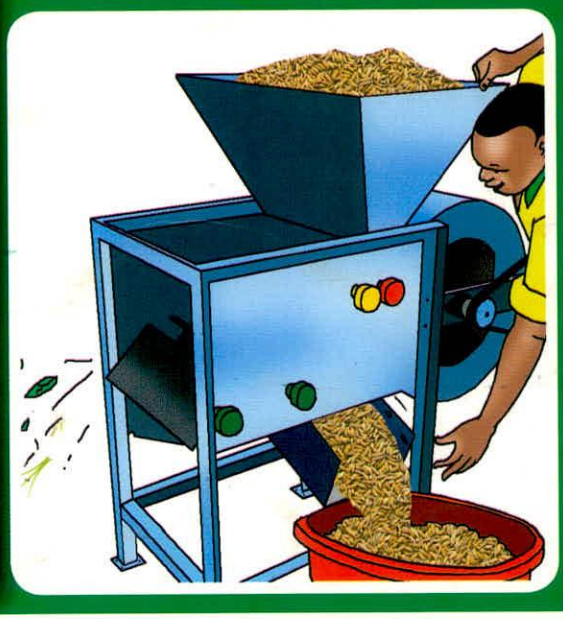
Rice

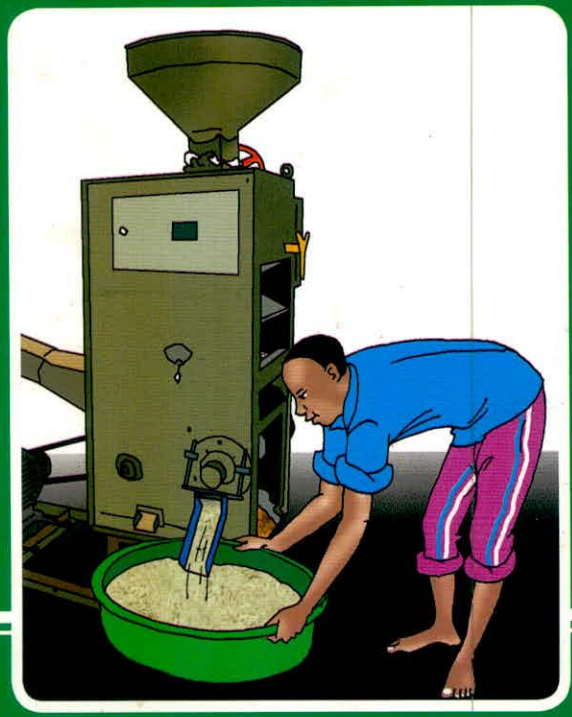
Labour Saving Technologies











2017

NGETTA ZONAL AGRICULTURAL RESEARCH AND DEVELOPMENT INSTITUTE

CATALOGUE FOR RICE LABOUR SAVING TECHNOLOGIES

COST COMPARISON OF USING HYDRO POWER TILLER ON HIRING BASIS FOR LAND PREPARATION VERSUS MANUAL LAND PREPARATION						
	MANUAL LAND PREPARATION			MECHANICAL LAND PREPARATION		
Items/activity	**Number of operation/ha**	**Unit cost/ operation (UGX)**	**Sub Total cost**	**Number of operation /ha**	**Unit cost/ operation/ ha (UGX)**	**Sub total**
Machine Depreciation		-	-			-
First ploughing	1	200,000	200,000	1	150,000	150,000
Second Ploughing	1	150,000	150,000	1	150,000	150,000
Third Ploughing	1	100,000	100,000			-
Labour wage			-			-
Repair cost		-	-			-
Fuel		-	-			-
Oil		-	-			-
Land levelling	1	50,000	50,000	1	50,000	50,000
Transport		-	-		5,000	-
Total Cost			**500,000**			**350,000**

Data source: Tororo rice farmers and Doho rice scheme 2017.

Advantages of using Hydro power tiller

- It cuts the cost of land preparation from UGX 500,000/ha to UGX 350,000/ha (30% of land preparation cost) on current hiring cost and UGX 500,000/ha to UGX 196,380 (60.7%) on ownership basis.
- Saves time for land preparation by 33%
- Fast and efficient (1–2 ha per day), uses less labour and ensures timely planting.
- Reduces stress, work load, and health risks.
- Ensures uniform crop establishment and maturity.
- Seedlings recover fast, tiller vigorously, and mature uniformly.
- It is able to work in deep mud and excessive water paddies

How to use the Hydro Power tiller machine

- Refer to the operational manual that comes with the machine.

Limitation

- It will only work in water saturated paddy fields
- Requires separate mode of transportation when transferring from one field to another
- Requires training &skills in operation and maintenance

Manual land Preparation for rice growing



Figure 1.3: A farmer digging

It costs 50 man days to do first weeding at a cost of UGX 5,000/man-day equivalent to UGX 250,000/ha. Second weeding takes 20man-days/ha equivalent to UGX 100,000/ha. Therefore, land preparation may cost approximately 500,000, twice the cost of weeding.

Mechanical methods for upland land preparation

The walking tractor and its implements for land preparation



Figure 1.4: Picture of a walking tractor

7) Sow the rice seeds on top of the plastic nets at the rate of 1kg per 0.75m × 1.5m net;
8) Cover the seeds with 2 -3cm thickness mulch or rice straw as protection from direct sunlight, rain, birds and rats(make sure that the rice straw does not contain seeds to avoid off-types);



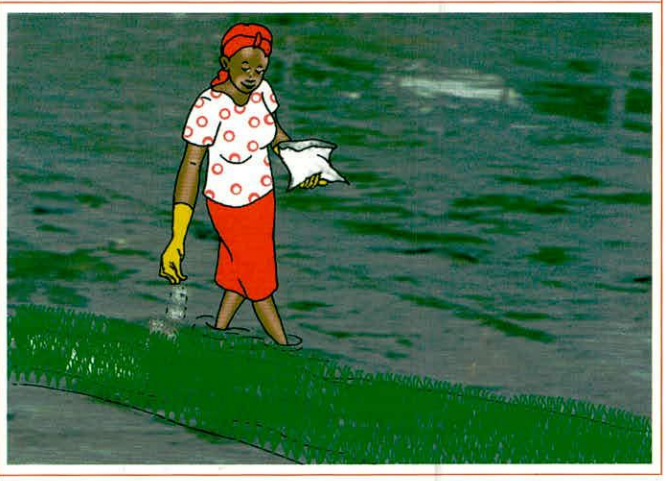
9) Irrigate the seedbed very well with sprinkler, sprayer or fill the canals with irrigation water twice a day (morning and afternoon); do this 1-4 days after sowing;



10) After 5days, remove the mulch or rice straw slowly, then irrigate the seedbed with about 2-3cm standing water and maintain this level up to 9days;



11) At 5 DAYS apply 1kg ammonium sulfate fertilizer for every 10kg seeds(1:10) and then immediately water the plants to avoid burning of the seedlings specially when the weather is too hot;



12) At 12-14 DAYS, the seedlings are ready for transplanting;

a) Slowly separate the paired plastic nets

b) Step on the lower net with your feet and pull the other net where the seedlings are attached

c) Distribute the seedling mats to the field where they will be planted

d) Slowly pull the seedlings from the net and distribute them to the field for transplanting at a distance of 20 cm × 20 cm.





2. Wetbed method to raise seedlings for lowland Rice

Preparing the Nursery Bed

a) Prepare a fine seed bed measuring 1m width with a length of your choice and leave a space of at least 40cm between beds for space during nursery management.



Level nursery bed with a stick



Keep nursery bed 40cm from each other

b) Broadcast seed on the nursery bed at a rate of 1kg/ 20m² area. Broadcast sparsely and evenly as shown in the figure below. Remove mulching materials after about 4-5 days after sowing





c) Transplant healthy seedlings at 16-21days old. Do not keep seedlings in the nursery for too long. Irrigate thoroughly before uprooting seedlings







4 TRANSPLANTING FOR LOW LAND AND DRY PLANTING FOR UPLAND

Mechanical Rice Transplanting using a rice transplanting Machine

LOW LAND RICE

Machine transplanting involves planting young rice seedlings into puddled soil by machine.

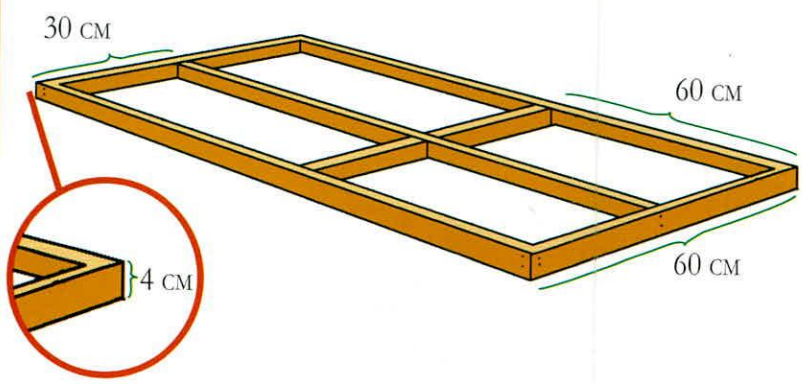


Figure 4.1: Illustration of a rice transplanting machine. Closed shot of essential parts (planting claws, seedling trays and floating parts)

Advantages of Mechanical Rice transplanting

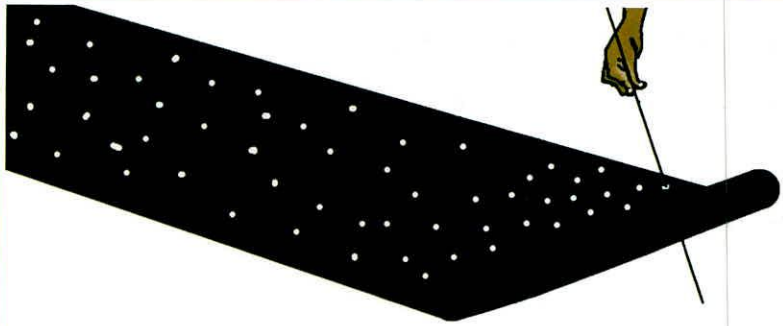
- Fast and efficient (1–2 ha/d), uses less labour and ensures timely planting.
- Reduces stress, work load, and health risks.
- Ensures uniform spacing and plant density.
- Seedlings recover fast, tiller vigorously, and mature uniformly.

Raising a nursery for using a transplanting machine

STEPS	ILLUSTRATIONS
Step 1 Make wooden frames	

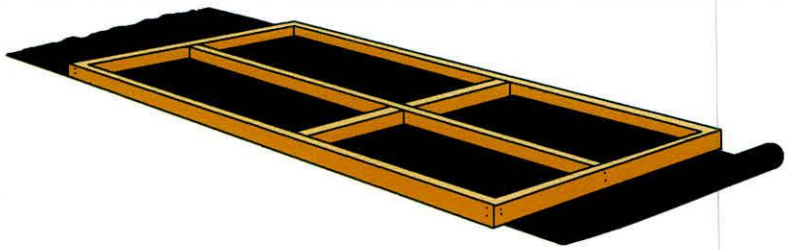
Step 2:

Buy a polythene with a width of 1meter and perforate using a pointed object like a bicycle spoke.



Step 3:

Place the polythene down and the wooden frame on top.



Step 4:

Fill the soil to the level of the thickness of the wooden frame (4cm).



Step 5:

Plant by broadcasting on top.



Step 6:

Cover with grass to keep the birds off



Step 7:

Remove the grass after 5 days.



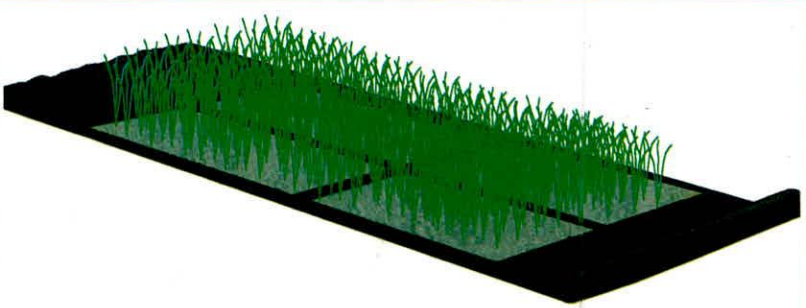
Step 8:

Remove the wooden frame



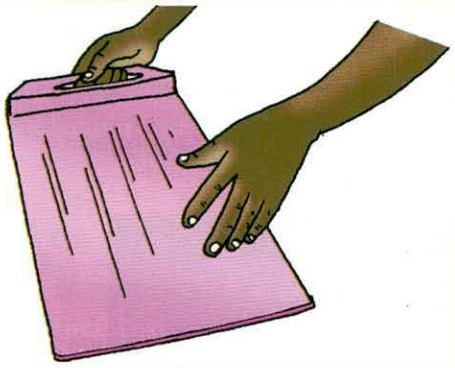
Step 9:

Seedlings are ready for transplanting from 14-18 days.



Step 10:

Place the nursery on the tray





Step 11:

Load the tray in the transplanter.



Step 12:

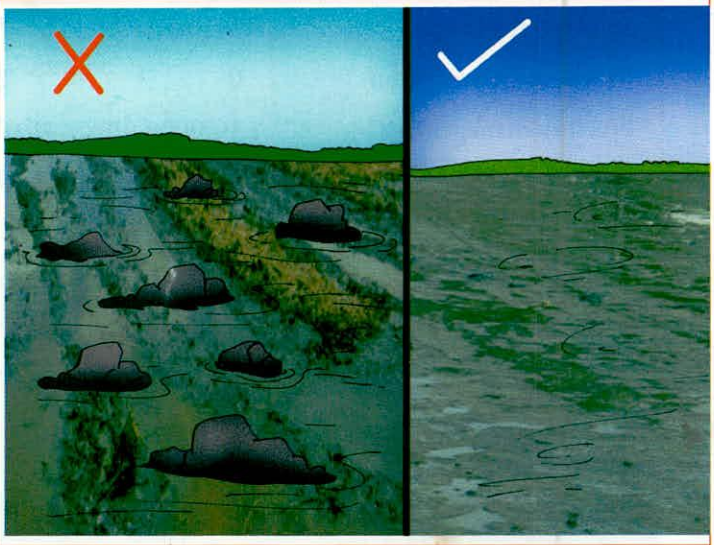
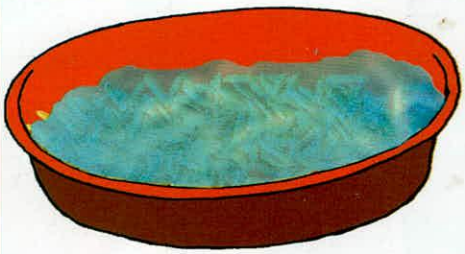
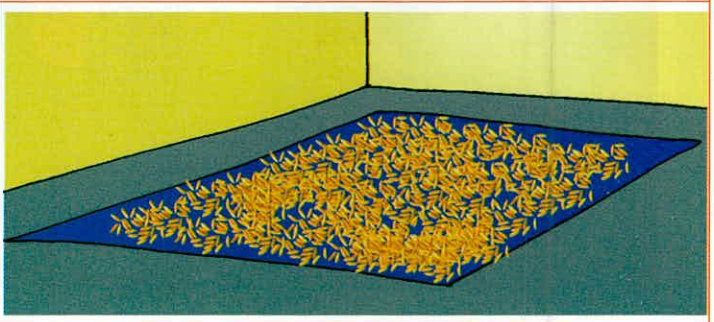
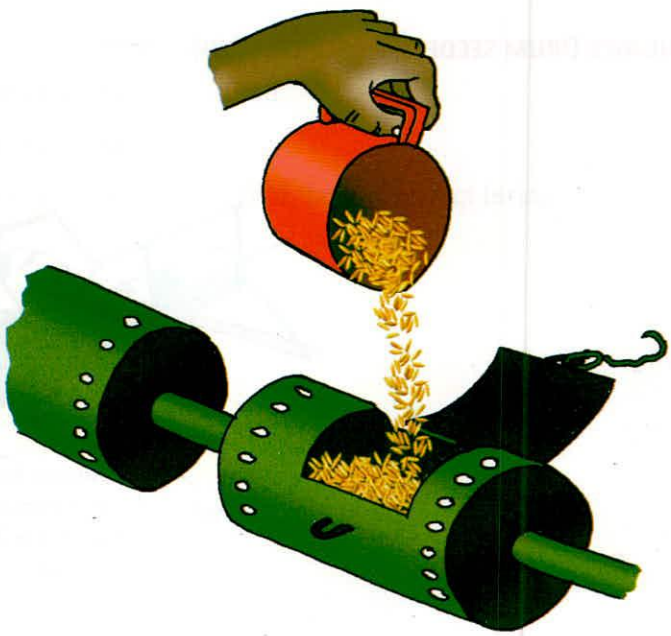
Load extra trays with seedlings on the storage mesh surface.



How to use the rice transplanting Machine

1. Raise seedlings in special mat nurseries or in seedling trays. Use 18–25 kg of good seed per 100 m^2 of nursery for each hectare.
2. Seedlings will be ready for transplanting in 12–15 days after seeding (Days after sowing).
3. Ensure that fields are well puddled and levelled.

How to use a drum seeder

Steps	Illustration
Step 1: Level the paddy field very well-there should be no soil mounds or ditches after final leveling.	
Step 2: Pre-germinate the seeds that are to be used in the drum seeder.	
Step 3: Air dry (under shade for 1-2 hours) the pre-germinated seed before filling into the drum to allow good separation.	
Step 4: Fill the seed drums up to ¾ to allow uniform seed dropping. When the drum is completely filled, seed will not drop out uniformly.	

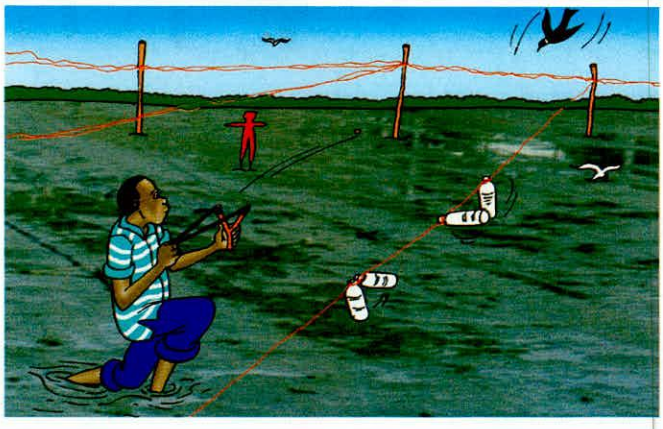
Step 5:

Use a rope to guide where the wheel is passing. However, with experience a rope may be used once for first line in which the wheels will be moving.



Step 6:

Keep the birds off the field for 3-4 days.



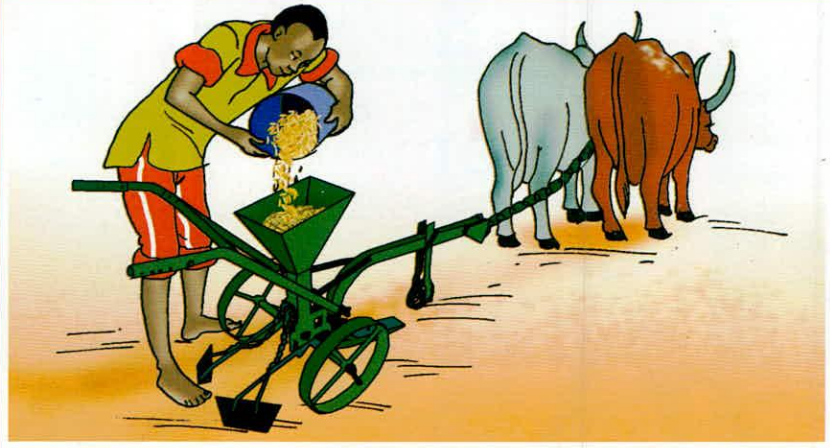
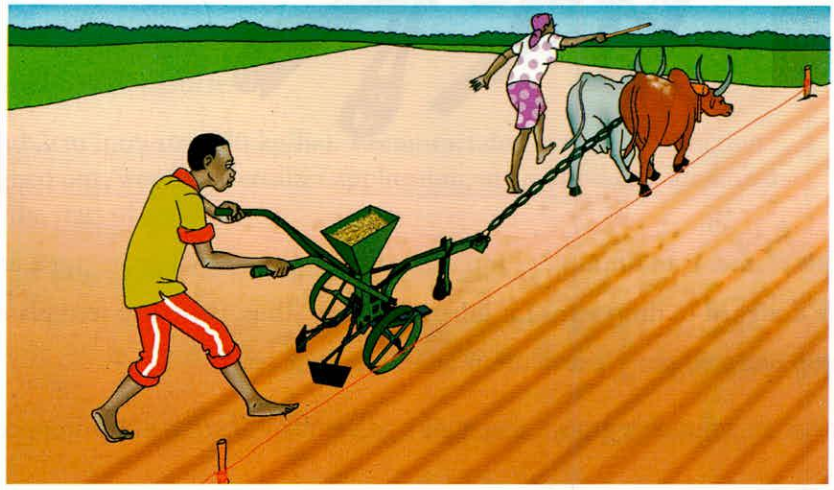
Advantages

- Simple and low cost.
- It is easy to manage.
- Portable and lightweight.
- Versatile, can be used for other crops
- Rice grains seeded in straight rows, allowing mechanical weeding between rows
- Reduces seeding rate compared to broadcasting.
- Saves on labour.
- Uniformity in seed sowing and plant population.
- One person can cover one ha per day.

Limitations

- It should be operated in fields with saturated water.
- Requires well levelled fields.

How it works

Steps 1: Connect the chain to the ox	
Steps 2: Load the seeds into the seed feeder	
Steps 3: Mark the first line with a string through which the wheels shall follow.	
Steps 4: Pull through the rest of the field as another person guides the ox.	

Limitations

- Only works well when the land surface is well prepared.
- Works only on upland.

5 WEED MANAGEMENT

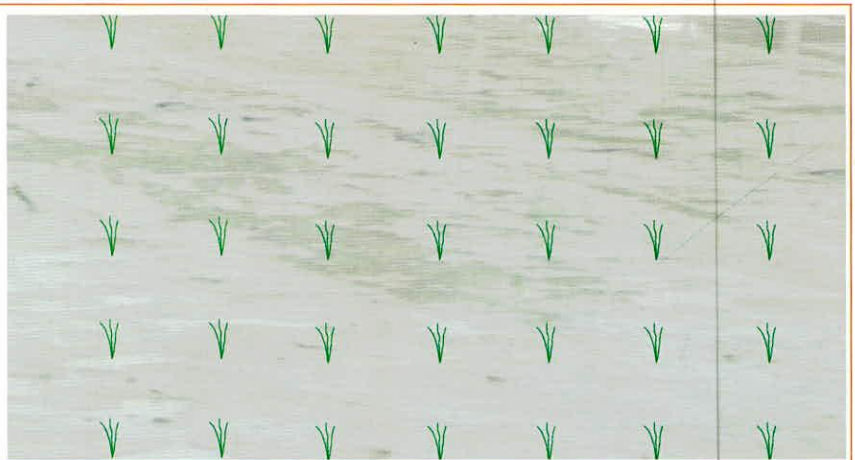
CONICAL WEEDERS



How to use a conical weeder

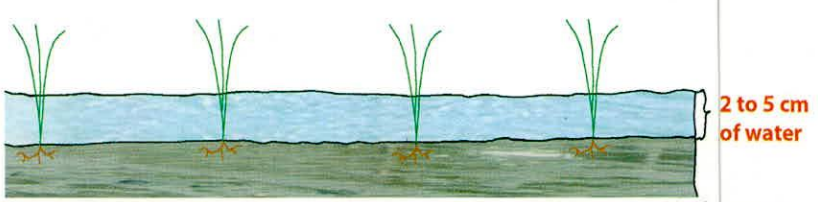
Step 1

Translate rice at spacing of 25x 25 cm at right angles (90º). This ensures that crops are in line in all directions hence allowing operation of the conical weeder.



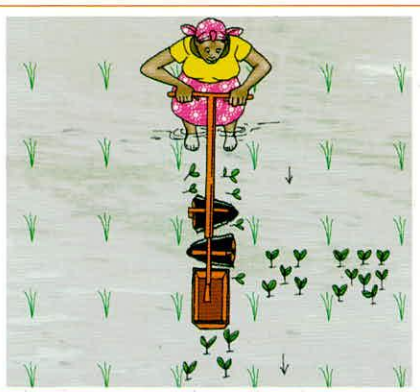
Step 2:

Allow 2-5 cm of water in the field for efficient operation of the conical weeders



Step 3:

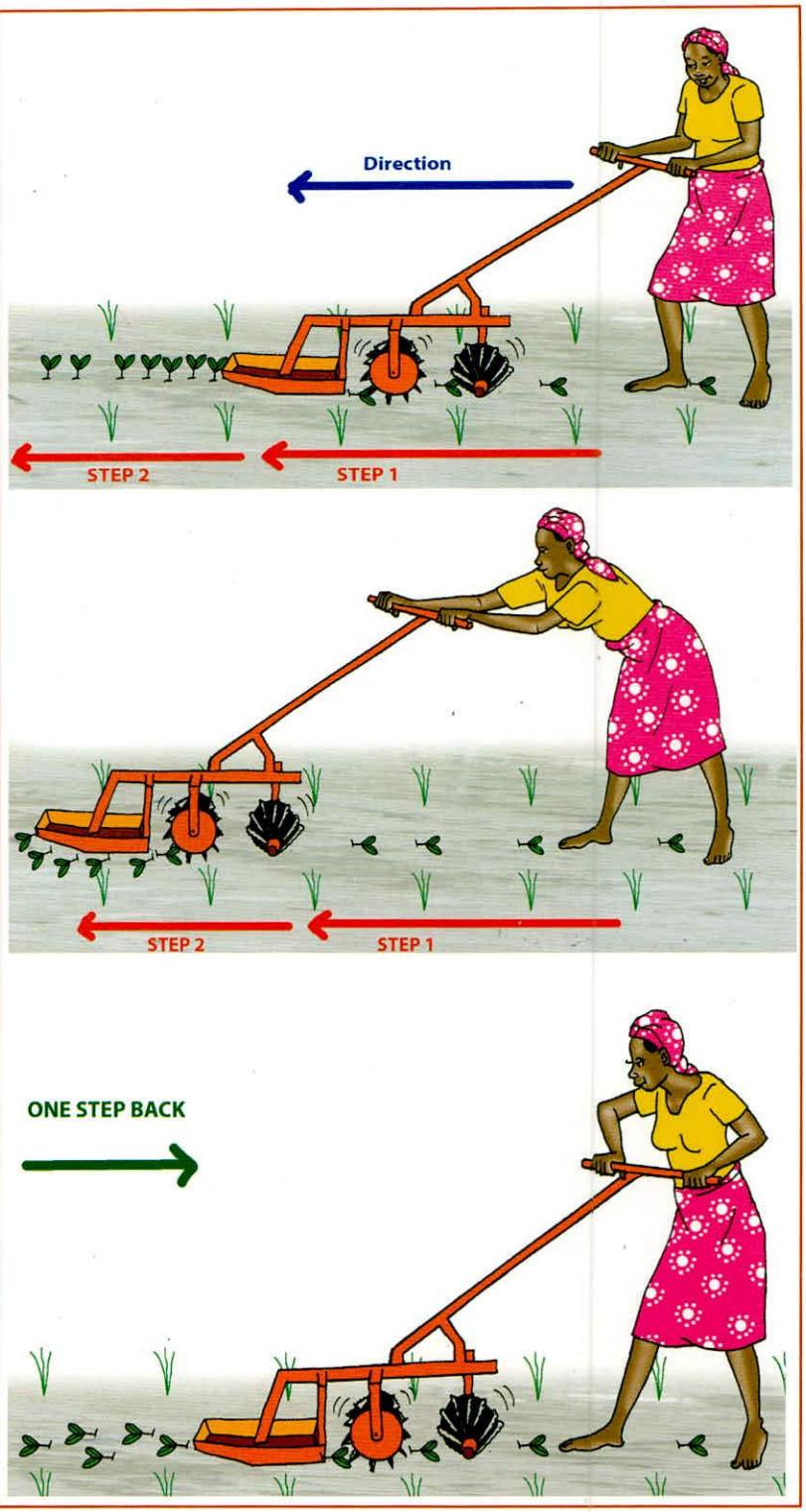
Weed east- west; north -south direction for complete removal of weeds.





Step 4:

While operating, move 2 steps forward and one step backward.



Cost

Cost of conical weeder is approx.: UGX 200,000

Advantages

- It can be fabricated locally
- Simple to operate
- Gender friendly

Limitations

- Only useful in lowland irrigated or rain fed
- Transplant spacing must be precise.
- Land must be levelled.

Table 5.1:Table showing specifications of a conical weeder

Function	For weeding in between rows of line sowing paddy crop
Power	Manually Operated
Number of Operators	One Person
Type of Operations	Push-Pull Operation
Operating Conditions	Water must be more in the field
Number of Rows	Single Rows
Weight	6 kgs
Width of Operations	140-160 mm
Field Coverage	0.10 – 0.12 hectare / day of 8 hours of Operation
No. of Cones(rotors)	2 nos.
Cones	Plastic Moulded with MS Blades
Blades	2 mm thickness, 6 numbers of plain blades, 6 numbers of serrated blades
Cone Holder	2 nos.
Float Assembly	1mm thickness Size : 320*120*65 mm. Float Angle 21 Degrees
Handle	Main Pipe : 20 mm dia. 18WSG Length:1200mm Cross Bar : 25 mm dia. 18SWG Length:460mm
Production capacity	75,000 Nos. per annum
Area of coverage	0.15 ha/day
Saving in labour	50%
Saving in cost	40% of weeding

Cost-benefit of conical weeders

First weeding done one week after transplanting and blanket weeding. The task is 1000sq metres for UGX 10,000 meaning 10tasks per ha equivalent to UGX 100,000 per ha.

Second weeding done 3weeks after transplanting. This is mainly spot weeding because crop has established at this time. It costs 6man-days per ha @ UGX 10,000/man-day equivalent to UGX 60,000/ha.

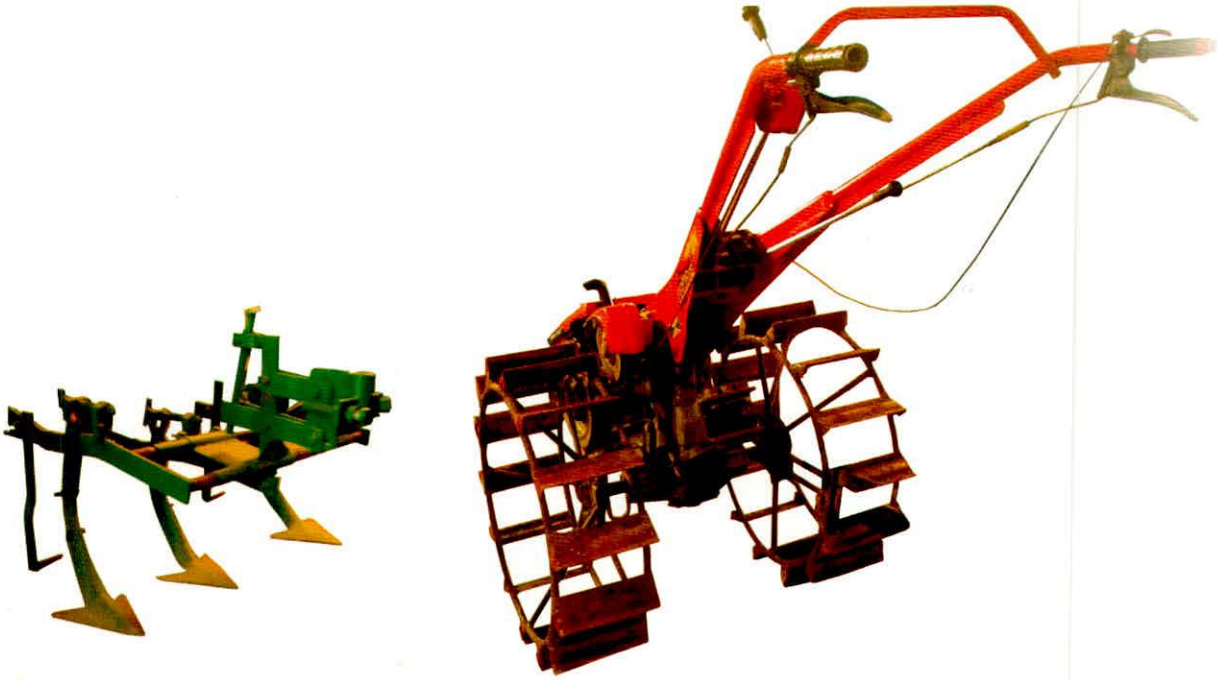
Current yield due to better weed control stands at 6.5t/ha from 3t/ha. Yield increment is due to better land preparation and weed control.

Manual weeding

It costs 50 man days to do first weeding at a cost of UGX 5,000/man-day equivalent to UGX 250,000/ha. Second weeding takes 20 man-days/ha equivalent to UGX 100,000/ha.

The walking tractor and its implements for weeding.

THE WEEDER



How it works

Step 1: Fix the rice weeder on the walking tractor using a pin.	
Step 2: Follow instructions in the manual and the training acquired from an instructor	

6 USING HERBICIDE

- Two kinds of herbicides are being used
- Pre-emergency and post-emergency herbicides.
- In post-emergency Propanil are used.
- In pre-emergency butacle is used.
- Butachlor is used immediately after transplanting.
- Propanil is used 3 weeks after transplanting.
- Spot weeding is normally integrated with herbicide use. At least one spot weeding is done costing 10man-days /ha at a cost of UGX10,000/man-day equivalent to UGX100,000/ha.
- Herbicide application is costed 1 man-day using 8 pumps, each 16 litters for 1 ha at cost of UGX10,000.

COST-BENEFIT ANALYSIS OF MANUAL WEEDING COMPARING WITH HERBICIDES AND CONICAL WEEDER PER HECTARE

Items/activity	Manual weeding	Using a conical weeder	Herbicides
Cost of herbicides	-		100,000
Labour for spraying herbicide	-		10,000
Spot weeding		50,000	100,000UGX
First weeding	250,000sh/ha.	100,000	
Second weeding	100,000sh/ha.	60,000	
Total cost	**350,000sh/ha.**	**210,000**	**210,000 UGX**

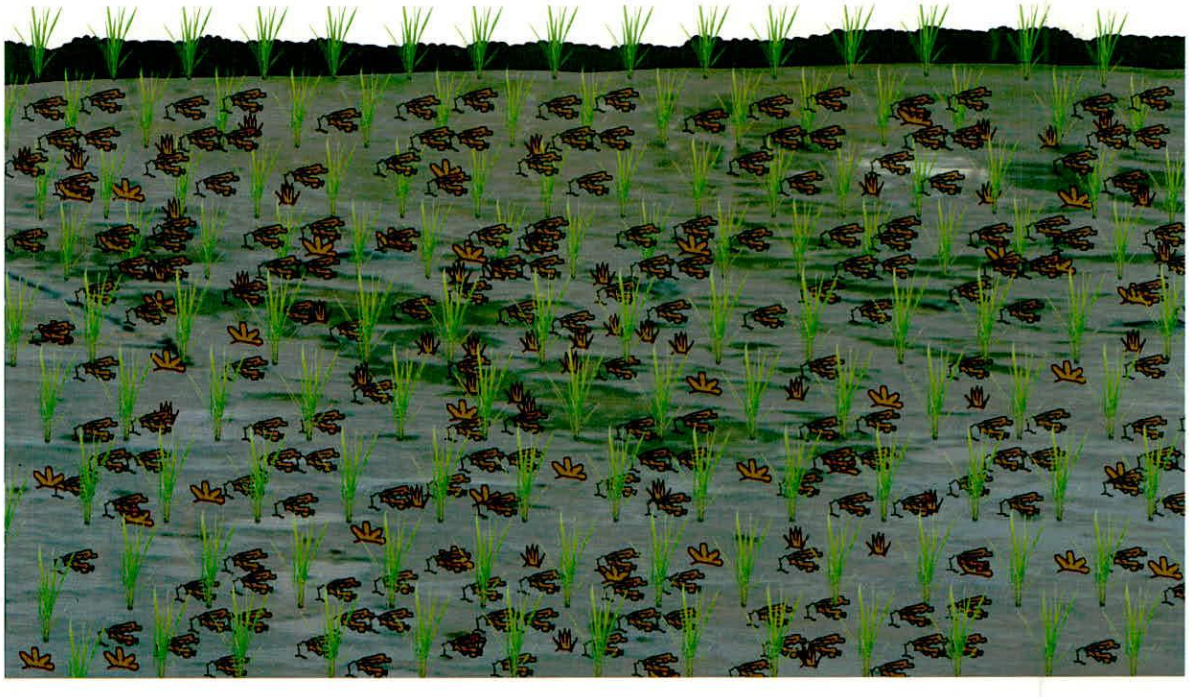
Data source: Tororo rice farmers and Doho rice scheme 2017.

In large schemes, these costs are reduced by $\frac{2}{3}$.

Before



After



Safe use of herbicides

- Always dress in protective wear
- Use concentrations and instructions as recommended by the manufacturer
- Know the weed types in the field.
- Rotate the herbicides to avoid weed resistance.

7 FERTILIZER APPLICATION

The most common limiting nutrients for rice are nitrogen (N), phosphorus (P), Potassium (K), sulphur (S), and zinc (Zn).

Variety: Long duration varieties need more fertilizer than shorter duration varieties.

Soil: Light soils need more split application of N and K compared to heavy soils.

Fertilizer should be applied based on a soil test and desired yield. The farmer should strive to obtain a fertilizer recommendation based on analysis of soil samples.

When a soil test is not possible, general recommendations can be a good guide to applying fertilizer based on local recommendations.

Ways of applying fertilisers



Figure 1.1: Spraying (Micro nutrients zn,B, mgso4)



Figure 1.2: Top dressing (Briquette fertilizer, N)



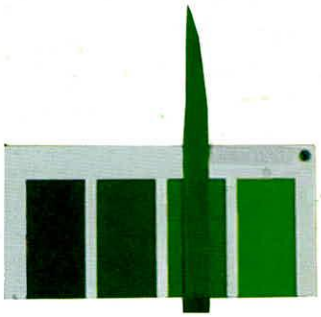
Figure 1.3: Basal application, DAP (Broadcasting uniformly)

P and K - Apply at final harrowing just before seeding.

N fertilizer- Nitrogen is the most limiting factor in rice production. However, in seed production judicial application of N fertilizer is important since excess N facilitates vigorous plant growth that increases pests and diseases and delays fruiting resulting in poor quality seed.

- For every ton of yield required, 15-20 kg N is needed.
- Use more splits for long duration rice varieties.
- Apply the first top dressing at 21days after seeding, and just after first weeding.
- Apply a second dressing at about panicle initiation between 45-50days after seeding.
- Broadcast uniformly over the soil surface.
- Don't apply more than 30-35kg ha^{-1} in a single split to minimise loss.
- Use a leaf colour chart to estimate N needs.

Leaf Colour Chart (LCC) for Fertilizer N Management in Rice



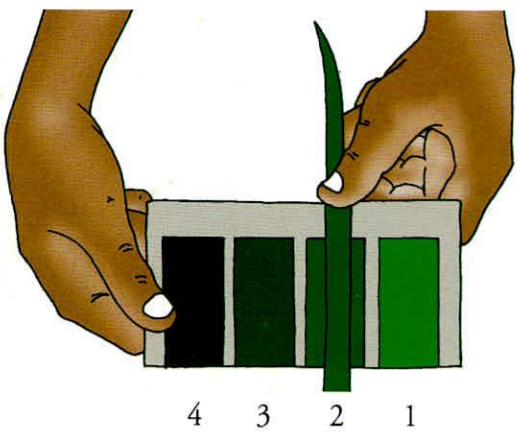
The LCC is usually a plastic, ruler-shaped strip containing four or more panels that range in colour from yellowish green to dark green.

How to use Leaf Colour Chart (LCC)

- Randomly select at least 10 disease-free rice plants or hills in a field with uniform plant population.



- Select the topmost fully expanded leaf from each hill or plant. Place the middle part of the leaf on a chart and compare the leaf colour with the colour panels of the LCC. Do not detach or destroy the leaf.
- Measure the leaf colour under the shade of your body, (direct sunlight affects leaf colour readings). If possible, the same person should take LCC readings at the same time of the day every time.
- When the colour of the leaf is below 3, apply N containing fertilizer.



- Determine the average LCC reading for the selected leaves.

8 HARVESTING

RICE REAPER MACHINE

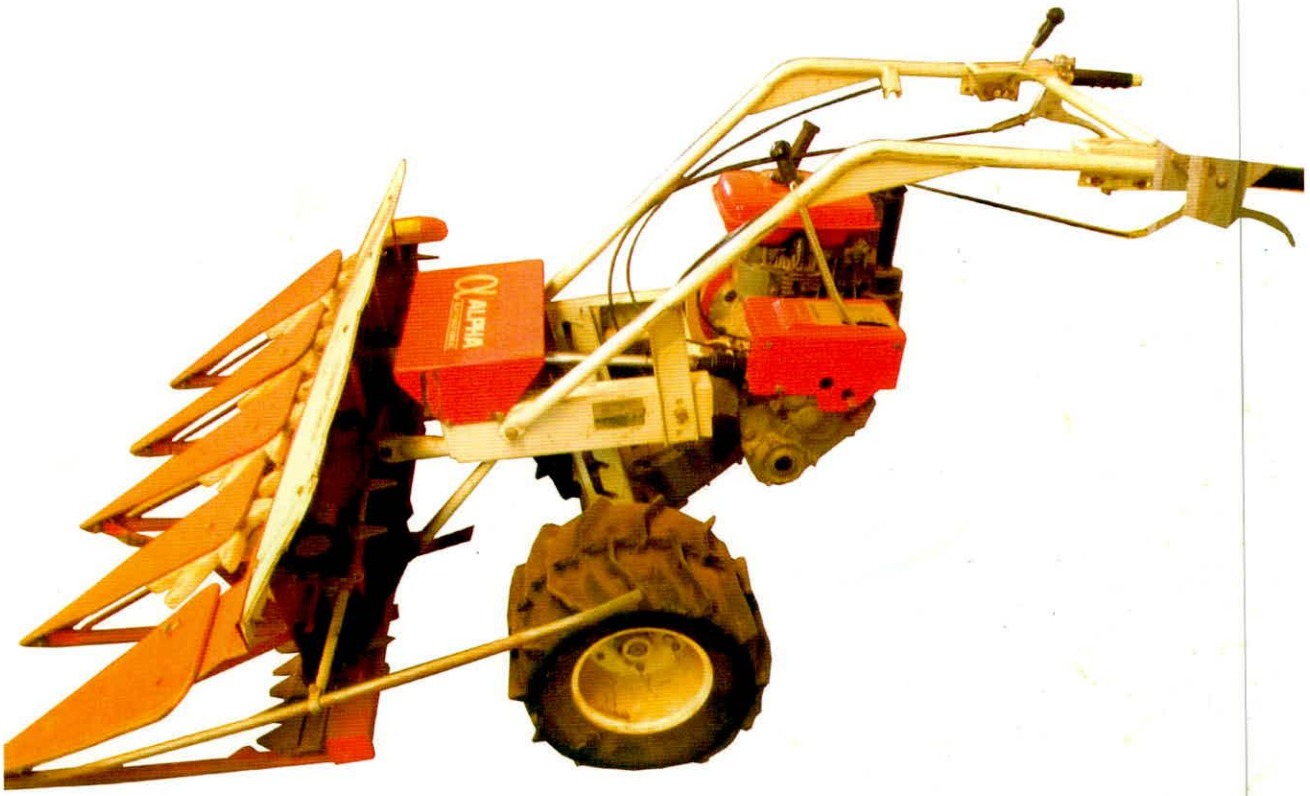


Figure 1.1: Figure 8.1: Parts of a motorised rice harvester.

How A rice harvester works

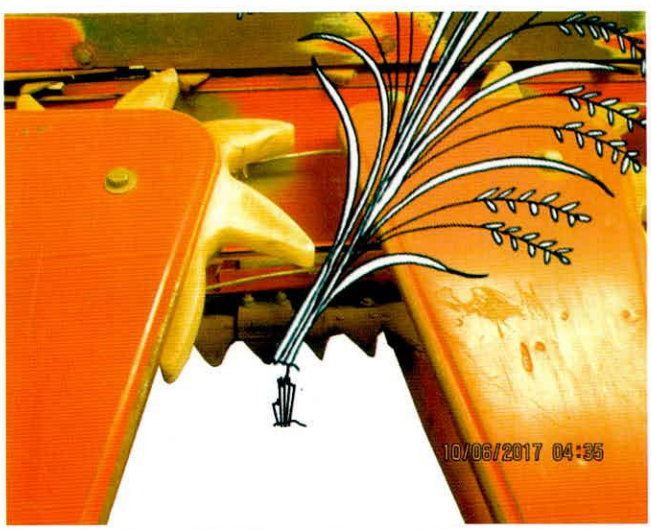




Figure 1.2: Figure 8.2: The machine cuts the rice using its sharp cutting edges as shown in the illustration



Figure 1.3: The harvested rice is rotated to the machine and pilled at the side in a proper line.



Figure 1.4: Then people carry the cut rice to the destination for threshing.

Advantages

- It saves time
- It saves labour
- It works in both low and upland

Limitation

- It may not be cost effective on small scale

9 DRYING RICE

RICE GRAIN DRYERS



Figure 1.1: Namulonge model

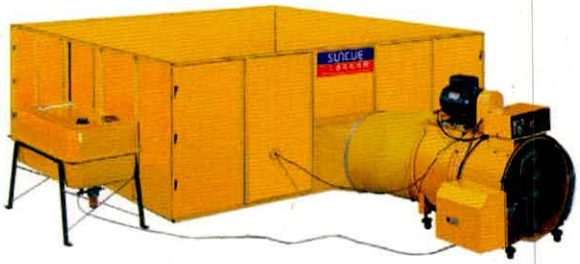


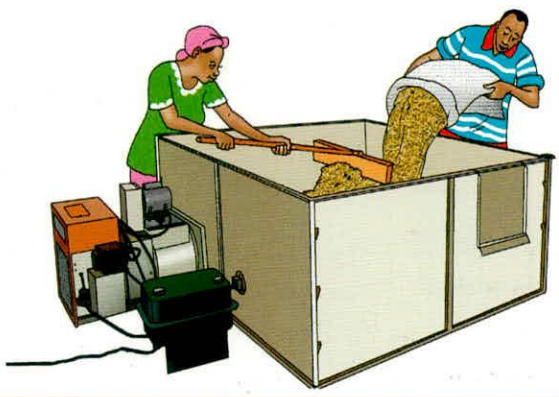
Figure 1.2: Reversible Flatbed Dryer Alim Industries Ltd. BSCIC Industrial Estate, Gotatikor,

Technical Details for a Reversible Flatbed Dryer

Model :	AIL.480E
Engine Output :	1 HP
Fuel :	Kerosene / Diesel
Dimension (L × H × W) mm :	3270 mm × 5281 mm × 1941 mm
Saftey Device :	Air pressure switch
Hot Air Temperature :	Ambient Temperature + 10oc ~ 30° C (Low heat)
Capacity :	500-600 kg (2 Hour) per batch
Fuel Consumed :	3.3 Liter (Per hour)

The Flatbed Dryer is a small capacity batch-in-bin dryer, designed for farm or village use.

How it works

STEPS	ILLUSTRATIONS
Step 1 After winnowing, pour and spread the rice seeds in the drying chamber.	

Step 2

Turn on the machine.

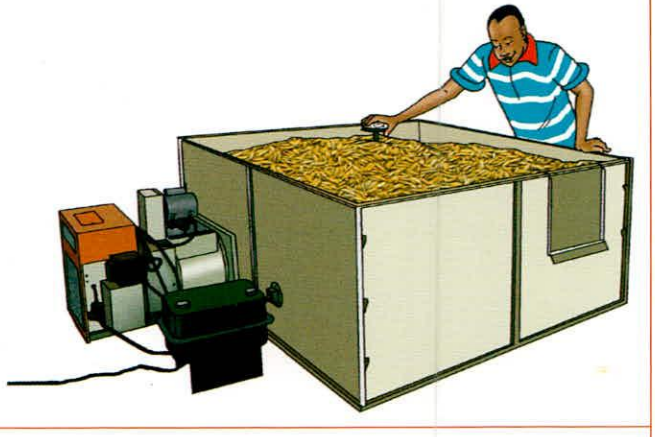
Step 3

Use the spade to turn the rice grains from one side to the other. If the drying chamber is full to capacity (500-600 kg/2hr), turn the grains at an interval of 1 hour.



Step 4

Measure the moisture content to 10/9.9 using a moisture meter.



Step 5

Pack the rice in well protected grain sacks.



Advantages

- It's simple to construct, easily available and easy to operate with unskilled labour.
- Both direct and indirect heaters can be used with the flat-bed dryer.
- It's suitable for all kinds of seeds and foods, such as chili, beans, garlic, coffee bean, cassava, sesame, rapeseed, paddy, wheat, corn, and sunflower seed.

10 THRESHING

A MOTORIZED RICE THRESHER

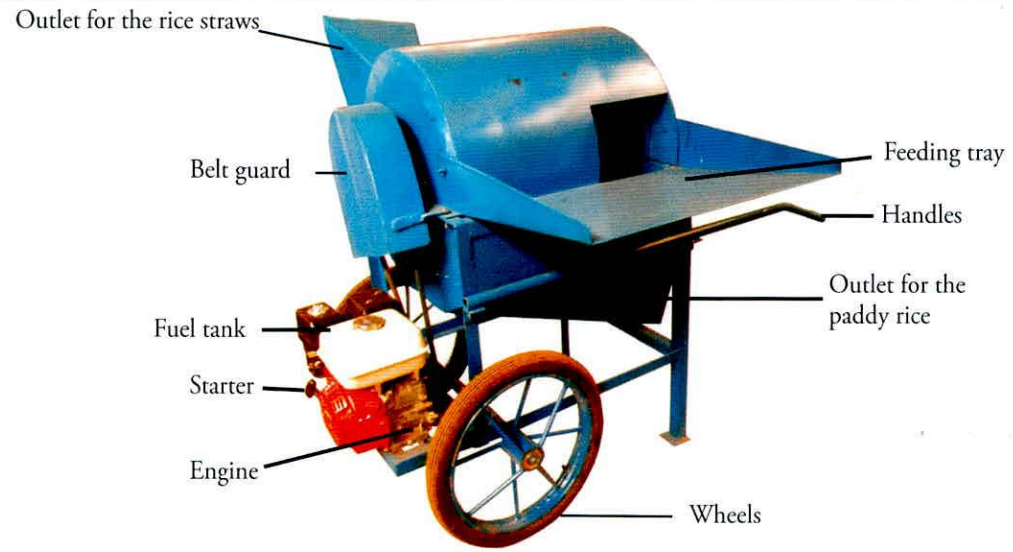


Figure 8.1: Parts of a motorized rice thresher

A thresher is a machine used for removing rice from straws of the rice plant. Its output is 600kg to 700 kg per hour using a litre of fuel (source: Agricultural engineering and appropriate technology research center Namalere - Kawanda)

How a motorized rice thresher works

STEPS	ILLUSTRATIONS
Step 1: Cut and heap the rice in one place	

Step 2:

Position the machine where it is convenient to access the rice for loading.



Step 3:

Start the machine.



Step 4:

Feed the machine.

The machine shall beat its maximum output capacity with 3 people providing labour; one heaping rice, another feeding the machine and the third collecting threshed rice.



Step 5:

Collect the threshed rice from the outlet for paddy rice.



Advantages

- It is motorized
- Wheels make it easy to move the machine from one place to another thus gender sensitive. Even women can carry.
- It is light in weight (80 kg)
- Spare parts are cheap and readily available
- Easy to maintain
- Easy to operate

Limitations

- Does not have a manual alternative in case there is no fuel. However, when the manual alternative was developed between 1999-2000, the following limitations were realized:

  1. Farmers complained of the machine being tiresome. The machines were abandoned and they preferred manual beating

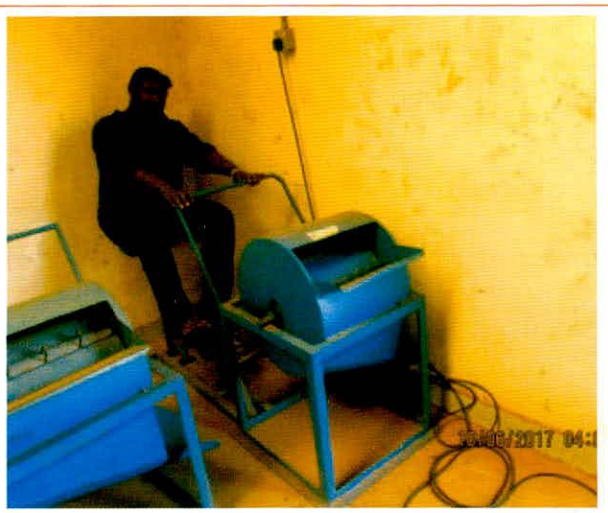




Figure 8.2: The manual versions of a rice thresher

11 MILLING

SEPARATOR, CLEANER AND MILLING/POLISHING RICE MACHINE

This machine separates dust, dirt, stones and other residue from rice. It produces final polished rice.



Figure 8.1: Parts of a 3 phase miller with a separator (Namulonge)

How it works



Figure 8.2: Illustration of a separator

Steps

- Pour the threshed rice with chaff in the feeding hopper of the separator
- The rice grains shall be separated from dirt, dust, stone and other residue
- The fine grains shall be automatically poured into the feeding hopper of the miller
- Collect the polished rice from the finished rice outlet

Advantages

- It can be operated by one person
- Saves labour and time

Limitations

- Uses electricity

COMBINED RICE MILL

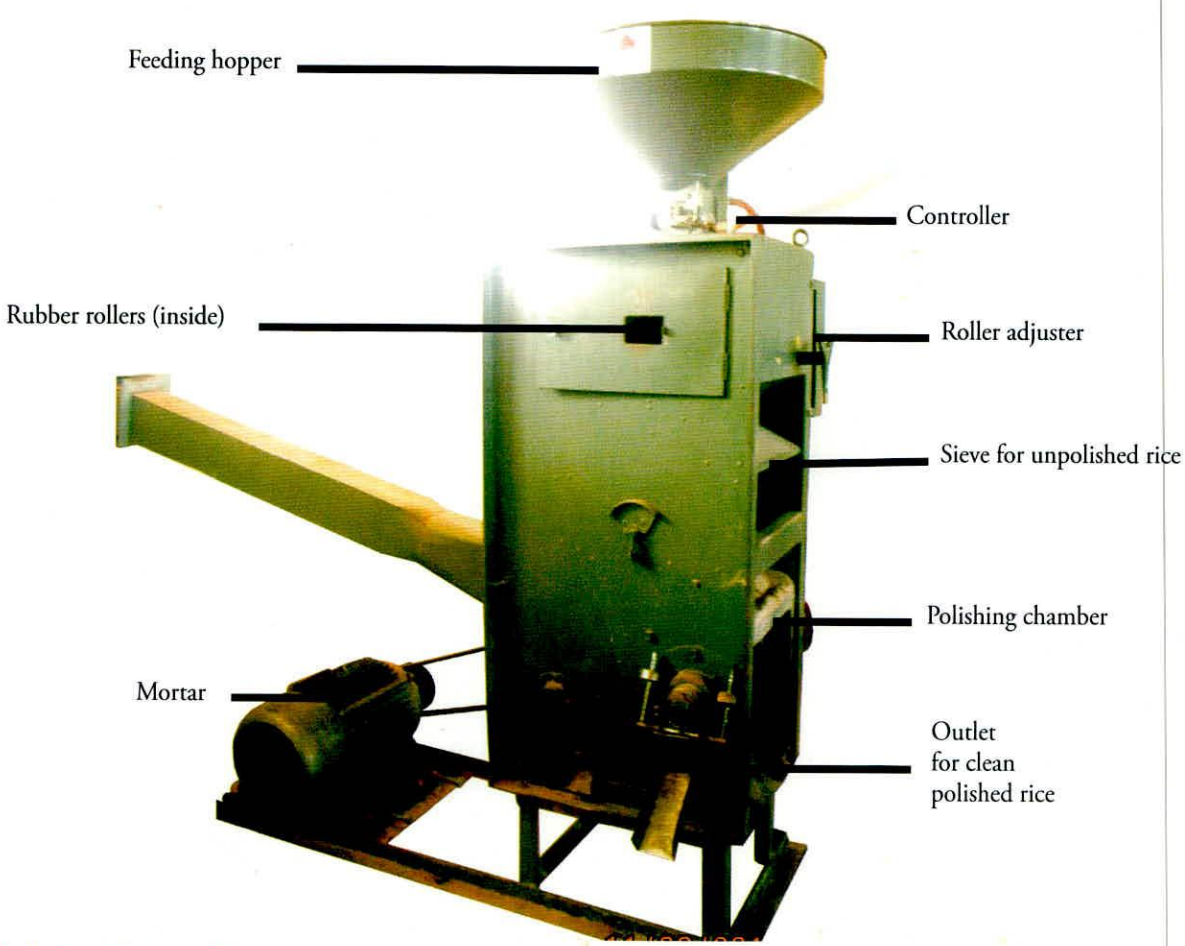
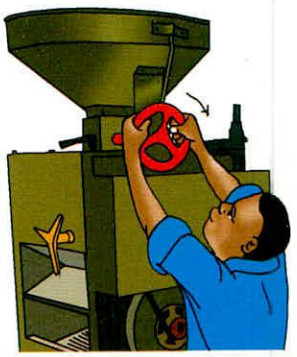
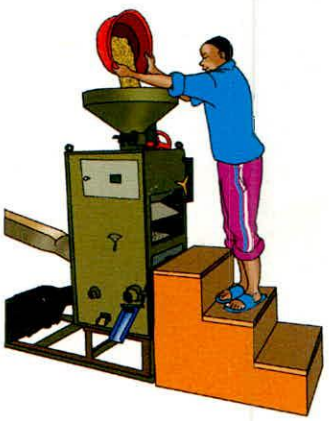
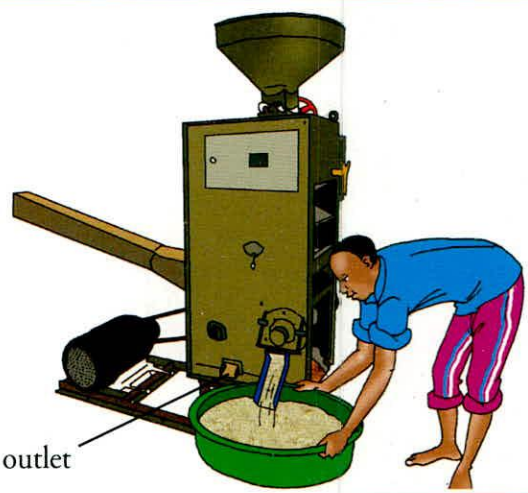


Figure 8.3: A rice milling machine

After cleaning rice from the blower, it is ready for milling. The machine uses rubber rollers to remove husks from the rice grains.

Steps	Illustration
Step 1 Close the controller	
Step 2 Load the blown rice into the feeding hopper.	
Step 3 Open the rubber rollers chamber to monitor the operations of removing husks from the rice grain. Use the roller adjuster to control the rubbers.	
Step 4 Check and collect the polished clean rice from its outlet. Stones are sorted through the stone outlet.	

Advantages

- Combines milling, sieving and polishing of rice in a single phase

Limitations

- No manual alternative in case there is no power.

Overview

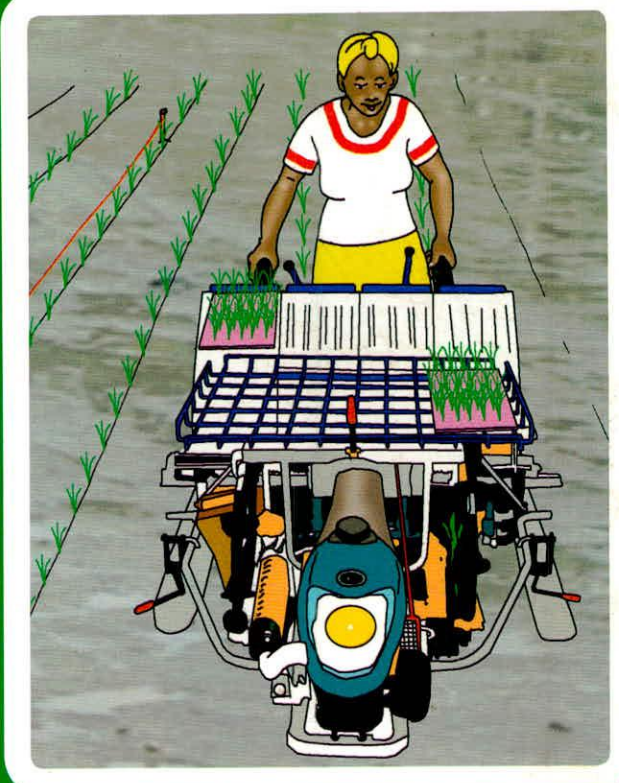
This manual is intended to identify and provide information on Rice Labour Saving Technologies suitable for the farmers.

The technology is well demonstrated using illustrations for simplicity. This document covers both low land and upland rice labour saving technologies under the following subtopics.









Methods of land preparation
Seed preparation for sowing
Nursery bed management
Dry planting for upland and transplanting for low land
Weed Management
Fertilizer application
Harvesting
Drying rice
Threshing
Blowing
Milling



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