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Efficiency of oil palm production in Nigeria: A review-pathway

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Abstract

The study reviewed the efficiency of oil palm production in Nigeria. Efficiency plays a major role in productivity in developing economies like Nigeria, where resources are limited and new technology must be adopted quickly to boost output. The research gaps addressed were: provision of reasonable data backing the efficiency of oil palm production, inquiry into the technical efficiency dynamics of the oil palm making, appraising the dynamics disturbing the oil palm making, addressing the sustainability of oil palm making, reviewing the problems and prospects connected with the oil palm commerce. The factors affecting the technical efficiency of oil palm fruit processing which includes a decline in production and yields, limited availability of specific fertilizers, scarcity of quality palm seedlings, aging palm plantations, limited access to suitable credit options, marketing challenges, including stiff competition from imported oils, inefficient palm oil extraction using traditional methods due to the prevalence of a poorly mechanized artisanal sector and limited access to credit tailored for palm nut processing. It was discovered that Oil palm making has a significant impact on employment in Nigeria. The problems associated with the efficiency of oil palm production include deforestation and habitat loss, environmental impact, social and labour issues, land tenure and conflict. Among the prospects of oil palm efficiency, alternative oil sources, technology and yield improvement, restoration and reforestation, consumer awareness and demand for sustainable products were optimal. It was concluded that the pathway of oil palm-making efficiency in Nigeria from 1980 to 2023 reflects a dynamic industry resulting by economic growth, environmental stability, technological and social compatibility. It is recommended that to enhance efficiency in oil palm, farmers ought to allocate greater resources to their production endeavours to align with the rising market demand and to enhance their profit margins.

Keyword: Oil palm; Oil Palm Products Efficiency; Production; Nigeria

1. Introduction

The oil palm (*Elaeisguineensis*) is an ancient plant with its origins in the tropical rainforest regions of West Africa. Throughout history, the oil extracted from its fruits has been a valuable resource used for both culinary and medicinal purposes. This versatile palm has now spread from approximately 16 degrees North latitude in Senegal to 15 degrees South latitude in Angola, extending eastward to encompass regions such as Zanzibar and the Malagasy Republic. However, the primary oil palm belt in West Africa spans across the southern latitudes of several countries, including Sierra Leone, Liberia, Ivory Coast, Ghana, Togo, Benin, Nigeria, Cameroon, and stretches into the equatorial areas of the Democratic Republic of Congo and Angola, falling between latitudes 10 degrees North and 10 degrees South (Carrere 2010). Interestingly, during the 14th to 17th centuries, some palm fruits made their way from West Africa to the Americas and eventually to the Far East (Edelman *et al*., 2013).

Efficiency is an important factor of productivity in a growing economy like Nigeria where there are dwindling resources for the adoption of improved technologies for increased production. In Nigeria, there exists a unanimous agreement

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that boosting agricultural production is imperious to address the continually escalating demands for both food and industrial resources owing to the speedy increase of the population, which is currently growing at a rate exceeding 2.83%. This growth is not being matched by a corresponding increase in food production, estimated at 2.5%, while the demand for food is expected to rise by more than 3.5%. Agriculture stands as a pivotal sector in any economy, offering a clear pathway toward poverty reduction, enhanced income distribution, accelerated industrialization, and the diversification of foreign exchange earnings (Bassey, 2016). Oil palm-making in Nigeria from 1980 to 2022 has undergone significant changes and challenges, influenced by economic, environmental, and social factors.

In the early 1980s, oil palm-making in Nigeria was in its growth phase. The government supported the sector through policies and investments. In the 1990s, the Nigerian oil palm commerce faced challenges, including aging plantations, lack of investment, and falling productivity (Idris and Ogunniyi, 1999). The early 2000s saw efforts to revive the oil palm sector through initiatives like the National Oil Palm Programme (Ogunniyi and Idris (2002). By the mid-2000s, concerns about sustainability, including deforestation and environmental effects, gained prominence (Obidiegwu, and Nwankwo, 2009). The late 2000s marked the introduction of sustainability documentation initiatives like RSPO (Roundtable on Sustainable Palm Oil) in Nigeria (Oke and Olatubara, 2014). In the 2010s, the Nigerian palm oil industry faced challenges in meeting export demand, leading to policy reforms and efforts to increase local production Adepoju, 2018). In modern years, the focus has remained on sustainability, with an emphasis on reducing environmental impacts and improving efficiency through technological advancements (Adeleke and Fashola, 2021).

Currently, the crude palm oil demand and other oil palm products like palm kernel cake and palm kernel oil, both for domestic and industrial use, lag behind the supply. This shortfall in local supply has led Nigeria to rely on imports to bridge the gap. Over the years, local supply has faced challenges, with a negative annual growth rate of -1.2%, decreasing from 1.17 million tons in 2005 to 1.1 million tons in 2010. This decline can be attributed to factors such as limited technological inputs, the prevalence of small-scale producers, restricted access to credit, dispersed farming communities, slow expansion of farm acreage, reduced yields due to inadequate market access, transportation challenges, and an underdeveloped road network. Additionally, global crude palm oil prices and weather conditions have had significant effects on the pricing of oil palm products in Nigeria (Potter, 2015).

1.1. Research Gaps

The research gaps addressed were:

- Provision of reasonable facts for the efficiency of oil palm production.
- Inquiry into the Technical Efficiency dynamics of the oil palm production.
- Appraising the issues affecting oil palm-making.
- Addressing the sustainability of the oil palm-making.
- Reviewing the problems and prospects associated with the oil palm industry.

2. Efficiency of Oil Palm Production

The significant role of efficiency in augmenting agricultural output has gained widespread recognition among both researchers and policymakers. In fact, substantial efforts have been dedicated to evaluating the efficiency of farming practices in developing nations. A fundamental assumption underlying most efficiency studies is that if farmers are not utilizing existing technologies efficiently, then endeavors aimed at enhancing efficiency would be more cost-effective than introducing new technologies to boost agricultural production (Shapiro, 2013). Efficiency holds particular importance in the background of productivity growth, particularly in developing agricultural economies where resources are limited, and opportunities for the expansion and adoption of superior technologies have been dwindling in recent times. Assessing the extent of inefficiency can assist in determining whether it is more prudent to improve existing efficiency or to invest in the development of new technologies to enhance agricultural productivity. The oil palm is a valuable crop that has historically played a significant role in the socioeconomic and political life of the people of Nigeria, despite its West African origins. Its significance and utilization extend beyond the West African sub-region.

Nigerian oil palm products, primarily palm oil and palm kernel, played a pivotal role in fueling the European Industrial Revolution (Sadiq *et al,* 2013). During the early stages of Nigeria's economic growth, the contribution of oil palm commerce in Nigeria was remarkably significant. In the first decade of the twentieth century, for instance, the oil palm industry served as the driving force of growth, accounting for over 80 percent of the annual domestic export earnings. However, this contribution gradually decreased to 54.5 percent between 1914 and 1918, and subsequently to less than 20 percent during the period from 1955 to 1966. This decline was primarily credited to the emergence of crude petroleum oil in Nigeria's economic landscape.

The predominance of palm oil and palm kernel in Nigeria's foreign trade and foreign exchange earnings from 1906 to approximately 1938 is well-documented (various issues of Central Bank of Nigeria, 1973-2003). The reduction in the production of oil palm products over the years has been attributed, among other factors, to technical inefficiencies among farmers. There is a agreement that oil palm producers in Nigeria were unable able to achieve optimum output from a specified set of inputs.

In the realm of agriculture, the assessment of efficiency is typically linked to the potential of farms to generate an optimal level of output using a specific bundle of resources or at the least possible cost. Technical efficiency in agricultural production is defined as the capacity to attain the highest output from a given set of inputs while utilizing the available technology (Olafisoye, 2020). This definition underscores the existence of variations in technical efficiency among farms. Within the context of a factor-product relationship, the production function assumes technical efficiency, where maximum output is achieved from a particular combination of inputs.

2.1. Stochastic Production Frontier Model

The stochastic production frontier is an econometric approach used to measure efficiency within production systems. It is based on the concept that a production system can be defined by a series of smooth and continuously differentiable concave production transformation functions, with the frontier representing the limit of all feasible production outcomes. This method offers the benefit of concurrently estimating the individual technical efficiency of participating farmers and identifying the factors influencing their technical efficiency (Paul *et al*, 2017). The initial specification of this approach includes a production function with two components: one to accommodate random effects and another to quantify technical efficiency. The model is specified as follows:

$$Yi = f(Xki\ \beta)e\Sigma i, \quad i = 1 \ldots\ldots n \qquad k = 1 \ldots\ldots\ldots\ldots k\ldots\ldots\ldots\ldots(1)$$

Where:

Yi = Farmers' output

Xki =Farmers' inputs

f = Functional form (Cobb Douglas or translog)

β = Parameters vector to be estimated

Σi = The farm-specific composite residual term comprising of two independent elements error term Vi and an efficiency component Ui

The symmetric component, denoted as V, represents a two-sided random term that follows a normal distribution independently as N(0, σv^2). These random variations in account components in output resulted from factors above the management of farmers, such as weather and diseases. In contrast, a one-sided component, U, reflects technical inefficiency relative to the stochastic component. This component is often assumed to follow either a truncated normal distribution as truncations at zero of the Normal (μ, σu^2) distribution or, a half-normal distribution N(μ, σu^2) (Dawson, 1990).

Using maximum likelihood estimation for equation (1), we can obtain estimates for β by making specific assumptions about the distributions of Ui and Vi. Here, β retains its earlier definition, while λ = σu/σv^2, and σu^2 is replaced with σ^2 = σv^2 + σu^2. This approach attributes output from the frontier to technical efficiency.

Measure of technical efficiency for individual farmer is calculated as:

$$TEi = \exp\ [E\ \{- Ui/\varepsilon\}]\ i = 1 \ldots\ldots\ldots\ldots n\ldots\ldots\ldots\ldots(3)$$

Ui in equation 3 is defined as:

$$U = f\ (Zi, \delta)\ldots\ldots\ldots\ldots(4)$$

Here, Z represents a vector of variables that could potentially impact a farm's efficiency, while δ is a vector of parameters that require to be estimated. The analysis employed the Cobb-Douglas stochastic frontier production function while assuming a truncated normal distribution to describe the technology used by the farmers.

The Role of the Stochastic Production Frontier: The Model in the oil palm production explains mostly the Technical Efficiency (TE). This refers to the ability of the farms to attain the highest level of outputs. This will be compared from one annual production to another, whether there are decreases or increases in productivity in consonant with the Model (Okeke and Emaziye, 2017).

2.2. Factors affecting the Technical Efficiency of Oil Palm Fruit Processing Units

Prior to 1960, the colonial administration primarily favored the trade of export crops. Subsequently, between 1960 and 1970, rural development policy shifted its focus towards promoting oil palm cultivation with the establishment of the National Society for Rural Development (SONADER). This initiative led to a significant increase in oil palm production, rising from 6,000 tonnes in 1966 to 14,300 tonnes in 1970 (Biodun *et al,* 2021). However, in the past fifty years, several issues have impeded the progress of oil palm production in Benin, which can be categorized as follows:

- Decline in production and yields attributed to:
    - Reduced rainfall: Oil palm has been adversely affected by drought periods occurring between 1963 and 1983. The annual rainfall averages approximately 1200 mm, but for optimal oil palm growth, around 2000 mm of well-distributed rainfall per year is preferable, with three months of less than 100 mm rainfall, according to Idris and Ogunniyi (1999) insufficient rainfall is a serious environmental setback to oil palm efficiency.
    - Limited availability of specific fertilizers.
    - Scarcity of quality palm seedlings.
    - Aging palm plantations.
    - Limited access to suitable credit options.
- Marketing challenges, including stiff competition from imported oils.
- Issues related to post-harvest processing, particularly the transformation of palm nuts into palm oil:
    - Inefficient palm oil extraction using traditional methods due to the prevalence of a poorly mechanized artisanal sector (Fournier *et al*., 2000).
    - Limited access to credit tailored for palm nut processing.

2.2.1. Trend Analysis of Oil Palm-Making and its Efficiency in Nigeria

The oil palm is an economically significant crop, and its products have played pivotal roles in the social, economic and political fabric of Nigeria since ancient times. While its origins lie in West Africa, its importance and utilization extend far beyond the boundaries of the sub-region. Notably, its products, primarily palm oil and palm kernel, played a vital role in fueling the industrial revolution in Europe (Lee *et al*., 2014).

The impact of the oil palm business in Nigeria was particularly substantial during the early phases of Nigeria's economic development. In the initial decade of the twentieth century, the oil palm business served as the primary driver of growth, contributing over 80 percent of the annual total domestic export earnings.

However, this contribution gradually declined, reaching 54.5 percent during the period from 1914 to 1918 and dropping to less than 20 percent between 1955 and 1966. This decline was primarily credited to the emergence of crude petroleum oil in Nigeria's economic landscape. The historical dominance of palm kernel and palm oil in Nigeria's foreign trade and foreign exchange earnings from 1906 to approximately 1938 is well-documented (Potter, 2015; various issues of Central Bank of Nigeria, 1973-2003). The decrease in the production of oil palm products over the years has been attributed to various factors, including technical inefficiencies among farmers, among other variables (Ogisi and Emaziye, 2015).

2.2.2. Oil Palm and Employment in Nigeria

Oil palm-making has a significant impact on employment in Nigeria, providing jobs along the entire value chain from cultivation to processing and distribution. Oil palm cultivation in Nigeria is predominantly carried out by smallholder farmers, which provides substantial rural employment opportunities Yusuf, and Ayanlade, (2015).The oil palm industry is labor-intensive, with tasks such as planting, harvesting, and processing requiring a significant workforce. Udom and Udofia (2015).The processing of palm oil involves various stages, including milling, extraction, and refining, which

generate employment opportunities in non-urban areas. Edem *et al* (2009). Small-scale palm oil processing units, often run by local communities, create jobs and income sources at the grassroots level Akpan and Udofia (2019).

2.2.3. Nigeria: Production of palm oil (2009 - 2022)

Nigeria palm oil production

In Nigeria, 1.4 million metric tons of palm oil were produced in 2022. The output volume increased generally between 2009 and 2022, with 2010 seeing the biggest growth, at over 14%. The output of palm oil production increased starting in 2014 and has continued to do so. Nigeria is among the world's top producers of palm oil growing domestic palm oil mainly for consumption.

In Nigeria, palm oil consumption was projected to reach 1.8 million metric tons by the crop years 2021–2022. In comparison to the ten years before, this year's consumption peaked, showing that the farm product is one of the nation's main crops with a rising domestic demand. The majority of palm oil is used industrially, and only a little amount is used by households.

Nigeria palm oil imports

Nigeria received 350,000 metric tons of imported palm oil in 2018. Despite the fact that this was a bigger volume than the year before, it indicated a decline in the product's overall imports. For instance, the nation imported more than 500,000 metric tons of palm oil in both 2013 and 2014. Nigeria imported the bulk of its palm oil from China and Malaysia in the fourth quarter of 2021 (Sasu, 2022). This importation practices grossly affected the viability of oil palm produce (Emaziye and Ovharhe, (2020).

2.3. Sustainability of Palm Oil-Making

Oil palm and its by-products profitability contributes to the sustainability of the oil palm industry (Emaziye and Ovharhe, 2020). Sustainability is driven by a triad of factors: environmental consciousness, financial growth, and social responsibility. In the global palm oil commerce, an endeavor known for its extensive land usage with millions of hectares dedicated to palm tree cultivation, various techniques have been employed by major players, notably in countries like Malaysia and Indonesia, to acquire land. One such technique is referred to as "land grabbing," akin to the unlawful acquisition of territory.

However, this practice has raised ecological concerns, particularly in terms of deforestation to make way for palm plantations, which has detrimental effects on the affected region's biodiversity. Additionally, the widespread adoption of bush burning as a cost-saving measure during land clearance for palm tree planting poses significant challenges to achieving environmental sustainability. The improper management of waste byproducts from palm oil processing, discharged into waterways and soil which could result to aquatic life harmfulness and soil toxicity. To ensure the sustainability of the planet, it is imperious to reevaluate policies related to environmental compliance, waste management, pollution control, and technological advancements in palm oil-making (Okokpujie *et al*., 2018).

The call for reform within the palm oil business was spearheaded by non-governmental organizations (NGOs) that highlighted human rights violations within the sector. In response, the international community swiftly reduced investments in palm oil production, sending a strong message to the industry regarding its practices and their impact on both human life and the environment. In reaction to this pressure, the palm oil industry initiated a business code that discourages the adoption of practices like bush burning in product production. A certification system was established to signify adherence to these guidelines, though it is still in its early stages. There is optimism that by 2030, the majority of palm oil producers will possess this certification, as stated by the World Economic Forum (Olafisoye *et al*., 2020; Sadiq *et al*., 2013)

2.4. Empirical Studies

Lawal *et al.,* (2013) in their study investigated the technical and cost efficiency of palm oil processing in Benue State, Nigeria. Primary data were collected randomly from 120 palm-oil processors, during the 2006/2007 cropping season, using structured questionnaire. The collected data were analyzed using descriptive statistics and stochastic production frontier model. Results of the technical inefficiency show that capital, labour and quantity of palm- fruit with coefficients 0.44, 0.84 and 0.15 respectively, had significant effect on the quantity of palm oil processed in the study area and that, the producers were producing at an increasing return to scale (1.98). Age and household size with the coefficients of 4.78, and 9.43 respectively, significantly and positively affect the technical efficiency of the palm oil processors while education with coefficient -1.93 had negative significant effect . The result reveals an average technical efficiency of 91

percent revealing that the processors actually function with a level of inefficiency (9%). Moreover, the results reveal that the labour and palm fruit cost with coefficients 0.51 and, 0.33 respectively, significantly and positively affect the total cost of palm oil production. Family size and processing experience with coefficients of 0.60 and -0.15 respectively, affect the allocative efficiency which varied widely (1.02-1.99) among the processors. This suggests that a considerable palm oil production potential remains to be exploited through better use of available resources. The study, therefore, recommends that better access to labour, palm fruits and farm-specific efficiency factors, which include enhanced education will sustain the production of palm oil.

Adanguidi (2019) stated that as the independent Benin's first export crop, oil palm continues to play an important role in the Beninese economy and society despite the decline in its production that has begun since the 1970s. It is present in most cropping systems throughout southern Benin. The objective of this article is, on the one hand, to assess the level of technical efficiency of oil palm fruit processing units in South-East Benin and, on the other hand, to analyze the determinants of this technical efficiency. The so-called "two-step" method was used, which consists of using a Data Envelopment Analysis (DEA) model for the analysis of technical efficiency scores followed by a Tobit regression model to analyze the determinants of technical efficiency. The data used were collected in 2018 within the Adja-Ouèrè municipality. The results obtained show that the average technical efficiency score of the processing units is 0.891, which means that it is still possible to improve the production. The analysis of the determinants of technical efficiency showed that variables such as membership to an agricultural producer organization and the number of direct relatives involved in the processing activity improve the technical efficiency of oil palm fruit processing units.

2.5. Efficiency of Oil Palm-Making Constraints

Deforestation and Habitat Loss: The forest product utilization and oil palm plantations expansion has resulted to extensive deforestation in tropical regions, resulting in habitat loss and biodiversity decrease (Emaziye *et al*, 2022).

- Environmental Impact: Oil palm cultivation is associated with soil erosion, water pollution, and greenhouse gas emissions (Gaze, 2018).
- Social and Labour Issues: Labor rights violations, including poor working conditions and low wages, have been reported on some oil palm plantations (Barlow, 2013).
- Land Tenure and Conflict: Conflicts can arise over land rights and displacement of indigenous communities when palm oil plantations expand (Obidzinski, 2013).

2.6. Prospects associated with the efficiency of Oil Palm production include

- *Sustainable Certification and Practices:* The adoption of sustainable practices and certification schemes like RSPO (Roundtable on Sustainable Palm Oil) aims to reduce the social and environmental impacts of its production (Nwauwa, 2010)
- *Alternative Oil Sources:* Research into alternative oil sources, such as algae and other oilseed crops, could provide sustainable alternatives to palm oil (Chisti, 2017)
- *Technology and Yield Improvement*: Continued research into agronomic practices and genetic improvement of oil palm can help increase yields per unit area, reducing the need for further land expansion (Emaziye *et al,* 2022; Sadiq *et al,* 2013)
- *Restoration and Reforestation:* Efforts to restore and reforest areas affected by oil palm cultivation can help mitigate habitat loss and promote biodiversity conservation (Turner, 2015). In reforestation, the inclusion of some arable crops increase land use management and productivity (Ike and Emaziye, 2015).
- *Consumer Awareness and Demand for Sustainable Products:* Increased consumer awareness and demand for sustainable products can drive industry change towards more responsible palm oil production Gaze (2018)

The oil palm business faces significant challenges, but there are also opportunities for improvement through sustainable practices and technological advancements.

3. Conclusion

The result of this study shows that oil palm-making is profitable and that majority of the farmers still operate their production on a small scale. Before independence Oil palm played major role in Nigerian export business and will continue to grow and develop the economy of the country in recent day if adequately considered a major economy builder from the agricultural sector level, a huge employer of labour and a catalyst in the manufacturing industries development. Overall, the pathway of oil palm production in Nigeria from 1980 to 2023 reflects a dynamic industry

resulting by economic growth, environmental stability, and social compatibility. Efforts have been made to address sustainability concerns while striving to meet domestic and international demand for palm oil.

Recommendations

To enhance efficiency in the oil palm industry,

- Farmers ought to allocate greater resources to their production endeavors to align with the rising market demand and to enhance their profit margins.
- Recent graduates should pursue careers in the oil palm industry so as to heighten productivity and profitability, while also addressing the aging farming population.
- Government authorities should prioritize the timely provision of essential inputs and incentives to support oil palm farmers production efforts

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest is involved.

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