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Research Article

Socio-Economic Analysis of Rice Postharvest System among Rice Producers in the North and South of Sierra Leone

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Abstract: This study examined the socio-economic characteristic of rice farmers and post-harvest losses of rice at three different stages (harvesting, threshing and milling) at selected Agricultural Business Centers (ABCs). Multistage sampling technique was used to select 150 rice farmers' household from major rice producing Agricultural Business Centers (ABCs) in the North and South of Sierra Leone. Results from the study showed 71% of the rice farmers cultivated between 1 and 3 hectares; 66% had farming experience of over 30 years. Ironically, 99% endured post-harvest losses, ranging from 7 to 25%, with threshing losses accounting for 25%, on per capita basis. Average income per farmer stood at Le 511,584.000 /Ha. The ordinary least squares regression estimates shows threshing losses and household sizes were significant determinants of rice farmers' income at 1% and 5% probability level respectively, while the analysis of constraints revealed that lack of harvesting equipment constituted the main challenge to rice post-harvest loss mitigation, as affirmed by 92.50% of the respondents. The study concluded that threshing losses had adverse effect on rice farmers' income and consequently threshing losses has a negative influence on rice farmers' income in the study areas. Losses from this source also constituted the bulk of losses encountered by rice farmers representing average of 25% of post-harvest losses, while the lack of processing equipment hindered processing operations. It is recommended that mechanization of the postharvest activities, providing technical knowhow and access to financial resources to acquire appropriate inputs could help reduce loses in rice production.
Keywords: Postharvest loss, Socio-Economic, Rice Farmers, Agricultural Business Centre, Processing.

Introduction

Sierra Leone a West Africa state that occupies 72,300 km^2 area, largely depend on natural resources as means of generating revenue by the government and agriculture serve as primary activities of the rural population. According to AgCLIR (2016), agriculture account for 59.2% of the working age population which is consider as self-employed.

Rice (*Oriza* spp) a major staple food crop globally consumed by over half of the world's population and the second widely cultivated cereal after wheat (WARDA, 2005 and IRRI, 2009a). It is also the top most cereal that is daily consumed nearly by every household in Sierra Leone. It is the single largest household food that consumed by almost every Sierra Leonean household daily. According to research by World Bank Poverty Reduction & Economic Management Unit Africa (2012) rice constitute about 20% of total spending for the average household.

Generally, Asia account for 90% of rice produces global with an estimated of 640 million tons in 2009 and a production area of 158 million hectares (IRRI, Africa Rice and CIAT, 2010). According to Muthayya *et al.,* (2014) China and India account for approximately 50% of annually production of rice with global annual production estimated to be 480 million metric tons of milled rice.

The Agricultural Business Centre (ABC) approach is an initiative of the Government of Sierra Leone in collaboration with the Food and Agriculture Organization (FAO) and World Food Program (WFP).

This approach is expected to providing a one-stop facility that responds to the farmers' need for an easy access to the factors that can enable them perform better. These includes offering services such as bulk input purchases and distribution, equipment hire services, processing and group marketing. It also address and reduce the risks to success of the ABCs, namely, lack of ownership and management capacity at the community level and sustaining the interest of stakeholders long enough to reach break-even point for first time service providers. Since the inception of the ABC model in 2010, a total of 193 ABCs have been established nation- wide (Gove of SL, 2010).

Smallholder farmers usually face diseconomies of scale in accessing the critical factors needed for them to improve their farming practice and increase agricultural productivity (e.g. improved seed, agro-chemicals, extension services, pest control credit, storage and marketing). These need to come as a package to be meaningful and useful for the farmer as the absence of some can lead to failure in any effort meant for agricultural development. It has been observed that the few service providers dispersed and accessing them can be cumbersome.

The Overall goal of the Smallholder Commercialization Program (SCP) was to reduce rural poverty and household food insecurity on a sustainable basis, and to strengthen the national economy (Gbla *et al.,* 2014). The specific Objectives of the SCP were to: Promote commercialization of smallholder Agriculture through increasing productivity, intensification, value addition, postharvest infrastructure, and marketing with emphasis on commodity chain development and institutional strengthening to build self-reliance of farmer-based organizations (FBO) and broaden smallholders' access to rural financial services tailored to the specific needs of clients expected to be individuals and groups, in particular FBOs/ABCs, etc. (Gbla *et al.,* 2014).

Since the establishment of the ABCs, there is insufficient data on socio-economic analysis of rice postharvest system among rice producers at the ABCs in Sierra Leone. Hence, it is urgently needed to estimate postharvest losses of rice producer and the socio-economic impact of their livelihood.

Therefore, the aim of this study is to access the performance, postharvest losses, and socio-economic impact of rice producers among the best performing ABCs in the North and South of Sierra Leone.

Study Methodology

This study was undertaken in the North and Southern provinces of Sierra Leone where four (4) districts were covered in the North (Tonkolili, Kambia, PortLoko, and Koinadugu) and four (4) districts in the South (Bo, Bonth, Moyamba and Pujehun).

Northern Province covers an area of 35,936 km^2 (13,875 sq mi) with a population of 2,502,865. The Southern Province covers an area of 19,694 km^2 and has a population of 1,438,572 (Statistics Sierra Leone, 2015).

Method of data collection

Data for this study was generated with the use of semi-structured questionnaires and physical estimation of postharvest losses. The questionnaires were administered to respondents through face to face interview.

Population and Sample size

The target population for this study comprised farmers in Agribusiness center (ABC) in the Northern and Southern regions in Sierra Leone. The population is 435 farmers, which consists of 8 Agribusiness Centers. The sample size is 150 farmers obtained by random sampling technique.

Sampling Technique and Sample Size

Multi-stage sampling technique was employed in selecting eight (8) Agricultural Business Centers (ABCs) from the two provinces, which comprise of farmers that were involved in rice production in the two regions. One (1) Agricultural Business Center was selected per district.

Analytical Technique

The statistical package for social science (SPSS) was used to analyze the data. Descriptive and inferential statistics was used to report the findings.

Descriptive statistics such as frequency distribution, percentages and tables were used to analyze data.

Results and Discussions

From the analysis below (Figure 1), it was revealed that 53.2% of female farmers kept records of their farming activities compared to male farmers with 37.0% of the respondents. Among the district Koinadugu district recoded the highest (66.7%) of record keeping and the lowest in Bonth district with 50.0%. This result shows that women are the highest records keeper and majority of the farmers do keep records on their farming activities. Record keeping is one of the most important activities of keeping track of input and output of farming; female involvement on farming activities shows better management of activities.

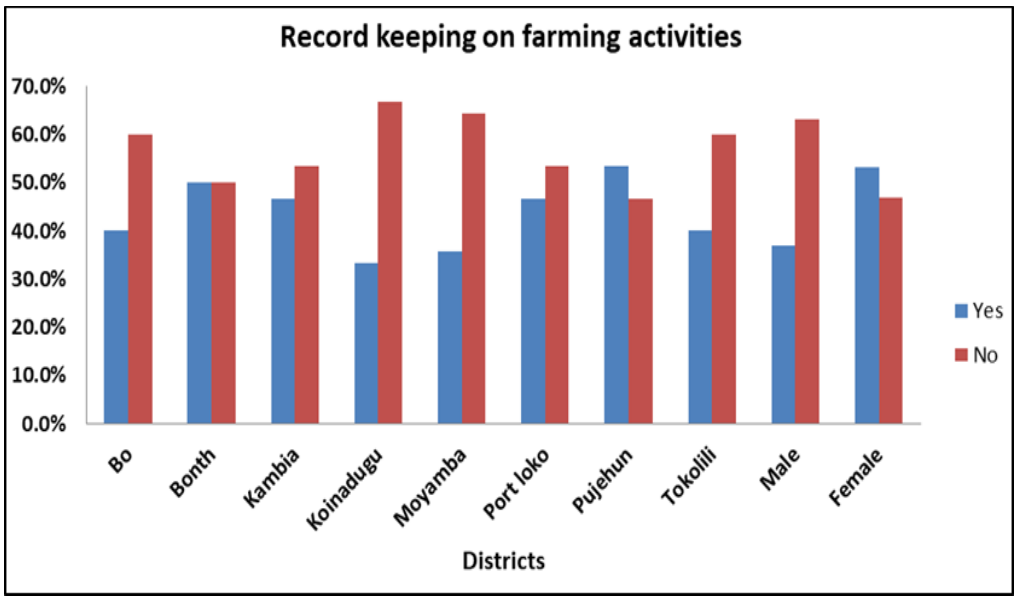

Figure 1. Record keeping on farming activities
(Field Survey 2019)

Figure 2 shows details causes of post-harvest losses in the study areas and their ranking. The attribution variables covered ranged from poor harvesting on the part of the respondents to lack of requisite processing equipment. The results revealed that lack of harvesting equipment was the major cause of post-harvest losses as indicated by an average mean of 4.36 of respondents, the situation aggravated with the lack of processing facility with a total mean of 3.62. Meanwhile, lack of storage facility constituted the least cause of harvest losses, as affirmed by the respondents. Interestingly majority of farmers in both regions indicated lack of storage facilities did not constitute any major problem to them.

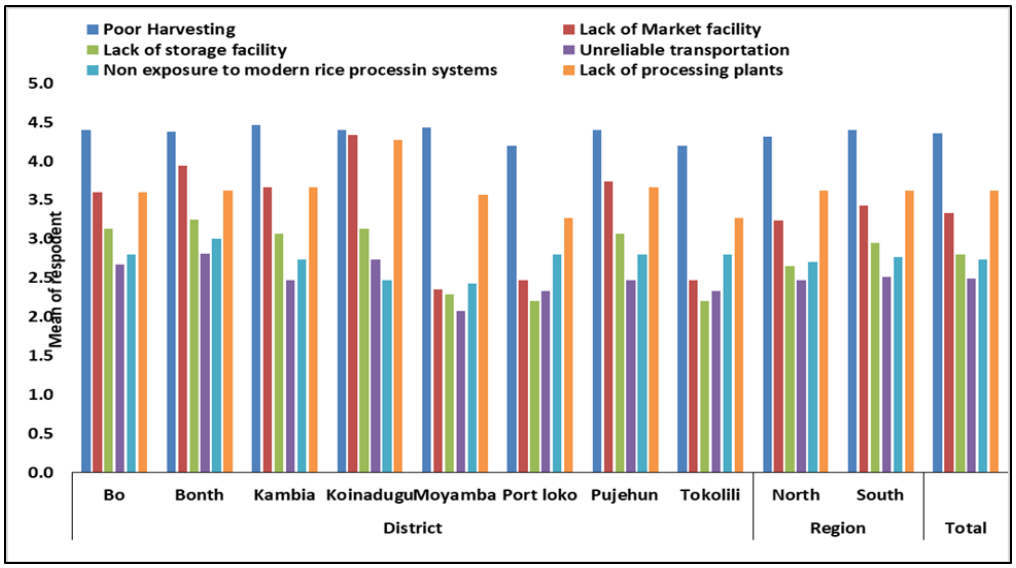

Figure 2. Courses and magnitude of rice postharvest loses from farmers point of view
(Field survey 2019)

Sources and quantity of Post-harvest Losses

Farmer's experience of postharvest losses varied. Ninety nine percent (99%) of the respondents reported that they had experienced postharvest losses of rice whilst the remaining 1% said they had not. According to the farmers, most post-harvest losses in rice production from harvesting to milling equally occur at threshing, harvesting and milling stages. An average sixty (75%) of the respondents indicated that the highest losses occur during threshing while another 10% reported that the highest losses were at harvesting. The results also showed 10 % of the farmers experiencing post-harvest losses at the milling stage, 5 % of farmers at the transportation, winnowing stage as shown in Figure 3. The farmers also reported that the causes of losses were as a result of lack of post-harvest machinery for threshing, flooding of rice fields during harvesting when there are heavy rains; , birds attack on the rice field, the use of manual labor, rice shattering at harvesting; as well as rice grain breakage during milling.

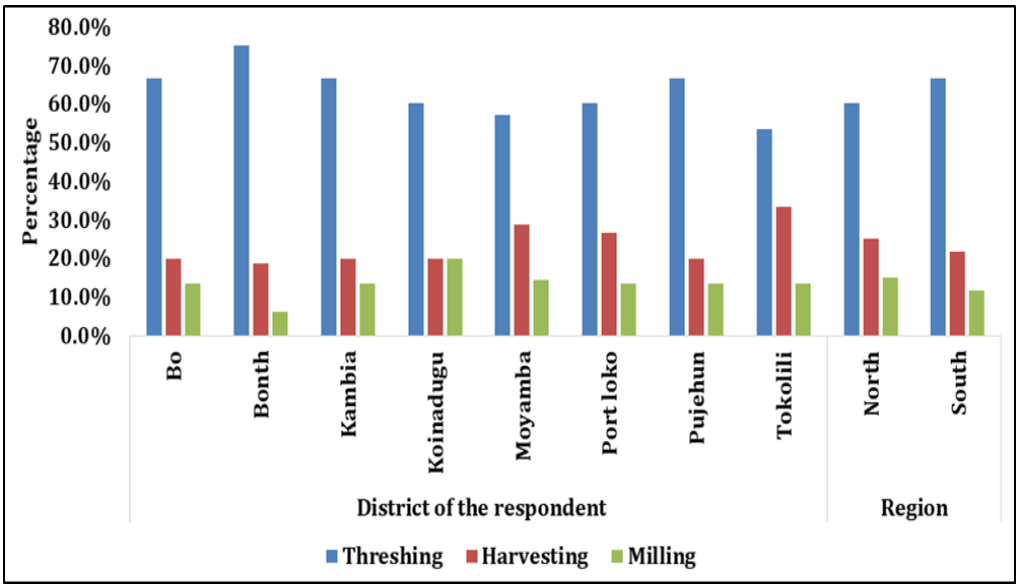

Figure 3. Three major stages of Post-harvest activities and gravity of losses

The result from figure 4 shows that about an average mean of 4.3 of the respondents indicated lack of finance as the most serious problem associated with rice farming. Weeding ranked second and crop pest was the third most important problem faced by an average mean of 4.08 and 3.95 of the respondents respectively. About an average mean of 3.75 of the respondent indicated that poor

transportation affect rice production in the study area, this was associated with poor road, high cost of transportation and poor transportation system which does not make it easy for them to transport there goods to the Centre. Lack of tools was indicated by 3.50 of the respondent as one of the problem they faced in the study area. Labor (3.37), harvesting (3.35) and inadequate agro chemicals (3.71), soil fertility (3.00) were also indicated to be some of the constraint faced by rice farmers, about an average of 3.43 of the respondent complained of poor access to improve seed variety which could enhance rice production if it was adequate and 2.09 also complained of inadequate land, this is probably due land fragmentation and land tenure system.

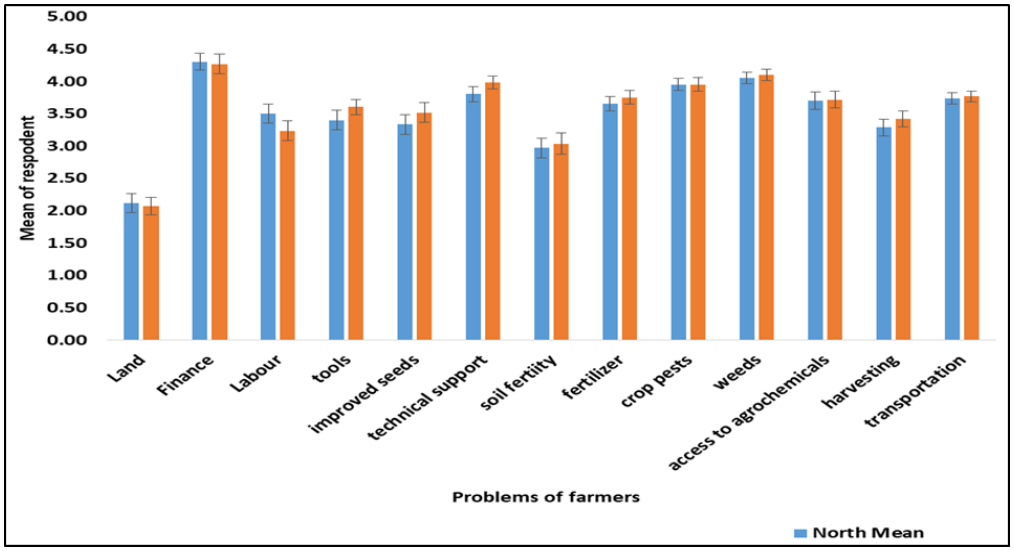

Figure 4. Major Problems faced by rice farmers

Cost-benefit of performing the physical functions of rice production
Cost-Benefit Analysis for One Hectare of Farm Land

Table 1. The Tables below shows the cost and returns of rice farmers per hectare

S. No.	Component	Operations		Av. Total	
1	Income Yield (kg)/loss/ (Le)	53 bushels			
	Sales price/Le	50,000.00		Le 50,000.00	
	Gross farm income			Le 2,650,000.00	
2	Production cost	Av. Unit price/Le/Ha	Av. Quantity/Ha	Total Cost (Le)	%
	Variable Expenses				
3	Seeds (kg)/ha	108,000.00	1 bushel	Le 108,000.00	5.1
4	Fertilizer(Kg)	143,333.00	2bags of 50kg	Le 286,666.00	13.4
5	Labour (man.day)/ha	15,000.00	78	Le1,170,000.00	54.7
6	Total Variable Cost			Le 1,564,666	73.2
	Fixed Expenses				
7	Land/Ha	40000.00	1ha	40,000.00	1.9
8	Hoe/ha	26,541.00	8	209,750.00	9.8
9	Cutlass/ha	22,125.00	6	144,041.67	6.7
10	Shovel/ha	35,000.00	4	140,000.00	6.5
11	Axe	40,000.00	1	40,000.00	1.9
12	Total Fixed Cost			Le 573,750	26.8
13	Total cost (TVC+TFC)			Le 2,138,416.00	
14	Net farm income (TR-TC)			Le 511,584.00	
15	Profit Ration				23.9%

Costs and returns profile of farmers rice enterprise

The average gross returns per hectare for the ABC rice farmers is Le 2,650,000.00. The average total variable cost (TVC) for the ABC rice farmers is Le 1,564,666 with labour cost, constituting the highest variable cost, which stood at an average of Le 1,170,000 per hectare season the average total fixed cost for the ABC rice farmers is Le 573,750 also, the average total cost for the investment Le 2,138,416 respectively. The average net farm income for the rice farmers was Le 511,584.000 implying that rice production in the study areas was profitable.

Breakeven point

The table below shows that when the sales price is fixed at Le 50,000/ bushel/ton, at least to 42.8 yield in ton/bushel/ha of rice must be produced to make a profit, otherwise only a loss will be incurred as inferred from the table below, inversely when 50 ton/bushel/ha is produced the price must be over Le 2,138,416.00 to make a profit.

Breakeven point = Total fixed cost/Rise in sales prise=2,138,416/50,000 = 42.8

Table 2. Estimated breakeven points in the yield and the prices

Sales Price (Le/ton)	Breakeven point in the yield (ton/Ha)	Yield (ton/ha)	Breakeven point in the sales price (Le/ton)
Le 50,000	42.8	53 bushels	Le 2,138,416.00

Table 3. Ordinary least squares regression result estimations

Variable	Linear (Y)	Exponential (LnY)	Cobb-Douglass (LnY)	Semi. Log (Y)
Constant	-154166.1 (-0.67)	11.34759 (16.65)	12.19744 (3.46)	-74328 (-0.07)
Harvesting loss	15.95421 (0.10)	.0008033 (1.40)	.3357649 (1.17)	15511.29 (0.18)
Threshing loss	-145.1184 (-0.89)	-.0013497 (-2.68)***	-.4164918 (-1.55)	-121477.8 (-1.34)
Parboiling loss	3.886633 (0.02)	-.0009149 (-1.26)	-.4209802 (0.107)	-18688.22 (-0.21)
Drying loss	-146.1682 (-0.54)	-.0010002 (-1.12)	-.1928298 (-0.81)	-48228.85 (-0.63)
Winnowing loss	31.0795 (0.68)	.0002249 (1.70)	.1300438 (0.64)	20982.74 (0.32)
Storage Loss	130.6458 (0.43)	-.0275594 (-1.39)	.0328694 (0.13)	28009.07 (0.33)
Transportation loss	-101.153 (0.36)	.0126553 (0.71)	.006826 (0.02)	-73336.74 (0.82)
Milling Loss	124.8049 (0.50)	-.000513 (-0.64)	-.0486675 (-0.17)	51955.25 (0.63)
Household Size	33802.43 (1.57)	.0671848 (2.36)**	.7207343 (1.93)	73954.22 (0.58)
Age(years)	4423.467 (0.96)	.0023028 (0.12)	.2235754 (0.32)	250257 (1.02)
Education level	-4298.815 (-0.64)	-.0115355 (-0.54)	-.0812345 (-0.57)	-68325.47 (-1.46)
F	0.1331	0.0002	0.0380	0.1608
R^2	0.0485	0.3160	0.2188	0.045
R^2 adjusted	0.0485	0.2315	0.1100	0.0453

Ordinary least squares regression analysis result

The result of the regression estimates shown in Table 3 was used to explain the effect of post-harvest losses on rice farmers' income in the study areas. Four functional forms were tried, which included linear, semi-log, double log and exponential forms. Expectedly, the model was examined in terms of appropriateness as confirmed by the F-statistic.

The functional forms were also examined in terms of the value of the coefficient of multiple-determination (R^2), the adjusted R^2 and the significance, quantity and signs of the coefficients of regression estimates. Ascribing from the above criteria, the exponential functional form was found to be the best goodness of fit and was chosen as the lead equation for further analysis in the study. The equation was significant at 1% alpha-level with a coefficient of determination of 0.3160. The value of the R^2 implies that about 32% of the variation in the income of the rice farmers is explained by the eleven variables included in the model altogether. Two variables were significant, with their coefficients conforming to the a priori expectations.

Threshing losses (X_2) was significant at 1% and negative, implying that an increase in threshing losses will reduce rice farmers' income by the value of the coefficient. This result confirms the alternate hypothesis of this study which stated that post-harvest losses influence farmers' income in the study areas. The outcome is in line with the results obtained by Essiet (2014), who observed that post- harvest losses cause a reduction in rice farmers' income.

In a related development PrOpcom (2007) revealed that a significant and positive correlation exist between income and the quantity of rice threshed. However, the results run contrary to that of Folayan (2013), who showed that gender, source of information and type of storage facilities were some of the determinants of post- harvest losses in maize, a cereal crop. On the contrary, household size (X_9) was significant at 5% probability level and positive, implying that with increase in the household size, farmers' income on rice will increase. This development could possibly relate to the influence of family labour in household rice production in the study areas.

The estimated exponential function is given as:

$Y = 11.34759 - .0008033X_1 - .0013497\ X_2 - .0009149X_3 - .0010002X_4 + .0002249X_5$ –(16.65) (1.40) (-2.68) *** (-1.26)
(-1.12) (1.70) $.0275594X_6 + .0126553X_7 - .000513X_8 + .0671848X_9 + .0023028X_{10}$
$.0115355X_{11}$ (-1.39) (0.71) (-0.64) (2.36) **
(0.12) (-0.54)
$R^2 = 0.3160$, F ratio = 0.0000

Conclusions and Recommendation

It is concluded that about 99% of the rice farmers interviewed indicated that they have experienced postharvest losses and that the losses were very high. Also, the problem of lack of post-harvest machinery was the major problem resulting in high losses. The researcher concluded that the problems faced by rice farmers include inadequate land, lack of financial support, poor transportation, inadequate storage facilities, high cost of inputs, inadequate agrochemicals, pest and diseases, weeds, and poor access to improved seed variety. The study also concluded that threshing losses has a negative influence on rice farmers' income in the study areas. Losses from this source also constituted the bulk of losses encountered by rice farmers representing average of 25% of post-harvest losses, while the lack of processing equipment hindered processing operations.

It is further concluded that post-harvest losses of rice during harvesting, threshing and milling ranges between 11 and 25%; the loss figures are very high. Also the average net farm income/ha for rice farmer is Le 511,584.00/ha which implies that rice production is profitable business. Mechanization of the post-harvest activities, providing technical knowhow and access to financial resources to acquire appropriate inputs could help reduce the losses in rice. It is recommended that mechanization

of the postharvest activities, providing technical knowhow and access to financial resources to acquire appropriate inputs could help reduce loses in rice production. Serious efforts to minimize postharvest losses of rice therefore should be pursued.

Conflicts of interest

Authors declare that there is no conflict of interest.

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