**Impact of Post- Harvest Losses of Rice (oryza sativa) on Rice Processors Income in Benue State Nigeria**

**ABSTRACT**

This study impact of post harvest losses of rice on rice processors income was conducted in Benue State Nigeria, the objectives were, to describe socio-economic characteristics of rice processors and to determine impact of post-harvest losses on rice processors income. The study employed the use of purposive, multi stage and simple random sampling procedures to select 150 rice processors using Taro Yamane’s proportionate sampling method. Simple descriptive statistics and ordinary least square regression analysis were used for data analyses. The result revealed, mean age of 41 years, 47.33% were married, 44.67% processed between 7 - 10 100kg bags of rice per week. 74.67% attended formal education, 36.67% had experience of between 10-15 years. Result of impact of post harvest losses of rice on rice processors income using ordinary least square regression model revealed that, adj R2 was 0.56 implying that about 56% of the variation in the income of rice processors is associated with the four variables included in the model, 3 variables of processing losses, storage losses and theft were negative and statistically significant at 1% implying that increase in these variables will lead to decrease in the value of the dependent variable income by the magnitude of their coefficients -5332, -3778 and -2217. The study recommends that; improving modern processing facilities, training and technology can significantly reduce post harvest losses by rice processors. Government and NGOs should invest in modern drying facilities; provide training on post harvest management for rice processors and improve transportation network and efficiency.

**Keywords:** Post harvest losses, Income, Rice processors, transportation network and efficiency.

**INTRODUCTION**

Nigeria is currently the largest rice producing country in West Africa (Danbaba *et al.,* 2019), in 2023 Nigeria’s milled rice was estimated to be 5,229,000 metric tonnes largest in West Africa (Sasu, 2024). *(Gesellschart Fur Internationale Zusammenarbeit* (GIZ) stated that, in 2013 food losses in crops along the [value](https://www.blueprint.ng/tag/value/) chains amounted to about ₦144million. Oguntade, (2014) stated that, 11.39% of paddy, produced in Nigeria that is about 1.99 Million Metric Tonnes of paddy constituted losses which was valued at 269.09 billion naira. Oba (2020) stated that, “[Nigeria](https://www.blueprint.ng/tag/nigeria/) is losing about $9 billion annually due to this menace which poses serious implications for food security and income”. “Post-harvest loss of rice includes loss across the entire supply chain from harvest until its consumed” (Aulakh *et al.,* 2013)., the losses significantly put at risk the livelihoods of small holder farmers across rice value chain, “It reduce the overall prosperity of the country and contributes to undernourishment among the large minority of the population that live in fragile ecosystems and or have little access to affordable imported foodstuffs. Hence, the elimination of post-harvest losses of Agricultural products is important to boost food security and availability” (FAO, 2016). Interventions in post-harvest losses reduction are seen as an important element in the efforts of many agencies to reduce food insecurity, shore up farmer’s income and the prosperity of the nation. Post-harvest losses due largely to the socio-economic characteristics of rice processors, the absence of viable storage and processing facilities are some of these challenges, which have impoverished farmers and dampened their enthusiasm for farming. Coker and Ninalowo (2016) reported that “these losses lead to heavy loss of income and food supplied to rural families’ thereby threatening household food security and that, in the face of threat of household food security, malnutrition easily results. However, a huge supply and demand gap already exists in domestic rice production and processing, which has led to high prices for the commodity in the country. Consequently, if processing losses are not checked, household food and nutrition security will be worsening, as evident in the impact of the menace”. Therefore, an understanding of post-harvest losses among smallholder rice processors is important owing to the persistent, severity and huge impact of post-harvest losses on the economy. This study therefore will analyze the socio economic characteristics of rice processors and determine the impact of post harvest losses of rice on rice processors income in the study area.

**Materials and Methods**

***The Study Area***

Benue state is Located along longitude 8o4’E and10o E. Latitude 6o 30’E and 8o10o’N, the state is endowed with abundant agricultural resources and is often referred to as the food basket of the nation. About eighty percent of the total population depends on agriculture for their sustenance and livelihood. The state has favourable climatic conditions and fertile soils conducive for the rearing of animals and cultivation of virtually all crops grown in Nigeria. Most prominent among the animals reared are pigs, goats, poultry and cattle while major crops grown are cassava, yam, rice, soybeans, sesame, maize, citrus, mangoes, vegetables and sugarcane etc. There is also available large capacity for fish production as a result of wide expanse of natural water bodies in the state. Benue state is located in the middle belt of Nigeria and derives its name from river Benue which is the second largest river in Nigeria. The state has the following features: Administration: Benue state was created in 1976 with Makurdi as the headquarters. At present, the state has 23 local government areas namely: Ado, Agatu, Apa, Buruku, Gboko, Gwer-East, Gwer-west, Guma Katsina-Ala, Kwande, Konshisha, Logo, Makurdi, Oju, Obi, Otukpo, Okpokwu, Ohimini, Tarka, Ukum, Ushongo, Vandeikya, And Ogbadibo. All these local governments are actively involved in agricultural activities. Demography: at present, the state has an estimated population of 5,663,355 million people, (NPC, 2021) and 4530.684 farm families. The average farm family size is seven (7) persons. Also, about eighty (80) percent of its current estimated 5.7 million people, that is about 4530684 persons earn their living from farming and other agricultural activities (SIB, 2012). The Estimated Land: the state has a land area of 33; 95sq.km. The land is level and made up of undulating plains at elevations ranging from 150m-300m above sea level. Climate: the state enjoys a tropical climate with two distinct seasons. The rainy season is from April to October while the dry season is from November to March. Annual rainfall varies from 1,750mm in the southern part to 1250mm in the north. Average annual temperature varies from 32Oc-380c.



*Figure 1: Map of the Study Area (Benue State) showing the Local Governments sampled*

Source: Geography Department, Benue State University, (2017)

 ***Population and Sampling Technique***

The population for the study was rice processors in Benue state which is the food basket of the nation, Multi stage, purposive and simple random sampling procedures were used for the selection of samples for this study. in the first stage, the three Agricultural Development Programme (ADP) zones in the state were selected, while in the second stage, one rice processing local government area was selected purposively in each of the ADP zones which gave a total of three rice processing local government areas for this study, due to the high concentration of rice processors in this local government areas, in the third stage, two rice processing communities within the local government areas were selected purposively to give a total of six rice processing communities for the study. Simple random sampling technique was used to select 150 rice processors for the study using Taro Yamane’s formula. They LGAS include: Kwande, Gboko and Otukpo Local Government Areas in Benue State.

***Sample Size Selection***

The sample size for this study was determined based on the 238 Rice processors obtained from the preliminary survey conducted in Benue State using Taro Yamane’s formula:

 n = $\frac{N}{[1+(Ne^{2})]}$ (1)

n = required sample size

N = population sample

e = error limit at 5% (standard error of 0.05)

1 = constant value.

Table 1: Sample Selection (Sampling)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| BNARDA ZONES | LGAs | Communities  | Sampling Frame | Sample Size% | Interval  |
| Central Zone | Otukpo | Otukpo Rice mill | 52 | 33 | 1.595 |
| Eastern Zone | Kwande | AdikpoRice Mill | 79 | 50 | 1.595 |
| Northern Zone | Gboko | GbokoRice mill | 107 | 67 | 1.595 |
| Total |  |  | 238 | 150 |  |

Source**:** Preliminary Field Survey, 2024.

***Methods of Data Collection***

Data for the study was from primary source. The primary data was collected through the administration of structured questionnaires to the respondents.

#  *Analytical Techniques*

The analytical techniques used in this study included:

1. Descriptive Statistics;
2. Inferential Statistics

**Descriptive Statistics**

The descriptive statistics such as frequency distribution tables, means, and percentages was employed for this study; these tools were used to describe the socio-economic characteristics of the smallholder rice processors.

**i.** The mean is expressed as:

$x̅=\frac{Ʃfx}{n}$ (2)

Where

$x̅$ = Mean

f=frequency

x=observations

fx=frequency of observations

Si=losses at each activity during processing

i= 1,2 .n

$Ʃfx$ = sum of individual observations

n = sample size

# Ordinary least squares regression model.

The model to analyse the effect of the post-harvest losses on rice processors’ income was expressed thus:

Y=bo+b1X1+b2X2+b3X3+b4X4+µ (3)

Where:

Y = Income from rice processing in N/ton

X1 =Post harvest losses due to processing operations in kg/Ha

X2 = Transportation losses in kg

X3 = Storage losses in kg

X4= losses due to theft in kg

β1 –β4=parameter estimates

µ = Random error

**Results and Discussions**

*Result of socio economic characteristics*

# Age of the respondents

Table2 presents the results of socio economic characteristics, including Age, Sex, Marital status, Scale of operation, Level of education and Distribution according to processing experience of the respondents.

 The result of age distribution of the respondents shows that 43.33% of the respondents fell within the age group of 43-50 years of age, 31.33% fell within the age group of 31-44 years of age, and 14.67 % fell in the age group of 59-72 and above. The mean age of the respondents was 41 years. This therefore could be attributed to the high interest of youths in the processing of agricultural products. This group comprised of youths in their prime age, it indicates the availability of energetic workforce that is required in the farm processing activities. This implies that the youths that are energetic, were more engaged in the processing of rice in the study area.

 Sex is important in agriculture; it determines the type of farming activity a farmer performs (Iorzua *et al.*, 2020). “Agricultural processing activities that require fewer efforts are performed by both male and female farmers, while female farmers mostly perform activities like winnowing, processing and transportation. The result shows that 63% of smallholder rice processors were male while 37% were female. This shows that both male and females are involved in the rice milling operations. Sex involvement in rice processing and post-harvest handling is well recognised among smallholder rice millers” (Iorzua *et al.*2020). In many cases, women are more active in these operations. In Benue State, men, women and the youths are the major players in rice milling and women do handling of parboiling of rice and most post-harvest handling activities of rice. Besides there is division of labour which exists among the sexes, also, gender has become a cross cutting issue in terms of promoting equity. The issues highlighted liaising male and female farmers to appropriate programmes, which target the improvement in household food security, and poverty reduction. Ayoola *et al.* (2011) stated that women were more involved in food processing, marketing and maintenance of the homestead farm.

Marital status means living singly or in a matrimonial relationship, which includes past and presents situation concerning whether one is single, married, separated, or divorced (Ibrahim and Alero, 2012).The result of marital status of the respondents Shows that 47.33% of the respondents were married, while 26.67% were divorced or divorcee. The result also shows that, 16.67 % of the respondents were single, not yet married; while 9.33% were widows/widowers. Majority of the farmers were married implying that, they may have a sense of sharing responsibilities that could foster agricultural production more especially in the use of recommended Trainings on rice post-harvest losses reduction in the study area. Being married in an African society signifies the sign of maturity and responsibilities.

This is the number of bags of rice processed by the respondents. This was measured in number of bags. The result shows the distribution of respondents according to number of bags processed. The result shows that majority of the respondents 44.67% processed 7 to 10 bags of rice per week; 26. 67% of the respondents processed 4 to 6 bags of rice per week, while 16.67 % of the respondents processed 1 to 3 bags of rice per week in the study area. The result revealed that, 6.66% of the respondents processed 11 to 13 bags of rice per week and only 5.33% processed 14 bags of rice and above. This is a pointer to the fact that, rice milling or processing in the study area is still at subsistence level and dominated by small scale processors. This can be attributed to inadequate capital for the purchase of inputs such as paddy rice, payments for labour, processing logistics etc. Since processors lack the means to procure modern processing technologies.

Education is regarded as an avenue for attaining managerial skills; this then increases their awareness in respect of new technology and practices that in turn increases their output. It is true that a person who is well educated is more likely to approach more positively, logically and analytically towards different things in different matter (Khan *et al.,* 2020).This was measured in terms of the total number of years of schooling. More processors that are educated are assumed to be able to process information and search for appropriate technologies to alleviate their processing or milling constraints. The belief is that education gives millers the ability to perceive, interpret, and respond to new information faster than their counterparts without education. The result shows that most of the respondents have attained some level of formal education. The result shows that 36.66% of respondents attained secondary school education while 25.33% of the respondents had no formal education. The result shows that, 22.00% of the respondents attended primary education and only 16.00% of the respondents attended Tertiary education . “The mean number of years spent in formal education was 4 years. In all, 74.67% of the respondents attended formal education and could read and write. The high percentage of literate processors among the sampled respondents implied that, they are capable of adopting innovations and could at least, read and write and have the ability to reduce losses associated with processing of paddy rice into table rice. Education in rice farming is a key factor used by governments around the globe and have routinely advocated investment in education. In addition, information is consistently an essential pillar in the development of farmers in Nigeria because their livelihoods can be improved Information and education raise a positive return to agriculture” (Adebayo *et al*., 2012). This implies that the more educated a respondent is, the easier the adoption of post-harvest technologies could become. This agreed with Yusuf and Fakayode (2012) who found that low level of literacy among the respondents could reduce the adoptability of innovations and effective use of post-harvest technologies.

Milling or processing experience is the measure of the period or number of years an individual has been involved in processing. According to Mubi *et al,* (2012) farm experience enables farmers to adequately organise and manage their farm enterprise in expectation of higher income. The distribution of the respondents according to processing experience shows that, that 36.67 % of the respondents had experience of milling rice for 10 to 15 years, 30.00% of the respondents have been milling rice for 6 to 10 years, while 21.33% of the respondents have been milling rice for 16 years and above and 12.00% of the respondents milled rice for 1-5 years. The mean number of years of milling rice was approximately 10 years. This means that, the respondents have experience in rice processing. This also implies that, the respondents were not only involved in rice processing activities but were also well experienced in rice processing, his experience also increase because of long years of processing.

Table 2. Socio Economic Characteristics of the Respondents

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable**  | **Frequency** | **Percentage** | **Mean** |
| **Age** |  |  |  |
| 17 – 30 | 16 | 10.67 |  |
| 31 – 44 | 47 | 31.33 |  |
| 45 – 58 | 65 | 43,33 | 37.5 |
| 59 – 72 and above | 22 | 14.67 |  |
| **Total** | **150** | **100** |  |
| **Sex** |  |  |  |
| Male | 102 | 68.00 |  |
| Female | 48 | 32.00 |  |
| **Total** | **150** | **100** |  |
| **Marital Status** |  |  |  |
| Married | 71 | 47.33 |  |
| Single | 25 | 16.67 |  |
| Divorced | 40 | 26.67 |  |
| Widow/widower | 14 | 9.33 |  |
| Total | 150 | 100 |  |
| **( No. of bags processed/week)** |  |  |  |
| <1-3 bags | 25 | 16.67 |  |
|  4- 6 bags bags | 40 | 26.67 |  |
|  7-10 baggs | 67 | 44.67 | 30 |
| 11-13bags14 bags and above | 108 | 6.665.33 |  |
| Total | 150 | 100 |  |
| **Educational Attainment** |  |  |  |
| No formal Education | 38 | 25.33 |  |
| Primary Education | 33 | 22.00 |  |
| Secondary Education | 55 | 36.66 | 4.33 |
| Tertiary Education | 24 | 16.00 |  |
| **Total** | **150** | **100** |  |
| **No. of years Processing rice**  |  |  |  |
| <1-5 year | 18 | 12.00 |  |
| 6-10 years | 45 | 30.00 |  |
| 10-15years | 55 | 36.67 | 4.33 |
| 16 years and above | 32 | 21.33 |  |
| **Total** | **150** | **100** |  |

Source: Field Survey, 2024

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# Results of Impact of Post-Harvest losses on Rice processors’ Income in Benue State

The result of the ordinary least square regression estimates of factors influencing effect of post-harvest losses of rice processors income in Benue State was evaluated using Four functional forms namely, linear, semi-log, double log and exponential functional forms of the ordinary least square regression model. The model examined using statistical, economic, and econometric criteria’s. Based on the criteria’s, the linear functional form was found to have the best fit and was selected as the lead equation. The equation was significant at 1% level with a coefficient of determination of 0.5628 and adjusted (R2) was 0.5566. The value of the R2 implies that about 56% of the variation in the income of the rice processors is explained by the five variables included in the model altogether. The result is presented in table 3 and the result of the diagnostic is presented on figure 2. Three variables were significant, and their coefficients conformed to economic criteria. rice processing losses was significant at 1% and negative implying that, increase in rice processing losses will decrease the income of farmers by -5332. This variable and income of processors have an inverse relationship, as losses increase during processing, rice processors will record less output and less output will transmit to low food available for consumption and sales which will lead to decrease in farmer’s income.

The coefficient of storage losses was also significant at 1% and negative with the coefficient of -3778 implying that, losses recorded in storage after processing and storage have an inverse relationship with income of rice processors, as losses during storage activity increases, income of processors is negatively affected.

 The coefficient of post-harvest losses of rice due to theft was also statistically significant at 1% and also had negative coefficient -2217 implying that, as losses due to theft increases, there will also be a decrease in the income of rice processors. Variable of transportation losses was not statistically significant but had negative coefficient, this result is in line with the previous result of Dzahan and Onuh (2023) of this study which stated that post-harvest losses influence farmers’ income in the study area. Dzahan *et al* (2023) reported that post-harvest losses cause a reduction in rice farmers’ income. Oguntade (2014) revealed that a significant and positive correlation exist between income and post-harvest of farm activities.

Table **3: Result of the effect of post-harvest losses on smallholder rice processors’ income in Benue State**

|  |  |  |  |
| --- | --- | --- | --- |
|  Income of rice farmers  | Coefficients | Standard Error | T-value  |
|  processing losses | -5332.127 \*\*\*  | 293.9151  | - 18.14  |
| Transport loses  |  -5.542374  | 11.95973  | -0.46  |
| Storage losses  | -3778.435\*  | 2132.767  |  -1.77  |
| Loses due to theft  | -2217.02 \*\*\*  | 848.514  | -2.61  |
| Constant  | -356722.8\*\*\*  | 115026.5  | -3.10  |
|  | R-squared 0.5628 | adj R-squared 0.5566 | pro>F =0.000 Root MSE =1.4e+04 |

\*\*\*significant at 1% \*\* significant at 10%.

*Source; Field survey, 2024*

***Standardized residual graph of rice farmers’ income***

Figure 2 shows the result of standardized income residuals of rice processors, the graph depicts that, although there are variations from the zero mean line, but the plots do not follow a particular pattern and are therefore randomly distributed within the mean value of zero. Since the residuals points of the plots are randomly dispersed and do not follow a particular pattern, therefore, the linear model is an appropriate model for this data.

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**Figure 2 Standardized residual graph of rice processors’ income**

***Field survey, 2024***

***Conclusion***

This study impact of post harvest losses of rice on rice processors income was conducted in Benue State Nigeria, the objectives were, to describe socio-economic characteristics of rice processors and to determine impact of post-harvest losses on rice processors income. The study employed the use of purposive, multi stage and simple random sampling procedures to sample rice processors using Taro Yamane’s proportionate sampling method. Simple descriptive statistics and ordinary least square regression analysis were used for data analyses. The result revealed that majority of those interviewed were within the active age range, most of them were also married, and majority of the respondents processed an average of 7 - 10 100kg bags of rice per week. Most of them also attended formal education; majority of the respondents also had experience of between 10-15 years. Result of impact of post harvest losses of rice on rice processors income using ordinary least square regression model revealed that, about 56% of the variation in the income of rice processors is associated with the four variables included in the model, 3 variables of processing losses, storage losses and theft were negative and statistically significant at 1% implying that increase in these variables will lead to decrease in the value of the dependent variable income by the magnitude of their coefficients. The study therefore recommends that; improving modern processing facilities, training and technology can significantly reduce post harvest losses by rice processors. Government and NGOs should invest in modern drying facilities; provide training on post harvest management for rice processors and improve transportation network and efficiency.

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