



PERFORMANCE OF MODERN RICE MILLS IN WESTERN AGRICULTURAL ZONE OF BAUCHI STATE, NIGERIA

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ABSTRACT

The study was conducted to assess the performance of modern rice mills in Western Agricultural Zone of Bauchi State. A multi-stage sampling technique was used in selecting 31 modern rice mills in the study area. The data were analyzed using descriptive statistics, inferential statistics and budgetary models. The result revealed that the average years of operation of the mills was 4 years, majority (71%) of the mills were owned by individuals and average number of employees were 15 workers. Also majority (67.7%) of mills engaged in both milling and marketing of rice, 48.4% obtained their capital through personal savings and all (100%) mills rely on electricity as a major source of energy. The result further showed that majority (58.1%) of mills obtain their paddy through marketers. The average working hour per day was 12 hours, average working days per week was 7 days, the average installed capacity was 1.4 tonnes per hour and average paddy milled per day was 4.7 tonnes. The monthly cost and return analysis indicated that variable cost constituted 89.60% of total cost while fixed cost constituted 10.40%. The total revenue (TR), Gross Margin (GM) and Net income (NI) were ₦15,849,961.28, ₦6,655,480.64 and ₦5,588,109.68 per month respectively. The return on Naira invested (ROI) and return on capital invested (ROCI) were ₦0.72 and ₦0.54 respectively. Also, years of operation, number of employees and working hours per day were found to influence the gross income of modern rice mills at $P < 0.001$, while installed capacity and type of mill influence mill's gross income at $P < 0.05$. It was concluded that modern rice mill is a profitable venture in the study area. The study recommended that processors should collectively source credit facilities from formal financial institutions in order to acquire the required working capital. Rice mills should also form associations so that they could demand necessary facilities such as adequate electricity and water supply from concerned authorities in order to improve their performance.

Keywords: Characteristics, Cost and Return, Influence, Modern, Rice Mill, Performance

INTRODUCTION

In Nigeria, rice is one of the cereal grain whose consumption has no cultural, religious, ethnic or geographical boundary (Gabdo *et al.*, 2020). Rice consumption is increasing rapidly in Nigeria because of the shift in consumer preference towards rice, increasing population growth, increased income levels, and rapid urbanization (Cadoni and Angelucci, 2013). Nigeria has the potential to be self-sufficient in rice production, both for food and industrial raw material needs and for export purpose. However, rice production falls short of demand (Kamai *et al.*, 2020). Consumption has already outpaced domestic production and as a result, Nigeria was at a time the leading importer of rice in the world, with an 8.2 percent share of imports in the global market (Gyimah-Brempong *et al.*, 2016). In order to bridge the gap between supply and the ever growing demand; the Nigerian government has over the years made concerted efforts and formulated and used various policy instruments and interventions to boost local production. Some of these measures include: import restrictions, tariff restriction, and



inauguration of presidential taskforce on rice, inputs subsidies, private sector involvement and ban on imports. The efforts are starting to show results, as Nigeria's rice production rose from 3.7 million metric tonnes in 2017 to 4.0 million metric tonnes in 2018 (kamai, *et al.*, 2020) and the official data from the Food and Agriculture Organization (FAO) indicate that Nigeria's paddy production stands at 8.4 million metric tonnes in 2019 (FAO, 2021). Achieving self-sufficiency in rice production and consumption is not a function of only planting large hectares of land with rice neither does it end at producing millions of tonnes of paddy rice. The quality and quantity of processed Nigerian rice available in the market and having the quality desired by consumers closes the rice import gap (Gabdo *et al.*, 2020). From the point of harvest till rice reaches the consumers table, rice passes through a wide range of unit operations which may have impact on the quantity and quality of the milled rice.

The processing involves several stages; from threshing of rice to removal of the husks, milling of the shelled paddy rice to removing the bran layer, then additional whitening stage to reach market standard. These processes generate several products which include the straws, the bran, the husks, and the milled rice grains itself (Ajit *et al.*, 2019). Rice processors have a major role to play in the improvement of the quality of home grown rice and their efficiency can be considered as a key element in the development of home grown rice market (Nwachukwu *et al.*, 2020). Though rice milling is a capital intensive industry, its importance to the national economy cannot be overemphasized, as it has become fashionable industry for small and large scale paddy processing that has a great contribution to the economy of the country. The enterprise has assumed greater significance in improving the employment opportunities and standard of living in the country (Gabdo *et al.*, 2020). Modern rice mills highlight the growth of economy as well as standard of living of people especially in rural areas. Modern Rice Mill supplies wide varieties of rice and their by-products to peoples using modern technologies at the same time low cost and high quality (Jinimol, 2018). The efficient utilization of processing resources is a critical requirement for attaining self-sufficiency in rice production and processing, particularly in low income countries where resource constraints are extremely necessary (Gabdo *et al.*, 2020). This study was therefore carried out to describe the characteristics of modern rice mills in the study area, compute the costs and returns of modern rice mills and determine the influence of rice mills' characteristics on its gross income.

MATERIALS AND METHODS

The Study Area

The study was carried out in western zone of Bauchi State, Nigeria. There are seven local government areas in Western Zone of Bauchi, these include; Alkaleri, Bauchi, Bogoro, Dass, Kirfi, Tafawa Balewa and Toro LGAs. The zone is located in the North-Guinea Savannah part of the State and is situated between latitudes $9^{\circ} 3' N$ and $12^{\circ} 3' N$, and $8^{\circ} 50'$ and $11^{\circ} 37' E$ on the Greenwich meridian. The landmass is $24,270.701\text{km}^2$ (Bauchi State Agricultural Development Programme, BSADP, 2018) with a projected population of 2,697,266 in 2023 and expected growth rate of 3.7% per annum (National Population Commission [NPC], 2018). The rainfall and temperature ranges between 600-1200 mm and $9.11^{\circ}\text{C} - 40.55^{\circ}\text{C}$, respectively. Arable farming is the main agricultural practice in the area. Pearl millet, sorghum, maize, rice, water melon, sweet potato and legumes are produced in commercial quantities as principal crops. The farmers in the study area also embark on small, medium and large-scale livestock production such as rearing of goats, sheep, cattle and poultry as well as marketing of their products (FAO, 2017).



Sampling Technique and Sampling Size

A multi-stage sampling technique was used in this study. In the first stage, Western agricultural zone which consist of 7 Local Government Areas was selected from the three agricultural zones in Bauchi State. In the second stage, four Local Government Areas were purposively selected due to the availability of modern rice mills in the LGAs, viz; Bauchi, Bogoro, Dass and Toro. In the final stage, all modern rice mills were selected as the sample. Thus, a total of 31 modern rice mills formed the sample size. The sampling procedure is presented in Table 1.

Table 1: Sampling procedure and sample size

Zone	LGAs	Population	Sample Size (100%)
Western zone	Bauchi	22	22
	Bogoro	1	1
	Dass	3	3
	Toro	5	5
Total		31	31

Reconnaissance Survey, 2022

Method of Data Collection

Primary data were collected using a structured questionnaire. Data collected on mill characteristics include years of operation, milling capacity, type of ownership, number of employees, channels of paddy procurement, source of energy and scope of operation. Processing information collected include paddy procurement cost, processing costs such as diesel, electricity, machine repairs & maintenance, firewood, labour, sack, tax etc. Returns from main product and by-products were also collected.

Method of Data Analysis

Data for the study were analyzed using descriptive statistics, inferential statistics and budgetary models. Descriptive statistics presented in tables of frequencies, percentages and means was used to analyze specific objective one. Budgetary models were used to analyze specific objective two, and inferential statistics in form of multiple regression was used to analyze specific objective three.

RESULTS AND DISCUSSION

Years of Operation, Ownership and Number of Employees of Modern Rice Mills

The distribution of mills according to years of operation is presented in Table 2. The results revealed that 3.2% of the mills were in operation for less than a year, 25.9% were in operation for 1- 2 years; 25.5% were in operation for 3-4 years, 22.6 had 4-6 years in operation and 6.5% of the mills had been in operation for 7 - 8 and 9 -10 years respectively. The mean years of operation were 4 years. This is a confirmation of the fact that most of the mills were recently established and were as a result of the Buhari regime's policy on domestic production and processing of rice. Modern rice mills are novel compared to traditional mills which were reported by Sadiq *et al.* (2021) to have a mean of 9.55 years. Also Johnson and Masias (2016) reported that, under The Agricultural Transformation Agenda (ATA), the Federal Government made large investments to build national capacity for rice production, processing, and marketing and these investments were what attracted private investors into the rice sector.

The distribution of mills according to type of ownership is also presented in Table 2. The results revealed that 71% of the mills were owned by individuals, 22.6% were established through partnership and 6.5% were family business. None of the mills were owned by



cooperative society or corporation. This result is similar to the finding of Khorne *et al.*, (2019) who studied the characteristics of small, medium and large sized rice mills in India and revealed that seven out of the ten rice mills studied were owned by individual processor while three mills were owned by partnership. He further added that ownership structure of rice mill plays vital role in processing of rice as it has direct impact on cost and quantity involved in processing of rice. Ibekwe *et al.* (2022) revealed that there is a positive relationship between ownership structure and output of agricultural firms in Nigeria.

The result of number of employees in Table 2 revealed that majority (61.3%) of the mills had 1 - 10 employees, 25.8% had 11 - 20 employees, 3.2% and 6.5% had 21 - 30 and 31 - 40 employees respectively, while only 3.2% of the mills had more than 40 employees. The average number of employees was 15 workers. Number of employees is an indicator of the size of firm and the quantum of production activities carried out. The size of a firm affects performance in many ways. Profitability increases as the size of the firm increases. If large firms have more organizational resources, they give better equipment to achieve their goals. Bigger firm can also devise better ways and means to fight market risks and uncertainties and have better chances to offset random losses and perform better. Dogan (2013) established that there is a positive relationship between size indicators (total assets, total sales and number of employees) and profitability of firms.

Table 2: Distribution of mills according to years of operation, ownership and number of employees

Variables	Frequency	Percentage	Mean
Years of Operation			
Less than 1	1	3.2	4 years
1 – 2	8	25.9	
3 – 4	11	35.5	
5 – 6	7	22.6	
7 – 8	2	6.5	
9 – 10	2	6.5	
Types of Ownership			
Sole proprietorship	22	71.0	
Partnership	7	22.6	
Co-operative	-	-	
Family business	2	6.5	
Corporation	-	-	
Number of Employees			
1 – 10	19	61.3	15 employees
11 – 20	8	25.8	
21 – 30	1	3.2	
31 – 40	2	6.5	
>40	1	3.2	

Source: Field survey, 2023

Types of mills and Sources of Capital, Energy and Paddy for Modern Rice Mills

Mills were categorized into two based on the activities they specify on, while some only mill for a fee, others engage in both milling and marketing of the rice. The distribution of mills



according to type is presented in Table 3. The result indicated that majority (67.7%) of the mills engage in both milling and marketing of rice, while 32.3% only mill others rice for a fee. However, it was discovered that even in the mills that engage in both milling and marketing, the quantity of rice milled and marketed for themselves was just a fraction of the total volume of rice milled. This is not unconnected with the high capital required to procure large volume of paddy for processing and marketing. Akarue and Ofoegbu (2012) and Ibitoye (2014) reported inadequate capital to be the major problems limiting rice processing in Delta and Kogi States.

The distribution of mills according to sources of capital is presented in Table 3. The result showed that 48.4% of the mills obtained their capital through personal savings, 41.9% obtained their capital through Bank and Government facilitated loans and 9.7% obtained their capital through family and friends. None of the mills got their capital through cooperative loans. This is in line with the findings of Okunola *et al.* (2019) who reported that majority of processors depend on their personal savings as sources of capital and fewer obtained their capital through cooperative loan, Government Assisted Project Loans, family members and Bank loans. The result also confirms the findings of Evbuomwan *et al.* (2013) who revealed that majority (75.7%) of Small and Medium Enterprises (SMEs) in Nigeria rely on their own funds to finance their businesses.

The distribution of mills according to major sources of energy is presented in Table 3. The result indicates that all (100%) the mills rely on government supplied electricity as the major source of energy for milling operations. This concurs with the findings of Sadiq *et al.* (2021) who stated that only few of the processors relied on fuel-diesel as a source of power for their plants, while the majority relied on the national electricity grid to power their milling machines. It is cheaper to use electricity sourced from the national grid because of subsidy as compared to diesel which has little or no subsidy. Thus, this enables the processors to benefit from profit margin rise as compared to the milling plant which runs on diesel due to a higher cost of production. This is contrary to the findings of Okunola *et al.* (2019) who reported that majority (76%) of rice processors rely on petrol/diesel for their operations in Ekiti State.

The major source of paddy for Mills is presented in Table 3. The result indicated that 58.1% of mills obtain their paddy mainly from marketers while 41.9% obtain their paddy from individual farmers. None of the mills had farmer cooperative or Mill's farm as their major source of paddy. This showed that most of the paddy is taken up by marketers and that farmers do not take advantage of cooperative societies to market their paddy. Soe *et al.* (2015) reported that selling paddy directly to middlemen or brokers or collectors is often less remunerative to farmers. The result further revealed that there was no backward integration in the rice milling enterprises. Mills don't cultivate what they process but rely on farmers and markets for supply of paddy. This is in line with the findings of Pharm (2016) who reported that rice mills mostly buy paddy from rice farmers or traders for parboiling, drying, milling and selling.



Table 3: Distribution of mills based on types and sources of capital, energy and paddy

Variables	Frequency	Percentage
Types of Mill		
Miller only	10	32.3
Miller-trader	21	67.7
Sources of Capital		
Bank loan	13	41.9
Family and friends	3	9.7
Personal savings	15	48.4
Retirement benefits	0	0
Cooperative society	0	0
Sources of Energy		
Electricity	31	100
Diesel	0	0
Renewable energy	0	0
Sources of Paddy		
Individual Farmers	13	41.9
Farmer cooperatives	0	0
Marketers	18	58.1
Mill's farm	0	0

Source: Field survey, 2023

Working Hours per Day and Working Days per Week of Modern Rice Mills

The working hours per day of rice mills is presented in Table 4. The result indicated that 77.4% of mills have 7 – 12 working hours per day, 9.7% percent work 1 – 6 hours a day and 12.9 % work double shift of 24 hours per day. The average working hour per day was 12 hours. Number of working hours is expected to increase the level of output and hence the level of income. Lonnie (2012) opined that longer working hours may be associated with greater output in a given industry, but they are also associated with diminished output per hour.

The number of working days per week is also presented in Table 4. The result indicated that majority (80.6%) of the mills work 7 days a week, 12.9% work 6 days a week while 6.5% work 5 days a week. The average working days per week were 6.7 days. This implies that almost all the mills work throughout the year except during festivals and special occasions. This is similar to the findings of Shwetha *et al.* (2011) who reported what modern rice mills operate for an average of 250 days per year in India.

Table 4: Distribution of mills based on working hours per day and working days per week

Variables	Frequency	Percentage	Mean
Working Hours			
1 – 6	3	9.7	12 hours
7 – 12	24	77.4	
13 – 18	0	0	
19 – 24	4	12.9	
Number of days			
5	2	6.5	6.7 days
6	4	12.9	
7	25	80.6	

Source: Field survey (2023)



Installed Capacity per Hour and Quantity of Paddy Milled per Month by Modern Rice Mills

The installed capacity per hour of mills is presented in Table 5. The result showed that most (83.9%) of the mills had installed capacity of 1 – 2 tonnes/hour. 9.7% had 2.1 – 3 tonnes/hour capacity, 3.2% had 4.1 – 5 tonnes/hour and 3.2% had less than 1 tonne capacity per hour. The average installed capacity per hour was 1.4 tonnes. This indicates that most of the rice mills were operating machines with medium installed capacity. This is in line with the recommendation of Competitive African Rice Initiative (CARI) project who proposed business models of rice mills with milling capacities ranging from 1.0 tons/hour to 2.5-3.0 tonnes/hour based on results of the study and achievements in rice milling industry of some Asian countries (Pharm, 2016).

The quantity of paddy milled per month is presented in Table 5. The result showed that 35.5% of the mills process 51 – 100 tonnes per month, 32.3% mill less than 50 tonnes, 22.6% mill 101 – 150 tonnes while 151 – 200 tonnes, 201 – 250 tonnes and 1800 tonnes are processed each by a mill. The average quantity processed per month was 139.29 tonnes. This is very small compared to the installed capacity. Mohieddine (2021) established that capacity utilization is an important indicator of firm's economic performance, growth, resource allocation and cyclical fluctuations. The relatively small quantity milled per month might be due to; inadequate paddy available for processing, lack of paddy driers in most of the mills and absence of integrated milling lines which automatically deliver paddy from one machine to another.

Table 5: Distribution of mills based on installed capacity and quantity of paddy milled per month

Variables	Frequency	Percentage	Mean
Capacity (tons/hr)			
Less than 1	1	3.2	1.4 Tons/hr
1 – 2	26	83.9	
2.1 – 3	3	9.7	
3.1 – 4	0	0	
4.1 – 5	1	3.2	
Quantity (tons/month)			
Less than 50	10	32.3	139.3 tons
51 – 100	11	35.5	
101 – 150	7	22.6	
151 – 200	1	3.2	
201 – 250	1	3.2	
1800	1	3.2	

Source: Field survey, 2023

Monthly Costs Structure of Modern Rice Mills

Table 6 shows the average monthly cost of modern rice mills. The result indicated that variable cost constituted 89.60% of total cost while fixed cost was 10.4%. The most important component of variable cost was the cost of paddy which constituted 82.3% of total cost, followed by cost of labour and electricity which covered 4.08% and 1.27%, bagging material and repairs and maintenance covered 0.99% and 0.30% respectively. The least important component was firewood which covered 0.01%. This implies that cost of paddy rice covered substantial amount of the total variable cost in the modern rice mill ventures. The least

percentage occupied by firewood is due to the fact that almost all the mills utilize rice husk (by-product of rice milling) as their source of energy for parboiling and hence do not buy firewood, which in turn minimize the cost of parboiling. Diesel cost is also minimal due to the fact that most of the small mills rely solely on electricity from the national grid and don't operate on diesel engine completely.

From the fixed cost components, interest on working capital had the highest proportion with 5.57% of total cost, followed closely by depreciation on capital items with 4.75% and tax which constituted 0.08%. The total fixed cost, total variable cost and total cost per month of modern rice mill were ₦1,067,370.96, ₦9,194,480.64 and ₦10,261,851.60 respectively. This is similar to the findings of Bose *et al.* (2020) who described paddy as the most important component of variable cost in rice processing constituting 85.10% of total variable cost. In a similar study, Akanbi *et al.* (2023) reported that variable cost accounts for over 95% of the cost of rice processing and cost of paddy rice constituted the highest percentage of costs, accounting for 78.12% of total processing cost. Ibitoye (2014) also reported that total variable cost constituted 82.34% of total rice processing cost and total fixed cost constituted only 17.66%.

Table 6: Monthly cost structure of modern rice mills

Items	Amount (₦)	Percentage
Fixed cost		
Interest on working capital (18%)	571524.19	5.57
Depreciation on Capital Items (10%)	487540.32	4.75
Tax	8306.45	0.08
TFC	1,067,370.96	10.40
Variable Cost		
Paddy (333.5 tons @ ₦25,306.5)	8,439,032.26	82.23
Electricity	130419.35	1.27
Diesel	59201.61	0.58
Firewood	1193.55	0.01
Repairs and maintenance	30612.90	0.30
Bagging material	102059.68	0.99
Labour	419,000.00	4.08
Miscellaneous	12961.29	0.13
TVC	9,194,480.64	89.60
TC (TFC + TVC)	10,261,851.60	100

Source: Field survey, 2023

Monthly Returns from Modern Rice Mills

The monthly returns from modern rice mill are presented in Table 7. The result shows that parboiled rice was the most important component of return constituting 74.64% of total revenue, followed by white rice and milling fee constituting 35.4% and 19.63% respectively. Returns from the sale of broken rice and bran were 1.72% and 0.27% respectively. Least was the revenue from the sale of husk which was 0.19% of total revenue. The total revenue (TR) was ₦15,849,961.28, Gross Margin (GM) was ₦6,655,480.64 and Net income (NI) was ₦5,588,109.68. The return on naira invested (ROI) and return on capital invested (ROCI) were 0.72 and 0.54 respectively. This implies that, in addition to recouping the amount invested, the mill earned in the short and long-runs ₦0.72 and ₦0.54 respectively on each naira invested in



the enterprise. This shows that modern rice mill is a very profitable venture in the study area. This is in line with the findings of Akanbi *et al.* (2023), Bose *et al.* (2020) and Sadiq *et al.* (2021) who all reported rice processing to be a profitable venture.

Table 7: Monthly returns from modern rice mills

Product	Quantity (Bags)	Price/bag (₦)	Returns (₦)	Percentage
Parboiled rice	371	31854.84	11,830,806.45	74.64
White rice	18.5	30315.86	560,806.45	35.40
Broken rice	18.5	14755.0	272,967.74	1.72
Bran	33.5	1255.95	42,074.19	0.27
Husk	32.9	961.29	31,661.29	0.19
Milling fee	1160.8	2680.65	3,111,645.16	19.63
Total returns (TR)			15,849,961.28	100
Gross margin (GM)		6,655,480.64		
Net income (NI)		5,588,109.68		
ROI		0.72		
ROCI		0.54		

ROI = Return on Naira invested ROCI = Return on capital invested

Source: Field survey, 2023

Influence of Mill's Characteristics on Gross Income

The influence of mill's characteristics on gross income was evaluated using multiple regression analysis. The result presented in Table 8 revealed that years of operation, number of employees and working hours per day, installed capacity and type of mill were the factors influencing the gross income of modern rice mills. Number of employees, working hours per day and installed capacity had positive coefficients and were significant at $P < 0.001$. Type of mill also had positive coefficient and was significant at $P < 0.05$. However, years of operation had negative coefficient and was significant at $P < 0.001$. The implication of the signs is that an increase in variable with positive sign would lead to an increase in gross income of modern rice mills and an increase in variable with negative sign will lead to decrease in same. The coefficient of multiple determinations (R^2) was 0.95 implying that 95% of the variation in gross income was explained by explanatory variables in the model. F-value (54.491) was statistically significant at $P < 0.001$ which also showed the model fitness and justification of the overall influence of the independent variables. This is in line with the findings Busayo, *et al.* (2017), Akben-Selcuk (2016) and Dogan (2013) who reported similar relationship between firm's characteristic and performance.

Table 8: Multiple regression result on the influence of mill's characteristics on gross income

Variable	Co-efficient	Standard error	t-value	Prob.
Constant	-6509715.038	5079618.918	-1.282 ^{NS}	.213
Installed capacity (X ₁)	7212152.053	3051000.215	2.364**	.027
Years of operation (X ₂)	-1903929.990	611833.773	-3.112***	.005
Type of ownership (X ₃)	-894843.195	3005246.331	-.298 ^{NS}	.769
Type of mill (X ₄)	1233753.068	632794.452	1.950**	.046
Number of employees (X ₅)	868398.726	171018.226	5.078***	.000
Source of paddy (X ₆)	-2003099.025	1208644.499	-1.657 ^{NS}	.112
Working hours per day (X ₇)	5321124.468	1859898.615	2.861***	.009
Buyers (X ₈)	-1635865.154	1551689.739	-1.054 ^{NS}	.303
R ²	0.952			
Adjusted R ²	0.934			
F – Value	54.491***			

Source: Field survey, 2023

CONCLUSION AND RECOMMENDATIONS

The study concluded that most of the modern rice mill in the study area were of small and medium size category. Modern rice mill is a profitable venture in the study area as evidenced in the profitability indices. Also, performance of modern rice mills is influenced by mill's characteristics such as installed capacity, years of operation, type of mill, number of employees, and working hours per day.

The study recommends that rice millers should be encouraged to collectively source credit facilities from formal financial institutions in order to acquire the required working capital and promote the growth and development of the domestic rice milling sector. Modern rice mills should form associations so that they could demand necessary facilities such as adequate electricity and water supply from concerned authorities. Programmes and Policies aimed at boosting dry season rice production should be reinforced so that mills could have access to enough paddy to operate fully all year round. In addition, indigenous industries should be encouraged to fabricate modern milling machines and equipment to enable mills have access to required machines and spare parts easily and at affordable prices.

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