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Assessment of Post-Harvest Losses among Small-Scale Rice Farmers in Nasarawa State, Nigeria

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Abstract

This study was aimed at assessing the effect of post-harvest losses in rice production among small scale holders. The need for this study arose due to the ineligible losses occurring after harvest in rice production. Using a multi-staged sampling technique, a total of 80 respondents were selected for the study. Data related to socioeconomic characteristics and post-harvest losses were collected using questionnaire and personal interview, presented in percentages and tables while Multiple Regression analysis was adopted for factors influencing post-harvest losses. The results obtained revealed that majority of the respondents had non- formal education, 95.0% were married, had 1-5 household size, 85.0% are engaged in farming and fell within the age bracket of 30-39. The regression analysis revealed that transportation facility, storage facility, threshing machine, markets access, access to credit, income and area of land cultivated by the respondents were the significant determinants of post-harvest losses in rice production. The result also shows that major losses (65.9%) occur at the farm level, other losses were estimated at the wholesale level (14.5%), processor level (16.8%) and retail level (2.8%). Based on the findings, the following recommendations were made: More widespread education in the causes of post-harvest losses and enlightenment on proper harvesting methods for rice crop; Support in the provision of better infrastructure to connect small scale holders to markets; Accessibility to microcredit so as to create opportunities to adopt collective marketing and better technologies that will reduce post-harvest losses in rice production; More effective value chains that provide sufficient financial incentives at the rice farmers' level; The public and private sectors sharing the investment costs and risks in market-orientated interventions.

Introduction

Nigeria's agricultural sector contribution to the Gross Domestic Product (GDP) has hovered between 20 and 40 percent and employs over 60% of the labor force in the economy [1,2]. An important constraint facing the smallholder farmers is low productivity, which also explains the prevailing high rural poverty. African Development Bank Group (2013) estimated that 70% of the Nigerian population lived on less than US$1.25 per day, and 63% of the population lived on less than US$1.00/day. By 2016, the estimated poverty rate in Nigeria was 84% [3]. Improvement in agricultural productivity is advocated as the way out of poverty because resulting surpluses will promote marketing activities, including value addition. Value addition, achieved

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through processing, is expected to increase rural income, among other benefits. Post-harvest losses in developing countries, even in the face of low productivity, is prevalent. Absence of post-harvest management keeps smallholders in poverty and forces them to sell off their produce soon after harvest and missing the opportunity to increase their revenue from sales of those crops (Tefora *et al*; 2011).

Rice is the most consumed staple food among over 174 million Nigerians across the federating states [4]. Nigeria's annual output of rice is about 2.7 million metric tons (FAOSTAT, 2020) while the annual consumption is about 5.9 million metric tons [5] and by 2050, it is projected to reach 36 million metric tons [6]. The estimated annual deficit has been met over the years through rice import [5]. Between 1961-2000 annual average yield, area planted and total output of rice was 1,677 kilogram per hectare, 808,055 hectares and 1.4 million metric tons respectively. However, between 2001 to 2020, average annual yield was 1,611 kg per hectare, average area planted was 3,324,786 hectares while average total output was 5.1 million metric tons (FAOSTAT, 2020) indicating a positive trend in area planted and production, and a decline in average yield per hectare.

The Nigerian government officially banned rice importation completely in 2015. The expectation was that local supply would respond to government policies and incentives to fill the supply-demand deficit. However, while the local rice output was estimated to be three million tons per annum, five million tons was the estimated amount demanded per annum [5]. Within the effort to close the gap between national rice supply and demand lies the need to improve post-harvest management in Nigeria. Post-harvest losses occur during and/or after harvesting crops and could be a direct or indirect loss. Direct loss involves the disappearance of food by spillage or consumption by insects, rodents, and birds while indirect loss is accrued to those involving lowering of quality to the point where people refuse to eat it. In West Africa, farmers indicated that losses for cereal crops starts immediately after harvesting, with birds and insects attack accounting for 10 to 20 percent of the loss [7]. The key stages of losses recorded for rice includes harvesting, drying, parboiling, winnowing, storage and transportation [8].

Rice is cultivated in virtually all the agro-ecological zones of Nigeria. It is a predominantly rain fed crop, particularly grown in the lowlands. Recent findings reflect a less than 10 percent use of irrigation amongst rice producers. There is a seeming gender division of labor in rice production and processing in the country, with production primarily under taken by men and post-harvest activities by women (Ogundare *et al.,* 2014). Urbanization is widely believed to have triggered the structural increase in rice consumption [9]. Post-harvest losses affect grain quantity and quality at the expense of processors and rice consumers [10]. Records on losses of agricultural products are not widely reported. This high lights the need to deepen studies on aspects of post-harvest losses [8].

Problem statement

Post-harvest losses in developed countries are relatively low, which may be attributed to more effective transport system, better management practices, storage and processing facilities which ensures that a larger proportion of harvested output is delivered to the market as at when due [11]. The reverse is however the case in less developed countries such as Nigeria, where there is no efficient communication to introduce new findings on how to reduce post-harvest losses in rural areas where such knowledge is lacking. Ogundare *et al* (2003), observed that post-harvest activities are undertaken mainly by women who do not have adequate information on proper crop harvesting and handling methods. This results in significant damage by insects and pests during storage and marketing [12]. (Kereth *et al*; 2013). Lack of data to estimate post-harvest losses have made policies regarding losses quite difficult to implement in the economy. This has threatened the living standard of small-scale holders with implication of selling off their crops soon after harvest at lower prices. As such, smallholders miss the opportunity to increase their revenue and food security. The present research intended to address these and other problems in rice post-harvest losses. The main objective of the study was the assessment of post-harvest losses in rice production among small scale holders. To meet the main objective, the study specifically focused on (i) describing the socio-economic characteristics of the respondents, (ii) determining the factors influencing post-harvest losses in rice, and (iii) estimating the quantity and value of post-harvest losses in rice among the respondents

Methodology

The study was undertaken in the Doma Local Government Area (LGA) of Nasarawa state. The local government is situated in the southern zone of Nasarawa state. The state lies between latitudes of 8.5705^{O}N and longitudes 8.3088^{O}E of the Greenwich Meridian and shares boundaries with Kaduna state in the North, Plateau state in the East, Taraba and Benue state in the south, with Kogi and Abuja in the West (Binbol and Marcus 2005). The Doma local government area of Nasarawa state has a land area of 2,714 square kilometer and a population of 139,607 based on the 2006 census and is located 22 kilometers away from Lafia, the state capital. The major occupations of the people are farming and trading. The major crops grown with in Doma LGA are rice, yam, beans, maize, melon, cassava and several others (Sule, 2016). **Figure 1** shows the map of Nasarawa state with its Local Government Areas (LGAs).

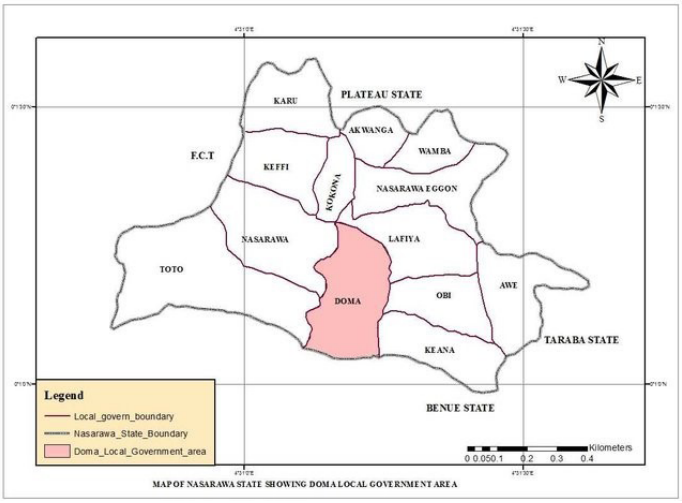

Figure 1: Map of nasarawa state showing doma local government area.

A multistage sampling technique was adopted for this study. In stage I, Doma LGA was selected purposively, as the largest producers of rice in the State. In stage II, five villages which are known to produce rice were selected, also purposively. In stage III, 16 farmers were randomly selected ineach village, giving a total of 80 respondents for the study. Primary data was used for the study. Primary data were collected through the use of structured questionnaires and focus group discussion. The data

were analyzed using descriptive and inferential statistics. Specific objectives 1 and 3 were analyzed using descriptive statistics, while specific objective 2 was analyzed using multiple linear regression. The following multiple linear regression function was applied to determine the factors influencing postharvest losses in rice production.

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots\ldots\ldots + \beta_{10} X_{10} + e$ where,

Y = post-harvest losses of rice in kilogram

β_0 = is the intercept

β_i = is the slope coefficient (i = 1, 2, 3, … n)

X_1 = age of the respondent in years

X_2 = education of the respondent in years

X_3 = gender dummy variable; takes the value "0" if female and "1" if male

X_4 = area under rice cultivation (ha)

X_5 = income of the respondent in Naira (local currency)

X_6 = storage dummy variable; takes the value "0" if the storage facility was assessed as adequate and value "1" otherwise

X_7 = transportation dummy variable which takes the value "0" if transportation facility was assessed as adequate and value "1" if otherwise X_8 = Threshing machine dummy variable ; takes the value "0" if availability of threshing machine during harvest was assessed as adequate and value "1" if otherwise X_9 = access to credit dummy variable; takes the value "0" if access to credit was assessed as adequate and value "1" if otherwise X_{10} = Markets dummy variable ; takes the value "0" if market access was assessed as adequate and value "1" if otherwise

e = Random term.

Results and discussion

Socio-economic characteristics of respondents

Farmers' level of education is one of the vital components of increasing productivity in agriculture since productivity is driven by the adoption of technology [13]. Minimally farmers need to know how to read and understand changing trends in agricultural technology (Taiwo *et al*., 2016). Attempts were made to group respondents by educational status. **Table 1** shows that 37.5% of the respondents had no formal education, followed by 28.8% with secondary education, 22.5% with primary education and 11.2% with post-secondary education. Our result suggests that the level of literacy among the respondents is very low.

Table 1: Measurement of leaf length.

Educational status	Frequency	Percent
Non formal education	30	37.5
Primary education	18	22.5
Secondary education	23	28.8
Post-secondary	9	11.2
Total	80	100

Source: Field Survey, 2017.

Study result shows that there were more male rice farmers (92.5%) than the female rice farmers (7.5%) among the sample studied. As presented in **Table 2**, majority of the respondents (95.0%) that participated in the study are married, followed by single respondents (2.5%) and the widowed respondents (2.5%).

Table 2: Distribution of respondents by marital status.

Marital status	Frequency	Percent
Single	2	2.5
Married	76	95.0
Widowed	2	2.5
Total	80	100
Total	80	100

Source: Field Survey, 2017.

It can be assumed, that a large household size can be an incentive for the adoption of labour-intensive new technologies. Rao *et al* (2001). From the results in Table 3, 38.8% of the respondents have 5 or less members of households, 23.8% have 6-10 members, 21.2% have 11-15 members while 16.2% have 16 or more members per household.

Table 3: Distribution of respondents by household size.

Household number	Frequency	Percent
1-5	31	38.8
6-10	19	23.8
11-15	17	21.2
16 above	13	16.2
Total	80	100.0

Source: Field Survey, 2017.

The analysis shows that the occupation of majority of the respondents is farming (85.0%) and a few numbers of the respondents are involved in other occupation (15.0%). **Table 4** shows that 33.8% of the sampled farmers are 30 to 39 years old, 22.5% are in either in the age group 30 years and lower or 40 to 49 years old, respectively. The results further shows that 16.2% of the farmers are 50 to 59 years old, while only 5% of the farmers that are in age group of 60 years and above. The respondents aged 30 to 39 years were most dominant and likely constitute the agriculturally active group. This has a positive bearing on their ability to adopt new agricultural innovations because majority of the farmers are young [14].

Table 4: Distribution of respondents by age group (years).

Age (years)	Frequency	Percent
below 30	18	22.5
30-39	27	33.8
40-49	18	22.5
50-59	13	16.2
60 above	4	5.0
Total	80	100.0

Source: Field Survey, 2017.

Factors influencing post-harvest losses in rice production

In **Table 5,** the multiple correlation (R) value is 0.953 indicating there is strong positive relationship between post-harvest losses and the causative factors. The coefficient of determination (R^2) is 0.580, suggesting that 58% of the variation in the observed post-harvest losses is explained by the factors listed in the study area. The F value is 2.69 with a P value of 0.08, suggesting an overall relevance of the model to the underlying data. The explanatory variables which positively and significantly explained post-harvest rice losses in the study area are transportation facility, storage facility, threshing machine, credit, market access, income and farm size (area of land). Only marital status, education and gender did not significantly explain post-harvest rice losses among the sample studied.

Table 5: Factors influencing postharvest losses in rice production.

Variables	Unstandardized Coefficients		t-value	Sig.
	B	Std. Error		
(Constant)	5.031	.461	10.903	.000
Marital status	.125	.209	.597	.552
Transportation facility	.031	.145	.215	.031**
Storage facility	.139	.145	.959	.041**
Threshing machine	.090	.119	.757	.052*
Credit	.315	.178	1.764	.082*
Markets Access	.282	.193	1.460	.049**
Education	.006	.009	.733	.466
Income	.088	.143	.616	.040**
Area of Land Cultivated	.080	.024	3.297	.002***
Gender	.294	.192	1.530 ^{NS}	.131
Multiple R	.953			
R square	.580			
Adjusted R square	.176			
Overall F	2.69			
Signi. of F (10.69)	.08			

Source: Field Survey, 2017.

Estimation of post-harvest losses at different stages in rice production

The estimated post-harvest losses in kilograms of rice produced or handled at different stages are presented in Table 6. The farm level post-harvest loss was estimated to be 242.7 kg of rice. The loss was high due to poor harvesting methods (66.3 kg) of the crop and attributed mainly to shedding of rice grains. The grain loss during the threshing activity was estimated to be 49.3 kg, mainly in the form of broken grains. Still at the farm level, the loss due to storage operation was estimated to be 40.6 kg, attributed mainly to poor storage structures, rodents, insects, dampness, and improper drainage at storage places. The grain loss from faulty transportation was estimated to be 25.4kg. A suggestion by [15], is that the losses could be noticed during loading and unloading of produce during transportation. The losses that occurred during cleaning or winnowing operation were estimated to be 40.3 kg, while packing losses was estimated to be 20.7 kg. The total post-harvest loss at wholesale level was 53.3 kg, with 36.2 kg attributed to storage and 17.1 kg due to transit. The post-harvest loss at the processor level was 61.9 kg, attributed to storage (27.7kg), transit (16.7) and grain scattering (16.5 kg). The post-harvest loss at the retail level was 10.2 kg, attributed to transit (3.0 kg), multiple handling of the produce during retailing (1.6 kg), and storage (5.6 kg). The total post-harvest loss is 368.1 kg, attributed to the farm level 65.9%), market level (14.5%), processor level (16.8%) and retail level (2.8%).

Table 6: Estimated post-harvest losses at different stages of rice value chain.

Harvest and post-harvest activities	Losses (Kg)	Loses (%)
Farm level losses		
Harvesting	66.3	27.3
Threshing	49.3	20.3
Cleaning/Winnowing Losses	40.3	16.6
Storage Losses	40.6	16.7
Transport	25.4	10.5
Packaging	20.7	8.5
Total	242.6	100.0
Wholesale level losses		
Storage Losses	36.2	67.9
Transport	17.1	32.1
Total	53.3	100.0
Processors level losses		
Storage Losses	27.9	45.7
Transport	16.7	27.3
Grain Scattering	16.5	27.0
Total	61.1	100.0
Retailer level losses		
Storage Losses	5.6	54.9
Transport	3	29.4
Handling Losses	1.6	15.7
Total	10.2	100.0
Total post-harvest losses	367.2	100.0

Conclusion and recommendations

Conclusion

Rice is by far Nigeria's most important staple crop- access to adequate supplies of rice in Nigeria is generally equated with food security. This study shows that losses occur along all the post- harvest activities for rice based on the responses received from the sampled small holder farmers Nasarawa State, Nigeria. The study estimated post-harvest losses in rice grain and found that about 65.0 per cent of the total post-harvest losses occur at the farm level and about 16.8 per cent at the processor level. The regression analysis has revealed that the explanatory variables which positively and significantly explained post-harvest rice losses in the study area are transportation facility, storage facility, threshing machine, credit, market access, income and farm size.A reduction in losses would mean an increase in total marketed output and hence a potential increase in income for those who able to sell rice. Post-harvest loss reduction can help to close the gap in domestic rice production, which is currently met with expensive imports in the country. It also holds the potential to contribute towards food security, among the rural poor. In the aggregate, a food secure rural sector will also lead to the overall food secure economy.

Recommendations

Based on the results in this study, the following recommendations are put forward: One, more widespread enlightenment is needed on the causes of post-harvest losses and proper harvesting methods for rice crop. Two, public support is needed in the provision of better infrastructure to connect small scale holders to markets. Three, access to microcredit is needed to create opportunities to adopt better technologies that will reduce post-harvest losses in rice production. Four, the public and private sectors need to be encouraged to share the investment costs and risks in market-orientated interventions.

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