DETERMINANTS OF PROFITABILITY OF SMALLHOLDER PALM OIL PROCESSING UNITS IN OGUN STATE, NIGERIA.

BY

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ABSTRACT

A total of 70 questionnaires were administered to the palm oil farmers randomly selected from five purposively sampled towns in Ogun state. Selection was based on the predominance of producers in the towns as well as their geographical spread covering the entire land space of the state. The response rate was 95.71 percent. Altogether, data used for final analyses were obtained from 17 manual, 36 semi-mechanized and 14 fully mechanized palm oil processors. Data were analyzed by the use of descriptive statistics, multiple regressions and budgeting. The quantity of input used (palm fruits) and output (palm oil) were measured in kilogramme and litres respectively. Other by-products of processing were measured also in kilogrammes. Averages of market prices for the input and output variables obtained through the consumer panel approach were used in calculating profitability. The profitability analysis revealed that fully mechanized palm oil processing was more profitable than other methods of processing. The F-ratio value is statistically significant ($P<0.01$) implying that the model is adequate for use in further analysis. The coefficient of determination (R^2) was 68%. Extraction cost and cost of palm fruits are negative and significantly associated with net returns, so also depreciation on tools and other fixed inputs. In contrast, no significant relationship was found to exist between net returns and such factors as processing experience and cost of labour. There is the need to improve palm oil processing techniques using mechanized (improved) systems in order to boost profitability among palm oil farmers in the study area and in Nigeria as a whole.

Keywords: Oil palm, cost, net return, profitability, mechanized processing.

₦ means Naira, the Nigeria currency; $1 at the time of study was equivalent to ₦158

INTRODUCTION

The oil palm is one of the important economic crops in the tropics (Anyawu *et al*., 1982). It is the most important source of oil and produces more oil per hectare than any of the oil producing crops. The primary products of the oil palm are palm oil (from the mesocarp) and palm kernel oil obtained from the kernels (seeds). In Nigeria, palm produce accounted for about 82.1 % of the total domestic export between 1966 and 1973 (Usoro, 1974) and earned the nation about 22 % of the foreign exchange up to the beginning of the civil war (Modebe, 1978).

Nigeria's domestic palm oil production as at 1986 was estimated to be 760,000 metric tonnes while her imports during the same period stood at 179,000 metric tonnes. Palm kernel is also produced in large quantities in Nigeria. Palm kernel output however declined from 419,000

metric tonnes during the period 1960 – 1965 to 385,000 metric tonnes from 1985 – 1987 probably due to the low level of patronage by buyers of the product.

According to the United States Department of Agriculture, palm oil production of Indonesia, Malaysia, Thailand, Colombia and Nigeria has been estimated to be 27,000.00, 19,000.00, 1,700.00, 900.00 and 850.00 metric tonnes respectively (USDA, 2012). According to Abah (2012) palm oil prices were expected to grow by at least 6 % by the fourth quarter of the year 2012. Oladunjoye (2013) has reported that the global demand for oil palm presently consolidates to 49.5 million tons and production is expected to grow by 8-10 percent in the year achieving a total volume of up to 58 million metric tons in 2014 and reaching 62.5 million tons by 2015. This growth is expected to be in response to the increasing demand from food, chemical and bio-diesel industries.

Despite the wide-spread awareness in the prospect of the oil palm, Nigerians still experience a low supply of palm oil in the markets and at very high prices. Palm oil processing is a commercial venture which is still largely under-developed in Nigeria. This is because most palm oil farmers in Nigeria are using the cumbersome and laborious traditional methods, involving the pounding of boiled fruits in a mortar or crushing of boiled fruits with legs to extract oil.

The village traditional method of extracting palm oil involves washing pounded fruit mash in warm water and hand squeezing to separate fibres and nuts from the oil/water mixture. A colander, basket or a vessel with fine perforated holes in the bottom is used to filter out fibres and nuts. The wet mixture is then put on the fire and brought to a vigorous boil. After about one or two hours, depending on the volume of material being boiled, the firewood is taken out and the boiled mixture is allowed to cool. On cooling to about the body temperature of 37.0^{o}C, a calabash or shallow bowl is used to skim off the palm oil. The method using this procedure is called the 'wet' method because of the large quantities of water used in washing the pulp (FAO, 2002).

As a result of this process, the grade of palm oil produced may have a high quantity of free fatty acids such as palmitic or stearic acid. The presence of high free fatty acids makes the oil slippery causing it to store only for a short period of time. The processes consume greater efforts and usually yield lesser quantity and quality of palm oil.

The modern approach however involves the extraction of oil with machines. It yields higher quality and quantity of palm oil compared to the traditional method. The focus of this paper is to determine and compare profitability of the various methods of palm oil processing.

METHODOLOGY

The data used for this study were collected by means of structured questionnaire schedule administered on 70 respondents using a combination of purposive and simple random sampling techniques. In the first place, five towns were purposively selected namely; Igbogila, Abeokuta, Ikenne, Odogbolu and Elere-Adubi, based on the fact that they form among others, the major producers of palm oil in the state. In addition, all the farmers sampled were literate in one form or the other. About 94.2% of them were formally educated at varying levels among which not less than 70 percent possess tertiary education certificates. The sampled towns were also distributed on geographical locations that cover the entire land space of the state. Fourteen out of an average population of thirty palm oil processors having records with the state agricultural development projects (ADP) were selected from each town using random sampling technique. The respondents were identified to belong to two major groups based on the levels of technology used in processing palm oil. These were the mechanized (improved) and the manual (non-

mechanized) processors. Data on input used and output realized were those of averages obtained from each of the groups. Palm fruits are the major input while palm oil and other by-products form the major outputs. Averages of prices over the entire seasons of the year as obtained through consumer panel approach were used for the various analyses. Palm oil and sludge sold for ₦625 and ₦180 per litre respectively while palm fruits, cracked palm kernels and un-cracked palm kernels sold for ₦96.34, ₦715 and ₦84 per kilogramme weight respectively. The mechanized processors were further subdivided into the semi-mechanized and the fully mechanized processors and analyzed separately for clarity. The analytical tools used in this study were descriptive statistics, gross income analysis (for profitability) and multiple regressions.

The demographic variables and problems of the oil palm farmers were analyzed using descriptive statistics. The gross income analysis was used to compute the difference in terms of costs and benefits, and hence determine the profitability of the enterprise. Thus, subtracting the direct costs incurred in the production of the goods sold from the associated revenue, gave the gross incomes. The technique used to measure profitability (in Naira value) can be expressed as:

$NFI = GFI - TC$

where:

GFI- Gross farm income (PQ)
NFI - Net farm income
NFI/TC-Net Return per unit investment
P – Price per unit of output
Q- Total output
PQ- The product of price and quantity of output
TC- Total Cost of production (VC + FC)
VC- Variable Cost
FC- Fixed Cost

The multiple regression technique was applied using three functional forms namely, linear, semi-log and Cobb-Douglas. The best fit was selected after considering the levels of estimated error, magnitude of R^2, number and signs of estimated regression coefficients.
Explicitly the model is specified as follows:

$Y = f(X_1, X_2 \ldots X_8, U)$

where:

Y= Net returns of palm processors in Naira (₦)
X_1= Processing Experience (years)
X_2= Labour Cost (₦)
X_3=Extraction Cost (₦)
X_4= Depreciation on Tools (₦)
X_5= Cost of Palm Fruits (₦)
X_6= Processing Period (days)
X_7=Other Costs (water transport, firewood etc.₦)
X_8= Technology Used (dummy 1-improved/mechanized method, 0- manual method)
U= Error term.

RESULTS AND DISCUSSION

Socioeconomic characteristics of respondents

Table 1 reveals that both male and female respondents made use of manual as well as semi-mechanized methods of processing. As observed, more males were into the mechanized palm oil processing than the females. Available records with the ADP indicated that there were no females among the processors using the completely mechanized method. This might be connected with the fact that most women still practice the traditional methods while some men have been able to adopt modern techniques due to the latter's access to financial incentives from governments and private lending agencies. The observation of greater accessibility of males to financial incentives for agricultural production than females is not peculiar to the study area; similar findings had been recorded by several authors locally and internationally (See Arthapathu, 1985; Tanko, 1994; Bali Swain, 2002; Yekini, 2010 and Chukwu and Nwaiwu, 2012). Another reason might be as a result of the observation that mostly the males own and manage their oil palm plantations in the study area. Since most of the farmers are owner operators in an integrated manner; those who own large plantations mostly have mechanized structure for processing. An investigation into the breed of oil palm raised by farmers showed that majority (more than 80%) of their old generation plantations are of the old groves. These are however being replaced gradually by new and improved high yielding varieties.

The modal age group for manual processors as shown in table 1 was within 46-55 years as it constituted 29.4 % of the processors. About 18 percent of the manual processors were within the age brackets of 26 years and 45years while the lowest number of processors (11.8%) was between the ages 16 and 25 years. For the semi–mechanized processors, 55.6 % of them were above 55 years while 5.6 % were between 26 and 35 years. On the other hand, only 7.1 % of the fully mechanized processors were above 55 years and 57.1% were between 36 and 55 years. This age distribution generally depicts greater involvement of active able-bodied men and women in the trade, hence their ability to take to new innovations in their processing techniques. Across board it was found out that 17 of 67 farmers (25.37 %) processed manually, 36 of them (53.73 %) and 20.89 % respectively processed through semi-mechanized and mechanized forms respectively. Highest percentage of the processors using both manual and mechanized methods, were married with an average household size of seven persons. This afforded some of the processors the opportunity to use their wives and children to work in their plantation and processing units, in view of the scarcity of hired labour especially during the peak of on-season production.

The study further revealed that 11.8 % of the manual processors and 5.6 % of the semi-mechanized processors had non-formal education while none of the fully mechanized processors were non-literate in formal education as shown in table 1. Acquisition of primary education was by 23.5 %, 38.9% and 14.3% of the manual, semi-mechanized and fully mechanized processors respectively. About 35.3 % of the manual processors, 24.0% of the semi-mechanized processors and 14.3 % of the fully mechanized processors had secondary education. Acquisition of tertiary education was by 29.4 % of the manual processors, 30.6 % of the semi-mechanized processors and 71.4 % of the fully mechanized processors. This tends to imply that education is highly necessary in the adoption of new technology. It also assists in the various technical operations involved in the use of modern machines.

Table 1: Socioeconomic characteristics of respondents

PROCESSORS	: MANUAL METHOD		SEMI - MECHANIZED		FULLY MECHANIZED	
Variables	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Sex of Respondents						
Male	12	70.6	28	77.8	14	100
Female	5	29.4	8	22.2	-	-
Total	17	100	36	100	14	100
Age (in years)						
16 – 25	2	11.8	-	-	3	21.4
26 – 35	3	17.6	2	5.6	2	14.3
36 – 45	3	17.6	5	13.9	3	21.4
46 – 55	5	29.4	9	25.0	5	35.7
56 & above	4	23.5	20	55.6	1	7.1
Total	17	100	36	100	14	100
Marital status (Average Family size)						
Single (1)	3	17.6	1	2.8	5	35.7
Married (7)	13	76.5	27	75.0	8	57.1
Divorced (4)	1	5.9	4	11.1	1	7.1
Widowed (3)	-	-	4	11.1	-	-
Total	17	100	36	100	14	100
Educational status						
Non-formal education	2	11.8	2	5.6	0	0
Primary	4	23.5	14	38.9	2	14.3
Secondary	6	35.3	9	24.0	2	14.3
Tertiary	5	29.4	11	30.6	10	71.4
Total	17	100	36	100	14	100
Varieties of oil-palm trees on Farms						
Improved	1	5.88	4	11.11	2	14.29
Hybrid	2	11.76	2	5.56	2	14.29
Old groves	14	82.35	30	83.33	10	71.42

Source: Computed from survey data 2012.

Profitability Analysis in Palm oil processing

Manual palm oil processing

The annual cost of inputs and value of output in palm oil processing using manual processing method is shown in Table 2. The total cost of palm oil processing was ₦188,450 for an average size of a 6 hectare farm in this study. The quantity of palm fruits processed was 850 bunches totaling 519 kilogramme weight. The total fixed cost which was ₦74,120 represented 39.3% of the total cost of production and the total variable cost of ₦114,330 represented 60.7% of total costs. Costs of palm fruits were the critical items of variable costs in manual palm oil processing, accounting for about 26.5% of the total production cost. The gross return was ₦205,150 and the net return and return per naira investment from the enterprise were ₦16,700 and ₦0.09k respectively. This implies that on every naira invested, a profit of 9 kobo was realized.

Table 2: Costs and returns in manual palm oil processing enterprise in Ogun state, Nigeria

Items	Value (₦)	% of total cost
Returns		
Palm oil	106,250	
Palm kernel (cracked)	85,800	
Palm kernel (un-cracked)	11,300	
Sludge	1,800	
Total Gross Return	**205,150**	
Variable Cost		
850 Palm Fruits bunches	50,000	26.5
Hired labour (Harvesting and Processing)	25,070	13.3
Extraction charge	15,000	8.0
Cracking charge	9,000	4.8
Other expenses (transport, water)	15,260	8.1
Total Variable Cost	**114,330**	60.7
Fixed Cost		
Plantation (10 hectares)	39,620	21.0
Interest on borrowed capital (Total capital of ₦50,000)	10,000	5.3
Depreciation on assets	4,500	2.39
Lifespan of 20 years	20,000	10.6
Total Fixed Cost	**74,120**	39.3
Total Cost (TVC+TFC)	**188,450**	100.00
Return per farmer (TR – TC)	16,700	
Return per Naira investment	0.09	

Source: Field Survey, 2012.

The calculated Benefit-Cost Ratio (BCR) for manual processing method as revealed in Table 3 was 1.09. The investment gave only a marginal return. An analysis of returns by Expense-Structure Ratio (ESR) gave the ESR value as 0.393 implying that about 39.3 % of the total cost of production was made up of fixed cost components. Thus, there is flexibility in the structure of expenses. The calculated Gross Ratio (GR) of 0.92 implied that from every ₦1.00 return to the industry, 92.00k was being spent. This means that only 8% margin was being realized from the enterprise.

Table 3: Profitability indicators in manual palm oil processing

Benefit Cost Ratio (TR/TC)	1.09
Gross Margin (GM = TR – TVC)	90,820
Rate of Return (NR/TC)	0.01
Gross Ratio (TC/TR)	0.92
Expense Structure Ratio (FC/TC)	0.393

Source: Field Survey, 2012.

Semi-mechanized palm oil processing

The annual cost of inputs and value of output in palm oil processing using semi-mechanized processing method is shown in Table 4. The total cost of palm oil processing was ₦755,819.91 for an average size of a 120 hectare farm in this study where 1,190 bunches

(726.7kg) of palm fruits were harvested. The total fixed cost was ₦182,719.91 (24%) and total variable cost, ₦573,100.00. Labour was the most expensive variable cost in semi-mechanized palm oil processing accounting for about 66.2% of the total production cost. The gross return was ₦892,000 and the net return and return per naira from the enterprise were ₦136,180.09 and ₦0.18k respectively. This implies that on every naira invested, a profit of 18 kobo was realized.

Table 4: Costs and returns in semi-mechanized palm oil processing enterprise in Ogun state

Items	**Value (₦)**	**% of total cost**
Returns		
Palm oil	800,000	
Palm kernel (cracked)	30,000	
Palm kernel (un-cracked)	60,000	
Sludge	2,000	
Total Gross Return	892,000	
Variable Cost		
10 Labour (Harvesting and Processing)	500,000.00	66.15%
Processing materials	70,000.00	9.26%
Other expenses (Marketing Costs, transportation)	3,100.00	0.4%
Total Variable Cost	**573,100.00**	75.8%
Fixed Cost		
Plantation (120 hectares)	77,000.00	10.2%
Interest on borrowed capital (Total capital of #200,000)	75,840.57	10.0%
Depreciation on assets	4,879.34	0.65%
Lifespan of 15 years	25,000.00	3.3%
Total Fixed Cost	182,719.91	24.2%
Total Cost (TVC+TFC)	**755,819.91**	100.00
Return per farmer	138,180.09	
Return per Naira	0.18	18.0%

Source: Field Survey, 2012.

The calculated Benefit-Cost Ratio (BCR) as revealed in Table 5 is 1.18. This indicator suggests that the enterprise was profitable probably as a result of increased capital, improved technology and skilled labour used. An analysis of returns by Expense-Structure Ratio (ESR) gave the value 0.242. This implies that about 24.2% of the total cost of production was made up of fixed cost components and that there was flexibility in the structure of expenses, since the proportion of fixed to total cost was minimal.

The calculated Gross Ratio (GR) of 0.85 implies that from every ₦1.00 return to the industry, 85.00k was being spent. Therefore, marginal amount of profit was being made using this method.

Table 5: Profitability indicators in semi-mechanized Palm oil processing

Benefit Cost Ratio (TR/TC)	1.18
Gross Margin (GM = TR – TVC)	₦318,900.00
Rate of Return (NR/TC)	0.18
Gross Ratio (TC/TR)	O.85
Expense Structure Ratio (FC/TC)	0.242

Source: Field Survey, 2012.

Fully mechanized palm oil processing

The annual cost of inputs and value of output in palm oil processing using the fully mechanized method is shown in Table 6. The total cost of palm oil processing was ₦1,477,095.16 for an average size of a 500 hectare farm. On the average, about five tons of palm fruits were harvested from this size of farm in this study. The total fixed cost which was ₦624, 548.13 represented 42% of the total cost of production and the total variable cost of ₦852,547.03 represented 57.7%. Costs of palm fruits were the critical cost factors in fully mechanized palm oil processing, accounting for about 56.2% of the total variable cost and 32.4% of the total production cost. The gross return was ₦1,911,700 and the net return and return per Naira from the enterprise were ₦434,504.84 and ₦0.29k respectively. The latter implied that on every Naira invested, a profit of 29 kobo was realized.

Table 6: Costs and returns in fully mechanized palm oil processing enterprise in Ogun state

Items	Value (₦)	% of total cost
Returns		
Palm oil	1,870,000	
Palm kernel (cracked)	15,600	
Palm kernel (un-cracked)	23,300	
Sludge	2,800	
Total Gross Return	1,911,700	
Variable Cost		
5 tonnes of Palm Fruits	478,759.40	32.4%
40 Hired labour (Harvesting and Processing)	122,644.50	8.3%
Extraction charge	83,702.61	5.6%
Cracking charge	64,218.72	4.3%
Other expenses (transport, water)	103,221.80	6.9%
Total Variable Cost	**852,547.03**	57.7%
Fixed Cost		
Plantation (500 hectares)	378,321.63	25.6%
Interest on borrowed capital (Total capital of ₦1,000,000)	136,503.70	9.2%
Depreciation on assets	24,000.00	1.62%
Lifespan of 10 years	85,722.80	5.8%
Total Fixed Cost	624,548.13	42.3%
Total Cost (TVC+TFC)	1,477,095.16	100.00
Net Return per farmer (TR – TC)	434,604.84	
Return per Naira	0.294	29.4%

Source: Field Survey, 2012.

The calculated Benefit-Cost Ratio (BCR) as revealed in Table 7 is 1.29. This investment though gave marginal returns, the performance was relatively better than others. An analysis of returns by Expense-Structure Ratio (ESR) gave the value of ESR as 0.423. This implied that about 42.3% of the total cost of production was made up of fixed cost components hence the flexibility in resource use. It is therefore worthwhile to invest in it. The calculated Gross Ratio (GR) of 0.77 implies that from every ₦1.00 return to the industry, 77.00k was being spent. This shows some reasonable amount of profit being made by using this method.

Table 7: Profitability of fully mechanized palm oil processing

Benefit Cost Ratio (TR/TC)	1.29
Gross Margin (GM = TR –TVC)	1,059,152.97
Rate of Return (NR/TC)	0.294
Gross Ratio (TC/TR)	0.77
Expense Structure Ratio (FC/TC)	0.423

Source: Field Survey, 2012.

Multiple Regression Results

The results of Multiple Regression of processor's net returns on resource inputs in Ogun state is presented in Table 8. Double log production function was selected as the lead equation based on (i) the magnitude of R^2 (ii) the significance of F-value (iii) the t-values and (iv), the appropriateness of the signs of the regression coefficients. The F-ratio value is statistically significant ($P<0.01$) which implies that the model is adequate for use in further analysis. The coefficient of determination (R^2) was 0.68. This implies that the independent variables explained at least 68% of the variability in processors net returns in the study area.

The coefficient of labour and other input costs involved in processing were negative and significant ($P<0.1$) showing negative relationship with processors net returns. This implied that those costs had decreasing impact on net returns. The same thing applied to the coefficient of depreciation cost being negative and significant at 5% level indicating that as depreciation decreased the net return increased. These essential costs, under optimal use of resources, are ordinarily expected to decrease in order to increase the processor's net returns. The regression coefficients of extraction cost and cost of palm fruits were both negative and significant at 5% levels of probability. This shows their negative relationship with the processors net return. This implied that they have decreasing impacts on the net returns.

The coefficient of the improved method was positive and significant ($P<0.01$); this implied its positive relationship with the net returns in oil palm processing. Efforts to raise farmers' production as well as processors' output require that farm drudgery be removed and their standard of living be improved. These could be achieved through a combination of measures such as the introduction of improved farm equipment and labour-assisting technologies as well as increased availability of energy and power that is affordable for them to purchase. An advantage of the use of mechanical digestion is the shorter period expended. Also oil extraction is more efficient unlike with manual processing, which is slower, yields low and with lower output quality (Cobezas, *et al*, 1995). There is no significant relationship between the coefficients of net returns and such factors as processing experience and processing periods although their signs follow the *a priori* expectation.

Table 8: Determinants of processors' net returns in Ogun state.

Explanatory Variable	Regression Coefficients	Standard Error	T-Ratio
Processors' Experience	0.2478	0.3139	0.7893
Labour Cost	-0.5398	0.1626	-0.3319*
Extraction Cost	-0.8681	0.3353	-2.5889**
Depreciation on tools	-0.3241	0.1332	-2.4326**
Cost of palm fruits	-1.3589	0.4158	-3.26781**
Processing period	-0.1742	0.1333	-1.30731
Other input costs (transport)	-0.8751	0.3389	-2.58231**
Improved method (Mechanization)	1.2134	0.3024	4.0121*
Intercept	-1.8459		
Coefficient of determination (R^2)	0.68		
Adjusted R^2	0.67		
F-value	12.72*		

Source: Data Analysis, 2012.

* Significant at 1% levels.

** Significant at 5% levels

CONCLUSION AND RECOMMENDATIONS

The results of profitability analyses in palm oil processing in the study area showed that use of mechanized (improved) methods was relatively more profitable than manual. This is evidenced in the various indicators of economic performance being in favour of the use of improved methods. Factors such as high rent payable on palm plantation, extraction and transport costs were the most critical factors inhibiting profitable palm oil processing. The results on the determinants of net return showed that extraction cost and cost of palm fruits were negatively and significantly associated with the net returns while the coefficient of improved method was positively and significantly related with the net return. On the other hand, no significant relationship was found to exist between net return and processors' experience. To improve profitability, farmers need to make inputs use more efficient by reducing the level of employment of some of these inputs. Some ways of achieving these is for the government to subsidize transport and palm fruits costs. Research centers should develop genetically improved varieties of oil palm seedlings to replace the old groves predominant in the farmers' plantation. This will efficiently convert to improved palm fruits yielding good palm oil. There should also be improved extension linkage to sensitize the palm oil processors of the need for the use of improved varieties of palm fruits. Processors should graduate from the era of using manual processing techniques to mechanized ones. This however demands that necessary incentives be put in place such as provision of ready markets for the products locally and for exports as well as education to train the minds of the operators in the use and advantages derivable from the preference for mechanized processing.

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