Analysis of the Factors Influencing Rice Processing and its Profitability in Sokoto State, Nigeria

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Abstract

This study analyzed the factors influencing the processing and profitability of rice in Sokoto State, Nigeria. A multistage sampling procedure was used select 120 rice respondents used for the study. The data generated were analyzed using descriptive, inferential statistics and gross margin analysis. Results of the data analysis revealed that the majority of the rice processors were males (87.50%) and in their active productive ages (18-28 years), most of them (63.33%) were not married and took up rice processing as their primary occupation. The findings further indicated that majority of the processors did not make use of modern technology for soaking, parboiling and milling of the rice due to poor knowledge of the existence of improved rice processing technologies. The common rice processing materials used by the processors were local materials such as cut-drums, pots, tarpaulin (spent bagco bags) and fire woods. Result of the inferential statistics revealed a significant relationship (P< 0.05) between the processors household size and the utilization of modern processing technologies. The study concluded that despite the use of local rice processing technologies, the business attracts more income compared to other trades in the locality. It is recommended that the rice processors should be assisted with modern rice processing technologies.

Keywords: Cost and returns, Rice; Strategy; Livelihood; Improvement; Processors

Introduction

Rice (*oryza sativa*), is a cereal food crop that belongs to the grass family called Poarceae of the plant kingdom. Domesticated rice comprises of two species, namely: *oryza sativa* and *oryza glaberrima*. The crop is native to tropical and sub- tropical southern Asia and South-Eastern Africa. The crop can grow in adverse environments but grows faster and more vigorously in wet and warm conditions (Africa Rice, 1996).

Rice (*Oryza sativa* L.) being the second largest consumed cereal crop after wheat shapes the lives of millions of people (Ben-Chendo, Lawal, Osuji3, Osugiri, Ibeagwa, 2015). More than half of the world's population depends on rice for 80 percent of their caloric energy requirements (Braun, 2006). Local rice demand is growing quickly due to population growth and urbanization and most of the consumers prefer local rice compared to imported rice. Nigeria's estimated annual rice demand is put at 5 million metric tons while the country's rice production on the average is about 2.21 million tons of milled products, leaving a deficit of 2.79 tons which is bridged by importation (National Rice Development Strategy-NRDS, 2017).

The increased in demand for rice is because the crop has moved from being an elitist to a staple food for many Nigerians. Many local dishes are prepared with rice and because it has relative ease of storage and preparation, rice is now one of the main cereals produced by the Nigerian farmers. Rice is cultivated virtually in all the agro-ecological

zones of Nigeria. It covers both the upland and the swamps, depending on the variety, (Kano State Agricultural and Rural Development Authority -KNARDA, 2007).

Considering the important position of rice, the United Nations designated and adopted year 2004 as the international year of rice on December 16th, 2002 (Devoting a year to a commodity was unprecedented in United Nations history. But however, due to its importance, the 57th session of the United Nations General Assembly noted that rice is the staple food of more than half of the world's population. Usman, Ango and Barau, (2013) affirmed the need to heighten the awareness of the role of the crop in alleviating poverty and malnutrition and reaffirmed the need to focus world attention on the role rice can play in providing food security and eradicating poverty.

According to Nigeria Federal Ministry of Agriculture and Rural Development (FMARD) (2015), rice sub sector generate about N4, 706 billions to the Nigerian economy. Over the last three years of rice transformation programme, rice had added N3, 206 billions to the nation's economy. The ministry further reported that from 2011-2015, rice sub-sector in Nigeria has attracted over $2billion over private sector investments. It was further reported that the Federal Government of Nigeria has saved about $800 million by encouraging local production of rice in the country (Premium Times, 2018)

Due to the importance of rice in the provision of caloric energy to the majority of the world population and income to bth the producers and processors, there is need for the farmers to be trained on how to add value to the product. Also, despite the increase in the demand of rice in Sokoto state, not much research work has been conducted particularly on value addition. In view of the above aforementioned problems, the objectives of this study are as follows: (a) Description of the socio- economic characteristics of the rice processors in the study area (b) evaluate factors influencing the choice of processing technology among the respondents. (c) evaluate costs and return to rice processing.

Research Hypothesis

H_0 There is no significant relationship between the socio economic characteristics of the rice processors and adoption of improved rice processing technologies.

Research Methodology

Study Area

This study was conducted in Sokoto State, Nigeria. The state is located in the Sudan Savannah agro-ecological zone of Nigeria. The state is located between latitude 11°00` - 14°00`N and longitude 3°50` - 8°00`E of the Sudan Savannah agro-ecological zone of Nigeria. The study area experienced erratic rainfall that hardly sustains agricultural crops. The average rainfall of the area is about 550mm per annum with maximum rainfall of 1100mm and minimum of 800mm. The area had a maximum temperature of about 45^{0}C between the months of March and June and minimum temperatures of about 15-18 ^{0}C during the Harmatan season, in the months of November to early February with relative humidity between 15-20% during the dry season and up to 70-75% during the rainy season (NIMET, 2012).
Sokoto state has a projected population of 4,850,374 at 3% annual population growth rate (NPC, 2015). The state shares a common boundary with Kebbi State to the South-East, Zamfara State to the East and Niger Republic in the North. The study area is basically an agrarian society with over 90% of the population engaged in agricultural activities. The common crops grown in the study area are millet, sorghum, rice, wheat, cowpea, vegetables, tuber and root crops. Animal husbandry and fishery activities are also practiced in the study area.

Sampling Procedure and Sample Size

The rice processors of Sokoto State constituted the target population for the study. A multistage sampling procedure was applied to arrive at the sample size for the study. In the first stage, Wamakko, Silame and Goronyo Local

Government Areas (LGAs) of the State were purposively selected for the study due to abundant local rice processors. The second stage involved a random selection of two districts from each of the selected LGAs. The third stage involves a random selection of two villages from each district while the last stage involves a purposive selection of ten rice processors from each village, thus, a total of 120 respondents were selected and used for the study.

Analytical technique

(1)The gross margin analysis can be specified as the difference between revenue and cost of goods sold divided by revenue

GM = GI – TVC
Where
GM = the gross margin
GI = Gross income
TVC = Total variable cost

(2) Regression Analysis
The multiple regression analysis is implicitly stated as follows:

Data for this study were obtained from both primary and secondary sources. The primary data was collected directly from the processors with the aid of structured questionnaire while the secondary information was obtained from related literatures (journals, books and book of proceedings) and internet sources. Data obtained were analyzed using descriptive, regression analysis and Gross Margin Analysis.

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11})$
Where: Y= dependent variable
The independent variables are as follows:
X_1= Age
X_2= Sex
X_3= Marital status
X_4= Primary occupation
X_5= Secondary occupation
X_6=Household size
X_7=Technologies used
X_8=Rice processing methods
X_9= Rice processing training
X_{10}=Income realized by the processors
X_{11}=Problems encountered by the processors

Results and Discussion

Socio Economic Characteristics of Rice Processors

Age: Results in Table 1 reveal that most (66.6%) of the processors were within the age bracket of 18-24 years while only (7.5%) of them were 44 years and above with mean age of 25.6 years implying that most of the processors were at their active and productive ages and as such they are expected to cope with the rigors associated with rice processing. This finding is in accordance with Ango, Illo, Yakubu, Yelwa, & Aliyu (2013) which reported that the active productive ages of individuals are the ages when individuals are more capable and energetic to perform assigned duties.

The majority (87.5%) of the processors were male while the female processors constituted only (12.5 %). The finding indicated that the males dominate the business. The reason behind a low number of female rice processors could be due to the cultural and religious restrictions of the females. The finding indicated that the males dominate the business. The reason behind a low number of female rice processors could be due to the cultural and religious restrictions of the females.

Also, 63.3% of the rice processors were single, 32.5% were married, 2.5% were widows, and 1.7% of them were divorced. These findings imply that unmarried people dominate rice processing. The high percentage of the singles in rice processing might result from the encouragement of youths in agribusiness.

A majority (82.5 %) of the rice processors had 1-3 persons. 12.5% of them had a family size of 4-6 persons in their family while few (5%) of them had a family size of 7 people and above. The mean family size was one. The findings therefore, imply that the processors have less family

burdens and as such had much time to concentrate on processing rice alone.

As shown in Table 1, 54.17% of the processors had rainy season as a means of generating additional income that aids in rice processing and 18.33% of them were bricklayers. The implication of this finding is that almost all the processors have one business or the other to supplement their primary occupation (rice processing).

Table 1: Distribution of Rice Processors According to Socioeconomic Characteristics (n = 120)

Variable	Frequency	Percentage
Age (in years)		
14 – 28	80	66.67
29 – 43	31	25.83
44 years and above	9	7.50
Sex		
Male	105	87.50
Female	15	12.50
Marital status		
Single	76	63.33
Married	39	32.50
Divorce	2	1.70
Widow	3	2.50
Educational attainment		
Formal education	17	14.16
Qur'anic education	89	74.16
Adult Education	14	11.66
Household size		
1-3	99	82.50
4-6	15	12.50
7 and above	6	5.00
Secondary Occupation		
Rainy season farming	65	54.17
Trading	9	7.50
Livestock keeping	9	7.50
Bricklaying	22	18.33
Others (driving, fish farming, handcraft and tailoring)	15	12.50

Source: Field Survey, 2015

Local Rice Processing Methods

Processing of rice in the study area is done in stages, these include sorting and screening of rice, soaking of paddy rice, parboiling and milling and at each stage different types of local technologies are used. Below is the result of each

stage of the value addition to rice in the study area. Danbaba *et al.* (2014) reported that traditionally, paddy parboiling process involves soaking in cold water overnight or longer and followed by boiling or steaming the soaked paddy to gelatinize the starch. Usually, the steamed paddy is cooled and sun dried before milling.

Sorting and Screening of Paddy Rice

Sources of stones and other unpalatable materials: As indicated in Table 2, most (57.8%) of the rice processors were of the opinion that threshing process of the rice was the main source of stones and other unpalatable materials while 29.2% of them expressed that drying process was the source of stones and other unpalatable materials in the rice. It is a common problem in Nigeria that the local rice contains stones and other unpalatable materials and in most cases the unwanted materials are introduced in to the rice through value addition process.

Means of removing stones and other unpalatable materials: The results indicated that 62.5% of the rice processors removed stones and other unpalatable materials through hand picking and 7.5% of the rice processors removed stones and other unpalatable materials through sieving. The findings indicated that majority of the rice processors use local method of removing stones and other unpalatable materials which could be due to lack of having access to and high cost of modern processing machines.

Table 2: Distribution of Processors based on Sources and Removal of Stones and other Unpalatable Materials from the Rice (n =120)

Variables	Frequency	Percentage
Source of stones and other unpalatable materials		
Threshing	107	57.80
Drying	54	29.20
Damage of bags	9	4.90
Packaging	8	4.30
Milling process	5	2.70
Parboiling process	2	1.10
	***185**	
Removal of Stones and other Unpalatable Materials		
Yes	84	70.00
No	36	30.00
Means of removing stones and other unpalatable materials		
Hand picking	75	62.50
Sieving	9	7.50
Non-removal	36	30.00

Source: Field survey, 2015; *****Multiple response

Methods of Rice Processing

a.Soaking of Paddy Rice: The findings in Table 3 show that majorities (86.67%) of processors soaked the paddy rice in cool water in a reservoir, 8.3% of them soaked their paddy rice in hot-water while only (5.0%) of them soaked the paddy rice in warm water. This finding implies that majority of the rice processors do not use modern technologies in soaking rice which could be due to lack of much trained man power and modern rice processing equipments. These findings is in agreement with Danbaba, Nkama, Badau, Ukwungwu, Maji, Abo, Hauwawu, Fati, & Oko (2014) which reported that modern technology is not in much use in rice

processing because of lack of trained human resources and high cost of purchasing the equipment. Findings in the Table further reveals that most (71.67%) of the processors soaked the rice in the reservoir filled with cool water for 1-2 days and 25.83% of them soaked the rice for less than one day. The findings indicated that the maximum time taken for soaking rice prior to parboiling in the study area was two days. The benefits behind soaking of the rice in warm water in sometimes are done purposely for the retention of the nutrients in the grain, avoidance of fermentation and fungal development. This statement is in accordance with IRRI (2018) reported that during cold **soaking**, starch fermentation occurs because of respiration of paddy grains and the release of carbon dioxide which leads to fermentation and fermentation can cause an off-flavor which can lead to excessive development of fungi and other microorganisms in the paddy. Larraine (2017) also reported that arsenic from industrial toxins and pesticides found in soil will contaminate rice as such researchers from UK's Queen's University Belfast found that soaking rice overnight will significantly reduce the level of the toxins. A more practical approach is to soak the rice overnight, as it reduces the toxins by 80%.

Table 3: Distribution of Processors based on Technologies and Time Taken for Soaking Rice (n = 120)

Variable	Frequency	Percentage
Technologies used in rice soaking		
Cool water in reservoir soaking	104	86.67
Hot-water in reservoir soaking	10	8.3
Warm water in reservoir soaking	6	5.0
Time taken for soaking		
> 1 day	31	25.83
1 -2 days	86	71.67
Above 2 days	3	2.51

Source: Field Survey, 2015

Parboiling of Paddy Rice

b.Parboiling: As shown in Table 4, majority (93.3%) of the processors parboiled the paddy rice before milling while few (6.7%) of them did not parboil the rice before milling, parboiling of the paddy helps in improving the quality of the rice by reducing cracking of the grains during milling. The reason behind not parboiling the paddy rice by some processors was based on the purpose for which the processed rice is used for. The parboiled processed rice is commonly used for rice paste, popularly known as *tuwon shinkafa* and pride rice while the non parboiled processed rice is used for *fura (rice porridge), danbu* and rice cake *(masa).*These findings indicate that in order to meet the demand of the people, the processing of the crop should be based on need and interest of the consumers. This finding is in agreement with Inuwa (2010) which reported that to meet up with the demand of the consumers, there is need for more effort towards engaging in processing the category of processed rice needed by the majority of the consumers in the study area.

Materials used for parboiling: Results in Table 4 also show that more than half (57.5%) of the rice processors used drums in parboiling, while the remaining (42.5%) of them parboiled the paddy rice with use of aluminum pots (*tukunya*). The findings revealed that majority of the rice processors used cleaned empty engine oil drums in parboiling of the product which could be due to the ability of drum to contain more rice compared to the aluminum pots. This statement is in contradiction with Inuwa (2010) in a related study who reported that majority of the rice processors used aluminum pots called *shafa/tukunya* in rice parboiling.

Source of Energy for Parboiling: Findings in the Table further indicated that 78.81% of the rice processors used firewood as source of energy, 12.5% of them used cereal stalks as source of energy, 5.3% parboiled rice using polythene bags and 3.97% of them used kerosene as source of energy for rice parboiling. The reason behind using fire woods, stalks and polythene bags as source of energy for parboiling could be due to lack of capital to purchase modern sources of energy and as a means of maximizing profit.

Parboiling Temperature: The findings reveal that almost half (49.2%) of the rice processors parboiled rice at a temperature ranges between 65-84˚C, 38.3% of them parboiled rice under a temperature of 85˚C and above and very few (5.8%) of the rice processors parboiled rice at a temperature range of 45˚C. The implication of this finding is that majority of the rice processors parboiled rice at a temperature range of 65- 84˚C in order to achieve uniform parboiling of the rice. This statement is in accordance with Danbaba *et al.* (2014) reported that rice processors subject paddy rice in sequence of processes before arriving at the edible products, such includes steaming at certain temperatures.

Results in Table 5 shows the Awareness of improved rice milling technologies: Majority (84.2%) of the rice processors were aware of long time introduced improved rice milling technologies while few (15.8%) of them opined that they were not aware of any improved rice milling technologies. These findings imply that majority of the rice processors were not aware of improved technologies for rice milling which were introduced to them recently and as result remain working with the obsolete technologies.

Rice Processing Experience: More than half (55%) of the rice processors spent 1-8 years in local rice milling enterprise, 31.7% of them spent 9-16 years and 9.2% of the local rice processors spent 17-24 years in the enterprise while few (4.1%) of them spent 25 years and above in rice milling enterprise. As indicated in the findings, majority of the local rice processors had been in the business for quite long period of time and as such they have gathered enough experience in rice processing. This could be due to long history of local rice processing in the study area. This statement is in agreement with Abarima, Kolamole, Fabusoro, Ajulo, Masunaga & Wakatsuki (2011) which reported that most of the local rice processors had been in the business for a long period of time and as such they have gathered enough experience in rice processing.

Rice milling technologies adopted by the processors: Almost all (90%) of the respondents adopted long time introduced electrical powered rice milling machine, 6.7% of them adopted gasoline powered rice milling machine while few (3.3%) of them adopted petrol powered milling machine. These findings imply that majority of the processors adopted the obsolete milling technologies (diesel/petrol and electricity powered milling machines) introduced to them 20-40 years ago.

Table 4: Distribution of the Processors based on Rice Parboiling, Materials Used for Parboiling, Source of Energy and Temperatures Used (n = 120)

Variables	Frequency	Percentage
Parboiling of Rice		
Yes	112	93.3
No	8	6.7
Materials used for parboiling rice		
Drums	69	57.5
Aluminum pots	51	42.5
Source of energy		
Firewood	119	99.17
Electric cooker	1	0.83
Gas cooker	2	1.67
Cereal stalks	15	12.50
Polythene bags	8	5.30
Kerosene	6	3.97
	***151**	
Parboiling temperature		
45 – 64˚C	7	5.8
65 - 84˚C	59	49.2
85˚C and above	46	38.3
No parboiling	8	6.6
Drying of rice before milling	120	100
Materials used for drying		
Tarpaulin	4	3.33
Old rice packaging sacks	115	95.83
On the bare floor/ground/tarred road	1	0.83
Time Taken for Drying (Days)		
>1	17	14.16
1-2	89	74.16
Above 2 days	14	11.67

Source: Field Survey, 2015. *: Multiple Responses

Table 5: Distribution of Processors based on Awareness of Improved Milling Machines, Processing Experience and Milling Tech. Adopted

Variables	Frequency	Percentage
Awareness of improved milling technologies		
Aware	101	84.2
Not aware	19	15.8
Rice processing experience (years)		
1 – 8	66	55.0
9 – 16	38	31.7
17 – 24	11	9.2
25 years and above	5	4.1
Milling technologies adopted by the processors		
Electrical powered machine	108	90.0
Gasoline powered machine	8	6.7
Petrol powered machine	4	3.3

Source: Field Survey, 2015.

Income of Processing of Rice

Average Cost and Return of Rice Processing

Findings in Table 6 indicated that 81.5% of the rice processors spent the sum ₦5, 199.17 in purchasing paddy rice at the point of production, 5.7% of them spent the sum of ₦363 on transporting the paddy rice from the market outside the study area to the point of production and 2.5% of the processors spent ₦150 for milling the parboiled rice. The findings further revealed that a gross margin of ₦850 was realized by the processors and for any one naira invested by the processors an income of ₦ 0.27 was realized, indicating that the business of adding value to rice is profitable.

Table 6: Total Variable Cost and Returns (n = 120)

Variables	Cost of processing/bag	Percentage
A. **Variable cost**		
Paddy rice	₦5, 199.17	81.5
Transportation	₦363.0	5.7
Soaking	₦90 .0	1.4
Parboiling	₦ 60.0	0.9
Energy source (Firewood)	₦200.0	3.1
Water	₦120.0	1.9
Labour	₦200.0	3.1
Milling	₦150.0	2.4
Total variable cost	**₦6, 387.17**	
B. **Returns**		
Gross income (GI)	₦7,178.31	
Gross margin (GM)	₦791.14	
Gross margin on Naira Invested	**₦0.27**	

Source: Field survey, 2015

Relationships between Study Variables

By using the un-standardized coefficients results of Linear regression analysis between the rice processors socio-economic characteristics and adoption of improved processing technologies revealed a significant relationship (P< 0.05) between age (b = 0.003), marital status (b =0.031) and secondary occupation (b = 0.008) and adoption of improved rice processing technologies.

Table 7: Relationships between the Processors' Socio-economic Characteristics and Adoption of Modern Rice Milling Technologies

	Modern Rice Processing Technology				
Variables	**Unstandardized Coefficients**		**Standardized Coefficients**		
	(b)	**SE**	**(β)**	**t-value**	**P-value**
Constant	1.699	0.181		9.411	0.000***
Age	0.003	0.005	0.081	0.565	0.573
Sex	-0.076	0.117	-0.069	-0.653	0.515
Marital status	0.031	0.074	0.055	0.415	0.679
Primary occupation	0.008	0.014	0.061	0.583	0.561
Secondary occupation	-0.005	0.012	-0.049	-0.474	0.636
Household size	-0.041	0.019	-0.293	-2.206	0.030*
R^2	0.047				
ΔR^2	0.047				
F-value	1.233				

Conclusion: Based on the findings of the study, it is concluded that the processing of rice is dominated by unmarried male youth who were within their active productive ages. The processing of paddy rice in the study area was mainly traditional (locally inclined) involving several cumbersome stages from sorting, screening, cleaning, steaming and milling. The study confirms that despite the local method used, rice processing in Sokoto state was profitable

Recommendations

Based on the findings, the study recommends that Government and donor agencies should provide modern processing facilities to the processors at a subsidized rate in the study area. Also, rice processors are encouraged to form cooperatives to access

credit facilities to purchase modern rice processing machines while training programmes should be organized by the cooperatives societies on the usage of the machines.

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