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Efficiency of palm kernel marketing in Southeast Nigeria: the intervening role of Information and Communication Technology (ICT)

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Abstract
The increasing trend in the use of ICT in agricultural marketing and the dearth of information on its use among palm kernel marketers in the southeast Nigeria informed this study. Thus the study investigated the intervening role of ICT on the efficiency of palm kernel marketing in southeast Nigeria. Data for this study were collected from 180 palm kernel marketers from 30 markets of 3 randomly selected states of southeast Nigeria using a multistage sampling technique. The collected data were analyzed using descriptive statistics, Gini coefficient technique and marketing efficiency model. The result on ICT facilities available for marketing of palm kernel showed that majority of the palm kernel marketers in Abia (65.00%), Imo (68.33%) and Anambra (86.67%) states used social media marketing platform in the marketing of palm kernel in the study area. The findings on the market structure for palm kernel in the study area showed a Gini coefficient value of 0.670 indicating high inefficiency in the market structure. In addition, the result on marketing efficiency level of palm kernel marketers in the area revealed a marketing efficiency level of 78.88% indicating higher operational inefficiency. Evidence from the study shows that palm kernel market in the region is characterized by imperfect competition and the marketers conducted their marketing activities inefficiently. it was recommended that state government in the region and other stakeholders should encourage ICT utilization in palm kernel marketing through training on the requisite skills, credit facilities be made available to youths in the region to encourage them into palm kernel marketing training on best practices in marketing palm kernel be put in place by state government in the southeast region and other stakeholders in the palm kernel industry.

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Introduction

The palm kernel industry in Southeast Nigeria plays a vital role in poverty alleviation, food security, and economic stability, providing income for rural farmers, particularly women (Onwubuya, Ajani and Nwalieji (2012) [11]. However, despite its economic importance, the sector faces various challenges that hinder its optimal marketing and efficiency. One of the key challenges is the inefficiency in marketing practices, exacerbated by limited access to market information and the underutilization of modern technologies. Nse-Nelson *et al*. (2022) [7] identified inefficiency that exists in the marketing system for palm kernel marketing as the principal factor responsible for the decline in the performance of the country's palm kernel sector. Similarly, Okere, *et al*. (2016) [10] in a study on palm kernel marketing in Ovia North East local government area of Edo State, Nigeria revealed seasonality of the product, means of transportation, lack of infrastructure, cost of equipment's and financial problems as the key constraints to palm kernel marketing in the country.

Traditional methods of palm kernel marketing in Southeast Nigeria often involve reliance on informal networks, outdated communication channels, and inefficient distribution systems (Nse-Nelson *et al*. 2022) [7]. Studies such as Okere *et al*. (2016) [10], and Nse-Nelson *et al*. (2022) [7] showed that this results in inefficiencies such as high transaction costs, information asymmetry, and limited market reach, ultimately impacting the marketing efficiency of stakeholders along the palm kernel value chain.

Moreover, the rapid advancement of Information and Communication Technology (ICT) presents both opportunities and challenges for the palm oil industry in Southeast Nigeria. While ICT tools and platforms offer the potential to revolutionize marketing practices, enhance market access, and improve decision-making processes (Ogunleye *et al*. 2022) [9], the adoption and integration of these technologies remain uneven and inadequate across the sector (Ahi *et al.* 2022; Ayene *et al*., 2023) [3].

Thus, there is a pressing need to investigate the extent to which ICT interventions can address the existing challenges and improve the marketing efficiency of palm kernel marketing in Southeast Nigeria. Specifically, there is a lack of comprehensive research that systematically examines the availability, accessibility, and utilization of ICT facilities relevant to palm kernel marketing in the region as well as describe the structure of the palm kernel market in the region. Furthermore, there is limited empirical evidence in the marketing efficiency levels attained by marketers following the usage of ICT in palm kernel marketing activities as available studies reviewed such as Ezeoha, *et al*. (2012) [6]; Nse-Nelson *et al*. (2022) [7]; Abdulrahman *et al*. (2017) [1]; Adeniyi and Yekinni (2018) [2]; Nwafor *et al*. (2020) [8]; Okere *et al*. (2016) [10]; Vasa and Trendov (2020) [14]; Ayeni *et al*. (2023) [4] and many others focused on the production and marketing of palm kernel, and the use of ICT in agricultural produce marketing.

Therefore, this study seeks to address these gaps by investigating the marketing efficiency of palm kernel marketing in Southeast Nigeria, with a specific focus on the intervening role of ICT. By describing the structure of palm kernel market and determining the marketing efficiency levels attained by palm kernel marketers following the usage of ICT, this research aims to provide valuable insights into the potential benefits of leveraging ICT solutions to enhance the economic viability and sustainability of the palm kernel industry in Southeast Nigeria.

Methodology

The Study Area

The study was conducted in the South-eastern zone of Nigeria. According to National population commission (NPC) (2007), the population of the Southeast zone is 16,381,729 persons, disaggregated into 8,306,306 males and 8,075,423 females. The region lies in the humid tropical agro-ecological zone of Nigeria, within latitudes 04° 24′N to 07° 00′N and longitudes 05° 34′E to 09° 24′E. The humid tropical ecology is characterized by two distinct seasons, namely, the dry season, which starts from November to late March and the rainy season, which starts from April to October. The general vegetation consists of woodland savannah in the northern part of the zone and mangrove forests in the deep Niger Delta area (Onyeneke and Madukwe, 2010 as cited by Onyeneke, Nwajiuba, Emenekwe, Nwajiuba, Onyeneke and Ohalete 2019) [13]

The Southeast region of Nigeria comprises of five States namely: Abia Anambra, Enugu, Ebonyi, and Imo State. The inhabitants of this zone are predominantly farmers, producing mainly food crops like rice, cassava, yam, and maize as well as palm kernel.

Population of the Study

The population of the study consisted of 1847 registered palm kernel marketers obtained in 2023 from the Palm kernel Marketers Association in the Southeast geopolitical zone of Nigeria

Sampling and sampling techniques

A sample size of 180 palm kernel marketers determined using Taro Yamane's method was used for the study. A multistage involving purposive and random sampling technique was used to select the 180 palm kernel marketers. The first stage involved the random selection of three States (Abia, Imo and Anambra) out of the five States that makes up the Southeast geopolitical zone of Nigeria In the second stage, five local government areas (LGAs) were randomly selected from each of the three States selected in the first stage to arrive at 15 LGAs. The third stage involved purposive selection of two rural market from each of the 15 LGAs earlier selected making a total of 30 markets. The selection was based on observable evidence of the existence of good numbers of palm kernel marketers. In the fourth stage, random sampling method was employed to select 6 palm kernel marketers from each of the 30 markets selected to arrive at a total of 180 respondents for the study. The data for the study were collected using structured questionnaire

Analytical Technique

The collected date were analyzed using descriptive statistics, Gini coefficient technique, and Shephard-Futrell model. Descriptive statistics such as frequency tables and percentages were used to describe ICT facilities available for marketing palm kernel; Gini coefficient technique was used to examine the market structure of palm kernel in the study area; and Shephard – Futrell model was used to determine the marketing efficiency palm kernel marketers.

The marketing efficiency model was specified as follows:

$$\text{Marketing Effciiency (ME)} = \frac{\text{total cost}}{\text{Total revenue}} \text{ X } \frac{100}{1}$$

(Shephard – Futrell 1982)

Where:

TC= total cost (₦)

TR = Total revenue (₦)

According to Shepherd – Futrell (1982), the lower the coefficient/ percentage, the higher the level of market efficiency and vice versa.

The GINI coefficient model was specified as follows:

$GC = 1 - \sum XY$

Where:

GC = Gini Coefficient, X = Proportion of Sellers, Y = Cumulative Proportion of Sales,

$\sum$ = Summation Sign, and 1 = constant or unity.

Result and Discussion

ICT facilities used in marketing palm kernel among marketers

The ICT facilities available for marketing of palm kernel in the study area are presented in Table1. The result revealed that majority of the palm kernel marketers in Abia (65%), Imo (68.33%) and Anambra (86.67%) used social media marketing platform in the marketing of palm kernel in the area. Generally, social media marketing enables marketers to have a more reliable and faster means of sending information and a greater ability to keep track of consignments in transit goods and on arrival at the market.

Table 1: ICT Facilities available for marketing of palm kernel

Items	Abia		Imo		Anambra		Southeast	
	Freq*	Percent	Freq*	Percent	Freq*	Percent	Freq*	Percent
Social media Marketing	39	65.00	41	68.33	52	86.67	44	73.33
E-commerce platforms	14	23.33	17	28.33	20	33.33	17	28.33
Customer relationship	5	8.33	4	6.67	7	11.67	5	8.89
Management (CRM) software								
Supply chain management Software	0	0.00	4	6.67	3	5.00	7	8.89
Mobile applications	5	8.33	5	8.33	5	8.33	5	8.33
Data analytics tools	11	18.33	11	18.33	11	18.33	11	18.33
Phone calls	16	26.67	19	31.67	22	36.67	19	31.67

***Source*:** Field survey, 2023. *Multiple response recorded

For the Southeast, the pooled data result indicated that the use of social media marketing was embraced by majority (73.33%) palm kernel marketers. This was followed by the use of Phone calls by 31.67% of palm kernel and 16.11% of palm oil marketers. The least favoured ICT facility was mobile applications used by 8.33% of the palm kernel marketers.

Market Structure of Palm Kernel

The market structure for palm kernel in the study area are presented in Table 2, Table 3, Table 4, and Table 5 for Abia State, Imo State, Anambra State, and Southeast respectively. Gini coefficient computation of the palm kernel marketers in Abia State is shown in Table 2. The value of the Gini-Coefficient (0.629), as presented in Table 2 implies a high level of inequality in the sales revenue of respondents indicating a good degree of market concentration. Gini Coefficient ranges between 0 and 1.

A Gini Coefficient of 0 implies perfect equality in distribution, while a coefficient of 1 means perfect inequality. The closer the value is to unity, the greater the degree of inequality and therefore, the higher is the level of concentration. In other words, higher Gini coefficient means higher level of concentration and consequently high inefficiency in the market structure. The inequality in the market could also be as a result of variation in the investment level of the respondents. This is in-line with the finding of Eronmwon *et al.* (2014) [5] who obtain a Gini coefficient of 0.677. High Gini coefficient is associated with poor market structure and performance.

Table 2: Estimate of Gini-Coefficient for Palm kernel Market in Abia State.

Income	Frequency	% (X)	Cum. %	Revenue	%	Cum. %	XY
< 100,000	7	0.1167	0.1167	99515.5	0.0420	0.042	0.005
100,001 – 200,000	13	0.2167	0.3334	173690.5	0.0733	0.1153	0.025
200,001 – 250,000	10	0.1667	0.5000	219423	0.0926	0.2079	0.035
300,001 – 400,000	9	0.1500	0.6500	322465	0.1360	0.3439	0.052
400,001 – 500,000	8	0.1333	0.7834	414815	0.1750	0.5189	0.069
500,001 – 600,000	7	0.1167	0.9000	517490	0.2183	0.7372	0.086
>600,000	6	0.1000	1.0000	622845	0.2628	1.0000	0.100
	60	1					0.371

***Source*:** Field Survey, 2023. Gini- coefficient = 1 – Σxy = 1- 0.371= 0.629

Gini coefficient computation of the palm kernel market in Imo State is shown in Table 3. The value of the Gini-Coefficient (0.719), as presented in Table 3 implies a high level of inequality in the sales revenue of respondents indicating a good degree of market concentration. The inequality in the market could also be as a result of variation in the investment level of the respondents.

Table 3: Estimate of Gini-Coefficient for Palm kernel Marketers in Imo State.

Income	Frequency	% (X)	Cum. %	Revenue	%	Cum. %	XY
< 100,000	11	0.1833	0.1833	92675.5	0.0399	0.0399	0.007
100,001 – 200,000	13	0.2167	0.4000	166850.5	0.0718	0.1117	0.024
200,001 – 250,000	13	0.2167	0.6166	212583	0.0915	0.2033	0.044
300,001 – 400,000	9	0.1500	0.7666	315625	0.1359	0.3392	0.051
400,001 – 500,000	7	0.1167	0.8833	407975	0.1757	0.5149	0.060
500,001 – 600,000	5	0.0833	0.9666	510650	0.2199	0.7347	0.061
>600,000	2	0.0333	1.0000	616005	0.2652	1.0000	0.033
	60	1					0.281

***Source*:** Field Survey, 2023. Gini- coefficient = 1 – Σxy = 1- 0.281= 0.719

The value of the Gini- Coefficient (0.663) for palm kernel market in Anambra State as presented in Table 4 implies a high level of inequality in the sales revenue of respondents indicating a good degree of market concentration.

Table 4: Estimate of Gini-Coefficient for Palm kernel Marketers in Anambra State.

Income	Frequency	% (X)	Cum. %	Revenue	%	Cum. %	XY
< 100,000	8	0.1333	0.1333	99815.5	0.0421	0.0421	0.006
100,001 – 200,000	13	0.2167	0.3500	173990.5	0.0733	0.1154	0.025
200,001 – 250,000	10	0.1667	0.5166	219723	0.0926	0.2081	0.035
300,001 – 400,000	10	0.1667	0.6833	322765	0.1361	0.3441	0.057
400,001 – 500,000	10	0.1667	0.8500	415115	0.1750	0.5191	0.087
500,001 – 600,000	5	0.0833	0.9333	517790	0.2183	0.7374	0.061
>600,000	4	0.0667	1.0000	623145	0.2627	1.0000	0.067
	60	1					0.337

***Source*:** Field Survey, 2023. Gini- coefficient = 1 – Σxy = 1- 0.337= 0.663

Table 5 x-rays the Gini coefficient figures for the use of ICT by palm kernel marketers across the selected States and the Southeast. The Gini coefficient values computed for Abia, Imo and Anambra State and the entire Southeast for the palm kernel marketers were 0.629, 0.719, 0.663 and 0.670 respectively. This implies that values of Gini coefficient 0.670 for palm kernel market in the Southeast means higher levels of concentration and consequently high inefficiencies in the market structures. These findings concur with Eronwon *et al*. (2014) who established a Gini- coefficient of 0.677, but however contradict Ozor and Nwankwo (2018) [15] who reported mean Gini coefficient of 0.30 for marketers of dry maize in Southeast Nigeria.

Table 5: Estimated Gini-coefficient for Palm kernel marketers in the Southeast

	Gini- coefficient
Abia	0.629
Imo	0.719
Anambra	0.663
Southeast	0.670

Marketing Efficiency of Palm Kernel Marketers

The marketing efficiency of palm kernel marketers in the study area are presented in Table 6.

Table 6: Marketing efficiency of Palm kernel Marketers in South east Nigeria

Item	Abia	Imo	Anambra Southeast
Total variable cost	98248100	143876000	142979300 1,283,678.35
Total revenue	121727080	1828051.00	1836853.60 1,627,392.00
Efficiency TVC ×100	80.71	78.70	77.84 78.88
TR 1			

***Source*:** Field survey, 2023

On Palm kernel marketing, result in Table 6 indicated levels of efficiency of 80.71%, 78.06%, 77.84% and 78.88% for the marketers in Abia, Imo, Anambra and the study area respectively. The higher operational inefficiency levels attained by the marketers of Palm kernel meant that the marketers' sales revenue on cost would have taken better investment decisions.

Conclusion and Policy Implications

The findings from the study shows that social media marketing platform dominates ICT facilities available for palm kernel marketing in the study area and thus could be attributed to its fastness when used in conducting marketing activities. The findings on market structure indicates high Gini-coefficient of 0.670 for the palm kernel marketers. This implies the existence of poor market structure that is high level of inefficiency in the market structure and hence imperfect market competition for palm kernel markets in the Southeast. Also, the marketing efficiency level of 78.88% for palm kernel marketers in the study area indicates high operational inefficiency.

Based on the findings of the study, the following were recommended

1. State government in Southeast region and other stakeholders in the palm kernel industry should encourage palm kernel marketers to utilize ICT in marketing palm kernel through training targeted at ensuring that marketers acquire the skills in using these facilities for their marketing activities.
2. Youths in the Southeast should be encouraged by their state government to go to palm kernel marketing business through the provision of credit facilities. This will encourage more entrants into palm kernel market and hence improve the structure.
3. Training on best practices in marketing palm kernel should be put in place by the state government in the region and other stakeholders in palm kernel industry. This will improve the revenue of these marketers and hence their marketing efficiency level.

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