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BRIDGING GAPS IN PROFIT EFFICIENCY: A STUDY OF MEDIUM-SCALE GRAIN MILLING BUSINESSES IN ABUJA, NIGERIA.

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ABSTRACT: *The broad objective of this study was to examine the profit efficiency of medium scale grain milling enterprises in Bwari Area Council, Abuja. Out of a sample frame of fifty seven, 50 respondents were randomly selected. The data collected was analyzed by the use of descriptive statistics, profit model and transcendental logarithmic stochastic profit frontier function. The results on socioeconomic analysis revealed that the mean age was 41 years, while 68% had primary education as their highest level of education. The mean household sizes and milling experience were 5 persons and 5 years respectively. Finally, almost all the respondents (98%) used both self financing and credit as the source of their capital. The result of the profit analysis revealed that an average medium scale grain mill in the study area recorded total revenue of N12, 842,080 per year with a net profit of N4, 522,161 per year. The coefficient of gamma () is large (0.81) and not significant implying that 81% of deviation from the profit obtained was not due to profit inefficiency effects. The coefficient of the cost of labour throughput (-69.28) was negative and statistically significant at 1%. The estimated coefficient of cost of machinery throughput (3.60) and cost of fuel throughput (8.07) were positive and statistically significant at 1%. All the interaction terms where statistically significant with three of the variables (cost of labour by cost of labour, cost of fuel by cost of fuel and cost of labour by cost of machinery) being positive, while the other three (cost of machinery by cost of machinery, cost of labour by cost of fuel and cost of machinery by cost of fuel) being negative. The mean profit efficiency was 69.8. It can be concluded that medium scale grain milling enterprises in the study area are profitable but not yet fully profit efficient. It is therefore recommended that training on better management practices be conducted by relevant agencies to improve profit efficiency.*

KEYWORDS: Profit Efficiency, medium-Scale, Grain Milling business, Transcendental Logarithmic, Stochastic Frontier.

INTRODUCTION

Medium grain milling enterprises are vital to Nigeria's agricultural and economic development, transforming grains like maize, rice, millet, sorghum, and wheat into flour, animal feed, and other products (Opaluwa and Ukwuteno, 2015). These enterprises provide employment, especially in rural areas, while supporting local economies and enhancing food security through a steady supply of affordable food products. By adding value to raw agricultural produce, they boost farmers' incomes and stimulate local economic activities. However, they face significant challenges such as limited access to finance, inadequate infrastructure, high energy costs, and outdated equipment. Despite these hurdles, the sector holds substantial growth potential. With better access to technology, funding, and government support, medium grain milling enterprises could enhance Nigeria's food processing capacity, reduce post-harvest losses, and promote greater economic self-reliance (Uzoejinwa et al. (2016).

As reported by Opaluwa and Ukwuteno (2015), the majority of grains consumed in Nigeria undergo some form of processing, with milling being the most common method. Gwirtz and Garcia-Casal (2014) identify two main industrial processing methods for transforming grains—dry and wet milling. In Nigeria, dry milling is the predominant method (Asiegbu, 2016), employing size reduction machines such as burr mills, hammer mills, and roller mills (Yakubu, 2017). The primary objective of the milling process is to remove the husk and, in some cases, the bran layers, producing an edible, impurity-free product in powdered form with varying particle sizes (Oghbaei and Prakash, 2016).

Grain mills in Nigeria fall into four main categories: micro, small, medium, and large-scale mills (Asiegbu, 2016). Micro-scale mills are typically found in residential areas, where households bring their grains to be milled for a fee. Medium-scale mills, using mid-sized modern machinery, are located in designated areas and primarily engage in production milling, buying grains, milling them into flour, and selling the finished products. Some millers also engage in contract milling to optimize the use of their equipment and generate additional income (Jonsson et al., 1994).

Despite the large price gap between maize producer prices (N8,000 to N10,000 per 100kg) and retail prices for maize flour (N15,000 to N25,000 per 100kg), increased investment in small-scale maize milling in Nigeria has not been as widespread as expected (Onyebuchi, 2017). This gap is also reflected in other grains , suggesting significant untapped potential in the grain milling sector (Onyebuchi, 2017).

However, in regions like Bwari Area Council of Abuja, medium grain milling enterprises face several challenges that hinder their ability to maximize profits despite favorable price conditions and the fixed factors of production. This research was therefore undertaken to assess the profit efficiency of small-scale grain milling enterprises in Bwari Area Council, with the following research questions aimed at understanding the constraints and opportunities within the sector.

a. What are the socio-economic characteristics of medium scale grain millers in the study area?

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b. What are the characteristics of medium scale grain milling enterprises in the study area?

c. What are the profits from grain milling by medium scale grain milling enterprise in the study area?

d. What is the profit efficiency of medium scale grain milling enterprises in the study area?

e. What are the constraints facing medium scale grain milling enterprises in the study area?

LITERATURE REVIEW

Measurement of Profit Efficiency

The main aim of these mills, like other Agribusiness enterprises, is to make profit. Profit is a financial benefit that is realized when the amount of revenue gained from a business activity exceeds the expenses, costs and taxes needed to sustain the activity (Usman *et al.,* 2014). However, limited studies have looked at the relationship that exists between business strategies and overall rganizational profitability (Altavilla *et al.,* 2018). Hence, leaving a gaps in academic literature yet to be filled from the context of flour milling firms in Nigeria (Bala and Alhassan 2018). Profit efficiency is the ability of a firm to achieve the highest possible profit at the point where there is minimum cost of production (Ettah and Nweze, 2016).

In assessing the efficiency of business firms, both parametric and non-parametric methods of measurements have been applied. The latter is less widely used however, as it is non econometric in nature by way of non-consideration of random noise (Arbelo *et al.,* 2020). Parametric approach presumes an explicit functional form to estimate the frontier of production, cost or profit functions. The performance of a specific firm is evaluated with respect to the efficient frontier, and any deviation from this efficient frontier is due to random errors and inefficiency (Arbelo *et al.,* 2020). The drawback of the parametric approaches lies on imposing a specified functional form that assumes the shape of the frontier. If it is misspecified, the calculated efficiency may be confounded with the specification error (Arbelo *et al.,* 2020).

According to Chuang-min *et al.,*(2018) there are three major parametric frontier techniques, namely; Stochastic Frontier Approach (SFA), Distribution-Free Approach (DFA) and Thick Frontier Approach (TFA). Many techniques can be used to estimate efficiency, such as the data envelopment analysis (DEA), stochastic frontier approach, thick frontier approach and distribution-free approach (Chuang-min *et al.,* 2018). But the choice of the method will depend on whether distributional assumptions on the error components are made or not (Kiplimo and Ngeno, 2016).

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Stochastic frontier approach (SFA)

The stochastic frontier approach (SFA) was developed by Aigner *et al.* (1977) and Meeusen and Van Den Broeck (1977) and, later, by Jondrow *et al*. (1982). This approach is also known as the econometric frontier approach. The frontier method has been the most often used methodology for estimating efficiency (Arbelo *et al.*, 2020) The SFA specifies a functional form for the cost, profit, or production relationship among inputs, outputs, and environmental factors, and allows for random error. It also has the ability to be estimated using a single-step procedure. The advantage of the stochastic frontier methodology is that it enables us to separate the distance between the efficiency of a company and its optimal frontier into random errors and inefficiency (Pérez-Gómez *et al.,* 2018). The distributional assumption for the stochastic term components is depicted by two-sided normal distribution, while the inefficiency term is assumed to be one-sided distribution.

However, the stochastic frontier analysis is not lacking of shortcomings. It imposes specific assumptions on both functional form of the frontier and distribution of error term (Gebregziabher *et al.,* 2012). The procedure lacks *a priori* justification for the selection of a particular distributional form for the one sided inefficiency term (Mohammed *et al.,* 2013). Despite these weaknesses, this study adopted the stochastic frontier procedure considering its attributes of separating the error term into two components (efficiency and noise).

Distribution-free approach

Distribution-free approach (DFA) was introduced by Berger (1993) following his criticism of the stochastic frontier approach. DFA specifies a functional form for the frontier, but separates the inefficiencies in a different way. The DFA assumes that the efficiency of each firm is stable and does not change over time, whereas random errors will average out to zero in the end. Thus, in contrast to the SFA, this approach sets no specific type of distribution to the inefficiency term.

Thick frontier approach

The Thick frontier approach (TFA) was proposed by Berger and Humphrey in 1992 (Amaechi et al. 2014). The thick frontier approach assumes that production levels may deviate from the frontier due to measurement errors or to factors beyond the control of the firm's management, besides inefficiency. Thus, observations may lie on both sides of the frontier. TFA does not enforce any distributional assumptions on inefficiency as well as random error, and does not provide exact estimates of efficiency for individual firms . One major drawback of this approach is that, the frontier function cannot be distinguished from the inefficiency effect of the model when using cross-sectional data (Kiplimo and Ngeno, 2016). This method is less popular amongst researchers.

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METHODOLOGY

Study Area

Bwari Area Council is located in the north-eastern part of Federal Capital Territory, Abuja. It is approximately 15km north of Abuja city and 25km northeast of Suleja, Niger state. Geographically, it is located 9^0 28” N and 7^0 39” E (Baba *et al.*, 2017). The northern expressway of Abuja is the boundary between Abuja Municipal Area council and Bwari Area Council. Its headquarters is in the town of Bwari. It has an area of 914km^2 and a population of 227, 216 according to the 2006 census (Baba, *et al.*, 2017).

According to Bwari Master Plan, the proposed land area to be covered in hectares for industrial uses is 139.96 hectares**.** Medium scale industries would cover 48.70 hectares and small scale industries would cover 53.70 hectares. The remaining 37.56 hectares was proposed for large or major industries (Baba, *et al.*, 2017).

Sampling Procedure and Sample Size

Purposive and random sampling techniques were employed for this study. Five wards out of the ten wards in the Area Council were purposively selected due to the higher concentration of grain milling enterprises in these wards. The sample frame distribution of the five wards was found to be 57. Out of the five wards purposively selected, 10 respondents from each ward were randomly selected making a total of 50 respondents.

Table 1: Sample frame and sample size distribution of the five wards

	Ward	Sample Frame	Sample Size
1	Kubwa	12	10
2	Bwari Central	11	10
3	Kuduru	11	10
4	Dutse Alhaji	12	10
5	Ushafa	11	10
	Total	**57**	**50**

Source: *Field Survey, 2018*

Data Collection

This study uses primary data which was collected using an Interview schedule

Method of Data Analysis

Objectives one, two and five were analyzed using descriptive statistics which include frequencies, percentages, means. Objective three was analyzed using the profit model which involves subtracting the total cost from the total revenue. Objective four, was estimated by the use frontier model. The MLE method was used to estimate all the parameters as it is mostly

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preferred due to its consistent estimates compared to ordinary least squares (OLS) (Aigner *et al.*, 1977).

Model Specifications

Profit model specification

The profit model is a tool used to determine the level of resources used and output realized in enterprises (Olukosi, Isitor, and Ode, 2012) The implicit form of the model is specified as follows:

PR = TR−TC …………………………………………………………………………… (i)

Where;

PR = Net profit from the enterprises

TR = Total revenue from the enterprise

TC = Total cost incurred by the enterprise

But,

TC = TVC + TFC

TR = p.q

Where

TVC = Total Variable Cost

TFC= Total Fixed Cost

p= Price per unit of output (N per kg)

q= Total Quantity of Output (kg)

Hence, the model becomes:

PR = p.q− (TVC + TFC) ……………………………………………………… (ii)

The TR (p.q) components are:

Sales of milled grains (in N per year)

Fee for milling (in N per year)

The TVC components are:

Cost of grains (N per year)

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Cost of manual labour (N per man year of labour),

Cost of fuel (N per year),

Cost of electricity (N per year),

Marketing Costs (N per year)

Repair and maintenance (N per year)

The TFC components are:

Depreciative value of machineries (N/year)

Depreciative value of milling house (N/year)

Depreciative value of storage house (N/year)

Stochastic profit frontier model specification

The transcendental logarithmic function was used to estimate the profit efficiency of small scale grain milling enterprises in the study area. The transcendental logarithmic function was preferred to the Cobb Douglas function because the Cobb Douglas function was more restrictive and it imposes strong assumptions about constant elasticity of production and substitutions.

The model would commence by considering a stochastic profit function with a multiplicative disturbance term of the form:

$_{i}= f\,(p_{i}\,, z_{i})\exp(_{i})$ ………………………………………………… (iii)

Where;

$_{I}$ = the profit of the mill defined as the total revenue less the total cost incurred by the firm,

p_i= the input price,

z_i= the level of fixed factor for the i^{th} mill

$_{i}$ = the error term assumed to behave in a manner consistent with the frontier concept.

The explicit transcendental logarithmic functional form for the small scale grain millers in the study area was specified thus:

$\ln\pi_i = \beta_o + \beta_1 \ln C_{1i} + \beta_2 \ln C_{2i} + \beta_3 \ln C_{3i} + 0.5(\beta_4 \ln C_{1i}^2 + \beta_5 \ln C_{2i}^2 + \beta_6 \ln C_{3i}^2) + \beta_7 \ln C_{1i} \ln C_{2i} + \beta_8 \ln C_{1i} \ln C_{3i} + \beta_9 \ln C_{2i} \ln C_{3i} + (V_i - U_i)$ ……………………………………………….…… (iv)

Where;

$\ln\pi_i$= profit function computed as the total revenue less total cost,

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C_{1i}= cost of labour (N),

C_{2i}= cost of machinery (N),

C_{3i}= cost of fuel (N),

B_1 to β_9= parameters to be estimated,

V_i = assumed to be independent and identically distributed random error which have normal distribution with mean zero and unknown variance, ^{2}

U_i= non-negative (zero mean and constant variance) random variable called profit inefficiency effect associated with the profit efficiency of the i^{th} miller.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

Table 1 shows the results for the socioeconomic characteristics of the respondents. The result indicates that 74% of the respondents are males with a mean age of 41 years while 68% had primary education as their highest level of education. The mean household sizes and milling experience were 5 persons and 5 years respectively. Finally, almost all the respondents (98%) used both self financing and credit as the source of their capital.

Table 1: Socioeconomic the characteristics of the respondents

Categories	Types	Freq.	%
Gender	Male	37	74.00
	Female	13	26.00
	Total	**50**	**100.00**
Age	20—30	4	8.00
	31—40	21	42.00
	41—50	19	38.00
	>50	6	12
	Total	**50**	**100**
	Mean	**41.84**	
Marital Status	Single	5	10.00
	Married	35	70.00
	Widowed	10	20.00
	Total	**50**	**100.00**
Highest Educational Levels	Primary	34	68.00
	Secondary	15	30.00
	Tertiary	1	2.00
	Total	**50**	**100.00**
Household	1—2	5	10

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Size	3—4	16	32
	5--6	25	50
	> 6	4	8
	Total	**50**	**100**
	Mean	**5**	
Processing Experience	1 – 3	2	4.00
	4 – 6	17	34.00
	7 – 9	25	50.00
	10 – 12	1	2.00
	> 12	5	10.00
	Total	**50**	**100.00**
	Mean	**5**	
Source Of Labour	Family Labour	19	38.00
	Hired Labour	31	62.00
	Total	**50**	**100.00**
Source of Capital	Self financing only	0	0.00
	Credit Only	1	2.00
	Self financing & Credit	49	98.00
	Total	**50**	**100.00**

Source: *field survey, 2018*

The demographic data presented highlights key characteristics of the individuals involved in grain milling. In terms of gender, the majority of respondents were male (74%), with females making up 26%, indicating a male-dominated industry. Age distribution shows that most respondents were between 31-40 years (42%), followed by those aged 41-50 years (38%), with a mean age of 41.84 years. This suggests a relatively experienced and mature workforce. Marital status data reveals that 70% of respondents were married, and 20% widowed, which may indicate stability in family life as a factor in participation in grain milling The implication of male dominance may also be that productivity is expected to be higher, because males have the tendency to be more labour efficient as compared to their female counterparts (Reddy, et al. 20).

.In terms of education, the majority of respondents had only primary education (68%), with very few attaining tertiary education (2%). This underscores the low educational background within the sector, which might affect productivity and adoption of modern techniques (Ndahitsa, 2008). Household size data shows an average of five members, with 50% of respondents having households of 5-6 members, implying that grain milling likely supports large families.

When looking at experience in processing, 50% of respondents had 7-9 years of experience, with an overall mean of 5 years. This indicates a relatively experienced workforce, but not highly seasoned Experienced millers are more proficient in the methods of production and optimal allocation of resources, resulting in mills with better efficiency (Abu and Kirsten, 2009). Labour sources reveal that 62% rely on hired labor, while 38% use family labor, reflecting a mixed approach to labor needs. Lastly, the source of capital indicates that nearly all respondents (98%) used a combination of self-financing and credit, highlighting the critical role of external financing in sustaining these businesses.

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These findings suggest that grain milling in the area is largely driven by experienced but low-educated male workers, often with limited access to independent financial resources. The reliance on a mix of labor and the significant role of family support may impact both efficiency and profitability (Nabil 2013 and Obinne, 1991).

Profit from Medium Scale Grain Milling Enterprises

Table 3 gives a breakdown of the annual averages of cost and returns for the respondents during the study period. It shows that fixed cost items accounted for about 11% of the total cost while about 89% was accounted for by the Variable cost.

Table 3: Monthly Cost and Returns for medium scale grain milling enterprises

		Descriptions	Amount (N)	%
A	**COSTS ITEMS**			
	1	**Fixed Cost Items**		
		Depreciation on Machineries	429,648	5.16
		Depreciation on Building and Structures	353,800	4.25
		Depreciation on Milling Accessories	112,919	1.36
		Total Fixed Cost (TFC)	**896,367**	**10.77**
	II	**Variable Cost Items**		
		Grains	5,607,472	67.4
		Labour	1,020,000	12.26
		Transport	136,240	1.64
		Bags	229,496	2.76
		Electricity	121,240	1.46
		Fuel	254,920	3.06
		Repairs	54,184	0.65
		Total Variable Cost (TVC)	**7,423,552**	**89.23**
	III	**Total Cost (TFC + TVC)**	**8,319,919**	**100.00**
B	**REVENUE**			
		Sale of milled grain	10,990,654	
		Milling fee	1,851,426	
		Total Revenue	**12,842,080**	
C	**NET PROFIT (B – A)**		**4,522,161**	

Source: *Computed from Field Survey data, 2018*

The monthly cost and returns for medium-scale grain milling enterprises demonstrate a healthy profitability but also underline significant operational costs. The total costs (₦8,319,919) are dominated by variable costs, which account for 89.23% of the total. The bulk of these variable costs is due to the purchase of grains, which alone constitutes 67.4% of the total expenses. Other

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variable costs include labor, transportation, bags, electricity, fuel, and repairs, indicating the various operational expenditures required to maintain production.

Fixed costs, including depreciation on machinery, buildings, and milling accessories, make up 10.77% of the total, with the depreciation on machinery representing the highest proportion at 5.16%. This relatively low fixed cost ratio compared to variable costs indicates that grain milling enterprises heavily rely on raw material inputs (grains) and labor, both of which are subject to price fluctuations that could impact profitability.

On the revenue side, the enterprise generates ₦12,842,080, with most of the revenue coming from the sale of milled grain (₦10,990,654), while milling fees provide an additional ₦1,851,426. This results in a net profit of N4,522,161, a substantial return, representing around 35.23% of total revenue. This profitability shows the potential viability of grain milling enterprises despite the high variable costs, especially in sourcing raw grains, labor, and transportation.

The data suggest that while medium-scale grain milling enterprises can be profitable, their financial success is highly dependent on efficient management of variable costs, particularly grain procurement. This agrees with the findings of Oluwasola (2010) who found that cost of grains comprised the highest share in the total cost of milling. The result also showed that majority of the revenue was generated from sales of milled grains. This is similar to the findings of Usman *et al*. (2014) who found out that sale of milled grains contributed the highest share in the total revenue realized from medium-scale milling.

Estimated Profit Efficiency

The estimates of the stochastic frontier profit model for medium scale grain milling enterprises in the study area are presented in Table 4

Table 4: Estimates from the stochastic profit model of medium scale mill processors

	Parameter	Coefficient	SE	t-ratio
Constant	0	348.42	1.00	348.42***
Ln(Cost of labour)	1	-69.28	1.00	-69.28***
Ln(Cost of machinery)	2	3.60	1.00	3.60***
Ln(Cost of fuel)	3	8.07	1.00	8.07***
Ln(Cost of labour) Ln(Cost of labour)	4	3.56	1.00	3.56***
Ln(Cost of machinery) Ln(Cost of machinery)	5	-2.60	1.00	-2.60***
Ln(Cost of fuel) Ln(Cost of fuel)	6	3.82	1.00	3.82***
Ln(Cost of labour) Ln(Cost of machinery)	7	4.61	1.00	4.61***
Ln(Cost of labour) Ln(Cost of fuel)	8	-2.27	1.00	-2.27**
Ln(Cost of machinery) Ln(Cost of fuel)	9	-2.25	1.00	-2.25**
sigma-squared	2	1.08	1.00	1.08
Gamma		0.81	1.00	0.81
Log likelihood function	LLF			-53.82

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Note: *** = significant at 1% level; ** = significant at 5% level; * = significant at 10% level;
Source: *Computed from Field Survey data, 2018*

For medium scale grain mills, the sigma squared (^{2}) coefficient was 1.08 and not significant. This result is in conformity with that obtained by Abu and Kirsten (2009) who also reported a non significant sigma squared. Sigma squared (^{2}) shows the correctness of the specified distributional assumptions about the error term. The coefficient of gamma () is large (0.81) and not significant implying that 81% of deviation from the profit obtained in this category of mill was not due to profit inefficiency effects. The coefficient of the cost of labour throughput (-69.28) was negative and statistically significant at 1% probability level, which indicates that decrease in the cost of labour would cause an increase in the profit level of these mills.

However, the estimated coefficient of cost of machinery throughput (3.60) and cost of fuel throughput (8.07) were positive and statistically significant at 1% probability levels. This means that increased costs of machinery and fuel tend to facilitate increased levels of profit. All the interaction terms where statistically significant. However, apart from the interaction between cost of labour throughput and cost of fuel, and cost of machinery throughput and cost of fuel which were significant at 5% level of probability, the remaining interaction terms were significant at 1%.

The coefficients of three of the variables (cost of labour by cost of labour, cost of fuel by cost of fuel and cost of labour by cost of machinery) were positive, which indicates a positive relationship between each of those variables and profit. However, the coefficients of the remaining three (cost of machinery by cost of machinery, cost of labour by cost of fuel and cost of machinery by cost of fuel) were negative, which indicates a negative relationship between the variables and profit.

Distribution of profit efficiency of medium scale grain mills

The distribution of profit efficiency of medium scale grain milling enterprises in the study area according to efficiency classes are presented in Table 5

Table 5: Distribution of profit efficiency of medium scale grain mills

Efficiency Range	Frequency	Percentage
0.10-0.50	17	34
0.51-0.60	11	22
0.61-0.70	12	24
0.71-0.80	8	16
0.81-0.90	2	4
0.91-1.00	0	0
Total	**50**	**100**
Mean (%)	**54.2**	
Minimum (%)	**13.2**	
Maximum (%)	**84.2**	

Source: *Computed from Field Survey data, 2018*

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The medium scale mills in the study area operate at profit efficiency levels ranging from a low of 13.2% to a high of 84.2%. The mean level of profit efficiency is 54.2% which suggests that medium scale grain mills in the study area lose an estimated 45.8% of profit owing to a combination of both technical and allocative inefficiency. In other words, the medium scale mills can increase their profit on average by 45.8% by improving their efficiency levels using the existing resources and technology (Abu and Kirsten, 2009).

CONCLUSION AND RECOMMENDATIONS

The result of the analysis confirmed that small-scale grain milling enterprises are profitable with a mean profit efficiency of 69.8%. Furthermore, marital status, milling experience and the source of capital contributed significantly to the inefficiency in medium scale mills in the study area. Based on the findings of this study, it is hereby recommended that training on better management practices be conducted by relevant agencies to improve profit efficiency.

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