PADDY RICE: CODE OF PRACTICE FOR THE HARVEST, TRANSPORTATION, HANDLING, DRYING AND STORAGE

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FOREWORD

A complete seed of rice is called paddy (and also referred to as rough rice) and contains one rice kernel. There are two most important cultivated species of paddy namely i) *Oryza sativa* and ii) *Oryza glaberriumn*. There are around 18 wild species of paddy grown in the continents of Asia, Africa and America. While *Oryza sativa* is grown in most parts of the Asian and American continents, *Oryza glaberriumn* is grown only in Africa. Nigeria is the largest producer of rice in West Africa and Paddy rice is, for the most part, grown by small farmers in Nigeria. The proper harvesting, handling and transportation of paddy is essential for obtaining an acceptable rice produce that meets requirements of National and International specifications. There is considerable potential for extending and intensifying rice production in the five rice-growing ecosystems found in Nigeria (plateau, rainfed plains, irrigated plains, lowlands and mangrove). This code would be useful in harnessing these potentials.

The development of this code is to enable the cultivation of globally acceptable and competitive paddy rice as well as, make the country self-sufficient in rice by raising production of paddy rice and increase the cultivation of high-quality paddy rice to encourage Good Agricultural Practices.

The Technical Committee on cereal and cereal products, prepared this Code of Hygienic Practice and in preparing the Code, references were made to relevant International Standards and industry practices, all of which are hereby acknowledged.

1. SCOPE

This Nigerian Code of Practice prescribes the general practices in the processing of paddy s from harvesting, transportation, drying, threshing, cleaning and storage of paddy rice to arrive at rice that is safe and of good quality for desired use (either as seed, feed, raw material or consumption).

2. NORMATIVE REFERENCE

The following references contain provisions applicable to this Nigerian Code of Practice. At the time of publication the editions indicated were valid. These standards and publications are subject to revision and parties using this standard are encouraged to investigate the possibility of applying the recent editions of these references indicated below.

2.1 CAC/RCP 47 Code of hygienic practice for transportation of food in bulk and semi packed food

2.3 CAC/RCP-1 Recommended International Code of Practice – General Principles of Food Hygiene.

2.4 National Agency for Food and Drug Administration and Control (NAFDAC): Guidelines for Food Hygiene Practices.

3 TERMINOLOGIES

3.1 paddy cleaning

Separation of undesirable material, such as weed seeds, straw, chaff, panicle stems, empty grains, inmate and damaged grains, sand, rocks, stone, dust, plastic and even metal and glass particles from rice paddy

3.2 paddy rice

Self-pollinated crop (rice) and botanically belongs to *Oryza sativa L.* or *Oryza glaberriumn* of Gramineae family which has retained its husk after threshing. Paddy rice is also known as rough rice

3.3 rubbing

The application of firm pressure in back and forth motion on the surface of harvested paddy for the purpose of threshing

3.4 threshing

The process in which paddy kernel is detached from the panicle

4 HYGIENE REQUIREMENTS IN PRODUCTION AREA OF PADDY RICE

4.1 Establishment: Design and Facility.

The requirements of Recommended International Code of Practice - General Principles of Food Hygiene, (CAC/RCP 1-1969), shall apply in the design of facilities relevant to paddy operations.

4.2 Equipment and Utensils

4.2.1 Materials

All equipment and utensils used in paddy rice handling areas and which may have contact with paddy rice should be made of material which does not transmit toxic substances, odour or taste, is non –absorbent and is resistant to corrosion. Where necessary, equipment and utensil should be durable and movable or capable of being disassembled to allow for maintenance, cleaning, disinfection, monitoring and for example to facilitate inspection for pest.

5 PADDY HARVESTING OPERATIONS

The quantity and quality of final milled rice depend on the efficiency of farm management, field operations and post-harvest operations.

5.1 Timing of Pre Harvest Operations

The field should be drained at least three days before harvest to reduce muds

Timeliness in postharvest operations should be done to ensure for good resultant produce and quality for the milled rice and byproducts.

5.1.1 Correct timing at harvest is essential and should be adhered to in order to avoid losses incurred by harvesting too soon or too late.

The optimum harvest time should be chosen depending on the variety planted.

In general, the recommended time to harvest is 1 week before the maturity date. Others indicators for optimum harvesting time for rice are as follows:

- 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.
- When at least 20 percent of the grains at the base have a hard dough stage.
- When the grain moisture content is between 21 and 24 percent.
- When the hand-dehulled grain, as indicated by daily tests near the projected harvested date, is clear and hard.

6 HARVESTING AND HANDLING OPERATIONS

Harvesting includes numerous operations, including: cutting the rice stalk; reaping the panicles; laying out the paddy-on-stalk or stacking it to dry; and bundling for transport. Correct harvesting and handling operations can considerably reduce post-production losses and therefore should be practiced.

Harvesting should be done when moisture content is between 21 and 24 percent to minimize shattering losses in the field

6.1 Harvesting methods

Methods used for harvesting of rice shall depend on the variety, lodging, soil conditions and terrains. There are a variety of different methods for rice harvesting of which the following are recommended:

6.1.2 Long stalk cutting by sickle

This is a widely used manual method with different styles in the design of sickles. Reaping efficiency depends on various cultural practices, plant density and variety, degree of lodging, soil conditions and the skill of the harvester, therefore special care should be taken in using the sickle. Lodged paddy and saturated soils may considerably reduce the cutting rate. Draining for three days is recommended if the field is lodged.

6.1.3 Modern mechanical methods

The use of mechanized harvesting are comparatively most effective and the methods depends upon the suitability of the machine and other socio-economic factors. Some of the machines recommended for this purpose include:

6.1.3.1 Reaper binder: The machine cuts and bundles stems together and lays them in the field in a single operation. However, this is not recommended for water lodged fields and shattering variety

6.1.3.2 Combine: These are very popular. In commercial rice production, large combines are used. The combine with pickers is recommended for use in lodged rice fields.

6.1.3.3 Stripper harvester: an innovation from International Rice Research Institute (IRRI) it works with varieties which are non-lodging, medium height, with erect panicles and low to medium shattering.

7 TRANSPORT PRACTICES

The transportation of paddy should be done in line with Code of hygienic practice for transportation of food in bulk and semi packed food (CAC/RCP 47-2007). Some methods used in the transportation of paddy are:

7.1 Traditional for Transport

Traditional transportation of paddy from the field to processing areas is performed mainly by humans and animals(beast of burden) and sometimes using mechanical power.

7.2 Mechanized procedure for Transport

The paddy harvested by combine harvest method are handled and transported in bulk. The paddy is unloaded from the combine by an auger conveyor and loaded into a waiting lorry or tractor-trailer located on the field road (part of the infrastructure for mechanized rice production). The paddy is then unloaded from the lorry or trailer onto a floor hopper in the rice mill area to be conveyed for further processing. Finally, commercial rice is bagged at the rice mill and normally transported to wholesale and retail markets by means of vehicles. This mechanized procedure results in much lower losses.

For whichever mode of transport adopted, it should abide with the Code of hygienic practice for transportation of food in bulk and semi packed food (CAC/RCP 47-2007) and National Agency for Food and Drug Administration and Control (NAFDAC): Guidelines for Food Hygiene Practices (2004) as referenced in section two of this code.

8 THRESHING

Threshing is an operation which can be carried out either by “rubbing”, “impact” or “stripping”. Threshing can be done using methods detailed in 8.1 and 8.2 below depending on suitability. However Mechanical Threshing is most effective and therefore recommended.

8.1.1 Manual threshing

Manual threshing is pedal-operated and involves: treading; beating the panicles on a tub, drums, threshing board or rack; or beating the panicles with a stick or flail device. A thresher consisting of a rotating drum with wire loops which strip the grain from the panicle when the paddy is fed by hand. This equipment is portable, can be used in hilly areas. This code does not recommend this practice as it does not guarantee optimum output.

8.1.2 Power/Mechanical threshing

Power/Mechanical threshing adopts mainly the impact principle, but there is also a built-in stripping action, the harvested crop is trampled.

8.2.1 Modes of Loss incurable during Threshing

Losses may occur during threshing for various reasons and special care should be taken in the following processes where gain losses could occur:

8.2.2 In manual threshing by beating, some grains remain in the bundle panicles and a repeat threshing is recommended in this situation.

8.2.3 When the bundles are lifted just before threshing grains could scatter, therefore threshing area should be designed to contain scattering

8.2.4 Grain can stick in the mud floor and therefore

8.2.5 Birds and domestic fowls feeding on the grain when not properly managed, therefore measures should be put in place to eliminate such.

9 DRYING AND OTHER HANDLING PROCESSES

The following factors affect The rate at which Paddy (being a living biological material)absorbs and gives off moisture depending on:

- paddy moisture content,
- relative humidity of the air and
- temperature of the surrounding atmosphere.
- In crops of high-yielding varieties it is necessary to dry large quantities of wet grain in the shortest time so as to minimize rice spoilage.

Paddy is usually harvested with moisture content of 24 to 26 percent (higher in the rainy season and lower in the dry season). Good drying is crucial for minimizing post-harvest losses, since it directly affects safe storage, transportation, distribution and processing quality

9.1 Drying Method

The following should be considered as factors in choice of drying method or system

- drying capacity requirement,
- ease of installation and operation,
- portability,
- full heat source and
- the initial cost of purchase.

A wide range of drying equipment and methods are available for rough rice, and computer models have been developed to assist agricultural research workers or farmers in their selection of dryers for a given crop and situation which include:

9.1.1 Sun or Solar Drying

The cheapest drying method is sun- or solar drying, practiced by farmers, cooperatives, commercial millers and government grain agencies. It is recommended that in operating Solar drying, use of clean and hygienic tarpaulins or any other medium to control the risks of

contamination be used. Adequate monitoring and attention should be given to the grains dried to protect grains from adverse weather conditions such as rain, sand storm and so on.

9.1.2 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. Persons operating the dryer should possess relevant know-how about the drying technology

9.2 Causes of Losses during Drying

The main causes of losses during drying which should be carefully maneuvered to reduce loss are as follows:

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

9.3 Recommended Temperature of Drying of paddy for seed

9.3.1 A temperature of 43°C is recommended for drying paddy for seeds and this can be achieved with shade drying. Higher temperatures can lead to physicochemical disorders in the grain.
9.3.2 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

9.4 Recommended Practices in Drying stage

9.4.1 Avoid excessive drying, fast drying and rewetting of grains, which causes more broken rice.
9.4.2 Immediate drying of the wet grain after harvest, preferably within 24 hours is recommended to avoid heat accumulation.
9.4.3 Uniform drying should be done to avoid hot and wet spots and mechanical damage due to handling.
9.4.4 Proper Hygiene and Sanitary practices should be followed during drying, to avoid contamination of grains and protect from insects, rodents and birds.

9.5 Paddy cleaning

This is an important operation and highly recommended on a large, medium, commercial and small scale paddy processing. The degree of cleanness of the paddy reflects to some extent the care applied during harvesting, threshing and handling.

9.5.1 Traditional Paddy Cleaning

It is recommended that farmers clean paddy immediately after manual threshing. hand-raking and sifting to remove straw, chaff and other large and dense materials is done before winnowing. In this process, the grains that fall during winnowing should be collected on a clean surface such as tarpaulin or a nylon sheet.

9.5.2 Semi-Mechanized Paddy Cleaning

A hand- or pedal-operated blower may be used and should be done in hygienic environment and conditions..

9.5.3 Mechanized Paddy Cleaning

An engine-powered fan is used and can simultaneously perform both operations: grading and cleaning. The mechanized cleaning is to be used in obtaining most optimal results.

9.6 Recommended Practices in Cleaning

9.6.1 Avoid the losses in threshing and winnowing by better mechanical methods.
9.6.2 Use proper technique of processing i.e. cleaning, parboiling and milling.
9.6.3 Adopt the grading practices to get more profit and to avoid the economic losses

10 STORAGE

Paddy may be produced once a year or throughout the year. For increased yield, it is recommended to improve and expand the post-harvest infrastructure for better handling, processing and storage of the paddy. Storage is a critical operation and losses can easily occur if preventive measures are not taken.

Appropriate storage is therefore required, both for rice for consumption and for rice for seed purposes.

The storage structure must protect the paddy from:

10.1.1 Extreme heat or cold;

10.1.2 Moisture, which causes microbial and fungal growth; and

10.1.3 Insect pests and rodents which consume or damage the rice.

10.2 Recommended Storage vessel ~~for small scale farmers~~

Small metallic silos with a have been successfully used by small rice farmers and is therefore recommended.

Other storage meachnisams can be considered but~~The traditional storage structure is a container made of woven bamboo, palm leaves or wood. But t~~The following are factors that affect the paady storage occurring in this system include: spoilage due to high grain moisture, rain, storms or flooding; dirt contamination; losses due to insects, rodents and even theft; collapse of the structure.

Common practice of storing in Woven polythene bags

Hermatic storage solutions are being used successfully on larger scale storage operations and development of technology in this area is encourage for larger scale operations and aggregation operations.

10.3 The main causes of losses in paddy during storage are:

10.3.1 Attack by insects, rodents and birds which should be prevented by provision of inadequate protection.

10.3.2 Long-term storage with 14 percent or higher moisture content, or more than 2 weeks' storage at 18 percent moisture.

10.3.3 Theft and pilferage in the warehouse.

10.3.4

~~10.3.3~~10.3.5 Security and other measures to protect grains should be put in place

10.4 Paddy Requirements before storage

10.4.1 The paddy retained for storage should be sun-dried several times and cleaned before loading into the storage container.

10.4.2 The farmer or processor shall determine the dryness required for storage on the basis of experience. Dryness is measured by pressing a bunch of grains hard into the hand: a fully dried grain is hard.

10.4.3 Paddy is recommended for storage at a moisture content of 14 percent or less.

10.5 Paddy is normally stored in a 1-tonne-capacity container for 6 to 12 months.

10.6 Recommended Storage and Transportation Practice in paddy rice

10.6.1 Use efficient and good packaging for storage, as well as in transportation.

10.6.2 Use proper scientific technique in storage for maintaining optimum moisture content i.e. 12 percent for longer period and 14 percent for shorter storage period.

10.6.3 Use pest control measures (fumigation) before storage.

10.6.4 Provide aeration to stored grain and stir grain bulk occasionally.

10.6.5 Move stocks in sacks to discourage pest incidence and their multiplication.

10.6.6 Proper handling (loading and unloading) of paddy/rice with good transportation facilitates helps in reduction in losses at farm and market level

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