Vol. 1 No.1, July 2021

FUAM Journal of Pure and Applied Science

Available online at
www.fuamjpas.org.ng

An official Publication of
College of Science
Joseph Sarwuan Tarka University,
Makurdi.

FUAM Journal of Pure and Applied Science
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https://fuamjpas.org.ng/
Vol.1. No. 1. July, 2021

Resource use efficiency of palm oil processing in Ovia North East and Ikpoba Okha Local Government Areas, Edo State, Nigeria

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Received: 19/04/2021 **Accepted**: 14/07/2021 **Published online**: 23/08/2021

Abstract

The study investigated the resource use efficiency of palm oil processing in Ovia North East and Ikpoba-Okha Local Government Areas of Edo State, Nigeria. Structured questionnaires were used to collect information required for the study from sixty (60) processors through systematic sampling procedure. The finding established that processors were relatively young (mean age of 39 years) and low-income earners with a mean income of ₦ 435,416.67($1,244.05) per annum. Return to scale was – 48.13 and processors operated at stage III (irrational stage) of production function curve. The mean technical efficiency was 0.726 indicating that processors were 72.60% efficient in the use of scare resources. The inefficiency model showed that household size (3.35) was positively related to technical inefficiency. Age (12.96 years) and processing experience of thirteen (13) years were also established to be positively related to technical inefficiency. The result also showed that years of schooling was a negative determinant of technical inefficiency. Based on the findings of the study, since fresh fruit bunch (FFB and labour costs were positive and significant determinants of palm oil processed more of these productive resources should be used. The variables – fire wood, water and depreciated costs were negative but significant determinants of palm oil produced. It was recommended that less of these resources should be used. The need for processors/producers to thrive to maximize the use of productive resources was recommended.

Keywords: Fresh fruit bunch (FFB), efficiency, resource, inefficiency, processing and palm oil.

Introduction

Food is considered as one of most important basic needs of man that its production is given a special attention to ensure food sustainability and security [1]. Shortage of supply and poor income has once been reported as some of the challenges that Nigeria tend to contend with [2]. Despite these issues, evidence has shown that about two - third of the total population of Nigeria in one way or the other depends on agriculture for a living [3] in [4].This underscores the place of agriculture in national development.

It has been documented that oil palm originated from tropical rain forest zone of West Africa where it is grown in wild grooves and plantation in Nigeria [5]. In Nigeria, the nativity of oil palm is traced to coastal area where it migrated inland to be stable crop [6].*Oil* palm is an important crop with both domestic and industrial values. [7] opined that oil palm is an important ingredient in economic development. The authors further added that apart from being a source of food for man and livestock, that it provides income to farmers, raw materials for growing industries, employment for teeming population and a major source of foreign exchangeto the nation. In line with this, [8] noted that oil palm can act as a stabilizing factor for ensuring food security, economic development and poverty reduction in Nigeria.

In Ovia North East and Ikpoba-Okha Local Government Areas, Edo State, Nigeria, oil palm and the numerous products such as palm oil, palm wine, local gin (*ogogoro*) among others play important roles as a source of income and livelihood for majority of farmers involved in the production of the crop and those involved in the sale of the products. Palm oil is a major source of vitamin in the diet of the populace. The palm wine and local gin (*ogogoro*) are also essential in traditional sector and ceremonies.

Processing is the conversion of the raw products (inputs) into a finished and more acceptable form (output). This process tends to provide utility (form, time, place and possession) to product. It improves the consumption of these raw produce, reduces spoilage, increases sales and reduces losses and increases both quantity and quality of product [9],[10] and [11].Oil palm can be processed to produce different products by applying different technology. Whichever method that is employed, the processing of palm oil involves the extraction of the oil from the palm fruits giving rise to palm oil [9]. The authors added that this process is an important operation that adds value to the product and extend the shelf life.

[12] reported that resource use efficiency is an important and basic approach to increasing agricultural productivity. They further added that farmers with ability to efficiently combine resources with other

factors are likely to make more profit. According to [13] efficiency is usually correlated with the likelihood of attaining optimal output with a given set of input with least cost.

Several studies have been carried out in Nigeria to determine resource use efficiency of crops. [13]estimated resource use efficiency of yam production among smallholder farmers and effect to the environment in the tropics. The result of the efficiency indicated that the farmers were not efficient in the use of resources. [12] also studied resource use efficiency and profitability of fluted pumpkin production in Ukwuani Local Government Area of Delta State, Nigeria. The broad objective of this study therefore was to determine the resource use efficiency of palm oil production in Ovia North East and Ikpoba-Okha Local Government Areas, Edo State, Nigeria. The specific objectives were to: examine the socioeconomic variables of the processors/producers and determine the resource use efficiency of palm oil processing in the study area.

Materials and Methods

This study was carried out in Ovia North East and Ikpoba-Okha Local Government Area of Edo state. The study area has a total population of five hundred and twenty-seven thousand, four hundred and twenty-four (527, 424) people. The total population figure consists of two hundred and fifty-one thousand, one hundred and fifty-eight (265,158) males and two hundred and sixty-two thousand, two hundred and sixty-six (262,266) females [14].Total projected population figure with a 3.2 percent growth rate as at 2018 was estimated as five million, nine hundred and ninety thousand, three hundred and twenty (5,990,320) people. This consists of three million, eleven thousand, five hundred and eighty-three (3,011,583) male and two million, nine hundred and seventy-eight thousand, seven hundred and thirty-seven (2,978,737)females. Agricultural production forms the major sector of the economy of the area. Oil palm and rubber constitute the major cash crops produced. A list of communities and palm oil processors in the study area was drawn with the assistance of Local Government Agricultural officers and Extension agents. Systematic sampling was adopted in selecting ten (10) palm oil processors that were randomly selected from three (3) communities in each of the two Local Government Areas. This resulted to a sample size of sixty (60) palm oil processors that were used for the study. Data used for the study was collected using primary source of data with well – designed questionnaire that were administered to palm oil processors within the months of September 2019 to March 2020.

Model Specification

Efficiency Model: Regression Analysis

Using Cobb Douglass function;

Log Y = $log\beta_o$ + β_1 Log (X_1) + β_2 log (X_2) + β_3 log(X_3) + β_4 log(X_4)

+ β_5 log(X_5) + β_6 log(X_6)$V_1 - \mu_1$ (1)

$Y = f(X_1, X_2, X_3, X_4, \ldots\ldots\ldots X_n)$ (2)

Where Y = Physical quantity of Output

and $X_1, X_2, X_3, X_4, \ldots\ldots\ldots X_n$ = Physical quantities of inputs employed.

X_1 = Quantity of oil palm fruits (kg)

X_2 = Depreciated or fixed cost (N)

X_3 = Family (household) labour (Mondays)

X_4 = Hired labour (Monday)

X_5 = Expenses on water (in litre)

X_6 = Expenses on firewood (in kg)

$V_1 - \mu_1$ = Error term

Inefficiency mode

$u_1 = a_0 + a_1z_1 + a_2z_2 + a_3z_3 + a_4z_4$

where;

u_1 = Inefficiency function, z_1 = Age of processors (years), z_2 = Educational level attained (years), z_3 = Years of processing experience, z_4 = Household size (number)

Results and Discussion

Socio-Economic Characteristics of the Respondents

The socio-economic characteristics studied and discussed were: age, marital status, educational attainment and household size. Others were processing experience, membership of organization and income level of processors. The finding revealed that the processors were relatively young with a mean age of thirty – nine (39) years. The mean age of thirty – nine (39) years indicated that the processors were within the economic viable age. Analysis of the marital status indicated that majority forty – two (70%) of the processors were married. Result of the educational attainment showed that literacy level was high. Result of the household size as presented in **Table 1** indicated that processors/producers in the study area had a mean household size of four (4). Further analysis of the processing experience showed that the respondents were well experienced with a mean experience of thirteen (13) years. The result also revealed that forty – one (68.33%) of the processors sourced their finance for the processing enterprise through personal saving. Sources of finance determined showed that eleven (18.33%) and eight (13.33%) sourced their finance by obtaining loan and acquiring assistance from friends and relatives respectively. Processors membership of organisation studied revealed that forty – nine (81.67%) of the processors were members of organisation or association. Income level result of the processors indicated that processors in the study area were low-income earners with a mean annual income of ₦ 435,416.67($1,244.05) per annum.

Table 1: Socioeconomic characteristic of palm oil processors (n = 60)

Variables	Frequency	Percentage (%)	Mean
Age (years)			
30 – 39	34.00	56.66	
40 – 49	11.00	18.33	
50 – 59	06.00	10.00	
Above 60	09.00	15.00	39.40
Marital status			
Single	09.00	15.00	
Married	42.00	70.00	
Divorced / Separated	05.00	08.33	
Widow / Widower	04.00	06.67	
Educational attainment			
No formal education	06.00	10.00	
Primary education	18.00	30.00	
Secondary education	34.00	56.70	
Post – secondary education	02.00	03.32	
Household size			
Less than 4	38.00	66.33	
5 – 9	13.00	21.67	
10 – 15	05.00	08.33	
Above 16	04.00	06.67	04.40 people
Processing experience			
Less than 4	02.00	03.33	
5 – 9	05.00	08.33	
10 – 14	19.00	31.67	
15 – 19	20.00	33.33	
Above 20	14.00	23.33	12.80 years
Sources of finance			
Personal savings	41.00	68.33	
Loan	11.00	18.33	
AFR	08.00	13.33	
Membership of organisation			
Yes	11.00	18.33	
No			
Income level			
₦ 100,000 – ₦ 200,0000	06.00	10.00	
₦ 201,000 – ₦ 300,000	12.00	20.00	
₦ 301, 000 – ₦ 400,000	38.00	63.33	
Above ₦ 400,000	04.00	06.67	
			₦435,416.67($1,244.05)

Source: Computed from field survey, 2020; *AFR: Assistance from friends and relatives

Maximum likelihood estimate (MLE)

The maximum likelihood estimate for palm oil processed was presented in **Table 2**. The result showed that the sigma (0.125) was statistically different from zero at 5% (critical t=1.96) level of significance. This indicated goodness of fit and correctness of the specified assumptions of composite error term. The gamma coefficient (γ) of 0.763 which was statistically significant at 5% level of significance implied that 76.3% variation in output of palm oil resulted from inefficiency effects. This suggested that the unexplained variation was due to relatively important variables that were not captured in the model.

Table 2: Maximum Likelihood Estimates (MLE) of palm oil processors

Variables	Coefficients	Standard error	t-ratio
Constant	154.17	1.45	106.06
Fresh fruit bunch	4.02	0.33	12.30
Labour cost	0.01	0.00	1.39
Firewood	- 6.72	6.86	0.98
Water (litres)	* - 45.39	8.11	5.60
Depreciated cost	* - 0.02	0.00	5.94

Source: Computed from Field Survey, 2020; Log likelihood function = - 357.06; Likelihood Ratio test (X^2) = 31.16; df = 6, P <0.05; * Significant at 5% (critical t-value = 1.96)

Elasticity of production and return to scale

The sum of the coefficient of the variables estimated using the MLE regression method showed the return to scale. The elasticity of production and return to scale was presented in **Table 3.** The analysis showed that the return to scale was - 48.13. This implied that a 1% increase in the use of productive resources will lead to a - 48% increase in the palm oil produced. The analysis also indicated that palm oil processors in the study area were operating at stage III (irrational stage) of production function. This implied that too many variable inputs were added to fixed inputs that resulted to negative addition to total output. It also implied that these variables or resources were not efficiently allocated.

Table 3: Elasticity of production of palm oil processors

Variables	Elasticity of production
Fresh fruit bunch	4.02
Labour cost	0.01
Firewood	- 6.72
Water (litres)	- 45.39
Depreciated cost	- 0.02
Return to Scale (RTS)	- 48.13

Source: Computed from field survey. 2020

Docile range of technical efficiency

The technical efficiency of palm oil processors ranged from zero to 75%with a mean of 0.6%. The frequency distribution showed that forty – four (44%) of the processors were within technical efficiency range of 0.751 – 1.000, while ten (10) were within the range of 0.501 – 0.750. The remaining four (4) and two (2) as indicated in **Table 4** showed that the respondents were within the technical efficiency range of 0.251 – 0.500 and < 0.250 respectively. The mean technical efficiency of 61.30% implied that oil palm processors in the study area were obtaining 61% output or maybe 61.30% technically efficient in the use of productive resources. It also implied that palm oil processing in the study was not fully mechanized.

Table 4: Technical efficiency distribution of palm oil processors

Technical efficiency range	Frequency	Percentage (%)	Mean
< 0.250	02	3.33	
0.251 – 0.500	04	6.67	
0.501 – 0.750	10	16.67	
0.751 – 1.000	44	73.33	0.613

Source: Computed from field survey, 2020

Technical inefficiency analysis

Technical inefficiency model estimate for palm oil processing was presented in **Table 4**. The technical inefficiency model showed that age (b = 12.69), household size (3.35) and processing experience were positively (critical t=1.95) related to inefficiency of the processors. The positive relationship between age and technical inefficiency implied that age increases technical inefficiency. This also implied that older palm oil processors were more technically inefficient than

younger processors. Similar results were obtained by [15] among small scale famers and [16] among garri processors in Delta State, Nigeria.

The coefficient of household size (3.35) was positive. This implied that there was a positive relationship between household size and technical inefficiency. This also implied that processors with larger household size were less efficient than processors with smaller household size. This also indicated that large household size reduces the efficiency of the processors. Large household size increases the level of consumption and expenditure and making little financial resources available for purchase of necessary inputs. This result was inconsonance with that obtained by [17] among agro forest farmers in Oyo State. It also agreed with the findings of [18].

The result further showed that years of schooling (-10.11) was a negative determinant of technical inefficiency. The negative coefficient of years of schooling implied that an increase in this variable would lead to a decline in technical inefficiency of palm oil processors. This result is consistent with that of [15]. The analysis also indicated that educational attainment of processors decreased technical inefficiency and increased technical efficiency.

The coefficient for processing experience (0.03) of palm oil processors was positive. This indicated that there was a positive relationship between processing experience and technical inefficiency. This implied that processors with longer experience in processing were more efficient than those with lesser processing experience. This also implied that processors with lesser processing experience were less technically efficient than those with longer processing experience. This also showed that processing experience as indicated in **Table 5** increased technical efficiency and decreased technical inefficiency.

Table 5: Technical inefficiency model estimation

Variables	Coefficient	Standard error	t – ratio
Constant	0.75	0.98	0.76
Age (years)	12.69	12.22	1.04
Household size	*3.35	1.35	2.49
Years of schooling	- 10.11	18.26	0.55
Processing experience	0.03	1.94	0.02

Source: Computed from field survey, 2020; Significant at (Critical t = 1.96)

Conclusion

The study established that processing in the study area was not gender specific as both male and female were involved in palm oil processing business. It also revealed that majority (45%) of the respondents were married. Palm oil processors/producers in the study area were relatively young with a mean age of 45 years. A mean household size of nine (9) was observed indicating large household size. Literacy level was high as average year of formal education was eighteen (18). Processors/producers were well experienced with a mean experience of eight (8) years. It was observed that majority (90%) of the respondents were member of oil palm association. Majority (76%) of the respondents had access to credit. The maximum likelihood estimate revealed that the parameter sigma (δ) (0.125) was statistically significant at 5% (critical t = 1.96) level of significance while the gamma (γ) coefficient was statistically significant at 5% level of significance. Oil palm processors/producers in the study area operated at stage III (irrational stage) of production function. The inefficiency model revealed that household size (3.35) was positively significant at 5% (critical t = 1.96) level of significance. The result also showed that age (12.69) and processing experience (0.03) were also positively related to inefficiency at 5% (critical t = 1.96) level of significance. Since the study revealed that a completely or modernised palm oil processing technology has not been adopted, government and private sector participation in provision of modern processing implements is recommended. Fresh Fruit Bunch (FFB) cost and labour cost were shown to be a positive and significant determinant of palm oil processed. More of these inputs should be used. Since firewood cost, water and depreciated cost were negative determinants of palm oil processed, a reduction in the use of these resources will lead to increase in output of palm oil processed. Less of these resources should be used by processors/producers. Since the processors were operating at stage III (irrational stage) of production function, they should thrive to maximise the use of production resources to achieve efficiency and operate at stage II (rational stage) of production function.

Declaration of conflicting interests

The authors declared no potential conflicts of interest

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Cite this article

Kaine A.I.N., Fantaya J.B. and Ogbonna S.I. (2021). Resource use efficiency of palm oil processing in Ovia North East and Ikpoba Okha Local Government Areas, Edo State, Nigeria .*FUAM Journal of Pure and Applied Science*,**1**(**1**):110-115