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TECHNICAL EFFICIENCY OF WOOD CARVERS IN EDO STATE, NIGERIA

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ABSTRACT

This study estimated the technical efficiency of wood carvers in Benin City, Edo State, Nigeria. Multi stage sampling technique was used for the study. A total of 100 respondents were sampled. The respondents were involved in wood carving from three zones in Benin City; Ugbowo, Igun and Airport Road. Data were collected with the aid of structured questionnaire administered interpersonally to the respondents. The questionnaire had 100% valid rate of return. The data were analysed with descriptive and inferential statistics, Stochastic Frontier Analysis (SFA) as econometric tool was used to measure technical efficiency of producers. Multiple regressions analysis was used to identify socio-economic factors affecting efficiency. The results show that socio-economic characteristics of respondents were gender sensitive with (100%) male domination. On age distribution, (41 – 50) years recorded the highest percentage of 43% with the mean age of 49years. Some of the respondents (38%) had monthly income of ₦50,000-₦100,000 with mean income of ₦71,341. All, (100%) of the respondents engage in the traditional method of wood carving. The mean Technical Efficiency (TE) of the wood carvers (pooled) was (43%). Technical Efficiency between zones in the study area was Ugbowo (42.8%), Igun (43.8%) and Airport (41.2%) respectively. There was no significant difference (p> 0.10) in the TE among the zones. The SFA revealed that technical inefficiency factors were marital status, educational status and years of experience. Furthermore, regression analysis revealed that age, marital status and years of experience were not significant (p>0.10) socio-economic factors while educational status is inversely significant (p<0.01). Suggestions include fiscal measures and appropriate forest policies should be implemented by government to assist the wood carvers to boost their technical efficiency.

Keywords: Woodcarving, livelihood, Tree species, Technical efficiency, Traditional method

INTRODUCTION

Wood, is the tough, fibrous supportive and water conducting substance beneath the bark of trees and shrubs. Wood is a renewable natural resource that is abundant in the forest. It is major world's industrial raw materials. Its ability to have different physical, mechanical and chemical properties as well as diverse colours has made wood the most versatile raw material for various uses. It is an organic material composed of cellulose fibers immersed in a matrix of lignin which resists compression (Hickey and King, 2001). Wood is one of the most important materials used in art to express thoughts. It has been used from pre-historic times to make various items for household use as well as for ceremonial use. Thus, an art of creating elaborate designs in wood by hand with the help of various wood working tools is called wood carving. The art of wood carving is of particular interest as it combines aesthetics with utility. Wood is mostly identified as secondary xylem in the stems of trees. In a living tree it performs a support function, enabling woody plants to grow large or to stand up on its own. It also conveys water and nutrients between the leaves, other growing tissues, and the roots. Wood equally refer to plant materials with comparable properties obtained from cellulose or wood chips or fiber (Horst *et al*,. 2005)

Wood is the yield by trees, which increases in diameter by the formation between the existing wood and the inner bark, of new woody layers which envelope the entire stem, living branches, and roots. This process is known as secondary growth; it is the result of cell division in the vascular cambium, a lateral meristem, and subsequent expansion of the new cells (GFRA, 2005). Where there are clear growth seasons, growth occurs in a discrete annual or seasonal pattern with formation of growth rings seen at the end of a log, but also visible on the other surfaces. If these seasons are annual, these growth rings are referred to as annual rings. Where there is no seasonal difference, growth rings are likely to be indistinct or absent (Otto wittmann *et al.*, 2005). Wood is therefore used in production.

According to Chambers(1998), Olajide and Heady (1982), production can simply be referred to as transformation of inputs into outputs. However, productivity is a measure of how effectively, resources are combined and used in order to accomplish specific, desirable results. The four major methods (Campbell *et al.*, 2005) used in productivity and efficiency measurement are: least squares econometric production models (LSEPM), total factor productivity indices (TFPI), data envelopment analysis (DEA) and stochastic frontier production function (SFPF) analysis.

According to Forsund *et al*, (1980), technical efficiency (TE) is the combination of input that for a given monetary outlay maximizes the level of production (Aruofor, 2000; Ekunwa and Orewa, 2007, Kumbhakar and Lovell, 2000; Ogundari and Ojo, 2007). TE measures show how efficiently the firm uses the available inputs to produce a given output (Karimov *et al*., 2013). In other words, TE determines whether the firm achieves maximum output using a given bundle of factors of production. Farrell (1975) measures the (delete) technical efficiency with linear programming techniques that simultaneously estimate the production frontier. To estimate the deterministic frontier production function by Farrell(1975); which provides the upper bound of output levels at all combination of inputs, as well as works of Aigner and Chu (1968). Timmer, (1970), Richmond, (1974), Schmidt (1974) and Arfat (1972) first used mathematical programming techniques, both parametric and non-parametric, and then the econometric approach to measure technical efficiency. The techniques led to latest econometric method developed to measure technical efficiency of firms using frontier models. According to Sengupta (1995) two types of efficiency measures are usually distinguished at the firm level in production economics: One is technical or production efficiency, to quantify firm’s success in producing maximum output from determined inputs. The other is the price or allocative efficiency, which measures a firm’s success in choosing an optimal set of input with a given set of input prices However, Wollni and Brummer (2012) noted that greater efficiency in resource use often leads to enhancement in overall production. This will have influence on wood carvers’ competitiveness.

Wood carving is an art of shaping statues, ornaments, furniture, and utensils out of wood by means of cutting tools, drills, and abrasives using wood as a medium to show the natural beauties of wood. Unfortunately, it lacks the weight, durability, and monumental quality of stone. Knowledge of the history of wood sculpture is distorted by the haphazard survival of carvings, which are vulnerable to dampness, fire, and the destructive activity of vermin. Wood carving involves cutting and rough-hewn with axes, saws, and knives. Various gouges, chisels, drills, and knives are used for the actual carving. Pieces are finished with rasps, files, and sandpaper. Carvings can either be painted or gilded directly on the surface or the wood may be left in its natural state and polished. Wood carving has been used for centuries as a means of creating sculptures from a plain block of wood. Manual or power cutting tools chip away pieces of wood until only the desired image remains. These can be a form of raised image or a simple shape carved with just a pocket knife. Thus, carving can be divided into two- Power and Hand carving. Power carving involves the use of powered tools and hand carving relies on hand tools. Consequently, in wood carving there is input and output to justify production activities. This underscores the objectives of this study which are: to describe the socio-economic profile of wood carvers and to identify carving method in the study area, identify the tree species used for wood carving, evaluate the technical efficiency of the enterprise and also identify the factors affecting efficiency of the wood carvers.

MATERIALS AND METHODS

The Study Area

The study was carried out in Benin City (*Figure* 1), Edo State of Nigeria. Benin City is located within latitude 6.2^{o}N and 5.3^{o}E and longitude 6.3^{o}N and 5.6^{o}E. The State covers a total land area of 17,802 km^2. The State is bounded in the north and east by Kogi State, in the south by Delta State and in the west by Ondo State. Edo State consists of 19 Local Government Area (LGA). Benin City is the capital of Edo State. The population of Edo State is 2,159,848 (NBS, 2006; NPC, 2009). Benin City is a city approximately 25miles north of the Benin River. It is situated 200 miles by road east of Lagos with an estimated population of 1,116,987. Attractions in the city include the National Museum, Benin City, the Oba palace, Igun street, (famous for bronze casting and other metal works for centuries). The Binis are known for bronze sculpture, its casting skills and their arts and craft.

Data Collection

Both primary and secondary data were used for the study. The primary data were sourced through questionnaire administration on the respondents. Information obtained was supplemented with secondary data.

Sampling Method

Multistage sampling technique was adopted to select respondents for this study. It involves three (3) stages:

Stage 1: Division of Benin City into three (3) strata based on existing divisions within the study area.

Stage 2: Purposive selection of settlements noted for wood carving based on reconnaissance survey.

State 3: Simple Random selection of respondents noted for wood carving from those settlements.

Hypothesis (Ho): There is no difference in technical efficiency among the locations.

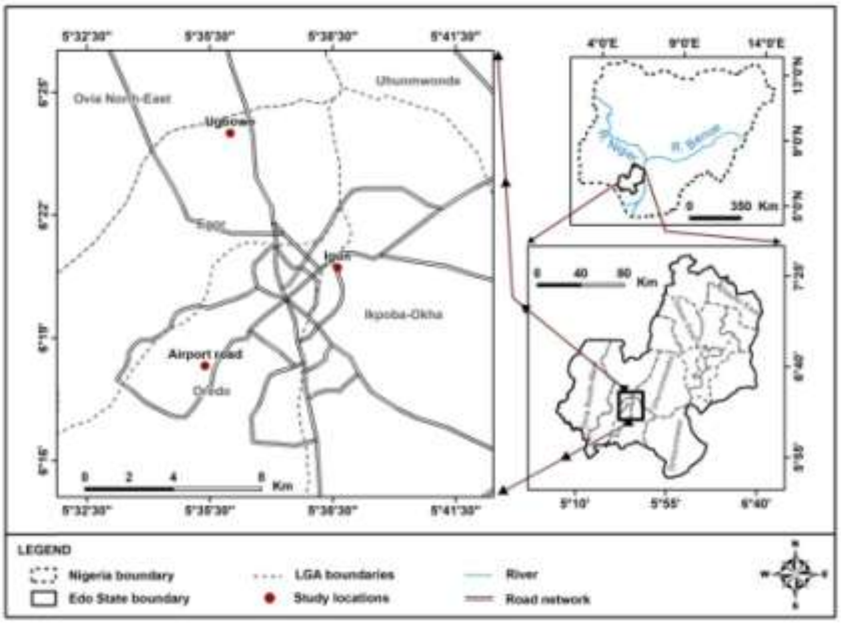

Figure 1: Map of Edo State showing Benin City

The Stochastic Production Frontier (SPF) Approach:

The production technology of the wood carvers was specified by the Cobb-Douglas production function which is specified as follows:

$lnY_i = \beta_o + \beta_2 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3$ +--- ... ... + $(V_i - U_i)$ …. (I)

Where Ln = Natural logarithm
Yi = Quantity of caved woods
X1 = Volume of trees (cm^3)
X2 = Labour cost (man-days)
X3 = Quantity of fuel for production

€$^=$error term which is equal to Vi - Ui; Vi represent stochastic effects outside the producers control, measurement errors, and other statistical noise while Ui is technical inefficiency of the producers.

β1 – β3 = parameters to be estimated.

$T = a_o + a_2L_2 + a_2L_2 + a_3L_3 + a_4L_4 + a_5L_5$….(2)

T = Technical inefficiency
L1 = Gender (1 if female, 0 otherwise)
L2 = Martial status (1 if married, 0 single)
L3 = Household size (number)
L4 = Educational level (Years)
L5 = Experience (Years).

Multiple Regression Analysis:

Multiple regression model is of the form;

$Y = a + b_2x_2 + b_2x_2$ --- --- - $+b_nx_n + e_i$ …. (3)

Where: Y = Livelihood activities
a = constant
$b_2 - b_n$ += regression co-efficient of $X_2 - X_n$
X_1 = Gender
X_2 = Age (years)
X_3 = Marital status
X_4= Household
X_5= Income (N)
e_i= error co-efficient

RESULTS

Socio-economic characteristics of respondents

Table 1 showed the socio-economic characteristics of respondents. Gender distribution shows male domination with 100 (del space) % male respondents. Age indicates mean age of 49 years with preponderance of age 31 – 40 years recording 43%. Marital status showed majority, (85%) of the respondents were married. The distribution by household size indicates majority (69%) had household size of 5 – 8 and (9%) had household of 1 – 4. The distribution by tribe shows that (93%) of the respondents came from Benin sub-tribe, while (3%) came from Igbo, Hausa and Yoruba ethnic groups. This is due to location of the study area (i.e Benin City in Edo State). Majority, (92%) of the respondents attained secondary education, while (5%) attained tertiary education. The distribution by religion shows that majority, (96%) practice Christianity, while (4%) of the respondents were Muslim. Most of the respondents (38%) had monthly income of ₦50,000 – ₦100,000, 22% had nothing for monthly income, which implies that they sometimes operated at a loss and 10% had monthly income of ₦150,000 – ₦200,000. The variation in the income may be due to the socio-economic capacity and the rate of production and sales.

Table 1: Socio-economic characteristics of respondents

Variables	Frequency	Percentage	Mean
Gender			
Male	**100**	**100.0**	Male
Age (Yrs)			
31 – 40	14	14.0	
41 – 51	43	43.0	49 yrs
51 – 60	29	29.0	
61 – 70	14	14.0	
Total	**100**	**100.0**	
Marital Status			
Married	85	85.0	
Divorced	3	3.0	Married
Widower	12	12.0	
Total	**100**	**100**	
Household size			
1 – 4	9	9.0	
5 – 8	69	69.0	6
9 – 12	22	22.0	
Total	**100**	**100.0**	
Tribe			
Bini	93	93.0	
Igbo	7	7.0	Bini
Yoruba	0	0.0	
Hausa	0	0.0	
Total	**100**	**100**	
Educational Status			
Primary	3	3.0	
Secondary	92	92.0	Secondary
Tertiary	5	5.2	
Total	**100**	**100.0**	
Religion			
Christianity	96	96	Chritianity
Islam	4	4	
Total	**100**	**100.0**	
Income (₦) Monthly			
₦1,000 – ₦50,000	30	30	₦71,341
₦50,001 – ₦100,000	38	38	
₦100,001 – ₦150,000	22	22	
₦150,001 – ₦200,000	10	10	
Total	**100**	**100.0**	

Table 2 shows the comparison among the locations of selected socio-economic variables. Ugbowo and Igun locations showed similarity in terms of age and experience but they differ on income. However, Airport road was different from Ugbowo and Igun in age, experience and income. The identified species used in carving were *Termnalia superba*, *Mansonia altissima*, *Triplochiton scleroxylon*, *Khaya ivorensis*, *Tectona grandis*, *Gmelina arborea*, *Afzelia africana*, *Petersianthus macrocarpum*, *Alstonia boonei*.

Table 2: Comparison of means among locations

Location	Age	Years of Experience	Income (~~₦~~)
Ugbowo	50.80 ± 1.538[a]	32.20 ± 1.676[a]	18954.60 ± 6959.454[a]
Igun Area	52.93 ± 1.105[a]	32.80 ± 1.140[a]	199520 ± 6935.062[a]
Airport Road	43.43 ± 1.042[b]	25.06 ± 1.369[b]	65850.00 ± 8712.618[b]

Means in the column followed by the same latter are not significantly different

Mean Efficiency of Wood Carvers across Benin

The distribution of respondents at the different locations and the efficiency level is presented in Table 3. Ugbowo (20%), Igun (15.2%) and Airport (26.7%) had technical efficiency range of 39% or less. Furthermore, majority, (80%) in Ugbowo, Igun (72.7%), and Airport Road (73.3%) wood carvers had technical efficiency range of 40% - 49%. However, only Igun (12.1%) had technical efficiency range of 50% and 59%. Consequently, Ugbowo carvers were 43% efficient, Igun Area 44% and Airport road 41% efficient. This implies no significant difference in technical efficiency among the zones in the study area (Table 4). Thus, the distribution showed over half (75%) of wood carvers had technical efficiency range of 0.40 to 0.49 representing 75% of the respondents. This implies that the wood carvers were averagely efficient.

Table 4 shows that (H_o) hypothesis should be accepted because there was no difference in technical efficiency across the locations (p>0.05 and p>0.01).

Table 3: Technical Efficiency of Wood carvers (Zonal)

Category of TE	Percentage within Zone			
	Ugbowo	**Igun**	**Airport**	**Total**
0.39 of less	4(20.0)	5(15.2)	4(26.7)	13(19.1)
0.40 – 0.49	16(80.0)	24(72.7)	11(73.3)	51(75.0)
0.50 – 0.59	0(0.0)	4(12.1)	0(0.0)	4(5.9)
Total	**20(100)**	**33(100)**	**15(100)**	**68(100)**
Mean Efficiency	**0.428**	**0.438**	**0.412**	**0.429**

Figures in parenthesis indicate percentage

Table 4: Variation in Technical Efficiency (ANOVA)

Variables	Sum of Squares	Sum of Squares	Mean Square	F	F-tab	
					α-0.05	**α-0.01**
Btw zones	2	0.007	0.004	1.381	3.15	4.98
Within zones	65	0.166	0.003			
Total	67	0.173				

Not Significant at P= 0.05 and 0.01

Stochastic Frontier Production Function analysis and efficiency variable estimate

The estimates of the stochastic frontier production function are presented in Table 5. The result revealed that out of the estimated coefficients of the variables of the production function, weight of carved product was not significantly (p> 0.10) different from zero, other cost factors such as fuel was significantly (p< 0.01) different, and transportation was also significantly (p< 0.01) different, while labour cost (cutting of trees, wood drying, felling of trees and transportation) was inversely significant (p< 0.10). Though the coefficients of labour was negative, this was due to the fact that most wood carvers do not keep appropriate and adequate record on the cost expended on labour during carving activities.

However, estimated inefficiency parameters, revealed that different household size was not significantly different from zero (p>0.01), that is an increase in household size will increase technical inefficiency by 2.8%. This is in line with the findings of Huynh and Mitsuyau, (2011) and Oladeebo and Fajuyigbe, (2012) that reported on the technical efficiency of men and women upland rice farmers in Osun State, Nigeria. The positive coefficient of marital status and educational level imply that an increase in any of these varieties will increase technical inefficiency.

Table 5: Stochastic Frontier Production Function Analysis

Production function Variables	Parameters	Coefficients	T-ratio
Constant	b_0	-1.738	-0.931
Weight of logs	b_1	-0.283	-1.385
Labour	b_2	-0.184	-1.578*
Fuel cost	b_3	1.033	4.584***
Transport cost	b_4	0.269	2.986***
Inefficiency variables			
Constant	α_0	120.394	1.121
Household size	α_1	-2.817	2.780***
Marital status	α_2	-62.844	-0.459
Educational level	α_3	-5.910	0.753
Years of experience	α_4	-0.378	-0.259
R^2		0.127	
F-ratio		3.133	

****Significance p<0.01, *Significance p<0.10*

Socio-economic factors affecting technical efficiency of carving in the study area

Table 6 shows socio-economic factors affecting technical efficiency of wood carvers. The R square value of 0.37 implies that 37% in the variability of the efficiency of wood carvers in the study area is explained by the combined effect of the explanatory variable used in the study. The goodness of fit of the model was deduced from the F-statistic of 3.974 and this indicates that the model gave a good fit for the analysis. The result revealed that among the variables: location, marital status and educational level were significant at varying levels of probability. However, educational status coefficient is negative. This implies inverse relationship meaning that efficiency of the production will not be affected with higher level of education. Education is not a factor for output determination.

Table 6: Factors affecting carving efficiency

Variables	Coefficients	T-ratio
Constant	13.188 (4.299)	3.069
Location	0.663 (0.156)	4.253***
Age	0.209 (0.116)	1.808*
Marital Status	0.209 (0.116)	0.193
Household status	0.147 (0.702)	0.193
Educational Status	-1.841 (0.660)	-2.792***
Years of Experience	-1.000 (0.809)	-1.237
R^2	0.370	

Figure in parenthesis are standard errors
*** Significance p< 0.01,*Significance p< 0.10 or 10%

DISCUSSION

Socio-economic characteristics of respondents

The socio-economic characteristics of the respondents present the profile of wood carvers in the study area. The variable gender shows the percentage distribution of respondents in terms of male domination. This agrees with FAO (1990) and Sunderland (1997) that reported on the strenuous nature of forestry jobs and thus revealing the pattern of domination in forestry activities. The mean age of 49years indicate able bodied respondents in wood carving. This shows satisfaction and agrees with the findings of London (1990) and BRAAf (1999) that reported on job satisfaction and commitment in forestry activities. Marital status of 62% married indicates preponderance of married respondents. This agrees also with FAO (1990) that respondents were more committed due to domestic requirement and household sustenance. Educational level of secondary school domination shows literacy level requirement of the activity. Average income of ₦71341 shows reward and satisfaction in wood carving. This agrees with Soaga and Ilori (2006) that respondents were able to generate employment and income from forestry activities in basketry in Odeda, Ogun State.

Table 2 reveals mean comparison and the influence of socio-economic factors on the activities of wood carvers. There were variations among the locations. The variations could be explained in terms of geo-spatial position of the locations which can be due to accessibility and consumers. Airport Road leverage on these to attract more income, experienced and matured carvers. Igun and Ugbowo were not as accessible as Airport Road. The technical efficiency (Table 3) shows preponderance of carvers in 0.40-0.49 (75%), an indication of 40-49% efficiency among the locations. This is attributed to local tools used in carving and restricting efficiency to below average. This agrees with the findings of Kareem *et al.* (2015) that reported on technical efficiency of agro forestry farmers in Ogun State. Thus, Table 4 indicates no significant difference among the zones in terms of technical efficiency because majority, (75%) of respondents was below average efficiency category (0.40-0.49). The result of SFA showed the mean technical efficiency (TE) of the wood carvers as (43%), which implies that the wood carvers were less efficient. Further, the SFA (Table 5) indentifies both the efficiency and inefficiency variables. Only three factors-labour, fuel and transportation were identified as factors promoting efficiency with R^2 value of 0.127. Thus, the factors only accounted for 12.7% contribution to efficiency. Other factors contributed to inefficiency while negative coefficients show capability of the variable to reduce technical efficiency. This corroborates the findings of Ekunwe and Orewa (2007) on technical efficiency and productivity of yam farmers in Kogi State. Socio-economic factors affecting TE were identified at two probability levels ($p<0.10$ & $p<0.01$). Age was identified at marginal contribution point of $p< 0.10$ while location and educational status show strong contribution at $p<0.01$. The R^2 recorded 0.370. This shows that these factors accounted for 37% contribution to efficiency.

CONCLUSION

This study has shown that wood carving is a gender sensitive activity dominated by male respondents. Furthermore, wood carving does not require higher educational qualification to enhance productivity in carving practices. In addition, traditional method of carving was the acceptable technique used by the respondents relying on tools and knowledge based approach for carving. Identified tree species showed a mixture of hardwood and softwood depending on the final product and the consumers. Suggestions include forest policy creating awareness to encourage carving business and fiscal measures improving technology adopted in wood carving through fund availability to enhance carving activity and therefore contribute to efficiency in the business.

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