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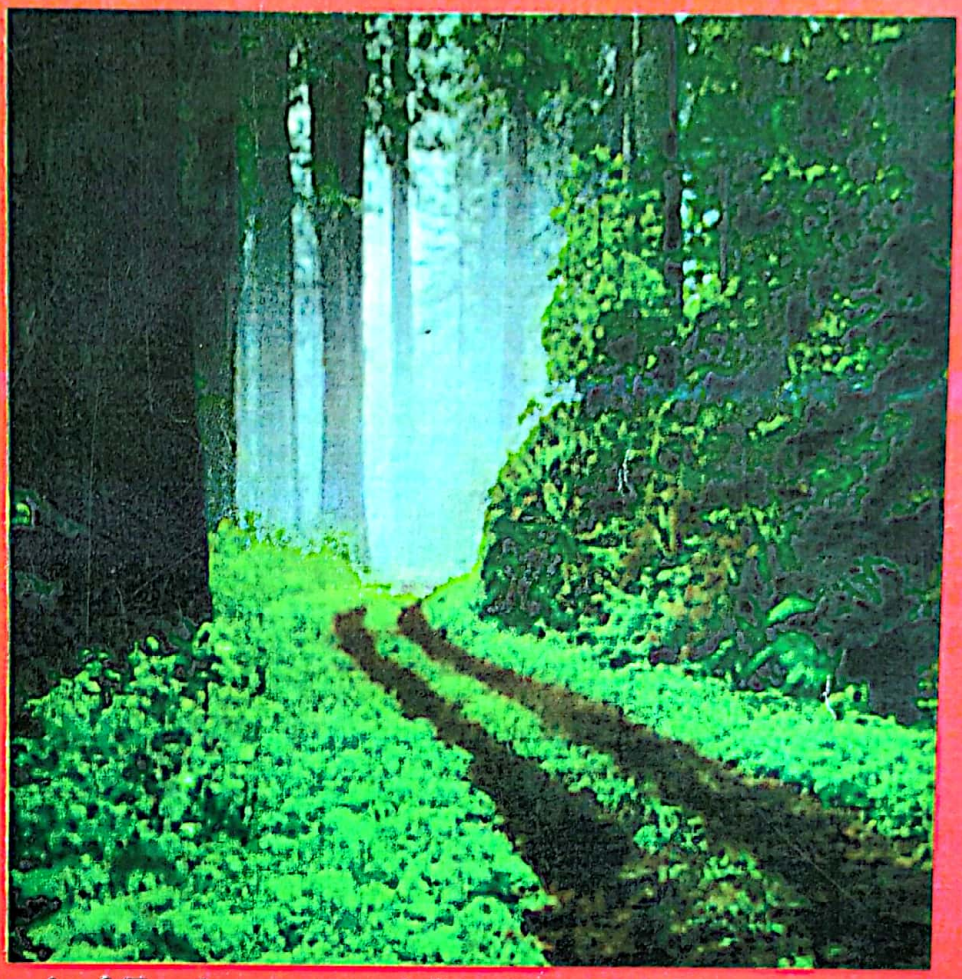

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RICE POST HARVEST MANAGEMENT PRACTICES, TECHNIQUES AND LOSSES ON INCOME OF THE FARMERS IN NORTH - CENTRAL, NIGERIA

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Abstract

Rice Post harvest management and losses were the major factors affecting food availability and security in many countries due to qualitative and quantitative losses during handling operations. The multistage sampling was used to select 200 respondents. Primary data was collected using structured questionnaire. Descriptive statistics and multiple regression analysis were used to analyze the data. The study shows that 100% of the farmers practiced rice harvesting, threshing, winnowing, drying, bagging and transportation, while 64% of farmers practiced storage systems and 63% of the farmers market their paddy rice directly. The study also shows that 97% of farmers cut their rice 4-5cm above the ground level during harvesting, 72% of farmers threshed on bare ground. The result indicated that 99% of farmers winnowed manually, 97% dried in the field before threshing, 88% used bags for storage. The results revealed that farmers in the study area are affected by rice post harvest losses during harvesting; threshing and winnowing were significant at 1% probability level. Storage losses were significant at 5% level of probability while parboiling losses was significant at 10% probability level. The study recommends adoption of improved technologies and use of post harvest machines by the farmers to reduce losses.

Key Words: *Post harvest, Losses, Income, Qualitative, Quantitative, Improved technologies*

Introduction

In Africa, rice is the fastest growing food source and its demand has been growing faster than other parts of the world far more than the sub-regional population growth in recent years, (Competitive African Rice Initiative, 2004). Due to the proximity of the study area to National Cereals Research Institute, were the technologies emanated most of the farmers planted improved varieties such as Faro 44, Faro 52, Faro 60, Faro 61 and other local varieties. One of the most critical factors in rice production is rice post-harvest system and requires utmost attention as rice is the major staple food in the world since every grain produced has to pass through proper handling before consumption (Mejia, 2002). A post-harvest system is a sequence of processes as a part of rice production cycle which involves handling techniques or treatments applied to the economic part of rice harvested from the

field for the purposes of transforming it into a form, condition, or composition that adds value, makes it storable or prolongs its shelf-life, and makes it useable or edible.

Post-harvest rice loss encompasses loss of grains in quality and quantity between the point of harvest and consumption of the crop (Harries and Lindblad, 2002). Post-harvest losses are the major problem in all food crops production, losses occurred during harvest and post-harvest activities. Post-harvest losses significantly affect the livelihood of farmers across the value chain by reducing valuable income and profitability. The annual demand for rice in Nigeria was estimated at 6.9 million metric tons which about 3.7 million metric tons are locally produced, while 3,200 hectares is cultivated for rice production. Many Countries including Nigeria had not been able to attain self-sufficiency in terms of rice production despite huge potentials and government interventions in the sector, which may be attributed to the losses, encountered by farmers' during post-harvest operations. Sequel to the above, this study examined the effect of rice post-harvest losses on farmers' income in North- Central, Nigeria. Therefore the study aim to describe the post-harvest management practices by farmers in the study area, identify rice post-harvest management techniques adopted by farmers in the study area and determine the effect of rice post-harvest losses on the farmers' income in the study area.

Study Area

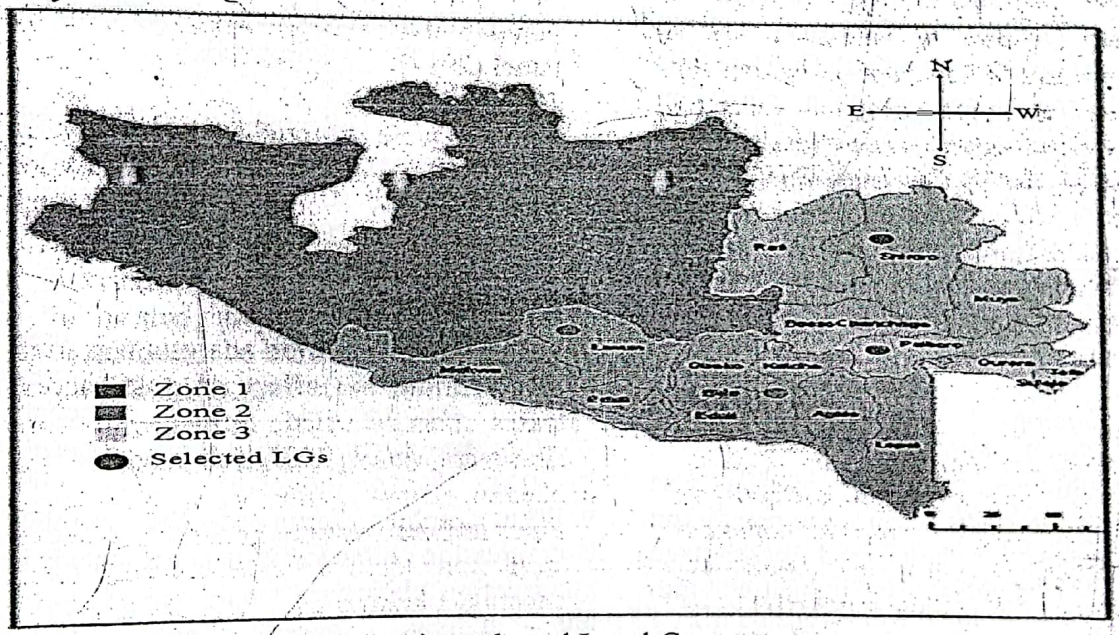

Fig: 1 Map of Niger State showing selected Local Government

The study was carried out in Niger State, Nigeria. The State was created out of the then North-Western state in 1976. The State lies between latitude 8° 11′ and 11° 20′ N of the equator, and longitudes 4° 30′ and 7° 15′ E of the equator. Kaduna State and FCT are her borders to the North-East and South-East respectively;

Zamfara State borders the North, Kebbi State in the West, Kogi State in the South and Kwara State in the South West, while the Republic of Benin along Agwara LGA boarders her North West. It covers an estimated area of 76,469,903 square km and the State has a population of 3,945,772 (NPC, 2006). According to the population growth rate of 2.5 percent in Nigeria (World Bank, 2013), the population of the State was projected to 7,003,745 as at 2018. Gwari, Nupe and Hausa are the major ethnic groups in the State (Usman *et al.*, 2017, Ndagi, UM, 2012)

Niger State experiences distinct dry and wet seasons with annual rainfall ranges between 1,100mm to 1,600mm. The average minimum temperature is about 26° C while the average maximum temperature is about 36° C. The mean relative humidity ranges between 60 percent (January to February) and 80 percent (June to September).The state falls within the guinea savannah vegetation belt, which supports the cultivation of root crops and grains. The predominant crops are rice, sorghum, millet, yam, groundnut and cotton (Lawal *et al.*, 2013). Livestock such as poultry, small ruminants and cattle are also raised by the farmers which serve as means of savings.

Methodology

Sampling Techniques

Multi-stage sampling method was used in the study because the population of interest is large and multi-stage sampling divides the population into distinct groups. The first stage involved a random selection of two Local Government Areas each from Agricultural zones I and II and one local Government Area from Zone III. The selected local Governments Areas were Katcha and Lavun for Zone I, Shiroro and Paikoro for Zone II and Wushishi for Zone III respectively.

Second stage involved random selection of villages from the selected Local Government Areas. Third and last stage involves proportionate selection of farmers in the selected villages based on the required sample size. However, based on the population of rice farmers in the rice production clusters of the study area, since the population are small as the case with rice production clusters (villages) in the selected Local Governments Areas, the Yamane formula was used in the study to select samples proportionate to the population in each community as cited by Israel (2013).

Data Collection

Data were collected from primary and secondary sources using personal interviews and structured questionnaires administered to 200 selected rice farmers in the study area.

Data Analysis

Multiple regression analysis was used to determine the effect of post-harvest losses on the rice farmer's income (Basavaraja *et al.*, 2007, Taherzadeh *et al.*, 2013).

The implicit form of the multiple regression models is as presented in equation 1 below;

$$Y = f(x_1, x_2, x_3\ x_4, x_5, x_6, x_7, x_8, x_9, e_i) \quad (1)$$

Four functional forms were tried and their explicit expressions are stated in equations: 2, 3, 4, and 5

Linear:

$$Y = \alpha + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + e_i \quad (2)$$

Exponential:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + e_i \quad (3)$$

Semi-log:

$$Y = b_0 + b_1\ln X_1 + b_2\ln X_2 + b_3\ln X_3 + b_4\ln X_4 + b_5\ln X_5 + b_6\ln X_6 + b_7\ln X_7 + b_8\ln X_8 + b_9\ln X_9 + e_i \quad (4)$$

Double-log:

$$\ln Y = b_0 + b_1\ln X_1 + b_2\ln X_2 + b_3\ln X_3 + b_4\ln X_4 + b_5\ln X_5 + b_6\ln X_6 + b_7\ln X_7 + b_8\ln X_8 + b_9\ln X_9 + e_i \quad (5)$$

Where,

Y= Rice output (kg)
X_1= Harvest losses (kg)
X_2 = Transportation losses (kg)
X_3=Threshing losses (kg)
X_4 = Winnowing losses (kg)
X_5 = Drying losses (kg)
X_6 = Storage losses (₦)
X_7= Parboiling losses (₦)
X_8= Milling losses (₦)
X_9= Marketing losses (₦)
e_i= error term.

Result and Discussion

Rice Post harvest Management Practices in the Study Area

The management practices distribution of rice post-harvest operations in the study area is shown in table 1. This involves all the basic activities carried out from field to marketing of rice. Farmers are involved in different practices in rice post-harvest aspect which varies from location to location, which aimed at producing better quality rice. The result in Table: 1 revealed that 100% of the farmers practiced rice harvesting, threshing, winnowing, drying, bagging and transportation, while 64% of farmers practiced storage systems and 63% of the rice farmers market their paddy rice directly without further processing. This agrees with the findings of Danbaba *et al.*, (2010), who recorded that farmers carried out major rice post-harvest operations in rice producing clusters. The result also shows that 31% of the respondents practiced parboiling of paddy and 28%, of the respondents also practice milling of rice, while 27% of the respondents practice milled rice marketing respectively. These rice parboiling, milling and milled rice marketing are mostly performed by women, though men handle milling machines for them. However, packaging and branding of milled is done by 3% of the respondents, which shows low level of locally branded rice in our markets. Major rice post-harvest operations are being practiced by farmers in the study area, though at traditional or manual level. Packaging and branding are being practiced by very few

farmers, which has effect on the income of the farmers. This results is similar to the findings of Basavaraja *et al.* (2007), CIRDAP (2010) and Danbaba *et al.* (2010) and IRRR (2012) who reported that produced on the farm have to pass through series of operations and exchange before getting to consumers.

Table: 1 Rice harvest and post-harvest management practice

Variables	Frequency	Percentage
Harvesting	200	100
Threshing	200	100
Winnowing	200	100
Drying	200	100
Bagging	200	100
Transportation	200	100
Storage	128	64.0
Paddy marketing	125	63.0
Parboiling of paddy	62	31.0
Milling of rice	56	28.0
Packaging & branding	5	3.0
Milled rice marketing	53	27.0

*Multiple response allowed

Rice Post-harvest Management Techniques in the Study Area

Table: 2 shows the distribution of respondents according to different post-harvest management techniques adopted or practiced by farmers in the study area. Rice post-harvest management techniques indicated what should be done, when it should be done, how it should be done to prevent or reduce losses of rice and enhanced income. Table: 2 shows that 97% of farmers cut their rice 4-5cm above the ground level during harvesting; only 3% practiced panicle harvesting method. This implies that farmers in the study area harvested rice manually using sickle or knife. It also shows that 72% of farmers threshed rice on bare ground while 28% thresh on tarpaulin or sacks. This explains why the locally produced rice is characterized by the presence of sand and stone, since the grains are threshed on bare ground, which affects the quality of the product and market value. The result also shows that 99% of farmers winnowed their rice manually, which causes losses of grains, 97% dried their rice in the field before threshing, causing high percentage of cracked grains, 88% used bags for storage of rice. The result also shows that 47% of the farmers used bicycle or motorcycle for the transportation of rice, 28% used car as a means of rice transportation while 18% used animal as a means of rice transportation. The results indicated that sacks storage system, paddy marketing through middlemen and traditional system of rice parboiling is prevalent in the study with 92% of respondents, 71% and 64% respectively.

The results also showed that steel huller mill is commonly used in the study area by farmers which recorded 51%, while measure (mudus) is the major means of marketing milled rice in the study area with 54%. This implies that the yield of milled will be lower compared to other improved mills that gives high milling recovery and use of measure gives room for more bargaining from consumer compared to packaged rice that has fixed price. The results in Table: 2 revealed that

79% of the rice farmers in the study area sold their produce within the first three month of harvest while 21% sold their rice within six months of harvest. This could be due the fact that farmers needed to pay for debt, school fees, medical bills and ceremonies, majority of farmers' sales off their rice within three months of harvest when the prices are low, thus resulting to low farm income. This agrees with the findings of Didier *et al.* (2013) and Abebe and Bekele (2006) who reported that farmers sold off their grains immediately after harvest, making them to be buyer of the grains for family consumption, but contrasted the findings of Kaminski and Christiaensen (2014), who recorded that 20% of total production is kept for household consumption or future marketing.

Table: 2 Rice harvest and post-harvest management techniques practiced by the respondents

Variables	Frequency	Percentage
Harvesting		
Panicle harvesting	6	3.0
Cutting above the ground	194	97.0
Threshing		
Threshing on tarpaulin or sacks	56	28.0
Threshing on bare ground	144	72.0
Winnowing		
Manual winnowing	197	98.5
Mechanical winnower	3	1.5
Drying		
Field drying before threshing	194	97.0
Drying after threshing	6	3.0
Bagging		
Jute bags	175	87.5
Polythene bags	19	9.5
None (do not use any of the above)	6	3.0
Transportation		
Bicycle/Motorcycle	94	47.0
Car	56	28.0
Animal	36	18.0
None (do not use any of the above)	14	7.0
Storage Systems		
Rhumbu	3	1.5
Sacks	183	91.5
Pots	14	7.0
Paddy Marketing		
Open Market	22	11.0
Contracts Marketing	14	7.0
Middlemen	141	70.5
None (do not use any of the above)	23	11.5
Parboiling		
Improved system	16	8.0
Traditional system	128	64.0
None (do not use any of the above)	56	28.0
Milling		

Custom milling	3	1.5
Rubber roll mill	4	2.0
Steel huller mill	101	50.5
None (do not use any of the above)	92	46.0
Packaging/branding		
Packaged and branded milled rice	3	1.5
Measure (mudus)	107	53.5
None (do not use any of the above)	90	50.0
Milled rice marketing		
Open market	22	11.0
Contract marketing	18	9.0
Middlemen	85	42.5
None (do not use any of the above)	75	37.5
Sales of harvested rice grain		
Within 3months of harvest	158	79.0
Within 6months of harvest	42	21.0

*Multiple response allowed.

Effects Rice Post harvest Losses on Farmers' income in the Study Area

The results in Table: 3 shows the four functional forms used in regression analysis semi- log function as the lead equation, with R^2 value of 0.3613 which implies that 36% variation in income of the rice farmers from harvesting to marketing was explained by the nine explanatory variables included in the model. The F- ratio 14.34 was significant, thereby indicating the good fit of the regression models. The result further shows that harvesting (X_1) threshing (X_3), winnowing (X_4) were statistically significant at 1% probability level, storage losses(X_6) was statistically significant at 5% levels of probability while parboiling (X_7) was statistically significant at 10% level of probability, indicating their coefficient conforming to the a priori expectations. This implies that during rice post-harvest operation losses significantly affects the income of rice farmers positively in the study area. The harvesting losses, threshing losses, winnowing losses and storage losses were positive indicating increase in rice farmers' income. (Guise, 2010) reported that during on farm activities farmers' experienced significant losses of their grains, which invariably affects their income. When there are losses the farmers output will be low, likewise the income accrued to the farmer. This is also in consistent with the findings of (Asiedu and Vas Gastel, 2001, Basavaraja *et al.* 2007, FAO, 2004, and Coker and Ninalowo, 2016), who reported that post-harvest losses affects the income of the farmer, living standard and wastage to the national food supply.

Table 3: Regression analysis on the effect of rice post-harvest losses on farmer's income

	Linear form	Exponential form	Double-log form	Semi-log form
	Coefficients & T-values	Coefficient & T-values	Coefficient & T-values	Coefficient &T-values
Harvest losses (X_1)	246316.6	0.641	0.260	93734.75
	(5.53)***	(4.16)***	(3.76)***	(4.91)***
Transport losses (X_2)	-29270.83	0.075	0.015	-6947.15
	(-0.45)	(0.30)	(0.32)	(0.51)
Threshing losses (X_3)	43078.51	0.414	0.178	40201.25
	(0.34)	(0.81)	(2.74)***	(2.68)***
Winnowing losses(X_4)	389697.7	2.068	0.426	79538.39
	(3.34)***	(4.35)***	(4.68)***	(3.92)***
Drying losses (X_5)	18204.97	-0.321	0.027	41871.69
	(0.11)	(0.48)	(0.11)	(0.68)
Storage losses (X_6)	5.984	0.000	0.086	46465.88
	(1.55)	(0.46)	(1.07)	(2.01)**
Parboiling losses (X_7)	-7.069	-0.000	-0.133	-29494.30
	(1.81)*	(1.90)*	(1.80)*	(1.56)*
Milling losses (X_8)	8.391	0.000	0.011	-9671.127
	(1.42)	(2.13)**	(0.20)	(0.49)
Marketing Losses (X_9)	-3.933	0.000	-0.038	-11362.267
	(1.26)	(1.57)	(0.53)	(0.55)
Cons	57316.5	11.708	13.937	539275.8
	(1.02	(55.45)***	(22.89)***	(3.27)***
R_2	0.38	0.33	0.35	0.36
F	11.86	11.42	14.35	14.34

Numbers in parenthesis are t - values, ***= Level of significance $p \leq 0.01$, **= level of significance $p \leq 0.05$ *= level of significance $p \leq 0.10$. Source: Field survey, 2016

Conclusion and Recommendations

The study examine rice post harvest management practices, techniques and losses on the farmers income in the study area, since paddy rice is subjected to more handling and processing steps as it moves from the field to the consumer table than any other cereal grain. During these handling stages magnitude of losses are encountered by farmers, which many do not recognized as losses. However, from the empirical findings, we concluded that rice post harvest management activities such harvesting, threshing, winnowing, storage, processing and marketing prevailed in the study area. Farmers in the study area experience significant losses during harvesting, threshing, winnowing, storage and parboiling operations. Therefore farmers should harvest their rice timely by visual appearance, colour, size, and the moisture content, thresh on wide tarpaulin or plastic sheets with the edges raised to catch all the grains being threshed or use a clean concrete slab. The use of good rice post harvest equipment or machineries is recommended such as rice reapers, threshers, winnowers, improved rice parboilers, good mills and dryers. During parboiling operation, proper cleaning before stepping, soaking at the right temperature and moisture content, proper steaming and avoid continuous or rapid drying in the sun to avoid cracks.

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