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Assessment of Production Capability in Nigeria's Palm Kernel Processing Industry

A.B. Ilori
Department of Project Management Technology, School of Management, Technology, Federal University of Technology, Akure, Nigeria

A.F. Lawal
Department of Project Management Technology, School of Management, Technology, Federal University of Technology, Akure, Nigeria

Simon-Oke
Department of Economics, School of Management, Technology, Federal University of Technology, Akure, Nigeria

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Abstract:

The study examined the assessment of production capability in small and medium scaled palm kernel processing firms in Southwestern Nigeria. The study covered Ogun, Ondo, Osun and Oyo, States in Southwestern Nigeria. The sample size of 265 palm kernel processors was obtained through respondent driven sampling techniques. The research tools used were questionnaire, personal observations, interviews and secondary data collection approach. The questionnaire was administered to the processor and elicited information on socio-economic characteristics of the respondents, their production capabilities, profile of the firms. Both descriptive and inferential statistical techniques were employed for data analysis. The study showed that majority (75.8%) of palm kernel processing firms invested above N500,000 for setting up their firms and 15.1% invested between N401,000 – N500,000. The sources of capital for the investments were from personal savings (77.7%), friends (34.0%), family members (15.5%) and cooperative society (34.0%) only very few of them sourced for investment capital from bank (4.3%), and government institution/agencies (1.1%). The investment capability rating on a 4-point Likert scale showed that palm kernel processors were able to carry out feasibility study (3.98), purchase raw materials (3.99), procure processing equipment (3.99), generate enough capital (3.55) and enough working capital (3.37) for production. The technologies employed by the processors in each unit operations were mainly indigenous technologies that were fabricated locally in Nigeria. Very few operators made use of imported technologies. About 89.8% of the firms produced more than 4,000 litres of PKO per month and 4.9% produced between 3,001 – 4,000 litres per month. The sales turnover in year 2011-2013 was high for most of the firms. Size of the employees (β=1.882, $p \leq 0.01$), source of information for raw materials (β=1.146, $p \leq 0.05$), price competitiveness (β=0.079, $p \leq 0.10$), investment in quality control (β=0.417, $p \leq 0.01$) and maintenance of machines (β=0.172, $p \leq 0.05$) had significant impact on the profitability of the firm. The coefficient of determination R^2= 0.724 indicated that 5 independent variables contributed between 72.4% and 87.3% to production and innovative capability in palm kernel processing firms. The study therefore concluded that palm kernel processors possess a high production capability through the use of indigenous technology.

Keyword: Palm Kernel Processing Firms, Production Capability, Investment Capability, Innovation Capability, Imported Technologies

I. INTRODUCTION

Production capabilities are the skills that are required to effectively operate a plant with a given technology and the improvement of the technology over time. Production capabilities influence the productivity of labour and capital as well as efficiency in material and energy use. Production capabilities relate to the knowledge and skills used in the organization's operation where on-the-job experience appears to be of great importance (Adegbite, 2010).

Akerele (2003) further suggests that three broad related activities could be identified in this category. These are classified as production management, production engineering in terms of raw materials control, production scheduling, quality control and repair as well as maintenance of physical assets which have been found to have positive impact on productivity improvement. The Bogota Manual (2001) also suggested three elements of production capability. These include: process engineering, product engineering and industrial engineering. Process engineering includes necessary activities, for production. Product engineering contains activities required to produce product or improved product specifications, such as assimilation of product design, improvement in product quality and design research. Industrial Engineering involves monitoring and control functions for process and product engineering. Therefore, production capability is the stock of capital goods and operating know-how required to manufacture existing goods with productive efficiency.

These capabilities also include production management which is the ability to monitor and improve the operation of installed plants, or production engineering; investment capabilities which the skills needed to identify, prepare, obtain technology for, design, construct, equip, staff, and commission a new facility; Project management which include the organization and monitoring of the activities involved in installing and expanding productive capability, or project engineering and prefeasibility studies (Lall, 1992; Bogota Manual, 2005). Firms that are able to search, gain access, adapt and use innovations are those that are able to manufacture goods with productive efficiency.

Palm kernel is a by-product of the palm oil industry. It constitutes about 45% of the palm nut of the palm oil *Elaeisguineensis* (Rossell, 1985; Goh, 1993 and Kadir*et al.,* 1998). It can be processed into palm kernel oil (PKO) and palm kernel cake (PKC). Palm kernel oil is rich in Lauric acid, G12 (48.3%) but also contains other major fatty acids such as myristic, C_{14} (15.6%) and Oleic acides, C_{18} (15.1%) (Gbasouzor*et al*., 2012). The oil is conventionally extracted using screw press with 40-43% (g oil/100g kernel) yield or liexone extracted with 44.5%-46.5% yield (Tang and Teoh, 1985). According to Gbasouzor*et al*., (2012) palm kernel oil is a white to yellowish oil of vegetable origin which is solid at normal temperature and is obtained from the kernel of the oil palm fruit (Elaesisguineensis). It is one of the best oil, which is obtained from the flesh of the fruit Gbasouzor*et al*., 2012). Malaysia produced about 2.4 million metric tonnes of palm kernel and about 1.1 million metric tonnes of crude palm kernel oil in 1998 (Porla, 1998). Hassan *et al.* (1999) emphasized that PKO is a high quality oil for food use and a valuable component of margarine formulation, giving rapid melt down of PKO in the mouth characteristics (Siew and Begger, 1981). Its high solid content at 15–20°C, together with rapid melt down, makes it particularly useful in confectionery products. It is commercially fractionated into liquid olein and solid stearin, the latter being a premium product (Hassan *et al.,* 2000).

The extraction of oil from crushed kernel results in production of PKC as by product (MPOB, 2003.) In 2003, Malaysia produced an annual quantity of 1.4 million tonnes of palm kernel cake (PKC) as a by-product of palm kernel oil mill. Two types of PKC exist, the expeller pressed and the solvent extracted, because of different methods of kernel oil extraction and difference in their oil content: 5 to 12% in the expeller pressed PKC and 0.5 to 3% in the solvent extracted type (Chin, 1991).The PKC is obtained out from two stages of oil extraction from the palm fruit. The first stage is the primary extraction of palm oil from the pericarp portion of the fruit, which also produces the kernel and by-products Palm Oil Sludge and Palm Press Fiber. The extraction of oil from crushed kernel then results in the production of PKC as by-product (MPOB, 2003). In 2003, World production PKO was 3236 metric tons out of which Malaysia produced 1644 metric tonnes of PKO (MPOB, 2003). There are three conventional methods used for extracting PKO from palm kernel. These include; Traditional, Solvent extraction and Mechanical extraction.

The traditional method of palm oil processing starts with the shelling of the palm nut. The shelling is performed by using two stones to crack each nut and separating the kernel and shell simultaneously (Gbasouzor*et al.,* 2011). This manual operation has been superseded by the use of nut cracking stations. The mechanical nut crackers deliver a mixture of kernel and shell that must be separated. The kernel/shell separation is usually performed in a clay bath which is a concentrated viscous mixture of clay and water. The density of the clay is such that the shells sink while the lighter kernels float to the top of the mixture. The floating kernel are scooped in a basket, washed with clean water and dried. Periodically the shell are scooped out from the bath and discarded. The traditional oil extraction method is to fry palm kernels or simply heat the dried kernel. The fried kernels are pounded or ground to a paste in a motorized grinder. The paste is mixed with a small quantity of water and heated to release palm kernel oil. The released oil is periodically skimmed from the top (Gbasouzor*et al.,* 2011).

The mechanical extraction method uses screw press as the principal means of extracting vegetable oil. The use of the screw press for full extraction has been on increase over the years in the less developed countries. Larger and more efficient machines are being developed for full extraction and pre-pressing of palm kernel oil. Mechanical extraction processes are suitable for both small and large scale operations. The three basic steps in this process are; kernel pre-treatment (cleaning, size reduction, flaking and steam conditioning), screw pressing, and oil clarification (Gbasouzor*et al.,* 2012). Proper kernel pre-treatment is necessary to efficiently extract the oil from the kernel. The feed kernels in the pre-treatment stage are cleaned of the foreign materials which can cause damage to the screw presses, increase maintenance costs and downtime and contamination of products. Magnetic separators are commonly installed to remove metal debris, while vibration screens are used to sieve sand, stones or other undesired materials. Breaker roll or a swinging hammer grinder or a combination of both then breaks the kernel into small fragments. This increases the surface area of the kernels, thus facilitating flaking (Gbasouzor*et al.,* 2012).

In palm kernel processing industry, particles size reduction is usually carried out in order to increase the surface area and facilitate flaking process. The closer the jaws of the mill are to each other, the smaller the particle size, resulting to increase in surface area, decreased compressive strength increased stickiness and reduce porosity. Thereby,leading to the extraction of more oil from the palm kernel. The quality of oil produced may however be reduced by the intensity of heat generated by the fact that heat distribution rate is higher in fine particles than in coarse particles (Gbasouzor*et al.,* 2012).

Akinoso and Igbeka (2007) reported eight main stages in the extraction of oil as shown in Figure 2.1. Preparation of the raw material, extraction, clarification, packaging and storage. Preparation of the raw material involves cleaning, dehulling, cracking, flaking, pulping, grinding, grating, and heating or conditioning (RRRP, 1997). Particles, such as plant cells left in the oil after the extraction process, are removed by a process referred to as filtering (Bachmann, 2001). Filter press is employed in removing the impurities from oil. Service and maintenance of filter press as well as operational principle were reported by Samuel (2006). In milling plant, shell content analysis in the kernel seeds supplied is employed in order to ascertain the acceptability of a particular supply. The higher the % age of the pieces of shell content, the lesser the amount of oil that can be extracted from kernel seeds and vice-verse (Samson, 2002). The milling defects analysis of kernel cake provides information concerning the efficiency of expellers. The lower the values of the milling defect of cake, the higher the efficiency of expeller (Samson, 2002). Palm kernel oil yield decrease with increase in moisture content and increased with increase in roasting duration and temperature (Bachmann, 2001).

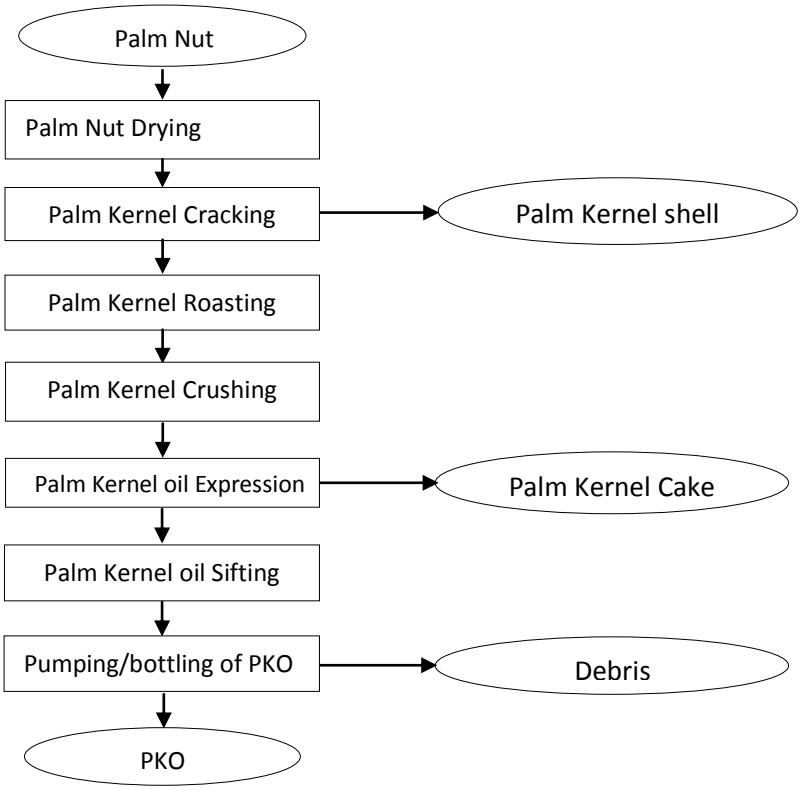

Fig. 1 Flow Diagram of PKO Expression Processes from Palm Nut
Source: Jekayinfa and Bamigboye (2006).

II. RESEARCH METHODOLOGY

The study area consisted of Oyo, Ondo, Osun, and Ogun states. These states were purposively selected because they have abundant supply of palm kernel and large small and medium palm kernel oil processing firms.

Two hundred and sixty five small and medium scale palm kernel oil processing firms were selected purposively from each state. This was made up of a total of 265 respondents for the study. At least one firm, if any, was chosen from each local government of the states.

The sampling procedure involved the initial purposive selection of a palm kernel processing firm in a town or location. The selected firms then gave direction(s) to his/her peers within the location. Through this procedure, 265 respondents were identified for the study.

The primary source of data was through the use of questionnaire, interview and personal observation. Secondary data was collected from the companies' records and directories, annual production of palm kernels for the past ten years..The questionnaire elicited information on availability of equipment source of raw materials, facility layout, production scheduling, quality control, capacity utilization, inventory management, product marketing and repair and maintenance of physical assets in the small scale palm kernel processing firm.

III. RESULTS AND DISCUSSION

3.1 Productions and Operations Management in Palm Kernel Processing Firms

Effective plant layout means placing the right equipment coupled with right methods in the right place to permit the processing of products in the most effective manner through the shortest move in shortest time (Dalela and Ali, 2006). Table 1 showed that majority (94.3%) of palm kernel processing firms used layout facilities in sequence, that is line flow type, while the remaining which are medium size used other flow types like L-type, U-type and S-type flows. Also, 1.9% claimed that the distance between each processing unit was high. Eighty three per cent (83%) and 15.1% of the respondents indicated that the distance was moderate and low respectively. This revealed that moderate and low distances between each processing unit operator were more preferable and this would enhance smooth operation.

Table I Facility Layout for Processing Firm in the Production of Palm Kernel Oil

S/No.	Parameters	Respondents	
		Frequency	Percent (%)
Do you use layout facilities in sequence?			
(a)	Yes	250	94.30
(b)	No	15	5.70

	Total	**265**	**100.00**
Distance between each production			
(a)	High	5	1.90
(b)	Moderate	220	83.00
(c)	Low	40	15.10
	Total	**265**	**100.00**
Type of production process employ			
(a)	Continuous	222	83.80
(b)	Batch	43	16.20
	Total	**265**	**100.00**

Field Survey, 2014.

Table 2 reveals the average monthly capacity utilization by the palm kernel oil processing firms in the study area. Seventeen per cent of the firms claimed to be operating at 100% capacity utilization, 78.1% operated between 81 – 90% capacity utilization while the remaining 2.6%, 1.1% and 1.1% operates at 61 – 80%, 41 – 60% and 21 – 40% levels of capacity utilization respectively. This implies that over 95% of the firms were operating above 80% of their capacity utilization per month.

The methods used by palm kernel processing firms in scheduling production are summarized in Table 3 Majority (90.9%) of the firms schedule their production based on availability of electricity. The oral interview conducted revealed that erratic supply of electricity made them to operate when there was supply of electricity. This indicates that firms were faced with problem of electricity supply. However, some of them also had standby generator which they used when there was no supply of electricity from the national grid. Other firms, 2.3%, 5.7% and 1.1% scheduled production based on demand, availability of raw materials and staff respectively.

Table II Capacity Utilization By The Palm Kernel Oil Processing Firms

S/No.	**Range of capacity utilization**	**Respondents**	
		Frequency	**Percent (%)**
Capacity utilization			
(a)	21 – 40	3	1.10
(b)	41 – 60	3	1.10
(c)	61 – 80	7	2.60
(d)	81 – 90	207	78.10
(e)	100%	45	17.00
	Total	**265**	**100.00**

Field Survey, 2014.

All palm kernel oil processor claimed to perform thorough inspection of palm kernel nuts before processing. This enables them to sort out the bad nuts and foreign particles such as stones and palm kernel shell which might affect the quality of their crude oil and palm kernel cake. The higher the percentage of the pieces of the shell content, the lesser the amount of oil that can be extracted from the kernel nuts (Samson, 2002). Most of the processors in the study area used their tacit knowledge to determine whether the moisture content of palm kernel nut is high or low. Tacit knowledge is uncoded knowledge acquired through experience on the job. The respondents claimed that when the moisture content is high, the nuts are sun-dried or dried mechanically before processing. However, medium and large–scaled mills have standard laboratory testing facilities which are used to carry out such tests as oil content, percentage moisture content among others. Excessive increment in moisture content of nuts could reduce the expulsion ability and enhance wear of mechanical part of the expeller (Samuel and Alabi, 2012).

Table III Methods Used By Palm Kernel Oil Processing Firms For Scheduling Their Production

S/No.	**Production scheduling**	**Respondents**	
		Frequency	**Percent (%)**
(a)	By demand	6	2.30
(b)	Raw materials supply	15	5.70
(c)	Staff available	3	1.10
(d)	Availability of electricity	241	90.90
	Total	**265**	**100.00**

Field Survey, 2014.

Consequently, palm kernel oil yield decreases with increases in roasting duration and temperature (Bachmann, 2001).

As also claimed by the respondents, rotten nuts may increase the free fatty acid (FFA) and lead to low price or total rejection of the crude oil by their major customers. It has also been reported that FFA content is an indicator of oil quality. Palm oil with FFA content higher than 3.5% may be rejected by oil refining industries due to higher processing cost of such oil (Basiron, 2005). High FFA raises a serious public health concern as it is more likely that such oil may have absorbed traces of metals during processing (Bek-Nielson, 1969). From the observation during processing and interviews, the processors ensured that roasting is done without allowing the nuts to burn. Excessive roasting, leading to burning according to them, would affect the colour of the crude oil. Good quality oil could be obtained from the palm kernel nuts with standard quality as stated in Table 4 below and prescribed by the Indian standard of physical and chemical society. The moisture shell and free fatty acid contents of the nuts should not be more than 8.5% and 5.0% respectively. Similarly the oil and moisture contents of cake should be 100% each in order to prevent unpleasant odour and mold growth during storage (Indian standard 1964 and Samuel and Alabi, 2012). Particles such as plant cells and impurities left in oil after the extraction process are usually removed by filtration process which is done by using filter press (Bachmann, 2001).

Meanwhile, about 94.7% of the firms spent less than ₦20,000 for quality control as shown in Table 5. Others 2.0%, 0.4% and 0.4% spent between ₦20,000 – ₦40,000, ₦41,000 – ₦60,000, and ₦61,000 – ₦80,000 respectively. However, 2.8% invested more than ₦80,000 on quality control depending on the size of firms and capacity utilization.

Table IV Standard Chemical And Physical Properties Of Good Quality Palm Kernel Nuts For Processing

S/No.	Crushing/milling parameters	IS Indian standard (%)
1.	Shell content of the nuts	8.00
2.	Oil content in the cake	10.00
3.	Milling defect in cake	10.00
4.	Moisture content in the cake	10.00
5.	Moisture content in kernel nuts	8.50

Indian Standard, 1964.

Table V Investment In Quality Control Per Year In The Palm Kernel Processing Firms

S/No.	Parameter (₦:k)	Respondents	
		Frequency	Percent (%)
(a)	< 20,000	251	94.70
(b)	20,000 – 40,000	5	2.00
(c)	41,000 – 60,000	1	0.40
(d)	61,000 – 80,000	1	0.40
(e)	> 80,000	7	2.80
	Total	**265**	**100.00**

Field Survey, 2014.

The type of inventory management practice was indicated as either buy raw material and use (Just In Time) or stock pile raw material in warehouse and withdrawn for production. Existence of warehouse for palm kernel was indicated as yes or no. Capacity of warehouse was indicated in tonnes. All the firms had warehouses where they kept their raw materials before processing. Table 6 shows the capacity of the warehouses. About 21.1% of the respondents had warehouse that could contain less than 10 tonnes. Majority (30.2%) of the respondents had between 11 – 20 tonnes capacity warehouses to stock pile raw materials, 20.4% and 13.2% had warehouse capacity of 21 – 30 tonnes and 31 – 40 tonnes respectively, while 15.1% had more than 40 tonnes capacity warehouses

From the interview the operator claimed that palm kernel nuts could be stored for a month without deterioration. Samuel and Alabi (2012) found that storage condition is irrelevant as long as the storage is within 10 days preferable and this would enhance smooth operation. Dalela and Ali (2006) claimed that a good plant layout reduces unit cost of production through; increased output with fewer men and machine hours owing to higher utilization of facilities and resources; little or no delay owing to better balancing; economic use of shop-flow area and capital; minimum material handling because of shorter moves, better use of labour (direct and indirect labour); less congestion on the shop floor, better safety; improved job satisfaction, safety and healthy working conditions.

Table VI Capacity Levels Of The Ware Houses In Palm Kernel Oil Firms

S/No.	Parameters (tonnes)	Respondents	
		Frequency	Percent (%)
(a)	< 10 tonnes	56	21.10
(b)	11 – 20 tonnes	80	30.20

(c)	21 – 30 tonnes	54	20.40
(d)	31 – 40 tonnes	35	13.20
(e)	> 40 tonnes	40	15.10
	Total	**265**	**100.00**

Field Survey, 2014.

Table 7 presents facility layout for processing and types of production process employed by the firms. About 83.8% employed continuous production process and 16.2% employed batch production process. Personal observations and interactions with owners and members of staff within the industry revealed that the continuous process was more preferred in palm kernel processing industry. In the continuous process, the raw materials are continuously fed to the expeller, which grinds and crushes the nuts as they pass through the machine. Most small expellers are power-driven, requiring about 3hp and are able for process between 8-45kg of the nuts per hour depending on the type of expeller used (Samuel and Alabi, 2012).

Table VII Facility Layout For Processing Firm In The Production Of Palm Kernel Oil

S/No.	Parameters	Respondents	
		Frequency	**Percent (%)**
Do you use layout facilities in sequence?			
(a)	Yes	250	94.30
(b)	No	15	5.70
	Total	**265**	**100.00**
Distance between each production			
(a)	High	5	1.90
(b)	Moderate	220	83.00
(c)	Low	40	15.10
	Total	**265**	**100.00**
Type of production process employ			
(a)	Continuous	222	83.80
(b)	Batch	43	16.20
	Total	**265**	**100.00**

Field Survey, 2014.

Maintenance is a combination of many actions which are being carried out in order to retain equipment and restore it to an acceptable condition. It ensures that the entire production system is kept reliable, productive and efficient (Dalela and Ali 2006). Table 8 reveals that 59.2% of the processors employed corrective strategy, which means they wait until machine breaks down before they take action to repair them. A proportion of them (38.1%), employed preventive strategy where organized maintenance work is carried out to prevent breakdown by well-conceived plan of inspection, lubrication adjustments, repair and overhaul. While the remaining 0.4% and 2.3% employed risk-based strategy and condition-based strategy respectively. This implies that corrective and preventive maintenance strategies were commonly used by the firms. About 77.0% of the respondents indicated that their strategies were effective, 18.9% claimed that they were very effective while 3.4% said it was fairly effective and 0.8% agreed that it was not effective. Samuel and Alabi (2012) have established that proper maintenance of facilities could go a long way in boasting the productivity in the palm kernel oil industry.

Table 9 showed the efficiency of the machines. Majority (96%) of the respondents claimed that the efficiency of their machines was very high, while 3.0% and 0.4% the efficiency to be of fairly high and low efficient machines respectively. Personal observations of their operations showed that their machines were functioning very well as at the time of this study. This shows that the machines were fabricated by highly skilled and competent artisans or technicians.

(a) Production of palm kernel oil by the firms in the study area.

Table 10 shows that 89.8% of the firms produced more than 4,000 litres of crude palm kernel oil per month. About 4.9% of the respondents produced between 3,001 – 4,000 litres while the remaining 1.9%, 3.0% and 0.4% produced 2,001 – 3,000 litres, 1,000 – 2,000 litres and less than 1,000 litres per month respectively.

(b) Palm kernel cake production by the firms in the study area

Table 11 showed the quantity of palm kernel cake (PKC) produced per month by the firms Fifty seven per cent of the respondents produced 500 – 10,000 kg per month and 34.0% produced 11,000 – 20,000 kg of PKC per month. About 5.7% of palm kernel processing firms produced over 40,000 kg of PKC monthly while the remaining 1.5% and 1.9% produced between 31,000 – 40,000 kg and 21,000 – 30,000 kg respectively per month.

Table VIII Maintenance Of Physical Asset In Palm Kernel Processing Firms

S/No.	Strategy employed	Respondents	
		Frequency	Percent (%)
Types of maintenance strategy employed			
(a)	Corrective strategy	157	59.20
(b)	Preventive strategy	101	38.10
(c)	Risk-based strategy	1	0.40
(d)	Condition-based strategy	6	2.30
	Total	**265**	**100.00**
Effectiveness of the maintenance strategy			
(a)	Not at all	-	-
(b)	Not effective	2	0.80
(c)	Fairly effective	9	3.40
(d)	Effective	204	77.00
(e)	Very effective	50	18.90
	Total	**265**	**100.00**

Field Survey, 2014.

Table IX Efficiency Of The Machines In Palm Kernel Oil Production Firms

S/No.	Efficiency of machines	Respondents	
		Frequency	Percent (%)
Efficiency of the machine			
(a)	Nil	-	-
(b)	Low	1	0.40
(c)	Fairly high	8	3.00
(d)	High	60	22.60
(e)	Very high	196	74.00
	Total	**265**	**100.00**

Field Survey, 2014.

Table X Quantity Of Palm Kernel Oil Produced Per Month

S/No.	Parameters	Respondents	
		Frequency	Percent (%)
(a)	<1,000 litres	1	0.40
(b)	1,000 – 2,000 litres	8	3.00
(c)	2,001 – 3,000 litres	5	1.90
(d)	3,001 – 4,000 litres	13	4.90
(e)	>4,000 litres	238	89.80
	Total	**265**	**100.00**

Table XI Quantity Of Palm Kernel Cake Produced Per Month

S/No.	Quantity (kg)	Respondents	
		Frequency	Percent (%)
(a)	500 – 10,000 kg	151	57.00
(b)	11,000 – 20,000 kg	90	34.00
(c)	21,000 – 30,000 kg	5	1.90
(d)	31,000 – 40,000 kg	4	1.50
(e)	>40,000 kg	15	5.70
	Total	**265**	**100.00**

Table 12 shows that 99.2% of the respondents claimed that the processing equipment are available, while (0.4%) claimed they are fairly available for production and 0.4% said they are not available. Most (95.8%) of the machines used for palm kernel oil production were fabricated locally, while few ones were imported from China and other Asian countries (Table 13). This is probably a major reason why many of those interviewed claimed that they did not have problems of unavailability of spare parts and maintenance generally, since the fabricators are readily available for any serious maintenance problem. Table 14 shows that majority (95.8%) of the respondents used locally fabricated palm kernel processing machines for their operations. The machines were operating efficiently as claimed by the respondents. This development agrees with endogenous theory of Schumpeter, (1950) and Schmookler, (1966) respectively, that indigenous technology development can enhance growth. However, 1.5% of the respondents used imported, while the remaining 2.6% make use of both local and foreign technology for their production

Table XII Availability Of Equipment For The Production Of Palm Kernel Oil And Refining Of Crude Oil

S/No.	Parameters	Respondents	
		Frequency	Percent (%)
Availability of processing equipment			
(a)	Very available	81	30.50
(b)	Available	182	68.70
(c)	Fairly available	1	0.40
(d)	Not available	1	0.40
	Total	**265**	**100.00**
Refining of crude oil			
(a)	Yes	2	0.80
(b)	No	263	99.20
	Total	**265**	**100.00**

Table XIII Source Of Equipment For Palm Kernel Production

S/No.	Parameters	Respondents	
		Frequency	Percent (%)
(a)	Local	254	95.80
(b)	Imported	4	1.50
(c)	Local and Imported	7	2.60
	Total	**265**	**100.00**

(c) Sources of raw materials in the palm kernel processing firms

Table 14 presents the sources of raw materials as well as information on raw materials. About 74.7% of the firms obtained their raw materials from the produce buyers for processing. The produce buyers buy from the farmers and sell to the processors. The remaining 24.9% got direct supply of palm kernel nuts from farmers. The result from the oral interview also indicated that some processor obtained palm kernel from the Republic of Benin. The Table further showed that 97.4% obtained information about the sources of raw materials from their customers, while 7.2% and 0.4% obtained information from co-processors and suppliers respectively.

About 92.1% of processors made use of telephone to contact palm kernel nuts suppliers. The oral interview conducted also revealed that most palm kernel processors preferred the use of telephone calls to reach their suppliers. In addition some respondents made personal visits (40.8%) to their suppliers, while 11.1% used e-mail to contact them.

Table XIV Source(S) Of Information For Raw Materials

S/No.	Parameters	Respondents	
		Frequency	Percent (%)
Source of Raw materials			
(a)	Farmers	66	24.90
(b)	Produce buyers	198	74.70
(c)	Produce merchant	1	0.40
	Total	**265**	**100.00**
Source(s) of information for raw materials			
Customers			
(a)	Yes	258	97.40

S/No.	Parameters	Respondents	
(b)	No	7	2.60
	Total	**265**	**100.00**
Co-Processors			
(a)	Yes	19	7.20
(b)	No	246	92.80
	Total	**265**	**100.00**
Suppliers			
(a)	Yes	264	99.60
(b)	No	1	0.40
	Total	**265**	**100.00**

3.2 Marketing capability of the palm kernel processing firms

Table 15 showed the modes of contact between palm kernel processors and their respective customers; 8.3% of the respondents contacted their customers through personal visit while majority (96.6%) made use of mobile telephones. Their customers were majorly medium and large scaled palm kernel oil processors that had facilities for refining the crude oil to edible vegetable oil and other industrial uses. The small scale processor also supply to other customers that make use of the crude oil for soap making. There is always an available market for their outputs. Hence the use of the outputs of these small scale enterprises as input for production by large scale firms would enhance profitability and growth of the enterprises.

Table 16 shows that the levels of linkage between the palm kernel processors and raw materials suppliers and customers. The linkage of the palm kernel processors and raw materials suppliers was rated strong (3.88) on a 5 point Likert scale. Their linkage with customers was rated very strong as well. However, there is a significant difference ($t=.000$, $p< 0.05$) between the ratings, individually that their linkage with customers was stronger. Table 17 presents knowledge of price charge by fellow palm kernel processors. Four percent had very adequate knowledge of the price while 44.2% and 52.1% had adequate knowledge and fairly adequate knowledge respectively. About 1.9% had inadequate knowledge and 0.4% had no knowledge of price charge by their colleagues in the business. In summary, the palm kernel processing firms have high marketing capability.

Table XV Modes Of Contact With Customers

S/No.	Mode	Respondents	
		Frequency	**Percent (%)**
Personal visit			
(a)	Yes	22	8.30
(b)	No	243	91.70
	Total	**265**	**100.00**
Telephone			
(a)	Yes	256	96.60
(b)	No	9	3.40
	Total	**265**	**100.00**
E-Mail			
(a)	Yes	-	-
(b)	No	265	100.00
	Total	**265**	**100.00**

Field Survey, 2014.

Table XVI Level Of Linkage Between The Palm Kernel Processors And Raw Materials Suppliers Or Customers

S/No.	Linkage of the palm kernel processor	Level of linkage					Mean rating
		Very strong	**Strong**	**Fairly strong**	**Weak**	**No linkage**	
(a)	Suppliers of raw materials	235(88.70%)	29(10.90%)	1(0.40%)	-	-	3.88
(b)	Customers	212(80.00%)	51(19.20%)	2(0.80%)	-	-	4.79

Table XVII Knowledge Of Price Charge By Fellow Palm Kernel Processors

S/No.	Parameters	Respondents		Mean rating
		Frequency	Percent (%)	
Knowledge of price charge				
(a)	Not at all	1	0.40	
(b)	Inadequate	5	1.90	
(c)	Fairly adequate	138	52.10	
(d)	Adequate	117	44.20	
(e)	Very adequate	4	1.50	
	Total	**265**	**100.00**	**3.45**

IV. CONCLUSION

The study concluded that the palm kernel processors experienced high investment capability, marketing and production capability. The challenges faced by the operators of the firms include seasonal variation in the supply of palm kernel nuts, price dictation by the large scale processors who further refined the crude oil and incessant outages of electricity for operation.

V. RECOMMENDATIONS

The following recommendations will improve production capability of palm kernel processing firms:

1. Government and private individuals should assist in building more vegetable oil refinery in various part of the country where palm kernel processing operations are large in numbers. Oyo state has established one Palm oil refinery in the state. This will reduce the bargaining power of the few existing medium and large scale refining firms that exploiting the small scales ones by dictating the price of the crude palm kernel oil.
2. Government can also assist in improving the knowledge, skills and capabilities of local processors and fabricators. This can be achieved through skill acquisition and training programmes through relevant organizations or agencies. The agencies include Nigeria institute for Oil Palm Research (NIFOR), National Agency for Science and Engineering and Infrastructure (NASENI) and Small and Medium Enterprises Development Agency of Nigeria (SMEDAN).
3. Government and private finance organization should make funds available to stakeholders in palm kernel processing firms in form of loans and incentives to enhance the production capability of the industry. Such financial institutions include Bank of Agriculture, Bank of Industry and Micro finance banks.
4. Government should be consistent in its policy formulation especially in the area of agriculture. The policy should encourage production of more palm produce in the country.
5. Government should provide of infrastructural facilities such as stable and regular supply of power and water, road network for enhancement of palm kernel nuts transportation from the rural areas to the processing centres.

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