



**TBT PROGRAMME**  
OVERCOMING TECHNICAL BARRIERS TO TRADE



# Training Manual

## Good Manufacturing Practices

### Rice production



# Rice – Key issues

- Damage during handling
- Water quality for washing and handling
- Fungal contamination
- Insect and animal infestation
  
- Proper drying
- Pesticide residues
- Chemical and other contaminants

# Rice

Paddy Rice

**NIS XXX:2014 Paddy  
(Rough) Rice -  
Specification**



Milled Rice

**NIS XXXL2014 Milled Rice  
- Specification**



# Paddy Rice - quality

S/N o	Characteristics		Maximum Limits			Test Method
			Grade 1	Grade 2	Grade 3	
1	Purity, %m/m		98	95	95	ISO 605
2	Foreign matter, % m/m	Organic	1.0	1.5	2.0	
		Inorganic	- 0.25	- 0.25	- 0.5	
3	Pest damaged grains, % m/m, max		0.5	0.75	1.0	
4	Discoloured grains, % m/m, max		0.5	2.0	4.0	
5	Moisture, % m/m, max		14.0	14.0	14.0	
6	Immature/shrivelled grains, % m/m		1.0	3.0	5.0	ISO 605

**NOTE** Broken % in brown and milled rice to be used to evaluate the paddy grades.

# Paddy Rice -grading



## GRADING REQUIREMENTS FOR PADDY RICE

GRADE	MAXIMUM LIMITS		
	LONG GRAIN	MEDIUM GRAIN	SHORT GRAIN
	3.4 : 1	2.3-3.3 : 1	2.2or less : 1
	L/W ratio	L/W ratio	L/W ratio
<b>Grade 1</b>	1.0 % Chalky	2.0 % Chalky	2.0 % Chalky
<b>Grade 2</b>	2.0 % Chalky	4.0 % Chalky	4.0 % Chalky
<b>Grade 3</b>	4.0 % Chalky	6.0 % Chalky	6.0 % Chalky

L/W =Length/Width

# Paddy Rice – Contaminants

S/N	Parameter	Limit (ppm max)	Test Method
(1)	Arsenic (As)	0.1	ISO 27085
(2)	Mercury (Hg)	0.1	ISO 6637
(3)	Lead (Pb)	0.2	Codex STAN 193-1995
(4)	Cadmium (Cd)	0.1	ISO 6561-1 or 6561-2

S/No.	Type of micro-organism	Limits	Test method
1	Total aflatoxin (AFB1+AFB2+AFG1 +AFG2)), ppb, max	10	ISO 16050
2	Aflatoxin B1 only, ppb, max	5	
3	Fumonisin, ppm, max	2	AOAC 2001.04
4	Yeasts and moulds, per g max	10 <sup>4</sup>	ISO 21527-2
5	S. aureus per 25 g max	10 <sup>3</sup>	ISO 6888
6	E. coli, per g	Absent	ISO 7251
7	Salmonella, per 25 g	Absent	ISO 6579

# Milled Rice – Grading

S/N o	Characteristics	Maximum Limits			Test Method
		Grade 1	Grade 2	Grade 3	
1	Broken, %	5	15	25	ISO605
2	Other contrasting varieties, %	1	2	3	ISO 605
3	Paddy grains, %	0.3	0.3	0.3	
4	Live weevils in kg	Nil	Nil	Nil	ISO 605
5	Filth, m/m %	0.1	0.1	0.1	
6	Moisture contents, m/m %	14	14	14	ISO 712

# Module 1 : paddy rice harvesting and handling

## Exercise 1: **Harvest rice**

Suggested minimum instructional time: **40 minutes**

### **Learning outcomes**

1.1 Identify the signs of maturity in rice

1.2 Harvest rice

### **Teaching strategy:**

Learning activities for the trainee must include the instructor to:

- Identify and explain the signs and maturity of rice.
- Explain and demonstrate the two methods of harvesting rice and state the advantages and disadvantages of each.

**Assessment condition: Trainee must be given** access to:

- i) information and handouts
- ii) sickles
- iii) mature rice field

### **Assessment criteria:**

1.1.1 Signs of maturity in rice are identified correctly

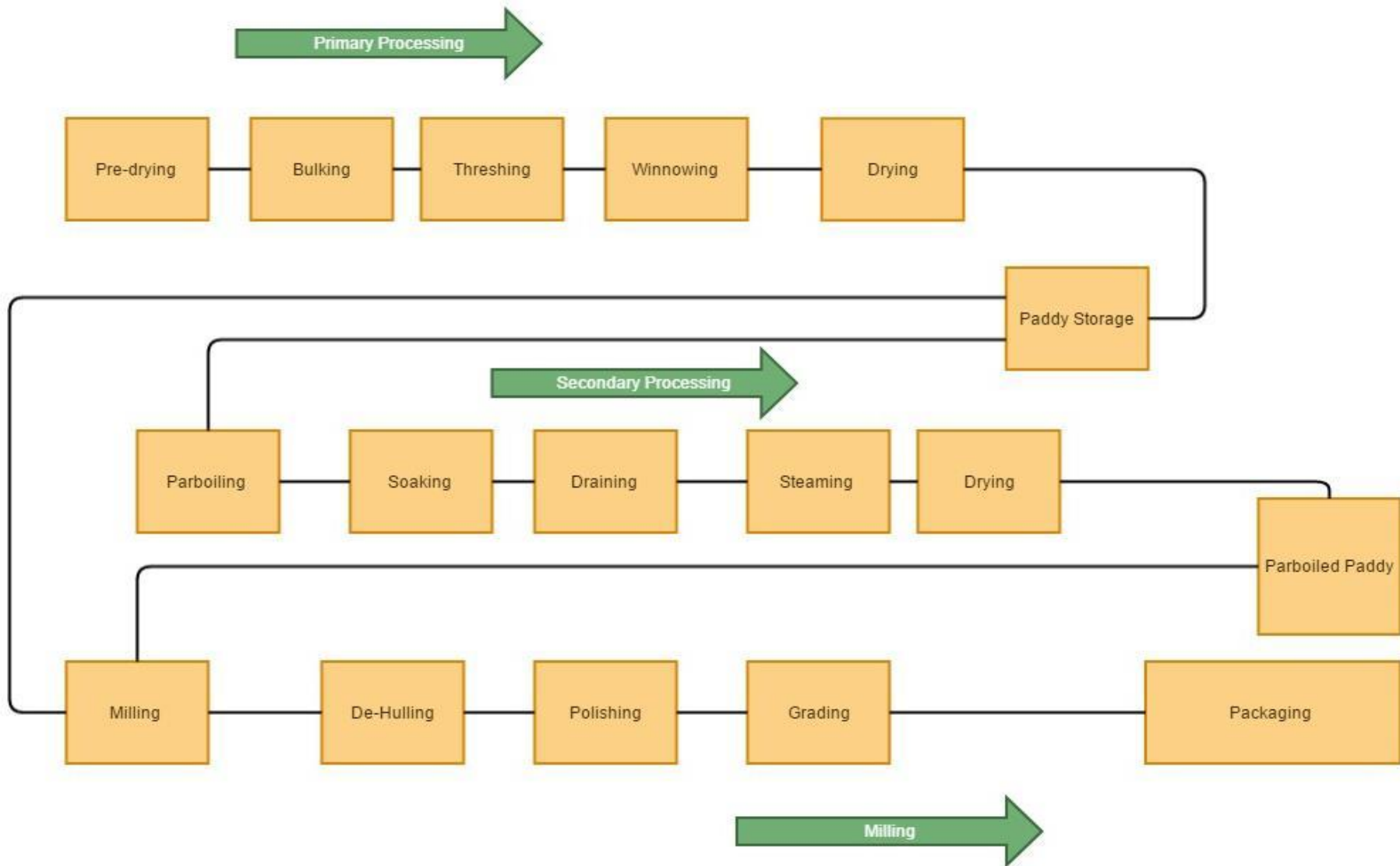
1.1.2 Rice is harvested using the methods specified in the instructional notes of this module.

**Assessment method: To demonstrate** achievement of the above criteria the trainee will be given:

- oral questions
- or written questions
- Practical demonstration



# Rice process flow chart



# INSTRUCTIONAL NOTES FOR Module 1 :

## paddy rice post harvest handling

How do I produce quality rice?

- The right variety should be selected as the differences in varieties planted in certain localities also affect the final milled rice, as the high-value rice market usually prefers a pure and single variety.
- There are wrong practices at the planting stage which can lead to losses: planting of red rice admixture, attacks by rodents and birds, poor weeding and a harvest maturity date which can be too early or too late.
- Correct timing at harvest is essential and should be adhered to in order to avoid losses incurred by harvesting too soon or too late.

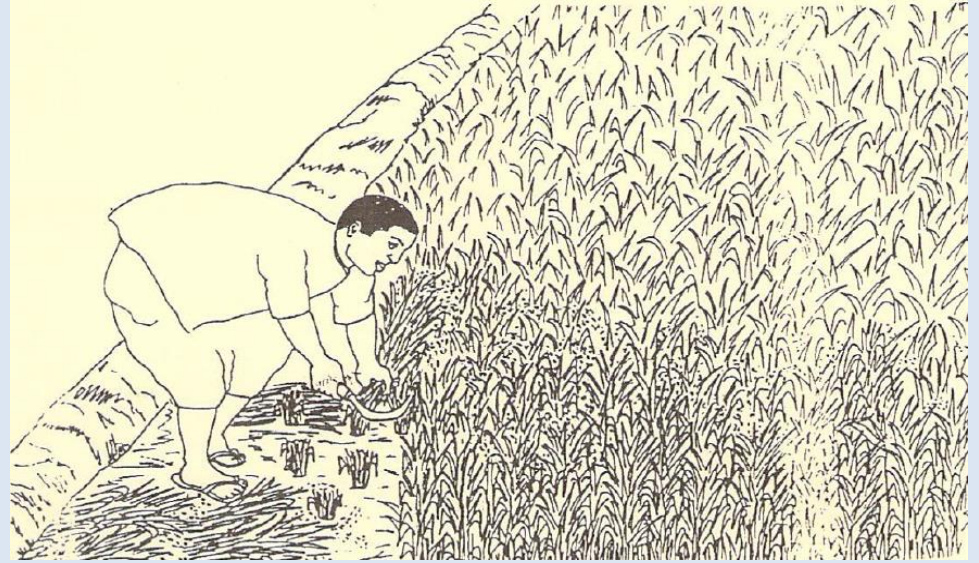
## Harvesting can be done:

- When the rice has reached the exact date of maturity or numbers of days after heading (usually 28-34 days).
- When 80 percent of the grains have changed from green to straw colour. (mainly yellow)
- When at least 20% of the grains at the base have a hard dough stage.
- When the grain moisture content is between 21 and 24%
- When the hand-dehulled grain is clear and hard.

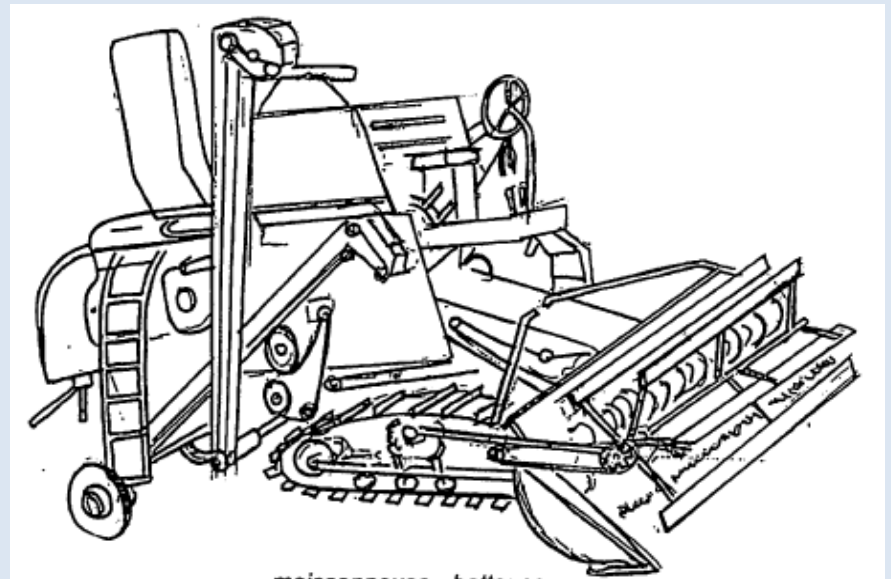


There are three methods of harvesting rice:

- Panicle harvesting
- Sickle or knife harvesting
- Modern mechanical methods



Manual Harvesting



Mechanical Harvesting

## EXERCISE 2: THRESH RICE

### **Teaching strategy:**

Learning activities for the trainee must include the instructor to:

- Explain the purpose of threshing rice
- Identify and demonstrate the steps in threshing rice using a whacking frame.

## EXERCISE 3: DRY RICE

### **Learning outcomes**

3.1 Dry rice to the required moisture content

### **Teaching strategy:**

Learning activities for the trainee must include the instructor to:

- Explain the reasons for drying rice
- Explain the required moisture content of properly dried rice
- Explain and demonstrate the ways for testing dryness of rice



# INSTRUCTIONAL NOTES FOR RICE THRESHING



- Threshing is the post harvest operation of separating the paddy grains from the rice straw.
- If not done properly can result in broken /damaged grains and mixing with other foreign matter including sand, stones and other rice varieties which present challenges for processing.
- Threshing is usually done mechanically but in some areas traditional manual methods are used.



## Manual threshing

Several methods are available, threshing is done

- marching on the straw,
- beating the straw against drums,
- putting the straw in bags and beat it against tree trunks, stones etc
- using sticks to beat rice straw heap.



## Mechanical threshing

**This** can be carried out with use of combine harvesters. In areas where the farm sizes and outputs are small the use of combine harvesters is difficult.

- **EXERCISE 4: Clean rice (winnowing)**

**Teaching strategy:**

Learning activities for the trainee must include the instructor to:

- Explain the reasons for cleaning rice
- Explain and demonstrate the cleaning of rice using wind energy

**EXERCISE 5: STORE RICE**

**Learning outcomes**

5.1 Identify proper storage of rice

**Teaching strategy:**

Learning activities for the trainee must include the instructor to:

- Explain the importance of proper storage of rice
- Explain the features of a good storage facility for storing rice
- Explain how rice should be stored in a storage facility.



# Instructional notes for winnowing

- ❖ This is the process of removing rice straw, sand, small stones weeds, chaff and other extraneous materials from the harvested paddy.
- ❖ Winnowing is an important step for obtaining clean paddy for storage and further processing.
- ❖ It protects the machines from dust, stones etc thereby prolonging its life.

Winnowing could be done by aspiration, manually and mechanically.

Good winnowing practice involves

- ✓ Use of plastic sheets /traditional mats(tarpaulins etc)
- ✓ A clean environment
- ✓ The operator should not re-contaminate the winnowed grains with dust, sand etc.

- With hand operated blowers, the operator winds the machine to generate a centripetal force which separates the grains from the chaff. The grains drop to the bottom while the chaff is blown out through the exhaust
- This machine is used for cleaning of paddy after threshing. Farmers can clean paddy at any time and at any place suitable to him by using this winnower
- Hand operated aspirators for winnowing can be improved upon by adding an engine to increase the winnowing capacity



## MECHANICAL WINNOWING

In mechanical winnowing blowers and cyclones (hand operated and motorised) are available. This has a larger output than the manual winnowing and the problem of recontamination is eliminated.

- Operate the same way as the manual but have increased output. They are however more expensive and are limited in availability. There is also the problem of the cost of fuel, maintenance and spare parts.
- **Recommended Practices in Cleaning** Is to avoid the losses in threshing and winnowing by better mechanical methods.

## Drying

- An important operations necessary for the storage quality of paddy and milled rice in case of raw-milled rice. This is done to reduce the paddy moisture content to between 12% and about 14%.
- High paddy moisture content will encourage the growth of moulds thus affecting the quality of milled rice



# Methods of drying

1. Sun drying
2. Mechanical drying

## Sun drying

- The best drying technique
- Between 70 and 90% of the field harvest retained in the farm is sun-dried.
- Drying usually takes place on paved areas next to the warehouse and rice mills; the paved areas slope slightly so that water can drain away during the rainy season

The main **constraint** of sun-drying is the dependence on good weather conditions.



## **Artificial or mechanical drying**

An artificial or mechanical dryer speeds up the drying process, reduces handling losses, maintains grain quality and gives better control during drying.

### **Constraints of artificial drying**

- » High fuel costs.
  - » It is popular belief that the bleaching effect of sun-dried paddy results in whiter grains than artificially dried paddy.
  - » Lack of capital for investing in artificial dryers.
- Lack of know-how about the drying technology

# Causes of Losses during Drying

Grains shattering from stalks or spilling out from bags during transport.

- Birds and domestic fowl.
- Spill-out outside the drying area.
- Over-drying, especially during sun-drying.
- Delayed drying or no grain aeration, resulting in stack-burning.

## Recommended Temperature of Drying of paddy for seed

- A temperature of 43°C is recommended for drying - this can be achieved with shade drying. Higher temperatures can lead to physicochemical disorders in the grain.
- The temperature for drying paddy should not be higher than 54.4°C for food grain drying in batches. Low temperatures help preserve the rice aroma principle 2-acetyl-1-pyrroline

## Recommended Practices in Drying stage

- Avoid excessive drying, fast drying and rewetting of grains, which causes more broken rice.
- Immediate drying the wet grain after harvest, preferably within 24 hours to avoid heat accumulation.
- Ensure uniform drying to avoid hot and wet spots and mechanical damage due to handling.
- Follow sanitation during drying, milling and after milling to avoid contamination of grains and protect from insects, rodents and birds.



# MODULE: RICE POST HARVEST PROCESSING

## **Learning outcomes**

Identify methods for post harvest processing milling rice

## **Teaching strategy:**

Learning activities for the trainee must include the instructor to:

- Identify the different stages of post harvest processing and their methods
- State the advantages and disadvantages of each method
- Explain and demonstrate the different stages using each method.

**Assessment condition: Trainee must be given** access to:

- i) information and handouts
- ii) mortar and pestle
- iii) rice milling machine
- iv) dried rice

## **Assessment criteria:**

Different methods of processing rice are identified correctly

Milling of rice using each of the methods is demonstrated correctly.

# Instructional notes for module 2: RICE POST HARVEST PROCESSING

## **Parboiling of paddy rice**

- ❖ Parboiling is a procedure in which the paddy is soaked in warm or cold water followed by steaming and drying before milling. This procedure is carried out in some but not all the countries of West Africa. Parboiling has the following advantages:
- ❖ To reduce breakage during milling
- ❖ To improve the nutrient content of the milled rice
- ❖ To change the cooking qualities (taste, appearance aroma texture etc) of the rice.

## **Operations involved in parboiling include**

- I. Cleaning,
- II. Paddy washing,
- III. Soaking,
- IV. Steaming
- V. Draining
- VI. Drying Parboiled rice
- VII. Milling

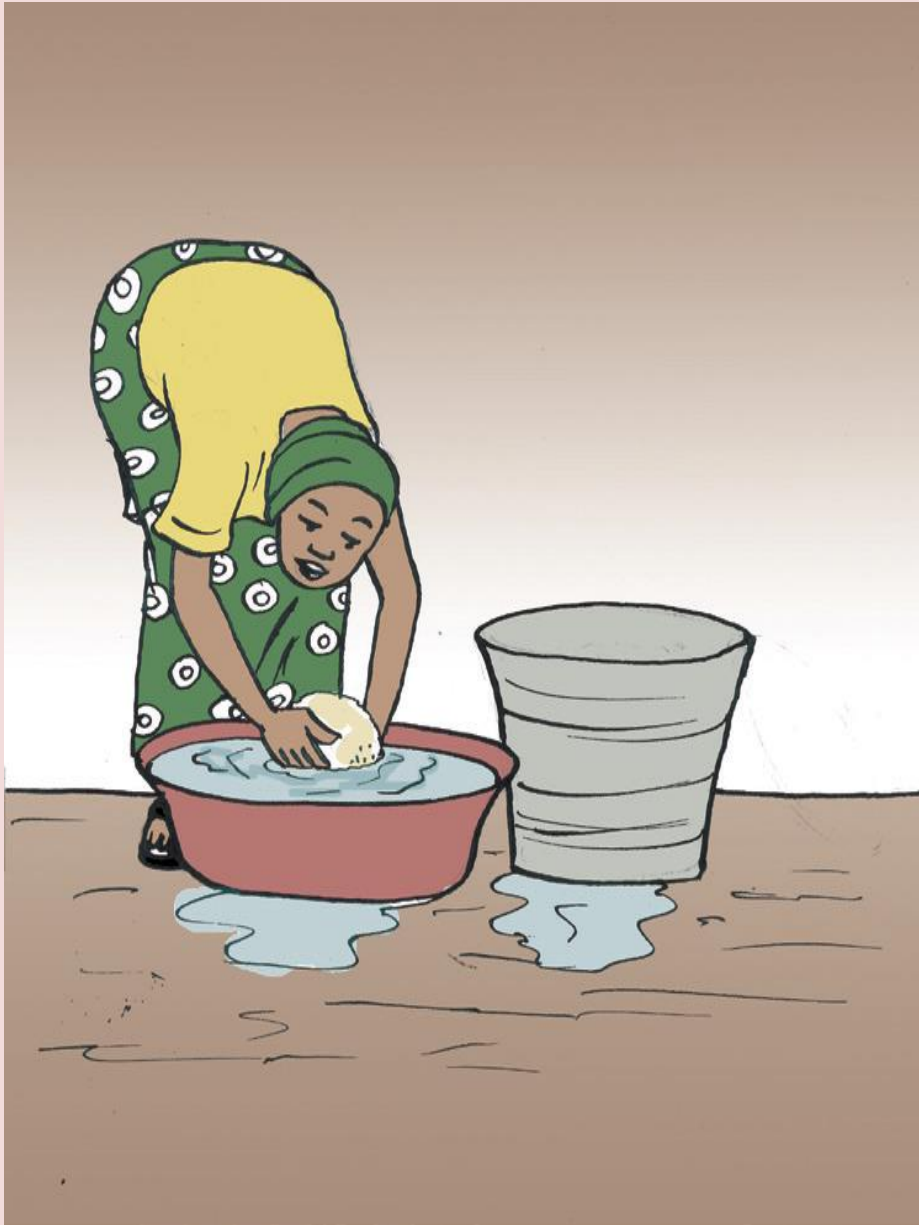
Each of these steps has direct bearing on the quality of the final milled rice.

## **I. CLEANING**

The paddy rice from the warehouse or store must be dry cleaned to remove pieces of straws, stones and other foreign materials before processing.

## **II. WASHING**

- ✓ Wash to remove straw, immature and shrivelled grains, mud and other extraneous contaminants.
- ✓ It gives the paddy the first level of hydration (tempering) necessary for proper steaming.
- ✓ Washing is carried out in spacious open containers (plastic, aluminum, stainless steel etc)



## washing operation

Depending on the quantity of paddy and the vessel, paddy is soaked in water enough to submerge the grains and then rubbed in between the palms. The immature, unfilled grains, straw, etc are floated off. Removal of the immature grains will also avoid discolouration of the milled products and reduce breakages during milling.

❑ The process should be repeated several times depending on the dirt on the paddy. Sand and small stones are removed with the soak water. Washed grains are put in perforated baskets to drain off the water. This operation should last long enough to remove all the wash water.

❑ This washing operation should be done with clean water.

### III. SOAKING

a. Soaking is the full submerging of washed paddy in water and allowing the paddy to fully hydrate. Usually paddy is soaked in cold water and heated to varying temperatures (usually 60 to 90°C) to 30% moisture.

b. The fire is then removed and the paddy should be allowed to soak to 8 hours depending on variety. The soak water is about 90°C, when it is too hot to touch but not boiling.



- c. If it is possible to keep the soak water at a constant temperature of 70°C, the soaking period can be reduced to about 5 hours.
- d. The soaked paddy should be rewashed up to 2-3 times with fresh water and then drained as before.

## IV. STEAMING

This is the major parboiling operation. It is the actual steaming of soaked paddy till full gelatinisation takes place. Optimal gelatinisation may be indicated visually when the husks of a majority of the grain split open.



## V. DRAINING

The parboiled rice should be properly drained after steaming for ease of drying. This is done by pouring in perforated basket to allow steam to evaporate and water to drain off. This process is to aerate the parboiled rice before drying. The process must be quick and not be delayed.





- ✓ Steamed paddy is manually dried by spreading under the sun for about 2 to 3 hours and then placing under the shed to equilibrate the moisture gradient and gradually dry down to 12 to 14 % moisture.
- ✓ However millers are encouraged to have **moisture meters** to effectively ensure that the moisture content comes to about 12 to 14%.

# VII. MILLING



- ❑ Removal of the husk to obtain 'brown rice' and gently polishing off the bran to obtain a whole milled grain.

Basically, milling

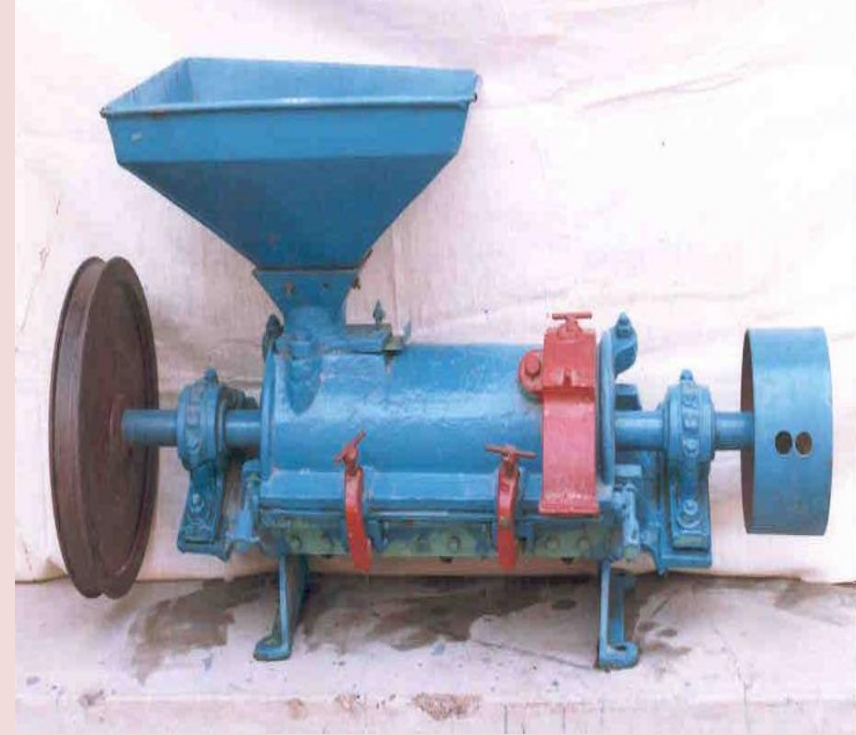
1. Remove the husk
2. Remove the bran layers
3. Produce whole white rice kernels that are
  - sufficiently milled,
  - free of impurities and
  - minimum number of broken kernels.

Milling can be done using traditional methods

- 1) mortar and pestle;
- 2) milling machines.

The stages in milling using a simple milling machine includes

- a) **Pre-cleaning** – this is where rubbish and stones are removed.
- b) **Hulling** – This is where the husk is removed
- c) **Separation** – This is where dust, broken grains, husk and rubbish is removed from the brown or peeled rice.
- d) **Whitening /Polishing** – Removing the bran layer from the brown rice to make it white.



Single pass steel mill

- Steel friction mill
- Very high pressure
- Originated from coffee grinder
- Low white rice recovery ( 50-55%)
- Head rice less than 30%
- Often used for par boiled rice





Two Stage Mill



Multistage Mill

- Super seeded Engleberg (steel) mill
  - Separate hulling and whitening
  - Rubber roller huller
  - Steel friction polisher
  - Capacity 0.5-1t/hr
  - Milling recovery - 60%
1. Pre-cleaning the paddy prior to milling
  2. Removing the husk or outer layer from the paddy
  3. Polishing or whitening the brown rice to remove the bran layer
  4. Separating the broken grains from the whole kernels
  5. Bagging the milled rice
  6. Managing the by-products



# Bagging

- Rice normally sold in 50kg bags
- Accurately weighed

