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POST-HARVEST LOSSES ALONG THE RICE VALUE CHAIN IN KWARA STATE, NIGERIA: AN ASSESSMENT OF MAGNITUDE AND DETERMINANTS

R. BABATUNDE[1], A. OMONIWA[1,*], J. ALIYU[1]

*E-mail: omotade29@gmail.com

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ABSTRACT. Post-harvest losses, particularly along the rice value chain, have been highlighted as a major source of reduction in revenue among the value chain actors. It is therefore imperative that empirical assessment of the magnitude and determinants be investigated, so as to be able to provide a reliable policy stand that can help reduce these losses. Patigi and Edu local government areas were purposively sampled from Kwara state, Nigeria, since they are the major producers of rice in the State. Data were gathered through the use of a questionnaire from 40 rice farmers, 40 rice processors and 40 rice marketers. Descriptive statistics and multiple linear regression model were used to analyze the data. The result showed that the loss was highest for farmers at 41-50 kg (₦14402.40) (1 Naira = 0.002772 U.S. $), 31-40 kg (₦2383.20) for processors and at less than 11 kg (₦398.30) for the marketers. Household size and farm size were significant at 1% in determining post-harvest losses for farmers, while only the household size was significant in determining post-harvest losses for processors. It was thus recommended that efficient milling machine should be introduced, particularly to rural rice processors, such that quality grains can be achieved.

Keywords: farmers; farm size; milling: processors.

INTRODUCTION

Rice sustains the livelihood of 100 million people and its production has employed more than 20 million farmers in Africa (WARDA, 2005). Rice has emerged the fastest growing sector and staple food, especially for urban dwellers, despite the large array of food and cash crops cultivated in Nigeria (Olantiwo, 2013). One of the reasons is that rice is relatively easy to cook, despite the fact that it was formerly considered a luxury food for special occasions only. However, that has changed in most part of the

[1] Department of Agricultural Economics and Farm Management, University of Ilorin, Ilorin, Nigeria

country due to change in consumer's preference (Ojehomon *et al.,* 2009).

Rice is cultivated in virtually all of Nigeria's agro-ecological zones, from the mangrove and swampy ecologies of the river Niger Delta in the coastal areas to the dry zones of the Sahel in the north (Akpokodge *et al*, 2001; Daramola, 2005; Imolehin and Wada, 2000). Rice is grown in lowland or on upland fields, depending on the requirement of specific varieties. Some of the common varieties include NERICA 1 (FARO 55), NERICA 2 (FARO 56), ITA 150 (FARO 46), and CISADANE (FARO 51) among others (Ojehomon *et al.,* 2009) and these are grown in the different ecologies. Also, most Nigerian farmers do not grow rice in isolation, but with other crops, such as maize, sorghum, while some keep animals (Olantiwo, 2013).

The Nigerian rice sub-sector has contributed to food security, job creation, and indeed reduced poverty. Although the country is the largest producer of rice in West Africa, yet it accounted for up to 20 percent of sub-Saharan Africans' import for domestic rice consumption (Omotola and Ikechukwu, 2006). To close the gap between domestic rice production and imported rice, Care must be taken at each post-harvest stage to reduce losses and increase supply. This is because rice is one of the staple crops on Nigeria's import list (Shehu *et al.*, 2007). Moreover, increase in rice production is necessary because it has a great role to play in contributing to food and nutritional security and economic growth of Nigeria (Ibrahim *et al.,* 2008).

According to WARDA (2007), Nigeria was below 25% self-sufficiency in rice production. This means that Nigeria still require huge imports to augment the difference in local demand. The efficiency of the food production system can be increased by increasing the technical efficiency of the crop production system and also reducing the post-harvest losses of the crop. By implication, considerable emphasis should be given not only on the crop production, but also on the post-harvest operations (Bala, 1997).

Post-harvest losses can occur during any of the stages in the post-harvest operations. Whatever the source, post-harvest losses represent more than just a loss of food as it ripples through the factors (including land, water, labor, seeds, time and fertilizer). Post-harvest losses of rice can be quantitative or qualitative. Quantitative losses lead to a reduction in weight or volume of the final usable product from the potential yield or harvestable paddy, while qualitative losses leads to a reduction in value of usable product due to physical and chemical changes in the rice, which diminish the grain size, cause poor appearance, bad taste and foul aroma. The wastes indicate that post-harvest food loss translates not just into human hunger and minimizing the revenue of farmers, but into tremendous environmental waste as well (Earthtrend, 2001).

According to Manful and Fofona (2010), qualitative losses could be as high as 50% in some developing countries. More so, reducing post-harvest losses could help in reducing rice imports with its accompanied economic losses. For effective reduction in losses it is therefore important to estimate the losses, determinant of losses, and the stages at which they occur. However, empirical information on the magnitude and determinants of losses that occur at each stage of the value chain has not been clearly stated in literature. This study therefore aimed at assessing the post-harvest losses that occur in rice production in Nigeria using Kwara state as a case study.

Rice is an important food crop whose popularity and consumption have been on a steady increase. During the last three decades, rice has increasingly become a staple food in most of Nigeria homes. However, rice post-harvest losses have continued to have its toll on rice value chain in Nigeria making the Nigeria local rice industry uncompetitive. Additionally, pest infestation, high cost of control mechanism, inadequate manpower, problem of transportation, high cost of processing and adoption of modern technology are some of the constraints faced by the various actors of post-harvest operations along the value chain. While there is no single root cause of post-harvest loss, poor storage, lack of training, and limited data are believed to contribute to rice post-harvest losses. Post-harvest losses in rice cover all losses that take place from harvest through to consumption. Considering the high rate of post-harvest losses in rice with its attendant devastating effect on rice value chain, which will make it very difficult for the Nigeria local rice industry to meet the over 5 million metric tons of rice, equivalent to about 100 million 50 kg bags of rice that is consumed annually in Nigeria (FMARD, 2012). However, increase in rice production by reducing post-harvest losses is imperative as it plays a great role in contributing to food and nutritional security and economic growth of Nigeria (Ibrahim *et al.,* 2008).

MATERIAL AND METHODS

Study area

This study was carried out in Kwara State, Nigeria. Kwara State is in north central Nigeria. Its capital is Ilorin. The primary ethnic group of Kwara State is Yoruba, with significant Nupe, Bariba minorities. Kwara State is situated between parallels 8° and 10° North latitudes and 3° and 6° East longitudes, with Niger State in the north, Kogi State in the east, Oyo, Ekiti and Osun States in the south and an international boundary with the Republic of Benin in the west.

The State has a population of about 2.37 million people (NPC, 2008), who individually consume about 24.6 kg of rice annually (IRRI, 2007). The state is divided into four Agricultural Zones by the Kwara State Agricultural Development Project (KWADP) authority based on agro-ecological considerations. Although rice is produced in all the KWADP Zones, the KWADP Zone B produces about 90% of the state's annual rice production. Kwara State's annual rice

production estimate ranges between 17.5-118.3 metric tons: 49.6 metric tons on average (KWADP, 2004). The target population for this study is the farmers and other stakeholders in the study area, given the four ADP zones of Kwara State.

Sampling technique

A three-stage sampling technique was employed to select the sample for this study. The procedure involves the use of purposive sampling techniques of Patigi and Edu local governments, which are the main rice producing area in the first stage. The second stage is the random sampling of 40 farmers from each of the selected LGAs. This consists of the random selection of 20 farmers from each of Patigi and Edu local government areas. Thirdly, a random selection of 40 processors (miller and parboilers), and 40 marketers (traders) consisting of 20 wholesaler and 20 retailers from the major markets centers in the selected local government areas to give a total of 120 respondents.

Method of data collection

Data was collected in 2015 from the sampled rice value chain actors with the aid of a questionnaire and personal interview where necessary.

Analytical techniques descriptive statistics

Descriptive statistics, such as percentage, frequencies, means and standard deviation, was used to describe the socio economic characteristics of farmers, processors and Marketers along the Rice Value Chain. It was also used to determine the level of post-harvest loss along the value chain, the losses where then quantified in monetary terms. Farmers, processors and marketers were asked to give the quantity of output harvested/hectare for the previous farming season. This was thereafter used to estimate what the actual losses could be in kg.

Multiple regression analysis

This was use to analyze the determinants of post-harvest losses for farmers and processors in the study area. The implicit function is stated as:

For the farmers

$Y_f = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, U)$ …..… (1), where,

Y_f = Post-harvest losses in kg for farmers
X_1 = Gender (male=1, female=0)
X_2 = Age (years)
X_3 = Household size (adult Equivalents)
X_4 = Variety grown (local=1, improved=0)
X_5 = Method of harvest (sickle=1, otherwise=0)
X_6 = Farm size (ha)
X_7 = Membership of cooperative (yes=1, 0 otherwise)
X_8 = Access to credit (yes=1, 0 otherwise)
U = Stochastic term represent the effect of other variables that are not included in the model.

For the processors

$Y_p = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, U)$ … (2), where,

Y_p= Post-harvest losses in kg
X_1= Age (years)
X_2= Household size (Adult equivalent)
X_3= Years spent schooling
X_4= Experience in processing (years)
X_5= Distance to market (km)
X_6= Marital status (Married=1, 0 otherwise)
X_7= Access to credit (Yes=1, 0 otherwise)
X_8= Access to extension contact (Yes=1, 0 otherwise)
U= Stochastic term represent the effect of other variables that are not included in the model.

RESULTS AND DISCUSSION

Socio-economic characteristics of the value chain actors

Table 1 shows the distribution of the various socio-economic characterristics among the rice value chain actors in the study area. The result shows that both men and women were actors along the value chain. Additionally, the above result shows that 87.5% of the rice farmers were male.

This may not be unconnected with the strenuous nature of farming and particularly rice farming. In contrast, only about 12.5% represents female farmers. However, 100% of both processors and marketers (wholesale and retail) are women. This is in tandem with the findings of NCRI (2006) and Olabisi, (2007), which posited that rice processing such as parboiling, milling, drying, among others are predominantly done by women.

Table 1 also shows that 62.5 % of rice farmers in the study area are within the active age of 31-50 years. While 65% of the processors also fall within the active age of 31-50 years, the marketers (wholesale and retail) also had an average age of 39%. Pendo-Edua (2011) argued that age structure can be used to facilitate an understanding about labour potential of a specific population.

With the foregoing background therefore, one can conclude that good percentage of the actors along the value chain in the study area were within the working age group. All these are also in agreement with findings of Olantiwo (2013).

The result on the level of education of the value chain actors in the study area showed that about 30% of the farmers had acquired primary education, while only 5% had degree educational level.

Furthermore, 40% of the processors had no formal education with primary and certificate education holders representing 7.5% and 5% of the sampled population. The result also showed that majority (42.5%) of wholesalers and retailers had no formal schooling. This therefore, goes to show that good percentage of the actors along the value chain had basic knowledge that can enhance their harvesting, processing and marketing (wholesale and retail) activities in the local rice industry in the study area.

With respect to the level of production experience along the value chain, majority representing 67.5% and 57.5% of the farmers and processors had 5-10 years farming and processing experience respectively. However, about 37.5% of the marketers had experience of more than 10 years.

Magnitude of post-harvest losses among the value chain actors per production cycle

Table 2 shows that the total mean loss for the farmers was highest at N9494.80. This is consistent with (Guisse, 2010), who submitted that losses on the farm is highest along the value chain. However, processors and marketers recorded a total mean loss

of N5587.60 and N398.30. This loss estimated in naira reflects lost in revenue, labour, man-power, food (rice), land and other factors of production employed.

Table 1 - Socioeconomic characteristics of value chain actors

	Farmers		Processors		Marketers	
	Freq.	%	Freq.	%	Freq.	%
Gender						
Male	5	12.5	0	0.0	0	0.0
Female	35	87.5	40	100.0	40	100.0
Age (years)						
≤30	8	20.0	9	22.5	8	20.0
31-40	15	37.5	16	40.0	12	30.0
41-50	10	25.0	10	25	15	37.5
51-60	7	17.5	5	12.5	5	12.5
Marital status						
Single	2	5.0	0	0.0	4	10
Married	38	95.0	35	87.5	32	80
Widow(er)	0	0.0	5	12.5	4	10
Educational Level						
No formal schooling	8	20.0	16	40.0	17	42.5
Adult literacy classes	1	2.5	1	2.5	0	0.0
Primary school	12	30.0	7	7.5	2	5.0
Secondary school	9	22.5	8	20.0	14	35.0
Certificate course	3	7.5	2	5.0	3	7.5
Diploma	5	12.5	6	15.0	3	7.5
Degree	2	5.0	0	0.0	1	2.5
Household size (AE)						
<5	15	37.5	19	47.5	9	22.5
5 – 10	10	25.0	15	37.5	20	50.0
>10	15	37.5	6	15.0	11	27.5
Years of production Experience						
<5	8	20.0	12	30.0	12	30.0
5 -10	27	67.5	23	57.5	13	32.5
>10	5	12.5	5	12.5	15	37.5
Secondary occupation						
Artisans	5	12.5	10	2.5	6	15.0
Civil servants	10	25.0	7	17.5	13	32.5
Petty traders	10	25.0	7	17.5	12	30.0
Drivers	0	0.0	0	0.0	7	17.5
Livestock rearers	15	37.5	16	40.0	2	5.0

Source: Survey Data, 2015

Determinants of post-harvest losses among rice value chain actors

Table 3 shows the determinants of post-harvest losses among rice farmers in the study area. The R^2 shows that variables included in the model was able to explain only 73.3% of variations in the dependent variable. Also, only the household size of the farmers and the farm size

were significant at 1%. This implies that as the household size and farm size increases, so will the amount of post-harvest loss. This may be attributed to the fact that farmers with large farm size with more household members would most likely employ family labour to save cost. However, often time family labour are less skilled in harvesting, particularly in rice production thus resulting in high post-harvest losses. This finding is not too different from that of MSME (2009) baseline survey in Kaduna state, Nigeria, where it was affirmed that the complexity of labour needed in rice farming accounts for high post-harvest losses.

Table 2 - Mean losses of actors along the value chain

Average loss (kg)	Farmers (₦)	Processors (₦)	Marketers (₦)
≤10	733.30	428.30	398.30
11-20	1191.60	1080.40	-
21-30	1825.10	1695.80	-
31-40	2419.90	2383.20	-
>40	14402.40	-	-
Total mean	9494.80	5587.60	398.30

Source: Survey Data, 2015

Table 3 - Determinants of post-harvest losses among rice farmers

Variables	Estimates	Z-value
Gender (male=1)	0.98	0.91
Age (years)	-0.22	-1.56
Houshold size (AE)	0.68***	4.94
Variety grown (local=1, others=0)	0.09	0.83
Farm size (ha)	0.42***	3.39
Membership of cooperatives (yes=1)	0.11	1.11
Access to credit (yes=1)	-0.11	-1.08
Method of harvest (use of sickle=1, others=0)	-0.08	-0.78
R^2	0.73	

Source: Survey Data, 2015; *** significant at 1%

Table 4 shows the determinants of post-harvest losses for rice processors in the study area. The R^2 implies that the variables were able to explained only 27% of variation in the dependent variable. However, only the adult equivalence of household size was found to be negatively significant at 10%. This implies that as the household size increases, the amount of post-harvest losses at the processing stage reduces. This can be attributed to the fact that majority (87.5%) of the processors were married (*Table 1*), which will most likely result in large household sizes. More so, since the major processing activities in the study area include

parboiling, milling and drying, which are less strenuous, compared with harvesting and also carried out mostly with the help of machines. This will help reduce the losses at this stage. This is consistent with the findings of IRRI (2007), where it was also acknowledged that losses at the processing stage is always smaller when compared to the amount of losses at the harvesting stage.

Table 4 - Determinants of post-harvest losses among rice processors

Variables	Estimates	Z-value
Age (years)	0.28	1.31
Marital status (married=1, 0=otherwise)	-0.17	-0.95
Years of schooling	-0.09	-0.42
Household size (AE)	-0.39*	-1.76
Processing experience (years)	-0.19	-1.06
Distance to market (km)	0.01	0.08
Access to extension contact (yes=1)	-0.13	-0.73
Access to credit (yes=1)	0.12	0.65
R^2	0.27	

Source: Survey Data, 2015; * significant at 10%

CONCLUSION AND RECOMMENDATION

Based on the research findings, it is evident that the magnitude of post-harvest losses in the study area is relatively high valued at an average of ₦9494.8 for the farmers, ₦5587.6 for the processors and ₦398.3 for the marketers. Also, household size and farm size were the significant determinants of post-harvest losses among rice farmers and processors in the study area. It can therefore be inferred that inadequate skilled labour and efficient milling system in the study area has resulted in the farmers and processors relying heavily on family labour thus the magnitude of post-harvest losses.

The study therefore recommends that reconstruction of rural roads be looked, into as this will make efficient rice processing mills easily accessible to rice processors thus reducing the magnitude of post-harvest losses. Also, increased access to credit facilities can help the rice farmers hire skilled rice harvesters, particularly for those with large farm sizes. All these will help reduce post-harvest losses and thus the income accruable to the value chain actors.

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