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**Research Article**

# Estimates of Post-Harvest Losses among Smallholder Rice Farmers in Benue State, Nigeria

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**Abstract:** The study estimates of post-harvest losses among smallholder rice farmers was conducted in Benue State Nigeria, the objectives includes, describing socio economic characteristics, estimateing post harvest losses and analyzing factors influencing post harvest losses of the respondents in the study area. The States geographic coordinates are longitude 7° 47' and 10° 0' East; Latitude 6° 25' and 8° 8' north. Multi-stage, simple random and purposive sampling procedures were employed in sampling 288 respondents; questionnaire was used for data collection. Means, percentages, frequency distribution tables and multiple linear regression models were used for data analysis. The result showed that, average age was 41 years, mostly males 63% and married 56% with average household size of 8 persons, average farm size was 1.6 hectares, and average years of formal education was 5 and average farm experience was 10 years. An average of 19.2% of farm produce was lost during post harvest activities. Harvesting activity recorded the highest losses followed by threshing, winnowing and storage. Farm experience, losses due to summation of on -farm processing activities, storage losses, theft and insufficient credit facilities influenced post harvest losses in the study area. The study therefore recommends that, rice farmers be trained and provided with facilities that will help in the management of post harvest losses on their farms.
**Keywords:** Estimate, Postharvest, Losses, Smallholders, Rice, and Farmers.

# INTRODUCTION

One third of the world food (about 1.4 billion tons) produced is lost each year during post harvest operations worldwide, the lost food can be estimated to about Us $1 trillion (Gustavsson, 2011; & FAO 2016).The amount of lost and wasted food in high – income regions is higher in the further phases of the food supply chain and vice versa situation in low-income regions were more food is lost in the start–up phases (Aulakh, 2013).This losses are characterized by uneconomic collection, loading and unloading (e.g. in the process of transporting seeds for purchase) clearing, calibration, drying and storage. The size of losses after harvest in the food supply chain varies greatly depending on the crop, geographical area and the type of economy, in developing countries, the society tries to make the best use of produced food, however significant amount of products is usually lost in operations after harvest due to lack of knowledge, inadequate technology for harvesting, transport technology and processing and/or poor infrastructure (Sawicka, 2019). Cereals such as wheat, rice and maize are most popular edible plants in the world and form the basis of the main food items in most developing countries and have the highest losses of about 53% (FAO, 2016). Only sub-saharan Africa (SSA) losses grain worth approximately us $ 4 billion per year. In Nigeria, rice is the leading food crop and is cultivated in all the agro-ecological zones (Maji, 2017). Nigeria is currently the largest rice producing country in West Africa (Danbaba *et al.,* 2019). Rice is a staple food crop in Nigeria, and the demand for rice is put at 7.0mm tones while local production stands at 5.7 mm tonnes the supply and demand gap of 1.3mm tones is met through rice import (Danbaba *et al.,* 2019).

Domestic Demand for rice in Nigeria has been growing at a rapid pace and in many African countries due to changing consumer preference, rising income and growing urban populations. Postharvest loss includes the food loss across the entire food supply chain from harvesting of the crop until its consumption. In the last few years, most of the countries have focused on improving their agricultural output, land use, and other policies measures to cope with this increasing food demand Post harvest food loss a critical issue has not received the required attention only in recent time, post harvest food loss has become a priority area of cooperation between FAO and the world development Banks. It is important to address food security concerns and one of such is appropriate control steps to prevent post harvest food-grain losses. Nevertheless, while government and other organizations are strategizing on how to reduce post-harvest losses particularly for rice in Nigeria little is known about the extent of the losses and factors that characterize the losses, it is necessary to understand the estimates of post harvest losses among the smallholder rice farmers

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# MATERIALS AND METHOD

The study was carried out in Benue State Nigeria, The state was chosen because of the high level of rice production. Multi stage, purposive and simple random sampling procedures were used for the selection of samples for this study. the first stage, the three ADP zones in the state which included Central, Eastern and Northern zones were selected in Benue State, While in the second stage, two rice producing local government areas were selected in each of the three ADP zones which gave a total of six local government areas for this study. In the third stage, one rice producing community within the local government areas was selected purposively to give a total of six rice producing communities for this study. Simple random sampling technique was used to select 294 rice farmers for this study using Taro Yamane's formula. However out of the 294 questionnaires that were distributed, only 288 questionnaires were correctly field and returned for the analysis of this study. They Local Government Areas include: Oju and Ogbadibo in the ADP central zone of the state, while Ushongo and Kwande were selected in the ADP eastern zone of the state, Makurdi and Gboko Local Government Areas were selected in the ADP Northern zone of the State. Simple descriptive statistics such as means frequency distribution tables and percentages were used for the socio economic characteristics and estimates of post harvest losses while multiple linear regression analysis was used to determine factors influencing post harvest losses of rice at the farm gate.

**Multiple Linear Regression Model**

The model was used to explain the factors influencing post harvest losses of rice

The explicit form of the model is:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + ei$$

Where

$Y_i$ = On-farm rice losses in (kg)/Ha
$X_1$ = Age of respondents (in years)
$X_2$ = Sex of the respondents (Dummy 1 for male 0 for female)
$X_3$ = Household size (No. of persons)
$X_4$ = no of years spent in formal education (in years)
$X_5$ = Farm size (hectares)
$X_6$ = Total quantity of rice harvested (kg)/Ha
$X_7$ = Farming experience (years)
$X_8$ = post-Harvest losses due to on farm operations (kg)/Ha
$X_9$ = losses due to transport N (kg)
$X_{10}$ = losses during storage (kg)
$X_{11}$ = losses due to theft (kg)
$X_{12}$ = Losses due to insufficient credit (₦)
$\beta_1$ -$\beta_{12}$ = parameter estimates
$e_1$ = Random error term

# RESULTS AND DISCUSSION

Rice farming is a male dominated enterprise in Benue state Nigeria, as shown in table 1, male constitutes 63.0% of the respondents. In developing countries, males dominate agricultural production due to the laborious nature of traditional farming system and land ownership or inheritance structure. The later cedes landed properties to males and puts household assets under the ownership of the household head. This finding is in line with Aidoo *et al.* (2014) tomato farming in Offinso district in Ghana was dominated by males (77%). Most of these farmers were married (56%). In subsistence farming, marriage is an asset as it is a source of labor for farm work. Average household size was quite large (8) persons. This is typical of farming communities in rural Nigeria and a system where a household comprised some members of the extended family. The result further showed that farmers had average of formal education of about (5) years depicting that they had, at least attempted primary education. The average age of farmers was (40.6) years old. This is the active and prime age at which farmers substantially contribute personal labor to farm work. Average farming experience was about (10) years meaning that most of the respondents got rice farming in recent time. Average farm size was 1.6 hectares meaning that rice farmers in the study area are mostly small scale farmers.

**Table 1.** Socio economic characteristics of the Respondents

| Variable | Frequency | Percentage | Mean |
|---|---|---|---|
| **Age** | | | |
| 17 – 30 | 61 | 21.18 | |
| 31 – 44 | 142 | 49.31 | |
| 45 – 58 | 56 | 19.45 | 40.6 |
| 59 – 72 | 19 | 6.60 | |
| 73 – 86 | 10 | 3.48 | |
| Total | 288 | 100 | |
| **Sex** | | | |
| Male | 182 | 63.0 | |
| Female | 106 | 37.0 | |
| Total | 288 | 100 | |
| **Marital Status** | | | |

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| | | | |
|---|---|---|---|
| Married | 161 | 55.9 | |
| Single | 45 | 15.6 | |
| Divorce | 60 | 20.8 | |
| Widow/Widower | 22 | 7.6 | 8.0 |
| Total | 288 | 100 | |
| **House hold size** | | | |
| 1-6 Persons | 123 | 42.7 | |
| 7-12 | 49 | 17.0 | 1.6 |
| 13-18 | 74 | 25.7 | |
| 19-24 | 42 | 14.6 | |
| Total | 288 | 100 | |
| **Farm Size(Ha)** | | | |
| 0.1-1.6 | 167 | 58.0 | 5.0 |
| 1.7.3.2 | 104 | 36.1 | |
| 3.3-4.8 | 6 | 2.1 | |
| 4.9-6.4 | 6 | 2.1 | |
| 6.5-8.0 | 5 | 1.7 | 9.6 |
| Total | 288 | 100 | |
| **Years of formal Education** | | | |
| **No formal education** | 98 | 34.0 | |
| 1-6 | 103 | 36.0 | |
| 7-12 | 85 | 30.0 | |
| 13-18 | 2 | 0.7 | |
| Total | 288 | 100 | |
| **Farm experience in years** | | | |
| 1-6 years | 86 | 30.0 | |
| 7-12 | 138 | 50.0 | |
| 13-18 | 44 | 15.3 | |
| 19-24 | 15 | 5.2 | |
| 25-30 | 5 | 1.7 | |
| Total | 288 | 100 | |

Field surveys, 2019

The result of Estimates of post harvest losses of rice on the farm as presented in Table 2, the result shows that, many of the respondents 34.0% lost between 21 % - 30% of the rice produce during post harvest handling activities on the farm, 30.0% of the respondents' lost between 1% - 10% of the rice produce during post harvest handling activities on the farm. 21.0% lost between11% - 20%. 16.0% of the respondents' lost 30%-40%. The mean post harvest lost incurred by the respondents was 19.1%. This result differs from several studies. (FOA, 2016) reported that,

Nigeria losses as high as 25% of rice during pre harvest and post harvest operations. According to estimates provided by the African Postharvest Losses Information System APHLIS (2015), physical grain losses (prior to processing) can range from 10 to 20 percent. Estimates of the postharvest losses of food grains in the developing world from mishandling and spoilage are put at 25%. This means that one-quarter of what is produced never reaches the consumer for whom it was grown, and the effort and money required to produce it are lost forever.

**Table 2.** Estimates of post-harvest losses of rice in percentages at the farm gate by smallholder rice farmers in the study area

| Range(%)magnitude of PHL rice losses | Frequency | Percentage | Mean |
|---|---|---|---|
| **1-10%** | 86 | 29.86 | |
| **11-20** | 59 | 20.48 | |
| **21-30** | 97 | 33.69 | 19.18 |
| **31-40** | 46 | 15.97 | |
| **Totals** | 288 | 100 | |

Field survey, 2019

Estimates of post –harvest losses of rice during the performance of various production activities on the

farm The result of estimates of post harvest losses of rice at various production activities on the farm is

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presented on Table 3. The result shows that harvesting activity accounted for the highest losses during post harvest handling activities of rice on the farm accounting for 21.39% of the rice lost, threshing activity recorded the second highest losses accounting for about 20.45% of the total losses, winnowing/cleaning activity accounted for about 14.73%. Storage activity accounted for 18.14% of the total post harvest losses while stockpiling/drying activity accounted for 10.09% of losses and transportation activity accounted for 9.58% of the total

losses. This result shows that, the percentage losses of rice during post harvest handling activities is huge with a total mean value 94.42 kg/hectare. This has negative economic implications on farmers output and and hence standard of living. Post harvest losses in rice occurring during harvesting, threshing, drying, storage and transportation have been estimated to claim between 9.5% to 32,6% in the study area, this imply that, rice farmers loss huge percentage of produce during post harvest operations.

**Table 3.** Estimates of post –Harvest losses of rice at the various activities of production processes on the farm

| Variables | Total PHL of rice at the farm | Mean Postharvest loses (kg/ha) | Percentage (%) |
|---|---|---|---|
| Harvesting | 5817.06 | 20.20 | 21.39 |
| Stockpiling/Drying | 4273.92 | 14.84 | 15.72 |
| Threshing | 5561.28 | 19.31 | 20.45 |
| Winowing/cleaning | 4006.08 | 13.91 | 14.73 |
| Transport | 2600.64 | 9.03 | 9.58 |
| Storage | 4933.44 | 17.1 | 18.14 |
| Total | 27192.42 | 94.42 | 100 |

Field Survey: 2019

**Factors influencing Post Harvest Losses by the Respondents**

Table 4 above shows factors influencing post harvest losses of rice by smallholder rice farmers at the farm stage in Benue State. Four functional forms were tried, which included linear, semi-log, double log and exponential forms. The models were examined in terms of appropriateness. The double log functional form was found to be the best fit. The equation was significant at 1% level with a coefficient of determination ($R^2$) of about 90.The value of the $R^2$ implies that about 90% of the losses incurred by the respondents is explained by the twelve variables included in the model. Five variables were significant with their coefficients conforming to economic criteria, meaning a positive relationship exists between these variables and the dependent variable, increase in the coefficient of any of these variables leads to an increase in the dependent variable which is total post harvest losses of rice at the farm stage. Post harvest losses due to the sum of on the farm processing activities was statistically significant at ($p \leq 0.01$) and positive implying an increase in losses during on farm during post harvest activities will lead to an increase in the total post harvest losses of rice at the

farm stage by 32%, Storage losses was statistically significant at ($p \leq 0.01$) and positive implying an increase in storage losses of rice on the farm will lead to an increase in the total post harvest losses of rice at the farm stage by 20%, Losses due to theft was also statistically significant at($p \leq 0.01$) and positive implying increase in theft of rice on the farm will lead to increase in the total post harvest losses of rice at the farm stage by 5.8%, and losses due to insufficient credit facilities was also statistically significant at ($p \leq 0.01$) and positive, implying that, when a farmer lack access to credit which he desires to use on farm labour during post harvest activities on the farm, this can increase the total post harvest losses of rice on his farm by 40.3% While the coefficient of farm experience was also significant at ($p \leq 0.01$) but negative implying that a negative relationship exists between farm experience and post harvest losses in the study area. as the farmers experience increases post harvest losses decrease by -17% meaning that as a farmer gets use to the farming practices overtime, his experience increases, then he begins to develop techniques of reducing post harvest losses on his farm. A transportation loss was significant at ($p \leq 0.10$) but negative.

**Table 4.** Result of factors influencing the magnitude of post harvest losses by smallholder rice farmers

| Logy | Coef. | Std. Err. | T | P>t | 195% Conf. | Interval |
|---|---|---|---|---|---|---|
| Log Age | 0.1376457 | 0.1165514 | 1.18 | 0.239 | -0.0918006 | 0.367092 |
| Log Sex | 0.000121 | 0.0769621 | 0.00 | 0.999 | -0.1513887 | 0.1516307 |
| Log Household Size | 0.0733726 | 0.0530886 | 1.38 | 0.168 | -0.031139 | 0.1778843 |
| Log Education | 0.0041682 | 0.0293447 | 0.14 | 0.887 | -0.0536007 | 0.0619371 |
| Log Farm Size | 0.0844885 | 0.0621428 | 1.36 | 0.175 | -0.0378476 | 0.2068246 |
| Log Quantity Harvested | -0.0063936 | 0.0530008 | -0.12 | 0.094 | -0.1107325 | 0.0979452 |
| Log Farm Experience | -0.1725742 | 0.0522003 | -3.31 | 0.001*** | --0.2753372 | -0.0698112 |
| Log PH Losses on | 0.3280686 | 0.0334497 | 9.81 | 0.000*** | 0.2622185 | 0.3939186 |

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| Farm operations | | | | | | |
|---|---|---|---|---|---|---|
| Log Transport Losses | -0.0525856 | 0.0304006 | -1.73 | 0.085 | -0.1124331 | 0.0072618 |
| Storage Losses | 0.2015845 | 0.0261977 | 7.69 | 0.000*** | 0.150011 | 0.2531579 |
| Losses due to Theft | 0.0583872 | 0.0161909 | 3.61 | 0.000*** | 0.0265134 | 0.090261 |
| Insf. Credit | 0.4033511 | 0.0150179 | 26.9 | 0.000*** | 0.3737863 | 0.4329158 |
| Cons | 2.105105 | 0.5123944 | 4.11 | 0.000*** | 1.096391 | 3.113819 |

R-squared = 0.8968  Adj R-squared =0.8923  F (12, 275) =51.14        Prob> F =0.0000

**\*\*\*** Significant at 0.01% ** significant at 0.05% * significant at 0.10%

Source: Field Survey 2019.

# CONCLUSION AND RECOMMENDATION

From the findings of the study, it was concluded that average post harvest loss among rice farmers in Benue State was quite large, losses occur during each of the processing activities on the farm with harvesting, threshing, winnowing and storage recording the highest losses. The study concludes that farm experience and a sum of losses during processing activities on the farm, storage losses. Losses due to theft and insufficient credit influence post harvest losses on the farm. The study therefore recommends that, rice farmers be trained and provided with facilities that will help in the management of postharvest losses on their rice farms.

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