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Profit Efficiency of Traditional Pottery Technology among Peri-Urban Farming Households in Ilorin East LGA of Kwara State Nigeria

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ABSTRACT
The study analyses socio-economic characteristics and profit efficiency of traditional pottery technology in Ilorin East Local Government Area (LGA) of Kwara State, Nigeria. Primary data which were mainly used for the study were collected with the aid of structured questionnaire administered through trained enumerators. A total of 80 potters were randomly selected from 3 settlements. The main tools of analysis were descriptive statistics and stochastic profit frontier function. Majority of the potters (62%) have total investment of less than ₦100,000.00 with mean education index of 0.7 years, and 63% had access to credit through cooperative societies. The study also revealed that all respondents belong to cooperative societies with a mean of about 22 years of membership. All sampled respondents were female and 95% were married with preponderance of farmers (94%) as their spouses. Average price of standardized clay ($p< 0.01$), family labor ($p< 0.01$) and depreciated items ($p<0.05$) were found to be positive and statistically significant. The profit inefficiency was statistically significant ($p<0.05$) and positively influenced by potters' experience while adjusted household size had a negative influence and statistically significant at 1%. This implies that potters with less years of experience exhibit significantly less profit. Household size was negative, indicating that additional increase in family labor could lead to increase in output. It is recommended, that pottery households should strengthen their formidable cooperative societies to access credit, organize training using community based informal education, to enhance increase quantity and quality products that translate into increase profit.

Keywords: traditional pottery, socio-economic characteristics, profit efficiency, Nigeria

INTRODUCTION

Pottery enterprise is an indigenous technology which can be found virtually in most rural areas in Nigeria but more commonly found in the Northern part of Nigeria. For long, Nigeria local pottery households are traditional and major producer of utensils such as cooking pots, water container, saving gadgets, dye equipment as well as varieties of local ceramics to rural and peri-urban households. Despite its long age practices as a complementary occupation for most rural and peri-urban farming households' spouses, the processes still remain local and archaic characterized with low capital investment and high labor intensive practices; and low productivity, and that cannot serve as a useful means of commercial production of households' utensils (Oladimeji *et al*., 2015).

During pre-independence era, the demand for products of Nigerian local potters, like other output from local indigenous crafts' products, has been consistently high, accounting for large percentage of rural and partly urban cooking and domestic utensils supply (Oladimeji, 2013). However, with emergence of massive importation of cooking pots and other households' utensils, most of these crafts that would have been developed into crucial technological sectors are still rudimentary and not well explored. Yet, the pottery enterprise has multiplier impacts on domestic and technological development if properly harnessed. In many developed countries, structured clay products are used for buildings, surfacing highways, making containers for corrosive acids, as aggregate for low-density concrete, as conduits for sewage, as structural arches supporting bridges, as roofs, and as chimney-liners. The reviving the local crafts, agriculture and indigenous technology including pottery offers succor capable of salvaging the people from chronic and transient poverty (Oladimeji, 2013a & b). Nigerian rural communities like other countries are rich in a wide variety of crafts such as pottery, weaving, blacksmithing, carpentry and joinery, visual arts, soap-making, leather-work, canoe-building, sculpturing, garment making, dyeing and bleaching;

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painting and decoration. In the nineteenth century, most of these crafts developed into extensive industries particularly in most developed countries and a few developing countries which include China, Malaysia and India (Olaoye, 1989, Oladimeji *et al*., 2015).

Rural households engage in wide range of income-generating activities for sustaining their livelihood to compliment farming. Evidence from literature revealed that there has been an increased recognition recently that the rural economy is not confined to the agricultural sector, but embraces the broad spectrum of needs of all rural people including social service provision, economic activities, infrastructure and natural resources (Csaki and Lerman, 2000; Davis and Bezemer, 2004; Idowu *et al*., 2013). Therefore, the economic diversity in the rural area has the potential to foster local economic growth and alleviate the rural-urban income gap and rural poverty (Davis and Bezemer, 2004).

It suffices to note that clay earth is the major raw material needed in pottery production. Clay is essentially fine-grained, earthy material that becomes plastic and tenacious when moist, and they become permanently hard when baked or fired (Velde, 1995). It may be composed of mixtures of clay minerals and clay-sized crystals of other minerals such as quartz, carbonate, and metal oxides. They are commonly formed either as products of the chemical weathering of pre-existing crystalline rocks and feldspar minerals, particularly in warm tropical and subtropical regions of the world or as a result of the hydrothermal alteration (Ojo *et al*., 2014).

Despite the vast use of clay and other earthy materials in making of pottery, it has uses in tiles, aerospace, biomedical, construction, and nuclear industries and more importantly, clay soil supply essential mineral elements to both arable and permanent crops for their growth and has been found valuable for their mechanical properties (as ceramic constituents), including strength, durability, and hardness. Pottery is a multi-component system formed by clay and temper. Adding temper, usually non-plastic material (such as mineral, vegetal and organic material) to clay during paste preparation is a common practice among traditional potters (Casimiro *et al*., 2008). As clay pottery is one of the most frequent elements related to a civilization, there is a declining trend in clay pottery production as well as a shortage of its supply in domestic markets as a result of a number of technical, socio-economic and institutional constraints, which need to be addressed. This is due to the general belief that most families no longer used them as cooking and domestic utensils with emergence of modern technology and largely due to poor quality of the products that are produced by the enterprise. The situation has made the potters to seldom engage in the practice based on the demand of the product from individual customer. It is often stated that development of local technology for developing small scale industry such as pottery would lead to rapid development of complex technology industries (Oladimeji, 2013a, Oladimeji *et al*., 2015).

According to Oladimeji *et al*. (2015), the pottery production enterprise is a profitable venture with estimated gross margin per pottery household per month of ₦11,000 ($68.8), and profit index, gross ratio and return on investment of 0.44, 0.56 and 1.8 respectively. Of recent, pottery products are generally found on a small scale and its production efficiency has been undermined. Thus, there is need to have a look into the technical and allocative efficiency through profit indices of pottery enterprise and socio-economic characteristics of potters and provide suggestions for enhancing productivity, profitability and sustainability of pottery enterprise.

Therefore, the objectives of this paper were to describe socio-economic and institutional characteristics of potters' households, estimate the profit efficiency of pottery enterprise, and determine profit loss in pottery production by socio-economic characteristics.

MATERIAL AND METHODS

Description of the study area

The study was conducted at Dada, Okelele and Karebu pottery settlements in Ilorin East Local Government Area (LGA) of Kwara State Nigeria. The clay is sourced from peri-urban settlements at Dada and Akerebiata areas; both are situated in the north-eastern part of Ilorin Township along Shao-Malete road, Sobi Ridge. The study area falls within Ilorin sheet 223NW (1:50,000) (GSN) lying between longitudes 4°30' to 4°37' and latitudes 8°27' to 8°32'.

Sampling procedure and data collection

Primary data which was subjected to a pre-survey were used for this study. Pottery workshop survey provided the basic cross-sectional data from randomly selected 80 pottery households in Ilorin East LGA, a peri-urban settlement: viz. Dada, Okelele and Karebu communities. Most potters were traditionally concentrated in these three communities with well-organized and formidable cooperative societies which made sampling technique robust. Data were collected from the pottery households with the aid of structured questionnaire and interview. The data collected include information on inputs and output as well as the socio-economic and demographic characteristics of the respondents.

Analytical techniques

Descriptive statistics were used to describe socio-economic and demographic characteristics of pottery households. Gross-margin analysis provides the profit index and household income of the potters in the study area. T-statistic was used to test for significant difference between sub-groups of socio-economic characteristics of potters. The stochastic profit frontier model was used to determine the level of efficiency in pottery technologies. The stochastic profit frontier function is given as

$\mu_i = f(Z_i; \omega)\, e^{v-u}$ (1)

The profit efficiency (PEj) of the j_{th} pottery households' was estimated by using:

$\pi_i = f(P_i, Z_i) \exp e_i$ (2)

$e_i = v_i - u_i$ (3)

So that Profit Efficiency probability axiom is of $0 \leq PEj \leq 1$.

This function can be estimated by ordinary least square (OLS) of maximum likelihood estimation (MLE) and the approach for profit function is written as

$ln\pi_i = \beta_i + \sum \beta_i lnP_i + \beta_l lnF_j + v_i - u_i$ (4)

The profit frontier model is thus defined as

$ln\pi_i = \beta_0 + \beta_1 lnP_1 + \beta_2 lnP_2 + \beta_3 lnP_3 + \beta_4 lnP_4 + \beta_5 lnP_5 + \beta_6 lnP_6 + v$ (5)

Where: subscript i refer to the observation of *ith* potters, ln = Logarithm to base e, $\pi_i =$ normalized profit defined as gross revenue less variable cost; P_1=average price of standardized clay consignment (₦); P_2=average price of temper material (₦), P_3=average price of hired labor (₦); P_4=average price of family labor (₦), P_5= average price of depreciated items: shed, small pestle, mortar, clay bat, woven cloth and calabash (₦), P_6= average price of other materials (such as charcoals, firewood and water), $\beta_0 - \beta_6 =$ parameters to be estimated and V_i=error term.

Profit efficiency (PE) of an individual pottery enterprise was defined in terms of the ratio of predicted actual profit (π) to the predicted maximum profit (π^{max}) for a best-practiced potters, conditioned on the level of price of output and inputs used by the pottery enterprise. Profit inefficiency was therefore defined as the amount by which the level of profit for the firm is less than the frontier profit. This is shown in equation 6:

$$PE_i = \frac{\pi}{\pi^{max}} = \frac{f(X_i\delta)exp(V_i - U_i)}{f(X_i\delta)exp(V_i)} = exp(-U_i) \quad (6)$$

Where: π normalized profit of the Ith pottery, X_i is a vector of inputs used by potters i, and ε_i is a "composed'' error term. The error term ε_i is equal to $v_i - u_i$. The term v_i is a two-sided $(-\infty < v_i < \infty)$ normally distributed random error ($v \sim N[0, \sigma_v^2]$) that represented the stochastic effects outside the potters' control. The term u_i is a one-sided $(u_i \geq 0)$ efficiency component that represented the profit inefficiency of pottery enterprise. The distribution of the term u_i can be half-normal, exponential, or gamma and half-normal distribution ($u \sim N[0, \sigma_u^2]$) was used in this study. The two components v_i *and* u_i were also assumed to be independent of each other.

The profit inefficiency was modeled in terms of the socio-economic and institutional factors that were assumed to affect the profit efficiency of pottery households. The determinants of technical inefficiency, (μ_i), is defined

$u_i = \omega_0 + \omega_1 Z_1 + \omega_2 Z_2 + \omega_3 Z_3 + \omega_4 Z_4 + \omega_5 Z_5 + \omega_6 Z_6 + \omega_7 Z_7$ (7) Where:

U_i= technical (profit) inefficiency of the ith potters,

Z_1= potters' experience (years), Z_2= level of education or training of potters (years), Z_3= production credit (₦), Z_4 =adjusted household size, Z_5= cooperative societies, $\omega_0 - \omega_7$= parameters to be estimated.

The stochastic profit frontier function (equations 5 & 6), and the inefficiency function (equation 7) were estimated using the Frontier 4.1C computer package (Battese and Coelli, 1995). The program combines the two-stage procedure into one and produces maximum likelihood estimates of the parameters of a stochastic profit frontier function. In addition, it does not violate the assumption that the inefficiency effects are independently and identically distributed (Battese and Coelli, 1995).

RESULTS AND DISCUSSION

Socio-economic characteristics

Summary statistics of the data reported in Table 1 indicate that traditional pottery practices are family labor intensive, with mean education index of 0.7 years, and that 62% of the respondents have total investment of less than ₦100,000.00 for the pottery enterprise. Although the average credit access through their cooperative was small (₦69,500), however, 63% of the respondents had accessed credit which is a cursor that the pottery enterprise in the study area had a formidable cooperative societies with mean of about 22 years and dominance indicator of 100%. Result also revealed that all sample respondents were female and 95% were married with preponderance of farmers (94%) as their spouses. This is further proved in subsidiary occupation of potters' as 54% engaged in firewood business and 34% in agricultural product marketing and processing. This shows that there is strong bond between pottery households and farming activities in the study area.

In addition, the level of investment, the socio-economic and institutional characteristics and average monthly income from pottery are indicators to the subsistence and rudimentary nature of pottery enterprise. The finding is

consistence with studies of Squires *et al*. (2002) on artisanal fisheries production in Malaysia, Oladimeji, (2013), Ajao and Oladimeji, (2013) on blacksmithing and apiculture production respectively in Kwara State of Nigeria.

Table 1: Socio-economic and production variables of pottery households

Variables	Dominance indicators	Mean	St. dev	Min	Max.	CV*
Gender (sex)	100% female	-	-	-	-	-
Age (years) **	90% above 50 years	55	6.2	25	65	11.3
Marital status	95% were married	-	-	-	-	-
Education (years) **	88%, no formal schooling	0.7	0.2	0	12	28.6
Experience (yrs) **	71% had up to 20 years	25	5.5	6	41	22.0
H. size (persons) **	75% had adjusted size of 6-9	7	2.4	4	13	30.0
Family labor/month	89% used family labour	69	7.9	35	95	11.5
Hired labor/month	43% hired additional labour	21	2.3	0	35	11.0
Credit accessed (₦)	62% had credit cooperative	69500	21488	0	150000	24.0
Cooperative (years)	100% (mandatory)	21.7	5.4	6	29	24.9
Investment (000'₦)	62% invest < ₦100,000	105	9.43	29	203.43	9.0
H. head occupation	94% engaged in farming	-	-	1	80	-
Income/month (₦)	55% earned <₦11,000/month	11000	3400	5.2th	21000	30.9
Off- income/year (₦)	79% had<₦20,000/year	15000	4500	6800	80600	30.0
Subsidiary occupation	54% engage in firewood	-	-	-	-	-
Subsidiary occupation+	34% in agric. mkt. & process	-	-	-	-	-
Expenditure (000'₦)	74% below 2/3 monthly	7.333	0.253	5.7	21.4	3.5

Source: field survey, 2013; Note: H denote household, labor was measured in man-day equivalent to average of 8 hours per man-day;*CV = Covariance of variation and 1US$ = ₦160 during field survey; **see details in Oladimeji et al., 2015b.

Profit efficiency of the potters

Table 2 which shows the estimated profit efficiency model for pottery production enterprise revealed that sigma squared (σ^2) was statistically significant at 5% which shows the correctness of the specified distribution assumption of the composite error term. The gamma (γ) value for the pottery households, which is the ratio of the variance of farm-specific profit efficiency to the total variance of profit (Abdulrahman *et al*., 2015; Oladimeji *et al*., 2015) was 0.557 of pottery production. This means that 56% of the variation in profits among the potters is due to differences in profit efficiency. Average price of standardized clay consignment and family labor were found to be positive and statistically significant at 1%. This implies that a unit increase in amount spend on either clay material or family labor could give 0.430 and 0.255 units increase respectively in total value of pottery output.

Table 2: Maximum likelihood estimates results of frontier profit function of traditional pottery production

Variables: Profit Function	β_i	Coefficient	Std error	t value
Constant	β_0	0.073	0.038	1.92*
ln price of standardized clay consignment	β_1	0.430	0.141	3.05***
ln price of temper materials (₦)	β_2	0.100	0.079	1.26
ln price of hired labor (₦)	β_3	0.049	0.056	0.87
ln price of family labor (₦)	β_4	0.255	0.100	2.54***
ln price of depreciation items (₦)	β_5	0.388	0.186	2.09**
ln price of other (un-depreciated) items (₦)	β_6	0.042	0.042	1.00
ln price of other materials (₦)	β_7	0.091	0.134	0.68
Inefficiency variables				
constant	Z_0	0.209	0.201	1.04
potters' experience	Z_1	0.174	0.078	2.23**
level of education	Z_2	-0.086	0.102	-0.84
production credit	Z_3	0.071	0.058	1.22
adjusted household size	Z_4	-0.073	0.023	-3.29***
cooperative societies	Z_5	-0.031	0.023	-1.32
diagnostic Statistic				
sigma square $\sigma^2 = \sigma_v^2 + \sigma_u^2$	σ^2	0.400	0.194	2.06**
gamma $\gamma = \sigma_u^2/\sigma^2$	Γ	0.557	0.151	3.68**
log likelihood function	*l/f*	-102.6		
LR test		28.9		
no of observation (n)		80		
average profit efficiency		58		

Source: Field survey, 2013, *Asterisk denote significance ***1%,**5%, *10%. LR=Likelihood Ratio.*

Furthermore, average price of depreciated pottery items was found to be positive and significant at 5% which clearly shows that fixed factors are relevant in pottery production. This study agrees with Oladimeji and Abdulsalm (2014) and Oladimeji *et al*. (2015) on technical efficiency of dry season irrigated vegetable and artisanal fisheries in Kwara State Nigeria respectively.

The parameters estimates for determinants of profit inefficiency were also reported in Table 2. The results further shows that the profit inefficiency of the pottery households were positively influenced by potters' experience ($p<0.05$) while adjusted household size had a negative influence and statistically significant at 1%. This implies that pottery households with less years of experience exhibit significantly less profit. However, household size was negative which implies that additional increase in family labor could lead to increase output and invariably more profit for the households. The negative and significant of household size is in sharp contrast to the findings of Ladipo *et al*. (1992) and Oladimeji *et al*. (2013a) on artisanal fishery who posited that excessive uses of labour resource in rural and peri-urban areas tend to be a common occurrence due to rather low opportunity cost for the labour input. Family labour cannot sensibly be 'laid off' in this enterprise in the study area because it is making a positive contribution to the household income.

The percentile distribution of profit efficiency of traditional pottery is presented in Figure 1. The profit efficiency ranged between 14.3 and 81.7 with an average of 61.8. The average percentile profit efficiency score of 61.8 implies that the average pottery household could increase profits by 38.2 by means of improving their technical and allocative efficiency. The result also shows that majority (86.25%) of the respondents have profit efficiency below of 0.60 while only 13.75% of the respondents was operating above 0.60 of profit efficiency. The bulk of potters (about 47.8%) were concentrated in efficiency range distribution of 0.41-0.60. Nevertheless, the results imply that a considerable amount of profit can be obtained by improving technical and allocative efficiencies.

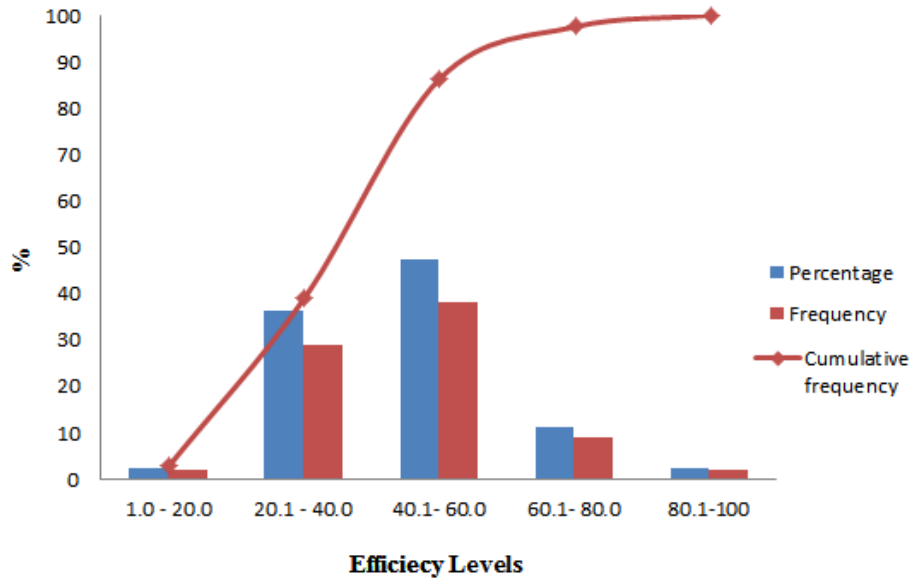


Fig. 1: Percentile frequency distribution of profit efficiencies of frontier profit function

Determinants of profit loss

Results for socio-economic factors contributing to profit loss by system are presented in Table 3. Profit loss is considered here as the difference between maximum profit and actual profit given prices and fixed factor endowments. Profit loss was 22% for potters who had no formal schooling and there was statistically significant at 5% between the actual profit of the potters who had no formal schooling and their counterpart that had primary education. Result also revealed that profit efficiency between potters with primary and secondary education was also statistically significant at 5%. The result is consistent with studies of Squires *et al*. (2002) and Oladimeji *et al*. (2015) on artisanal fisheries in Malaysia and Nigeria respectively who found that additional schooling could improve literacy and cognitive skills which may reduce technical inefficiency by increasing the ability of artisans to adopt innovations and new techniques.

Table 3:Profit loss from production per clay consignment in pottery enterprise by socio economic characteristics

Variables	n	Actual profit (₦)	Estimated Profit loss (₦)	% profit loss	Profit efficiency
Education					
None [a]	70	9255.9	2032.0	22.0	0.6121
Primary [b]	6	10976.8**[ab]	1876.8	17.1	0.6090*[ab]
Secondary [c]	4	12002.7*[bc]	1903.3*[bc]	15.9	0.7605**[bc]
	80				
Household size					
3-5 persons	17	10994.5	1907.5	17.3	0.6906
6 and above	63	11048.5	1896.0	17.2	0.7822
t-ratio	80	0.94	2.72***		3.98***
Credit					
No access	30	9765.6	2105.3	21.6	0.6004
Access	50	12760.8	1795.0	14.1	0.8644
t-ratio	80	1.87*	2.29**		3.00***
Experience					
< 5 years [a]	7	9346.2	1986.4	21.3	0.5432
5.1-10 years [b]	16	10786.4***[ab]	2013.7	18.7	0.6905***[ab]
> 10 years [c]	57	10543.1*[bc]	2049.7	19.4	0.6243***[bc]
	80				
Investment					
Low (< ₦100,000)	50	10321.8	2856.6	27.7	0.6096
High (> ₦100,000)	30	12800.7	1458.8	11.4	0.8754
t-ratio	80	2.19***	4.08***		2.60***

Field survey, 2013, n denote number of observations, Asterisk indicate significance ***1%,**5%, *10%.

Household size was categorized into 3 sub-groups for profit loss. These are households with 3-5 and 6 members Result also revealed that years of experience play significant and diverse role in determinant of profit. For example, there was a statistically significant differences ($p<0.01$) in both actual profit and maximum profit efficiency of potters that had less than 5 years and those with 5-10 years' experience. However, the profit loss was higher (19.4%) among potters with more than 10 years of experience compared with those with 5-10 years of experience (18.7%). This was expected the negative effects may be derived from aging or reluctance to change from old and familiar practices and techniques to those that are modern and improved. Similarly, low and high investment determines to a large extent the amount of output and invariably the profit that accrued to potters. While the actual and estimated profit were statistically significant at 5% and 1% respectively, the low investment potters had a profit loss of 27.7% compared to 11.4% profit loss from high investment group. The finding could also be substantiated with statistically significant difference ($p<0.01$) between the profit efficiency of the low and high investment group and profit efficiency values of 0.61 and 0.88 respectively.

CONCLUSION AND RECOMMENDATIONS

This paper described the socio-economic and institutional characteristics of pottery households; estimated the profit efficiency and determine profit loss in pottery production. The study revealed that the level of investment, the socio-economic and institutional characteristics and average monthly income from pottery are indicators to subsistence and rudimentary nature of pottery enterprise. The output of potters and invariably profit could be sustainably increased, if resources such as clay consignment, family labor and fixed items that were found to be positive and statistically significant could be increased efficiently and optimally utilized. The presence of inefficiency largely due to socio-economic and institutional characteristics in pottery production system should also be addressed if potters intend to maximize their profit.

It is recommended, that pottery households should strengthen their formidable cooperative societies to access credit, organize training using community based informal education, to ensure improve investment that may lead to a complete restructuring of the production process and proper understanding of modern equipment and adopt technology (such as introduction of grinding, drying, spraying and firing machines) capable of increased quantity and quality products that enhance increase profit and efficient use of resources.

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