



The Nature of Postharvest Losses of Rice among Rice Farmers in Makurdi Local Government Area of Benue State Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AFSJ/2021/v20i930345

Editor(s):

(1) Dr. Uttara Singh, Panjab University, India.

Reviewers:

(1) Maria Madalena Rinaldi, Brazil.

(2) Randa El Bedawy, The American University in Cairo, Egypt.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/72183>

Original Research Article

Received 04 May 2021
Accepted 09 August 2021
Published 12 August 2021

ABSTRACT

This study examined the nature of postharvest losses of rice in Makurdi Local Government Area of Benue State. The study specifically examined the stages of the postharvest losses of rice. A sample of 399 rice producers were drawn in Makurdi using the Taro Yamane formula. Quantitative data collection techniques were used to elicit information from respondents. The findings from the study revealed that, the nature postharvest losses of rice start from harvest to consumption stage, with threshing recording the highest loss of 27%. However, the total losses from all the stages are between 37%-40%. The study therefore recommended sensitization of farmers through the relevant agricultural agencies on postproduction of rice, establishment of reserves for the preservation of rice, linking farmers with agro-processing equipment available in state or those at national research institute at an affordable price, plus farmers to take advantage of cooperatives to benefit from agricultural projects establish by the government.

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Keywords: Postharvest losses; rice; nature; farmers; production.

1. INTRODUCTION

Rice (*Oryza Spp*) is a member or seed of the semi-aquatic grain or grass family (Poaceae). It is also a cereal belonging to the Gramineae, a large monocotyledonous family of some 600 genera and around 10,000 species [1]. The domestication of rice ranks as the most important development in human history as it has fed more people over a longer time than has any other crop. The origins of rice have been a long debate and due to its antiquity, the exact time and place of its first development remain unknown. However, the cultivation of rice was discovered at Non-NokTha in the Korean area of Thailand. The plant remains from 10,000 B.C were discovered in a spirit cave on the Thailand-Myanmar border [2]. However, rice production started in Nigeria in 500BC with low-yielding indigenous red grain species *O. glaberrima Steud.* Widely grown in the Niger Delta region [1].

Rice is a nutritional staple food that provides instant energy as its most important component is carbohydrate (starch). On the other hand, rice is poor in nitrogenous substances with the average composition of these substances being only eight percent and fat content or lipids only negligible, i.e., one percent and due to this reason, it is considered as a complete food for eating. Rice flour is used for making various food materials and rich in starch. It is also used in some instances by brewers to make alcohol. Similarly, the straw mixed with other materials can be used in the production of earthenware. Rice is also used in the manufacturing of paper pulp and livestock bedding (Deepak and Kirti, 2011). The nutritional value of rice plays an important role in the health and balance diet of consumers of rice around the world [3]. More than half of the world's population depends on rice for their calories [1]. According to Priya Nelson, Ravichandran and Antony (2019) rice is the primary source of human nutrition in Asia. Rice provides up to 50% of the dietary calorie supply and a substantial part of the protein intake for about 520 million people living in poverty in Asia [4]. Rice provides more than one third of calorie intake in west Africa [5].

Rice is a staple food for the largest number of people on earth with over half of the world's population depending on the crop as their source of food. Also, it is the single largest source of

food for the poor. Rice is synonymous with food throughout Asia. It is the most important food grain in most of the tropical areas of Latin America and the Caribbean; where it supplies more calories in people's diet than wheat, maize, cassava and potato [2]. In Africa, rice is one of the most important food crops, the economic activities related to its production, distribution, and consumption are widely considered a key for economic development, food security, and poverty reduction. It is estimated that rice sustain the livelihood of 100 million people and its production has employed more than 20 million farmers in Africa. In most of sub-Saharan Africa, rice is the most demanded staple food and the food product traded in the highest quantities [6].

In Nigeria, there is a rapid growth in demand for rice by households, livestock feeds, and manufacturers. Different types and grades of rice are consumed by Nigerian consumers. At the household level, it is consumed as boiled or fried with stew or it is used to prepare special dish such as tuwo. Also, rice is a luxurious food prepared for special occasions such as weddings, birthdays, and burials. However, different culture in Nigeria has distinct preferences regarding taste, texture, color, and stickiness of rice varieties that they consume [7]. Rice is a strategic commodity in the Nigerian economy, thereby interfering in the rice economy. Thus, rice is now a structural component of the Nigerian diet, it is a high political commodity that has always been the center of government agricultural policies, with a considerable political interest in the increase of local production [6]. Also, it is used by industries to produce other rice-based food and pharmaceutical products. In some instances, paddy rice is used in the production of animal feedstock [8].

Rice farming is the largest single use of land for producing food [2]. The production is mostly associated with low-income nations as categorized by World Bank and all is nearly (90%) produced in Asia with China and India as the largest producers, each with a share of 29.6% and 22.6% of global production while 3.8% and 2.8% of the rest rice production is shared between Latin America and Africa respectively. Africa rice production contributes 14% of the total grains produced in the region and West Africa is the main producing subregion,

accounting for more than 40% of African production while Nigeria is the largest producer of rice in West Africa with an estimated production of 3.7 million metric tonnes in 2017 and accounted for 36.8% and 37.4% of total sub-regional paddy and milled rice productions, respectively [9,10]. Been a predominant crop in Nigeria, it produced in over 18 states of 36 states in the country with Benue state as the third-largest producer of the crop accounting for 9.8% of the total production after Kaduna and Niger, each with a share of 20.2% and 16.0% respectively [11]. According to Odoemenem and Asogwa [12], Benue state is estimated to produce more than 300,000 metric tonnes of rice annually.

Smallholder farmers form the bulk of the producer of rice in the world [13]. Asia where rice accounts for approximately 33.3% of the domestic grain output in 2013, the major producers are traditional small-scale farmers [14]. Rice production in Sub-Saharan Africa (SSA) is controlled by subsistence, smallholder farmers who have restricted access to markets, no modern equipment except primitive tools [6]. According to PWC (2018), more than 80% of Nigeria's rice is produced by small-scale farmers, while the remaining 20% is produced by commercial farmers.

The high demand for rice is the main driver for its production. However, postharvest losses are one of the major challenges that affect rice along the supply chain [15]. The annual demand for milled rice in Nigeria is 5.2 million metric tons, while the average production of rice is at 3.3 million metric tons. According to JICA [15], Nigeria bridges its demand gap of 1.9 million metric tons by importing coupled with its processing capacity of 2.8 million metric tons. Insufficiency in rice production is blamed on the inadequacies that occur from farm to fork. Thus, the reason for self-insufficiency in rice production in Nigeria is the lack of adequate facilities of post-production preservation [16].

Rice has high moisture content and if not properly handle could cause the nutritional value to deteriorate or cause a physical loss during the process of the food supply chain [17]. According to GRISP (2013), the postharvest sector of rice is still characterized by high losses. In Africa and Asia, Losses of rice range from 10% to 30% [2]. In Sub-Saharan Africa alone, 20-30% of rice produced is lost at various points of post-harvest operations [9]. It is estimated that ten percent (10%) of the crop (rice) productivity is lost during

post-harvest operations. Nigeria 15-20% of rice is lost during post-production process [18].

The post-harvest losses of rice by nature, occur during the processing and handling stages from the farm to the final consumer. During the process of post-production, there are several stages the crop (rice) most undergo. During these processes, rice can be lost at any stage. These stages are harvesting, threshing, cleaning, parboiling, drying, storage, transport, and marketing (Kumar & Kalita, 2017). The losses during these stages are caused by spillage, losses to pests, low milling yields, inappropriate postharvest management practices, delays in the postharvest chain, outdated postharvest equipment and infrastructure, and low operator skills [2].

Losses of rice during postharvest operations affect the quality and quantity of the crop along the supply chain. Thus, affecting the market value of milled rice by 10-30%. It often forces farmers to sell their rice immediately after harvest at a low price and so lose out in maximizing their return [2]. In Asia postharvest losses of rice at the stages of marketing, processing and storage have translated into hunger and minimization of generating revenue for farmers [19]. Due to inadequate postharvest operations in Africa at the postharvest handling level, farmers are vulnerable to selling their rice immediately after harvest at the lowest price and exposes themselves to food insecurity [20]. GIZ [21] found out that, postharvest losses of rice in Nigeria contribute significantly to the loss of revenues for farmers.

Improvement in post-harvest management plays an important role in achieving the potential yield of rough rice. Thus, increase in food production is not the final solution but complementary good harvest and post-harvest practices will reduce food loss and enhance food availability. Post-production accounts for more than 55% of the economic value of the agricultural sector in developing countries [9]. The impacts of post-harvest food losses contribute to food insecurity in Africa, directly impacting on lives of millions of smallholder peasant families every year [22]. The population of the world is estimated to reach 9 billion in the year 2050 and reduction of food losses is said to be the remedy to food security than reliance on the increase in food production with limited resources [22].

Therefore, reduction in the postharvest losses of rice is important to sustain the actual production

capacity and improve food security, provide income to rural farmers and ensure economic growth in the society. It is against this background, the study focused on the nature of postharvest losses of rice in Makurdi Local Government Area of Benue State with the following objective; to identify the nature of postharvest losses in rice in Makurdi.

2. MATERIALS AND METHODOLOGY

The study was conducted in Makurdi Local Government Area of Benue State, Makurdi, town, capital of Benue state. It is situated on the south bank of the Benue River. Makurdi was founded about 1927 and rapidly developed into a transportation market center when the railroad was extended from Port Harcourt to Jos and Enugu. In 1976, Benue-Plateau state was divided into two states, and Makurdi was made the capital of Benue state. Makurdi local government area shares boundaries with Guma Local Government area to the North East, Gwer to the South, Gwer west to the West, and Doma local government area of Nasarawa state to the North West. Makurdi is divided into two major blocks by River Benue hence the North and South banks. It has a population of 300,377 (2006, census), with a projected population of 405,500(2016, projection) and it has a landmass of 16km radius. All forms of transportation such as road, Rail Air, and water are obtainable in Makurdi. Makurdi local government area is made up of eleven (11) wards they include Agan, Ankpa/Wadata, Bar, Central South Mission, Fiiidi, Mbalagh, Market Clark, Modern Market, North Bank I, North Bank II, Wailomoyo.

Rice farmers in Makurdi Local Government constitute the population of the study. According to Benue Agricultural and Rural Development Authority (BNARDA) as of 2017, there were six hundred and ten (610) registered rice farmers spread across the local government area. It is from this population sample size of three hundred and ninety-nine (399) respondents was drawn using Taro Yamane (1967) sample size determination formula. 399 respondents were randomly selected from the six hundred and ten (10) registered rice farmers in Makurdi at Benue Agricultural and Rural Development agro rice seminar. The study utilized a questionnaire as the method of data collection because, majority of the respondents were literate and the few semi-literates were assisted by a research assistant. However, after the survey three hundred and ninety-five (395) questionnaires

were retrieved. The data created were subjected to descriptive analysis.

2.1 Limitations of the Study

The major challenge encountered in the study include, the challenge of ascertaining who were rice farmers, because the Benue State Agricultural Authority and Rural Development only have total figure of rice farmers in the Local Government Area, but information of their households not available. However, the challenge was defeated when the researcher made use of the rice farmer population from BARNDA and used the Yamane Formula to sample the population for study.

Another challenge was the vast nature of the study area which has a landmass of 16 km radius that made adequate and proper coverage difficult giving also the terrain of the area. This challenge was overcome when the researcher clustered the study area into 11 clusters and purposively selected only 7 clusters that are the major rice producing zones in the study area.

Lastly the findings were viewed in the specific context of the conditions prevailing in the study area and was not generalized for wider geographical or society. However, careful and rigorous procedure was adopted to carry out the research as objective as possible. Some respondents did not give us complete responses, but our findings and conclusion that was drawn from the study will form the basis for future research studies.

3. RESULTS

The results of socio-demographic variables are presented in table 1 below. The demographic variables presented here includes sex, age, marital status, educational status, occupation and years of farming. Analyses of demographic variables of the table revealed that males participate more in the farming of rice as compared to their opposite sex (female). The data on the table shows that 64.1% (253) of the respondents were males and 141 (35.7%) of the respondents are female. the data in the table below further revealed that most of the respondents were married (65.3%) while 26.9% are either single, widowed, divorced or separated.

Age is an imperative demographic characteristic because it decides the amount and quality of the

labor force. In terms of the age of the respondents, majority of the rice farmers were below 41 (59.3%). With respect to the religious faith of the respondents, 72.7% (287) of the respondents were Christians, while 6.3% (25) were Muslims and the rest respondents of 1.5% (18) were traditional worshippers.

Table 1. Socio-Demographic Characteristics of Respondents

Variables	=395	%
Sex		
Male	253	64
Female	141	36
No response	1	
Marital Status		
Married	258	65
Single	78	20
widowed	20	5
divorced	5	1
Separated	3	1
No response	31	8
Age		
Below 20years	9	2
21-29years	82	21
30-39years	143	36
40-49years	100	25
50-59years	45	11
60years and above	4	1
No response	12	3
Religion		
Christianity	287	73
Islam	25	6
Traditional religion	18	5
No response	65	17
Educational attainment		
No formal education	16	4
Primary	14	4
Junior secondary	28	7
Senior secondary	185	47
Tertiary	136	34
No response	16	4
Occupation		
Civil servant	15	4
Farming	244	62
Civil/farming	87	22
Student/farming	22	6
Public servant/farming	8	2
Business/farming	11	3
No response	8	2
Years of farming		
1-10years	120	30
11-20years	110	29
21-30years	97	25
31-40years	43	11
41years and above	8	2
No response	17	4

Source:Field Survey, 2018

Table 2. Distribution of Respondents on the Stages and rank of post-harvest losses of rice in the Local Government Area

Stages of PHL	Magnitude (kg)	Percentage (%)	Rank
threshing	0.27	27.00	1 st
harvesting	0.16	15.00	2 nd
winnowing	0.15	15.00	3 rd
milling	0.12	12.00	4 th
transporting	0.13	13.00	6 th
storage	0.09	9.00	7 th
drying	0.08	8.00	8 th
Total		100.00	

Source: Field Survey, 2018

Table 3. Damaged Rice over Harvested Rice in the study area between 2016 & 2017

Years	Total harvested (TH)	Total Damaged (TD)	Percentage
2016	3904	1465	37.5%
2017	3888	1566	40.3%

Source, Field Survey, 2018

The educational status of the respondents in the study area showed that 4.1% (16) out of the total 100% of respondents had no formal education, 3.5% (14) had attained the level of primary education, while 7.1% (28) of the respondents attended junior secondary school and 46.8% (185) had attained senior secondary school education. Those with tertiary education accounted for 34.4% (136) of the total respondents.

Furthermore, on the occupation of the respondents, majority of the respondents are farmers (61.8%) while the rest respondents (31.4%) combine work and farming or their education and farming. Attempts were made to ascertain years of farming experienced by the respondent. The results show that, at least 90% of the sampled respondents have been farming for not less than 21 years.

Table 2 detail the stages and magnitude of post-harvest losses in the study areas and their rankings. The attribution variables covered ranged from harvesting losses to milling losses. The result showed that post-harvest losses ranged from 0.08 kg per farmer at the drying stage (8%) to 0.27 kg per farmer at the threshing stage (27%).

Table three (3) losses incurred between 2016 and 2017 during the postharvest operation in the study area, it clearly shows that post-harvest losses of rice in the study area are estimated at 38 to 40%, with a slight increase (2.8%) in losses in 2017.

3. DISCUSSION

Table one (1), analyzed the sociodemographic characteristics of the respondents, the findings show that, male participate more in rice farming, this confirms Ayanwale and Amusan [23], who stated that Nigeria there is a clear gender division in the production of rice where production is mainly done by the male. By implication, there is clear manifestation of gender inequality in rice farming in the study area. This calls for concerted effort in mobilizing and empowering women in the participation of rice production in study area, with a view to enhancing their economic activities.

Majority of the respondents were married (64.1%), This could have implication on postharvest losses in rice production since; married farmers are likely to rely on family labor especially for harvesting. The time taken to harvest may be longer and, in an attempt, to rush the works rice are badly handled due to poor skill in handling as compared with hired laborers. An active age farm rice in the study area, this indicated a good supply of active productive workforce in rice production in the study area, and rice farmers in the study area are Christians, also an indication that, most of the rice farmers at the study area practice the Christianity.

The rice farmers have attained a certain level of formal education. This implies that, rice farmers in study area are enlightened enough to know that postharvest losses of rice have effect on

their production. with their level of education, they will adopt modern postharvest technology to prevent losses of rice at postharvest chain, if adequate equipment and necessary infrastructural facilities are provided for the rice farmers. The study area constitutes a farming population. The rice farmers were highly experienced in the cultivation of rice, implying that, they could be relied upon for sustainable rice production with minimal postharvest losses when provided with the required inputs and aids.

In table two (2), there is variation in losses at different stages of postharvest losses of rice, the losses range from 8-27% at the farmer's level. The findings confirm the work of GIZ [21], who posits that the nature of postharvest losses of rice is at every stage at the farmers' level in Nigeria, from harvest to marketing with threshing as the highest with an estimated percentage of 4.97%. the findings distinguish with the work of Caixeta-Filho and Péra, [24] in terms of the stage that records the highest losses in the postharvest operations of rice, with the transportation stage as the highest. However, the authors affirm that every level of postharvest operations of rice losses occurs at every level. By implication, nature postharvest losses vary from one society to another because, in Makurdi (study area), losses of rice at different stages showed higher percentages of loss than other societies as compared by other authors. This is an indication that Makurdi rice farmers are lacking behind in the adoption of modern agricultural practices use to tackle the post-handling of rice along the postharvest chain.

In table three (3), the total percentages of postharvest losses in the study area between 2016 and 2017 are estimated at 38 to 40%, these findings differ from the 28.52% obtained by GIZ (2014), although Kumar and Kalita (2017) confirmed that, the total losses of postharvest losses of rice are between 40.99% to 50% with storage as the main stage of postharvest losses.

According to Caixeta-Filho and Péra, [24], the nature of postharvest losses of rice in Africa occur at all stages, but the losses vary in terms of quality and quantity losses, postulated that quantity losses reach between 10-20% while quality losses reach 50%.

4. CONCLUSION

Based on the findings of this study, the nature of postharvest losses of rice in the Makurdi Local

Government Area is high; therefore, needs to be tackled. Postharvest losses of rice have proven to be detrimental to the income of rice farmers in the study area. The nature of postharvest losses is attributed to several factors. The losses of rice at the postharvest stages vary in terms of the level and the quality of losses and it differs from one stage to another stage.

6. RECOMMENDATIONS

1. Benue state government should send extension agents from Benue Agricultural and Rural Development Authority (BNARDA) to go and learn new rice practices on rice postproduction from the western nations and return to transfer the knowledge to rice farmers in the study area.
2. The Benue state government should build grain reserves at strategic areas in the study area that will enable them to buy off excess produce from farmers to avoid losses and sell to the farmers at a subsidized rate during the lean period.
3. Village markets should be set up close to farmers to reduce the burden of transportation. Markets should not be centered in one place and farmers compelled to move from one distant location to another in order to sell their rice. This would also reduce postproduction losses.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
 The peer review history for this paper can be accessed here:
<https://www.sdiarticle4.com/review-history/72183>