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Review Article

Investigation on Local Rice Processing, Packaging and Storage among Farmers in Some South Eastern Nigeria

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Abstract *- Improvement of local rice processing, packaging and storage among farmers in some southeastern Nigeria was carried out, and a survey was made involving the use of questionnaires and personal interviews during the field trips. The major objective was to identify the strategies to be adopted for improving the processing, packaging and storage of rice production in Enugu, Anambra and Ebonyi States of Nigeria. The author was able to issue 90 questionnaires to the owner and staff of the rice farm randomly, 90 questionnaires were recovered, and 10 rice farms were visited in each state. The investigation survey was carried out by rice processors and packagers, including the preservers that came to purchase from them. The survey results showed that 84.4%, 66.7 % and 50 % of respondents reported rice spoilage on the packaging, storage and variation in milling moisture content. The majority of the rice farmers knew nothing about moisture content and modern means of threshing, drying, parboiling, polishing, whitening and destoning of rice as adopted by farmers. The author also found out that most farmers do not store rice in a confined constructed structure. For that reason, stored rice get damaged by pest, rodent and microorganism easily. Therefore, to avoid spoilage and wastage in rice production and establish safe moisture content for harvesting, milling, and storage of rice should be adhered to. The modern machines used in the unit operation of rice production should subside to improve the working conditions, minimize waste, and increase the production and processing of rice for these individual farmers. The author recommended that the southeast should adopt modern methods of rice production, processing and storage to enhance the quality and quantity of rice and also requested government, non-governmental organizations (NGOs), and private investors to assist rice farmers.*

Keywords *- Investigation, Local rice, Processing, Packaging, Storage.*

I. Introduction

Rice (Oryza sativa) is a main source of nourishment for over half of the world's population. Rice is by far one of the most important commercial food crops, and its annual yield worldwide is approximately 700 million tons. At least one hundred and fourteen countries produce rice, with China and India supporting 50% of total production [11]

During the last two decades, rice has moved from a ceremonial to a staple food in many countries, including Nigeria. Statistics from the United State Department of Agriculture, USDA [12] indicate that Nigeria is by far the largest rice importer in West Africa, with an average yearly import of 2.2 million tons of milled rice while annual consumption per capita stands at 32kg, and this has continued to rise, induced by income growth.

According to United States Agency and international development (USAID), presently, Nigeria's rice sub-sector is dominated by weak and inefficient producer market linkage due to poor infrastructure, including a lack of improved processing facilities, low rice productivity, and poor post-harvesting and storage. Expensive and poor access to input (high-quality seed fertilizer and crop protection products), inadequate market information, low capacity to meet quality standards and limited efficiency of distribution networks.

Farmers at these locations perceived ecological factors as the main constraint to production [1]. Fluctuating rainfall patterns are one main ecological factor pointed, improved seed, agrichemical processing machines, lack of access to vital inputs at an affordable price, microcredit, placing less emphasis on dry season irrigation, rice processing machines such as designer, husk remover, paddy separation, whitening or polishing processing machine, rice milling, equipment used and the skill of the mill operator are unavailable to Anambra, Enugu and Enonyi [1].

Harvesting is considered the first step in paddy processing and is a critical operation in deciding the overall

rice quality. In some Southeastern Nigeria, Paddy harvesting is performed mainly manually using hand-cutting tools such as sickles, knives, scythes, and cutters. Almost all of the rice is harvested using combined harvesters in developed countries.

Harvesting timing and method are two critical factors dictating the problem during harvesting operations. A large amount of losses occurs before or during the harvesting operations if it is not performed at adequate paddy maturity and moisture content. Too early rice harvesting at high moisture content increases the drying cost, making it susceptible to mould growth insect infestation and resulting in a high amount of broken grains and low milling yields [8]. However, leaving the matured rice un-harvested results in high shattering losses, exposure to bird and rodents attack, and losses due to natural calamities (rain, hailstorms etc. [2]. According to a study conducted in some South Eastern Nigeria, due to high scattering losses, the paddy harvesting losses were found to increase by about 67% (2.5% from 1.5%) by delay in harvesting [8]. Another post-harvest loss study in India estimated a 10.3% increase (1.74% to 1.92%) in paddy harvesting losses due to delayed harvesting because of a lack of adequate harvesting equipment [7].

In Southeastern Nigeria, threshing is usually done manually, even though mechanical threshing is used at large irrigated fields. Farms have limited the use of combine harvesters, and mixed verifies cropped on the same land. Farmers mainly threshed by beating the harvested straw with a wooden stick or against metal drums or cemented vessels, tree trunks, stones etc. After the threshing, the cleaning process is performed to separate whole grains from broken grains and other foreign materials, such as straw, stones, sand, chaff, and weed seed. Winnowing is the most common method used for cleaning in developing countries. Screening/sifting is another common method of cleaning, which can be performed either manually or mechanically. Inadequately cleaned grains can increase insect infestation and mould growth during storage, add unwanted taste and colour, and damage the processing equipment. A large amount of rice is lost as spillage during this operation, and rice losses during winnowing can be as high as 4% of the total production [10].

Unlike in most parts of the world, about 90% - 95% of harvested paddy rice in Nigeria is processed into parboiled milled rice before marketing. Parboiling is a hydrothermal treatment given to paddy where it is first soaked in hot water and steamed before drying and milling [4]. In Southeastern Nigeria, the traditional parboiling process involves a lot of drudgeries and the use of large quantities of water and fuel, wood obtained from the forest and the production of poor-quality milled rice [3]. The practice is not economically and environmentally sustainable [13]; parboiling in the traditional method entails the soaking of paddy in cold water for 2 to 5 days in a large clay or aluminium pot or steel drums and continuing heating the content to just below the boiling point of water with the container covered with jute sack to conserve heat during the parboiling process periodically, the paddy is inspected until the splitting of the paddy when the heating is discontinued. The parboiling rice is then evacuated and spread out on a mat or along with the highways for sum drying [5]

Rice storage facilities take many forms depending on the quantity of grain to be stored, the purpose of storage, and the store's location. In general, it was recommended that rice for food purposes be stored in paddy form rather than milled rice, as the husk provides some protection against insects and helps prevent quality deterioration. However, when rice is stored as brown rice, 20% less storage capacity is needed [9]. Grain is maintained at 14% or less moisture levels, and seed is stored at 12% or less. Grain is protected from insects, rodents and birds, and the grain is protected from re-wetting by rain or imbibing moisture from the surrounding air. The longer the grain needs to be stored, the lower the required moisture content will need to be. Grain and seed stored at moisture contents above 14% may experience the growth of moulds, rapid loss of viability and a reduction in eating quality [14].

The problem facing rice production in Southeastern Nigeria in the processing, packaging and storage are numerous, and most of the farmers use a prevailing method of threshing with a stick which causes the breakage of rice husks. There is an uneven circulation of heat during the parboiling of rice due to the local and timid way of handling it. There is no adequate drying of rice because of the local farmers' uneven or cultural method of drying. A lot of breakages were observed from the rice milling site due to this uneven drying before milling. The study is to identify the strategies to be adopted for improving the processing, packaging and storage of rice production in some of Southeastern Nigeria. The specific objectives are to suggest to the farmers the modern way or means of harvesting, threshing, parboiling, polishing, whitening and destoning of paddy rice and suggest to the farmer the best way to handle and store packaged rice.

2. Materials and Methods

This study was conducted in southeastern Nigeria, which includes Enugu, Anambra and Ebonyi States. These zones comprise a land area of approximately 18,399km, and the vegetation of the area is a mixture of savanna and tropical rainforest with an average annual rainfall of 2500mm [6]. These states harbour small- and large-scale farmers that process, package & store rice.

2.1. Study Area and Data Gathering Description

The study was conducted in some of Southeastern Nigeria, the country's major rice-producing states. Rice

production is much favoured in this Eastern part of the country as a result of the naturally fertile land of the flood plains of the river stretched from the cross-river (which marks the border of Cross River state). The vegetative cover in Ebonyi is a thick forest. There exists in the study area an intermingling of silt loam at the surface and clay in the subsoil, and Enugu is a tropical rainforest. There exists in the study area an intermingling of sandy clay at the surface. All the aforementioned, allied with good climate conditions and farmers' experience, have combined to place Ebony and Enugu state in a very much competitive position and advantage in rice production with other rice-producing states in the country.

2.2. Method of Data Collection

The data collection method includes direct visits to the rice farmers, rice processors and preservers, a rice field reconnaissance survey, personal observation and structured questionnaires.

The author was able to issue ninety (90) questionnaires to ninety (90) rice farmers and processors randomly in each state visited. Southeastern Nigeria comprises five states, including Enugu, Ebonyi, Anambra, Imo and Abia states, but Enugu, Ebonyi, and Anambra were covered in the study.

2.3. Design of Study Questionnaire

The Questionnaire was designed in such a way as to provide information already outlined in chapter one under the objectives of the study. The study was designed on the basis of investigating the survey research approach (ISRA). The investigative survey research approach for obtaining the data of the work entails the schedule of the visit to places of interest but is relevant to the research work. The task to be accomplished during such a visit include the following;

- Physical visit to places where rice processing, packaging and storage are done.
- Administration and collection of Questionnaires on how they harvest, process, package and store rice.
- Interviews with the rice processing farmers on the problem encountered on the cause of processing rice

2.4. Questionnaire Administration and Problems Encountered

The administration of the Questionnaire to respondents took almost 3 months. The Questionnaire was not to be filed by any farmer except those growing, processing, packaging and storing rice in large quantities. This made the administration a little bit difficult because most rice processors were peasant farmers. The administration of the Questionnaire was undertaken by myself and 4 other students of ESUT.

During the administration of the Questionnaire, the author encountered some problems, which included inadequate responses from the farmers and problems accessing those farmers in rural areas that grow and process rice in large quantities.

3. Data Presentations and Analysis

The investigative survey conducted by the author was carried out by different rice farmers in some of Southeastern Nigeria. The figures and tables below show the data obtained from the questionnaires issued, physical observation and oral interviews with the rice farmers and other relevant staff.

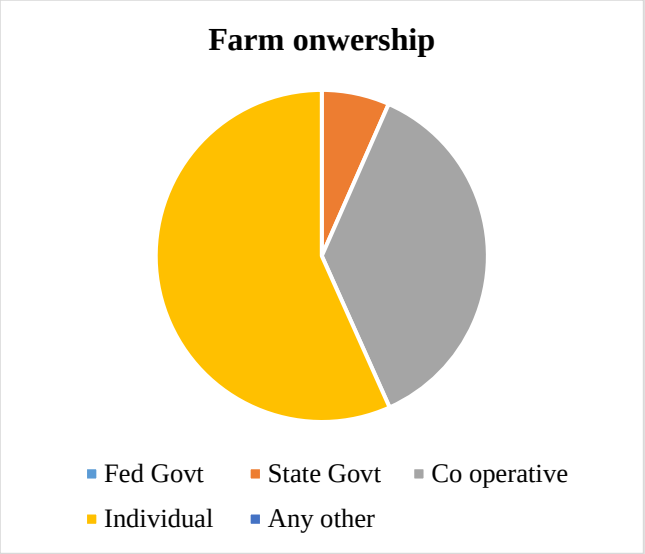

Fig. 1 Representation of ownership of the farm

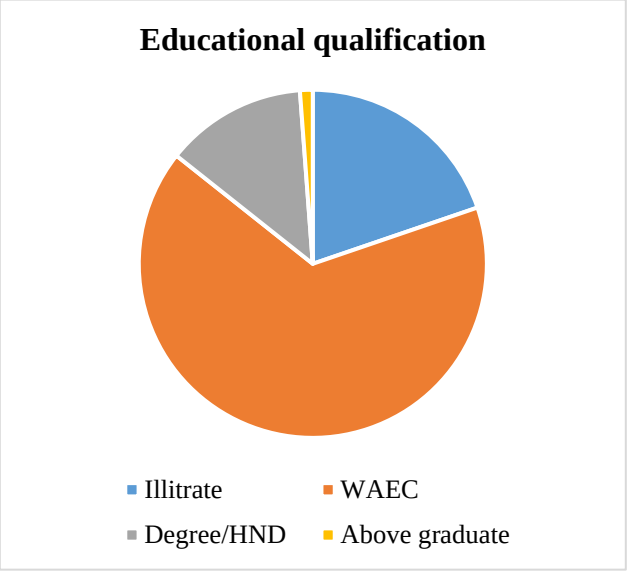

Fig. 2 Representation of educational qualification of the respondents

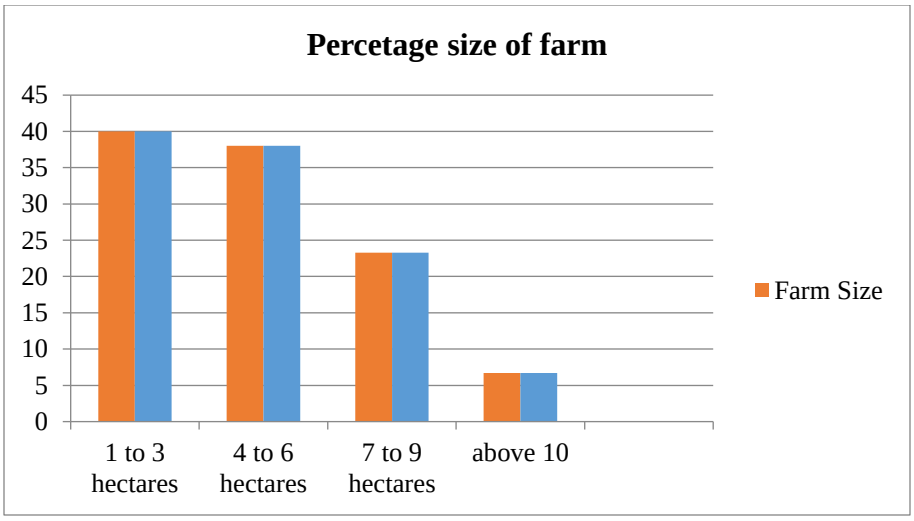

Fig. 3 Representation of percentage size of farm

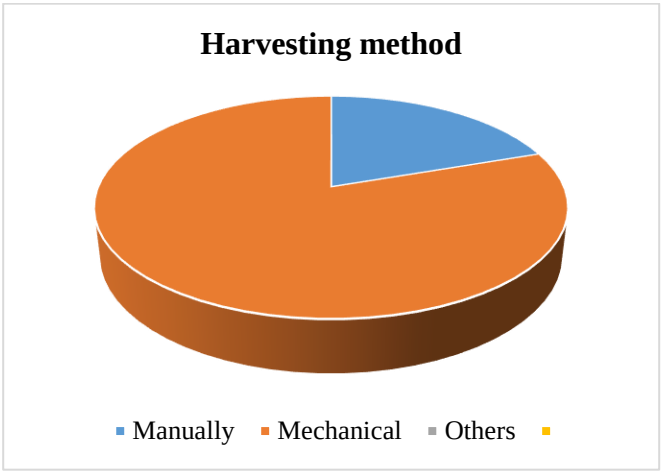

Fig. 4 Representation of the method of harvesting mostly used

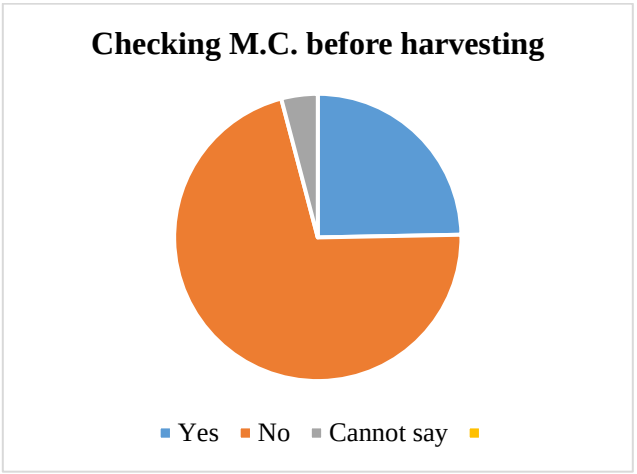

Fig. 6 Pie chart representing the knowledge of moisture content

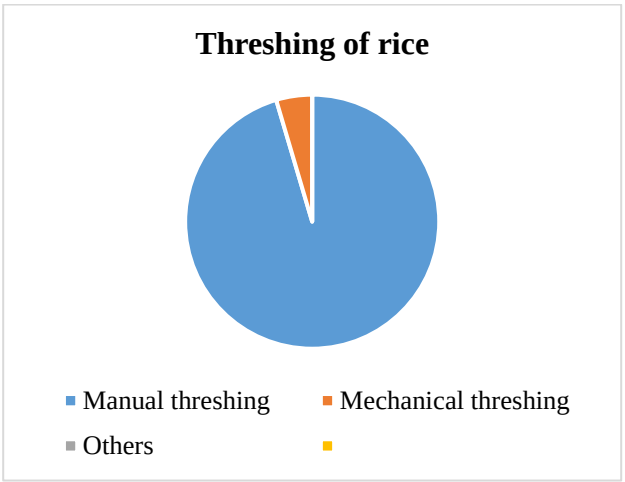

Fig. 5 Pie chart representing the rice threshing method

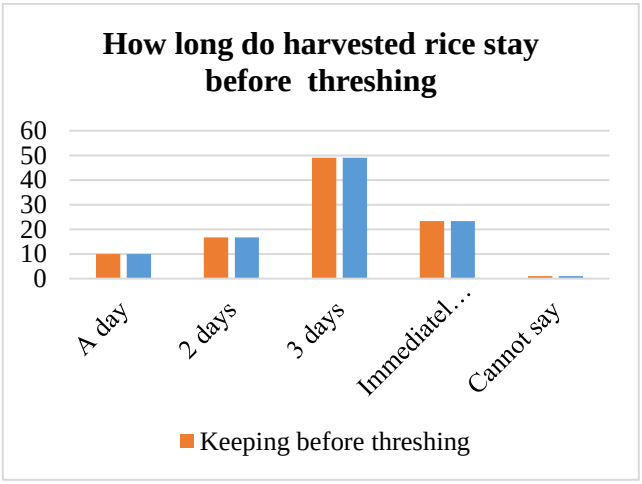

Fig. 7 Bar chart representing how long harvested rice stays before threshing

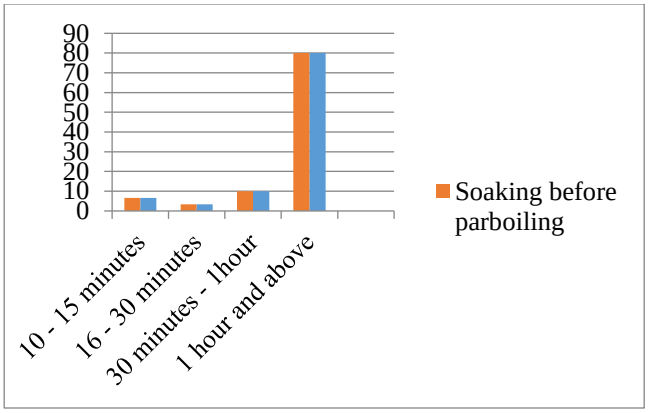

Fig. 8 Soaking of threshed rice before parboiling

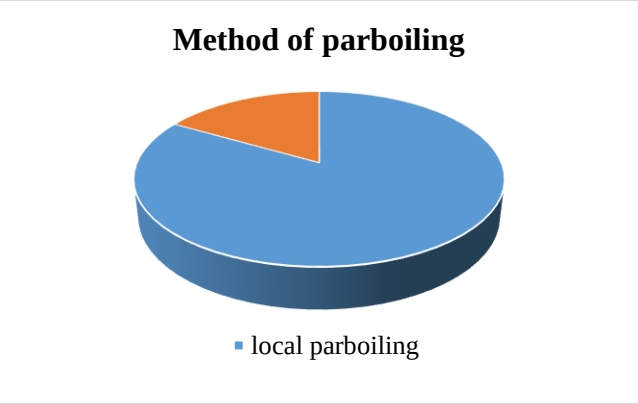

Fig. 9 Parboiling of paddy rice

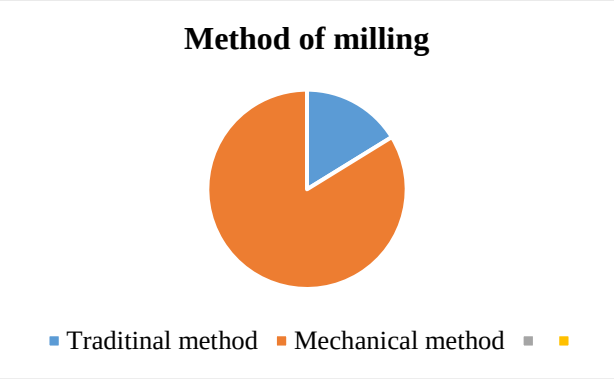

Fig. 10 Method of milling rice used

Table 1. Method of drying rice and moisture content level after parboiling

Drying	Number of respondents	Percentage (%)	Moisture content level after parboiling	Number of respondents	Percentage (%)
Solar drying	30	33.3	10-14%	54	33.3
Sun drying	45	50	15-20%	21	50
Heated air drying	15	16.7	21-25%	15	16.7
Others (please specify)	-	-	26% above	-	-
Total	90	100	Total	90	100

Table 2. Quality of whole rice after milling and causes of cutting in rice milling

Quality of whole rice	Number of respondents	Percentage (%)	Cause of rice cutting	Number of respondents	Percentage (%)
Complete whole rice without cutting	18	20	Parboiling method	15	16.7
Eighty percent whole rice and others cut	63	70	Drying method	34	37.8
A lot of cutting	9	10	Milling method use	41	45.5
Others (please specify	-	-	Others (please specify)	-	-
Total	90	100	Total	90	100

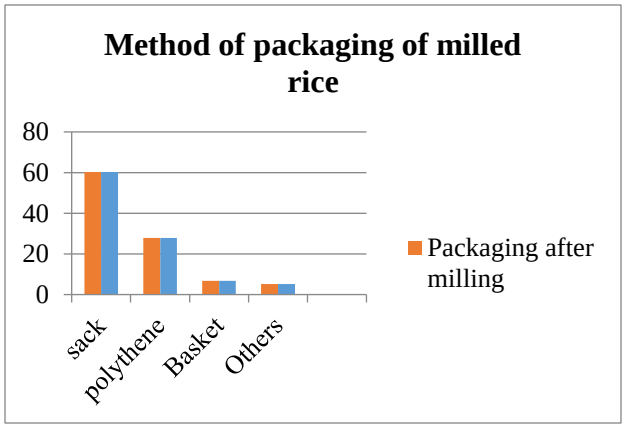

Fig. 11 Representation of rice packaging after milling

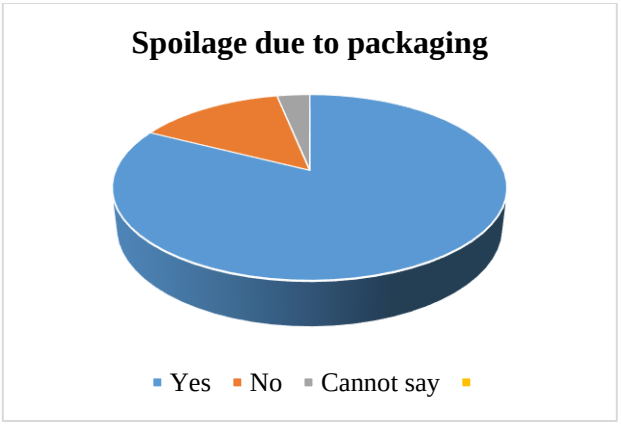

Fig. 12 Pie chart showing spoilage in the cause of packaging

Table 3. The causes of spoilage on storage and milling method

Spoilage due to the milling method	Number of respondents	Percentage (%)	Spoilage on storage	Number of respondents	Percentage (%)
Type of packaging use	24	26.7	Pest attack	40	44.4
Milling type use	21	23.3	Bacterial attack	32	35.6
Moisture content	40	44.44	Microorganism	14	15.6
Any other (specify)	5	5.56	Any other spoilage (specify)	4	4.4
Total	90	100	Total	90	100

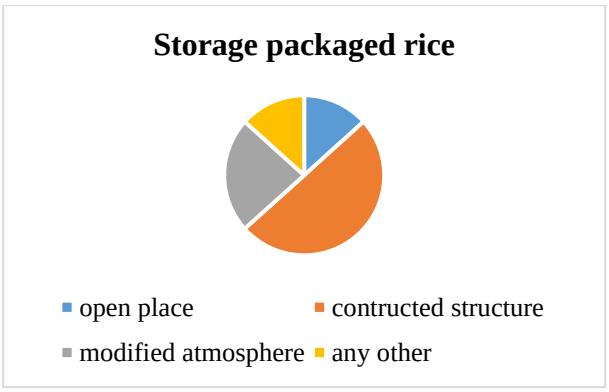

Fig. 13 Pie chart showing the storage of package rice

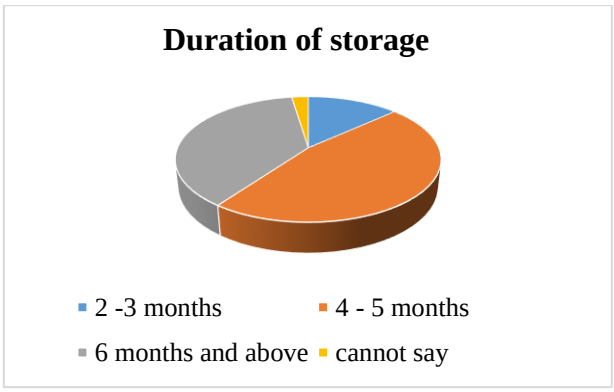

Fig. 14 Pie chart showing the duration of package rice

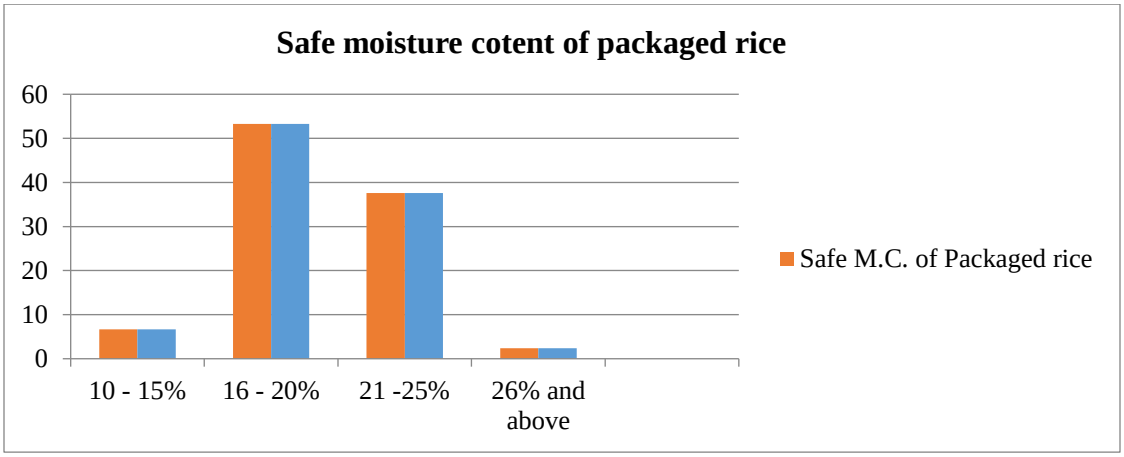

Fig. 15 Safe moisture content for storing package rice

4. Analysis of Results

The farmers in some Southeastern Nigeria comprise males and females with different years of experience. The respondents that were given the author's information include workers at state government, co-operative farm and individual farmers that has the highest percentage (56.7%) of rice farmland, as shown in Figure 1. The educational qualifications of the respondents are shown in Figure 2. The highest percentage of the educational qualification of the respondent was WAEC, which has 66.7%, while the lowest percentage was first degree which was 13.3%. The result showed that the majority of the farmers are not well educated.

The results in Figure 3 show the size of the rice farm. The highest percentage of the respondent, which was 40%, reported that the area of their farmland is between 1- 3 hectares of land.

The result obtained by assessing the response to the method of harvesting matured rice is shown in Figure 4. The highest percentage of the respondent, which was 66.7%, reported that the majority of their matured rice was harvested by manual means.

The result in Figures 5 and 6 showed the respondent record on the method of threshing of paddy and the moisture content before harvesting. The highest percentage of, 66.7%, claimed that they threshed manually by heating a stick on the rice on the floor, while 73.3% reported that they do not check moisture content level before harvesting.

The respondents scoring on how long harvest rice stays before threshing is shown in Figure 7. The highest percentage, which is 50%, reported that it stays up to 3 days before threshing, while the lowest, which is 10%, threshed immediately after harvesting.

Figure 8, it was presented the results of soaking threshed rice before parboiling and the duration of the soaking. It was shown that 100% soaked rice before parboiling while the highest percentage of 80% soaked above 1 hour, and the lowest percentage that has 3.3%, soaked within 16 – 30 minutes before parboiling.

The response from a method of parboiling is shown in Figure 9. The highest percentage, which was 83.3%, claimed that they use a local method of parboiling, while 16.7% reported using a mechanical method of parboiling.

The results in Figure 10 show the response to the method of milling used. The highest percentage, 86.3%, claimed that they milled using a mechanical method of milling, while 16.7 used the traditional method of milling.

The result obtained on the method of drying rice and moisture content level to dry after parboiling is shown in Table 1. The highest percentage of, 50 % claimed that they dry under the natural sun (sun drying), and 50% reported to dry within 15 – 20 moisture content levels after parboiling.

Table 2, it was shown the response to the quality of whole rice and the problem of cutting in milled rice. It was gathered that the highest percentage of 70% claimed that they have eighty percent of whole rice and another cut, while 45.5% said that the cause of cutting is due to the drying method used.

Figures 11 and 12 show the responses on rice packaging after milling and spoilage in the cause packaging. It was gathered that the highest percentage of, 63.3% used sack bags for storage, while 84.4% said that they noticed spoilage on the cause of packaging of milled rice.

The result obtained on the causes of spoilage during storage and the milling method used is shown in Table 3. The highest percentage of 44.44 noticed spoilage during storage and affirmed that the cause was mostly pest attack. Also, 44.4% confirmed spoilage on the milling method used, which was attributed to the level of moisture content before the milling of packaged rice.

In Figures 13 and 14, respondents' response on the type of storage and duration of stored package rice before selling or disposing of it was shown. It was seen that 63.7% stored packaged rice in constructed structures and the lowest percentages of 13.3% stored in an open place and other means, while 46.7% said that the duration of stored packaged rice was between 4 – 5 months.

The result obtained by assessing the respondent on the safe storage moisture content for packaged rice was recorded in Figure 15. The highest percentage of the respondent, which was 53.3%, claimed that the safe moisture content for package rice was between 18 – 20 %, and the next highest percentage was 40%, which said the store at 10 – 15%.
It was also gathered from a personal interview that 66.7% of rice farmers in the study area cultivate Oriza-glaberrime rice species, and they do not know the moisture content in milling, packaging and storage.

5. Summary of Research Findings, Conclusion and Recommendations

5.1. Summary of Research Finding

The outcome of data and information obtained by the researcher yielded the following. The majority of rice farmers trained in means of rice processing, packaging, and storage do not have pertinent information related to the modern method of a unit of operations. The majority of the

respondent knew nothing about modern means of threshing, drying, parboiling, polishing, whitening and destoning of rice adopted by farmers. Good safe moisture content was established for the safe storage of rice, but the author found that most farmers do not know much about equilibrium moisture content for grain storage.

The author also found that most farmers do not store rice in a confined constructed structure. For that, stored rice get damaged by pest, rodent and microorganism before attaining the desired duration for selling or disposing of it.

5.2. Conclusion

It was discovered that most rice farms were owned by an individual who could not afford modern machines to produce and process rice in some Southeastern Nigeria. Therefore, most of these farmers were illiterate and had no idea how to increase their rice production, processing and storage.

It is important that agricultural development agencies, both governmental and non-governmental, in the region, need to work closely with the small-scale farmers in the field to understand the challenges facing them and make necessary provisions for them. They should also provide modern machines at subside rate for improving the working conditions, minimizing waste, increase production and processing of rice to these individual farmers.

There was an established safe moisture content to use at the time of milling of rice and storage of rice, which had caused a lot of damage to the milled and stored rice from these farmers within the southeast of Nigeria.

5.3. Recommendations

It is recommended to adopt modern methods of rice production, processing and storage to enhance the quality and quantity of rice for commercial activities in southeastern Nigeria.

It is noted that rice farmers in the southeast cannot record a remarkable mass production because rice production and processing is a capital-intensive project which requires financial support from the government, non-governmental organizations (NGOs), and private investors interested in agriculture (Agri-preneurs), among others.

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