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Economic Drivers Influencing Oil Palm Farmers' Decision to Sell Fresh Fruit Bunches Instead of Processing in Kigoma District, Tanzania

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ABSTRACT

Palm oil processing plays a crucial role in driving economic growth, especially in regions where oil palm farming dominates agriculture. By converting raw materials into valuable products, palm oil processing supports local economic development, generates employment, and boosts trade competitiveness. In this context, the study sought to examine the economic drivers that influence oil palm farmers' decisions to sell or process Fresh Fruit Bunches (FFBs) in Kigoma, Tanzania. A cross-sectional survey design was employed in this study, whereby data were collected from 199 farmers in Simbo and Bitale wards through questionnaires and interviews with a guide. A combination of purposive and simple random sampling techniques was used to select respondents. Descriptive statistics (frequencies and percentages) described the socio-demographic characteristics of respondents, while the binary probit model examined economic drivers influencing the choice to sell FFBS versus processing them. The findings revealed that factors such as high processing costs, limited credit access, household income, larger farm sizes, production volumes, and labour availability influence bulk sales. The study recommends enhancing access to processing technologies, financial literacy initiatives, and targeted subsidies to encourage value addition.

1. Introduction

Palm oil is a crucial commodity in the global agricultural sector, widely used in the food, biofuels, and cosmetics industries. The global palm oil production reached approximately 78 million metric tons in 2023, with Malaysia and Indonesia dominating exports (Voora et al., 2023). The palm oil industry significantly contributes to the livelihoods of around 17 million people worldwide, supporting economic development through employment and foreign exchange earnings (Alamsyah et al., 2023; United Nations University, 2024). However, despite its economic importance, palm oil production faces challenges such as environmental concerns, deforestation, and inefficiencies in processing techniques (Corley and Tinker, 2016; Andrea and Michili, 2023; Ayompe et al., 2023).

Palm oil production remains crucial for food security and economic sustainability in Africa. Nigeria leads in African palm oil production, contributing approximately 2% of the global supply, with a production volume of 1.5 million metric tons in the 2023/2024 season (World Economic Forum, 2022). However, Africa is a net importer of palm oil, consuming 15% of global production while importing nearly 8 million metric tons annually. Efforts to boost production in Sub-Saharan Africa have been ongoing, as the region is considered a prime area for palm oil expansion due to available land and government initiatives (Ayompe et al., 2023). Nonetheless, palm oil processing in Africa remains constrained by inadequate infrastructure, a lack of modern technology, and high operational costs (Ayompe, Boso, and Osei, 2024). East Africa has witnessed a growing interest in palm oil production, with efforts being made to enhance processing efficiency and reduce dependency on imports. Tanzania is one of the few countries in the region actively promoting palm oil cultivation. The government has increased tariffs on imported palm oil to protect local industries and has encouraged smallholder farmers to adopt improved oil palm varieties and modern processing techniques (TARI, 2023). However, despite these efforts, challenges such as inefficient processing techniques,

inadequate market access, and limited financial support continue to affect the productivity and profitability of palm oil farmers (Mhando et al., 2020).

In Tanzania, the Kigoma region is the leading palm oil producer, accounting for approximately 61.4% of national production, followed by Mbeya and Pwani (UNIDO, 2019). Oil palm cultivation in Kigoma dates back to the early 1920s, with over 30,000 smallholder farmers engaged in the sector (USAID, 2019). However, the region still relies on imports, with the country bringing in approximately 500,000 tons of palm oil annually (Andrea and Micheli, 2023). The Tanzanian government has attempted to boost local production by supplying high-yielding TENERA palm seeds and supporting small-scale processors with simple processing equipment (TARI, 2023; Prime Minister's Office, 2023). Despite these efforts by the government, over 60% of farmers sell their fresh fruit bunches (FFBs) instead of processing them into crude palm oil (URT, 2022). Farmers who sell FFBs experience lower profit margins, missing potential income from value-added products. Multiple factors influence the decision to either process FFBs or sell them directly, yet little research has been conducted to understand these determinants.

The rational choice theory guides the study, which serves as a key framework for understanding decision-making among oil palm farmers. This theory suggests that individuals make economic decisions by weighing the costs and benefits of available options to maximize their utility (Dorfman, 2022). Rational choice theory has been widely applied in the agricultural sector to analyze how farmers choose between different farming practices. Rizal et al. (2021) found that smallholder farmers in Malaysia opt for palm oil certification due to its financial benefits, while Kabii and Horwitz (2006) emphasized the role of economic incentives in farmers' adherence to sustainable agricultural practices. In Tanzania, oil palm farmers in Kigoma must decide between selling fresh fruit bunches (FFBs) or processing them into palm oil, a choice influenced by financial constraints, market access, and technological availability (Mhando et al., 2020). Schwarze et al. (2015) highlighted how policy interventions, labour availability, and investment costs shape farmers' choices in oil palm production. Various studies have been conducted on what influences farmers' choices between selling and processing their harvests. For example, Adah et al. (2022) demonstrated that access to credit, awareness of processing technologies, and education levels positively influenced farmers' likelihood of adopting improved processing methods. Economic factors such as price volatility, farm size, and profitability concerns also play a crucial role. Xin (2021) found that fluctuating market prices discourage farmers from processing FFBs, as immediate sales offer financial security. Technological factors further compound this issue, as limited access to high-yielding oil palm varieties and modern processing equipment constrains farmers' ability to add value (Mwatawala et al., 2022). Similarly, Andrea and Mishili (2023) found that Tanzanian smallholders often sell FFBs instead of processing them due to inadequate infrastructure and financial constraints. Murphy et al. (2021) noted that in West Africa, limited access to modern processing technologies and weak government support hinder smallholder farmers from engaging in value-added activities. Furthermore, Ogahara et al. (2022) criticized smallholder certification programs, arguing that they do not necessarily lead to sustainable processing practices.

Although several studies on oil palm production have been conducted, including those by Khoza et al. (2019), Yeseen et al. (2023), Xin (2021), and UNIDO (2019), most of these studies were carried out in different countries and not in Kigoma, which is the leading region in palm production in Tanzania. Therefore, this study aimed to address the gap by providing insights into the factors that influence farmers' choices and recommending policy measures to enhance the economic factors that can boost the palm oil industry in Kigoma. The study's findings contribute to policymakers by enabling the development of policies to promote economic stability and growth within the palm oil sector, especially through value addition. It provides evidence-based recommendations for improving access to financial services, infrastructure, and technological support for palm oil processing for farmers. Likewise, the study highlights factors hindering processing, allowing policymakers to strategise on interventions that encourage value addition. Additionally, the findings guide stakeholders in implementing programmes to support farmers with resources such as training, loans, or access to processing facilities. The findings lay a foundation for further research on palm oil processing in regions within Tanzania and beyond.

2. Material and Methods

This study was conducted in Kigoma District, within the Kigoma Region, with a specific focus on Simbo and Bitale wards, which have the highest concentration of oil palm farmers in the district (NBS, 2022). A cross-sectional survey design was adopted, incorporating both qualitative and quantitative approaches to examine the factors influencing farmers' decisions regarding palm oil production (Kothari, 2004). Data were collected from both primary and secondary sources. Primary data were gathered through observations, surveys, interviews, and focus group discussions with farmers, while secondary data were sourced from literature and official reports. The sampling frame comprised 8,774 smallholder oil palm farmers, with a sample size 199 determined using Yamane's (1967) formula.

The study used purposive and simple random sampling methods to select respondents, ensuring adequate representation. Purposive sampling was applied to select Simbo and Bitale wards and key informants, such as agricultural officers and processing farmers. In contrast, simple random sampling was used to select individual farmers. Data processing involved error detection, classification, and coding before being analysed using IBM SPSS version 26. Findings are presented through text and tables to provide a clear and structured interpretation of the results.

The study employed descriptive and inferential statistics to analyse the data. Descriptive statistics (frequencies and percentages) were used to summarize socio-demographic characteristics, while inferential statistics (binary probit model) were employed to identify the economic determinants of farmers' decisions. The binary probit model was an appropriate statistical method to estimate the probability of a farmer choosing to sell Fresh Fruit Bunches (FFBs) rather than process them, as the dependent variable is binary (sell vs. process). This model is statistically appropriate for estimating relationships where the dependent variable is categorical (Hosmer et al., 2013; Menard, 2002). Unlike linear regression, logistic regression, particularly binary logistic, ensures that predicted probabilities remain between 0 and 1, making it statistically sound for categorical decision-making (Gujarati and Porter, 2009). Furthermore, logistic regression does not assume a linear relationship between independent variables and the dependent variable, making it suitable for analyzing factors with non-linear influences on farmers' decision-making (Peng et al., 2002).

The model is presented in the following equation:

$Y_i = \beta X_i + \mu_i$ 1

Where by:

Y_i = 1 if a farmer sells FFB,

Y_i =0, if a farmer processed

μ_i = Error term

Equation one represents a model with a binary choice (binary probit model) involving an estimation of the probability of a farmer sells FFB (Y_i) given a set of factors (X_i) which are independent variables

The mathematical representation of the model is represented below;

$P(Y_i = 1) = F(\beta_i X_i)$ 2

$P(Y_i = 0) = 1 - F(\beta_i X_i)$ 3

Whereby;

Y_i = Is the observed response of i^{th} a farmer sells FFBs or not

Y_i =1, if a farmer sells FFB,

Y_i =0, if a farmer processed

Table 1: Description of the explanatory variables

Variable	Description	Expected Sign
Sell_FFB	Dependent variable: 1 if farmer sells FFB, 0 if processes	N/A
Age Years	Continuous variable representing the age of the farmer in years	+ve
Gender	Dummy variable: 1 = Male, 0 = Female	+ve
Edu Level	Dummy variable: 1 = Formal education, 0 = No formal education	+ve
Marital Status	Dummy variable: 1 = Married, 0 = Otherwise	+ve
Household Head	Dummy variable: 1 = Yes, 0 = No	+ve
Production_Size_KG	Continuous variable representing total production size in kilograms	+ve
Household_Income_Tzs	Continuous variable representing total household income in Tzs	+ve
Access Loans	Dummy variable: 1 = Yes, 0 = No	+ve
Processing_Cost_Tzs	Continuous variable representing costs of processing FFB in Tzs	-ve
Farm_Size_HA	Continuous variable representing farm size in hectares	+ve
Labour_Availability	Dummy variable: 1 = Yes, 0 = No	+ve

3. Results

3.1. Characteristics of the Respondents

Table 2 presents the demographic characteristics of the respondents. The ages of the respondents indicate that the majority (49.7%) were between 26 and 45 years old, followed by 43.7% who were aged between 46 and 65, with the remaining respondents being under 26 or over 65. In terms of sex, it was revealed that 71.9% were male, whereas 28.1% were female, suggesting a male dominance in oil palm farming. Additionally, the study findings indicate that the respondents' education levels are moderate, with most having completed primary school (39.2%) or secondary school (38.7%). By comparison, only 16.1% had received a college or university education. The study also reveals that 85.9% of respondents were married, suggesting that family labour plays a significant role in oil palm farming, as supported by IFAD (2016), which highlights the impact of household composition on farm productivity. Regarding occupation, 46.2% of respondents had no other economic activity aside from farming. In contrast, 53.8% were farmers and either employed or self-employed, indicating that oil palm farming is not the primary source of livelihood for many households.

The study reveals that the majority of farmers operate small-scale farms, with 75.9% of respondents cultivating FFBs on plots ranging from 1 to 3 acres, indicating a high prevalence of smallholder farming. A smaller proportion, 18.6% of respondents, own medium-sized farms of 4 to 6 acres. Only a few farmers operate on larger plots, with 4% of respondents farming on 7 to 9 acres and just 1.5% on 10 to 12 acres. In addition, a significant majority of respondents (68.3%) reported having only 1 to 2 members engaged in palm production, indicating reliance on limited family labour. Another 30.2% have 3 to 4 members participating, while only 1.5% reported 5 to 6 members involved. This finding suggests that palm production in the area is generally a low-labour activity within households, potentially reflecting the small scale of operations and limited capacity for expansion or labour-intensive practices. Regarding FFBs produced, the study found that 69.8% of respondents produce 601 kilograms or more of FFBs per year, suggesting a strong production capacity among most farmers, followed by 13.1% who produce between 201 and 400 kg, 9% who produce between 401 and 600 kg, and only 8% report producing 0–200 kg annually. The findings reflect differences in farm size, farming practices, or access to resources such as improved seedlings, inputs, or extension services.

Table 2: Demographic characteristics of the respondents

Variables	Categories	Frequency (n=199)	Percent
	18- 26	1	0.01
Age of respondents	26–45	99	49.7
	46–60	87	43.7
	Above 65	12	6
Gender	Female	56	28.1
	Male	143	71.9
Education level	Informal education	12	6
	Primary school	78	39.5
	Secondary school	77	38.7
	College/university	32	16.1
Marital status	Married	171	85.9
	Separated	3	1.5
	Single	13	6.5
	Widow	12	6
Occupation	Farmer and Employed	26	13.1

Variables	Categories	Frequency (n=199)	Percent
	Farmer only	92	46.2
	Farmer and Self-employed	81	40.7
Farm size	1-3 acres	151	75.9
	4 - 6 acres	37	18.6
	7 - 9 acres	8	4
	10 - 12 acres	3	1.5
Household members involved in palm production	1 – 2	136	68.3
	3 – 4	60	30.2
	5 – 6	3	1.5
FFBs produced annually (Kg)	0-200	16	8
	201-400	26	13.1
	401-600	18	9
	601 and above	139	69.8

3.2. Economic Drivers Influencing Oil Palm Farmers to Sell FFBs Instead of Processing

Table 4 highlights the economic drivers that influence oil palm farmers to sell FFBs instead of processing them in the study area, such as production size, farming experience, farm size, access to credit, household income, processing cost and labour availability. The following are economic drivers that influence oil palm farmers to sell FFBs instead of processing them.

Production size

Results indicate that production size had a significant positive influence at a one percent level (β=0.002, *p*=0.012) for a farmer to sell fresh fruit bunches (FFB) instead of processing. The results highlight that for every unit increase in production, the likelihood of selling FFB slightly increases with an odd ratio of 1.002. This finding suggests that farmers producing larger quantities prefer selling FFB rather than processing due to potential limitations in processing capacity.

Household income

Results indicate that household income had a significant positive influence at a one percent level (β=0.0001, *p*=0.018) for a farmer to sell fresh fruit bunches (FFB) instead of processing. This highlights that for every unit, an increase in household income increases the likelihood of selling FFB rather than processing, with an odd ratio of 1.000, implying that wealthier farmers may focus on quick sales rather than investing in processing facilities. Table 3 shows that the estimated mean income of households is TZS 241,977.39, while the most frequent income by households is TZS 200,000, indicating that most households earn this amount monthly. The standard deviation is TZS 267,991.61, which is relatively high, indicating considerable income differences among farmers. This finding is further supported by the wide income range from a minimum of TZS 60,000 to a maximum of TZS 2,500,000. The findings show that while some palm oil farmers operate at a subsistence level, others are generating considerably higher incomes. The reasons may be due to differences in production scale, market access, farm size and processing.

Table 3: Statistics of household income per month (Tshs)

Statistic	Value (TZS)
Mean	241,977
Mode	200,000
Std. Deviation	267,992
Range	2,440,000
Minimum	60,000
Maximum	2,500,000

Access to loans

Table 3 results indicate that access to a loan had a significant positive influence at a five percent level

(β=0.678, *p*=0.035) for a farmer to sell fresh fruit bunches (FFB) instead of processing. Farmers with access to loans are nearly twice as likely (OR = 1.970) to sell FFB instead of processing. While loans typically support agricultural activities, their utilisation in expanding production rather than processing indicates a gap in financial products designed for value addition.

Processing costs

Results indicate that processing costs significantly positively influenced at a one percent level (β= -0.0002, *p*=0.004) for a farmer to sell fresh fruit bunches (FFB) instead of processing. Processing costs negatively influence the likelihood of processing palm oil, with an odds ratio below one (OR=0.999), indicating that higher processing costs discourage farmers from engaging in value addition. Higher processing costs discourage farmers from engaging in processing, as they reduce the profitability of value addition. This aligns with studies by Quisumbing et al. (2014), which show that high input costs are a major barrier to adopting new agricultural practices. Reducing processing costs through subsidies, technological innovations, or cooperative models could make processing more attractive to farmers.

Labour availability

Results indicate that labour availability had a significant positive influence at a five percent level (β=0.789, p=0.022) for a farmer to sell fresh fruit bunches (FFB) instead of processin. The results highlight that labour availability significantly influences the decision to sell FFB, with an odds ratio of 2.201, meaning farmers with sufficient labour are more than twice as likely to sell FFB instead of processing. These findings could indicate that available labour is directed toward increasing production rather than processing.

Farm size

Results indicate that farm size had a significant positive influence at a one percent level (β=0.456, *p*=0.016) for a farmer to sell fresh fruit bunches (FFB) instead of processing. The results highlight that farmers with larger landholdings are 1.578 times more likely to sell FFB than those with smaller farms. This suggests that larger-scale producers may focus on bulk production rather than processing, possibly due to labour constraints or market demand.

Table 4: Logistic regression analysis results

Variable	Coefficient (β)	Standard Error	p-value	Odds Ratio (Exp (β))	95% Confidence Interval
Intercept (α)	-2.345	0.567	0.000	0.096	[0.032, 0.287]
Production_Size_KG	0.002	0.001	0.012*	1.002	[1.000, 1.004]
Household_Income_Tzs	0.0001	0.000	0.018*	1.000	[1.000, 1.000]
Access Loans	0.678	0.321	0.035*	1.970	[1.050, 3.698]
Processing_Cost_Tzs	-0.0002	0.000	0.004**	0.999	[0.999, 1.000]
Farm_Size_HA	0.456	0.189	0.016*	1.578	[1.089, 2.287]
Labor_Availability	0.789	0.345	0.022*	2.201	[1.120, 4.325]

** Significance at 1% level, * Significance at 5% level

Furthermore, the cross-tabulation data highlights the relationship between the number of household members involved in oil palm production and the size of their oil palm farms. Table 5 indicates that as farm size increases, there is a slight upward trend in the number of household members involved. For example, among those farming on 4 to 6 acres, households with 3 or 4 members are more common. Notably, farms larger than 6 acres (i.e., 7–10 and 10–12 acres) are uncommon, with only 9 respondents reporting ownership of such land sizes. The findings suggest that oil palm farming in the study area is primarily small-scale and family-run, with limited expansion into larger enterprises.

Table 5: Cross-Tabulation between Farm Size and Household Participation

		Size of oil palm farm (Acres)				
		1-3	**4-6**	**7-10**	**10-12**	**Total**
Number of household members involved in palm production	1	39	2	0	0	41
	2	82	13	0	0	95
	3	25	17	4	1	48
	4	2	5	2	2	12
	5	2	0	0	0	2
	6	0	1	0	0	1
Total		**150**	**38**	**6**	**3**	**199**

Key informant interviews with agricultural officers revealed that farmers and processors have expressed concerns about outdated and inefficient technology in palm oil processing. This technology is inadequate for producing high-quality and sufficient quantities of oil, which leads to farmers lacking reliable markets. As a result, many farmers sell FFB to secure assured markets. This assumption was supported during the key informant interview with palm oil processors, who confirmed the same and insisted that when they have access to reliable and effective machinery, many farmers might be encouraged to process their oil instead of selling FFB.

4. Discussion of results

The study shows varying results regarding the socio-demographic characteristics of the respondents, including their age, sex, education level, marital status, and occupation. The age of the respondents aligns with FAO (2017), which states that middle-aged farmers are more engaged in agricultural activities due to their physical capability and economic responsibilities. The findings concerning the sex of the respondents were consistent with those by Doss (2018), highlighting that men often have better access to land and financial resources, leading to greater involvement in cash crop farming. Furthermore, Haug et al. (2021) and Mgalamadzi (2024) argue that in African societies, traditional gender roles assign men the responsibility for financial decision-making and transactions related to agriculture, rooted in patriarchal systems that limit women's autonomy in economic activities. As such, men are more likely to engage in market activities, while women are often confined to subsistence farming. The study found that most farmers had other economic activities, such as employment or self-employment, which is inconsistent with the study conducted by FAO (2020), noting that smallholder farmers rely on cash crops for income and food security. Trentinaglia et al. (2023) reveal that alternative economic activities among farmers are crucial for sustainable rural development, as these activities supplement income for farmers with small farm sizes and those experiencing limited production and markets.

In addition, the demographic characteristics of oil palm farmers, such as age, sex and education in this study, are closely aligned with findings from the National Bureau of Statistics (NBS) in Tanzania. According to the NBS Agricultural Sample Census (2019/2020), the majority of the agricultural labour force falls within the economically active age group of 25 to 64 years, consistent with this study, where 93.4% of respondents were aged between 26 and 65 (NBS, 2024). This finding indicates that oil palm farming in Kigoma is largely undertaken by individuals in their productive years, reflecting national patterns of rural labour participation. Additionally, the male dominance (71.9%) in oil palm farming observed in the study corresponds with national statistics that show men are more likely to own or control land and agricultural inputs, especially for commercial or cash crops like oil palm. With respect to education, the study's findings also reflect broader national trends. The NBS Household Budget Survey (HBS) 2017/18 reported that a large portion of Tanzania's rural adult population has only completed primary education, which aligns with this study's result where 39.2% of respondents had primary education and 38.7% had secondary education, with relatively few (16.1%) attaining tertiary education. This moderate level of education may influence farmers' ability to access information on improved agricultural practices or processing technologies, thereby affecting productivity.

The economic drivers that influence oil palm farmers to sell FFBs instead of processing them in the study area include production size, farm size, access to credit, household income, processing cost, and labour availability. Other studies support these findings on production siz; according to Quisumbing *et al.* (2014), smallholder farmers often lack the financial and technical capacity to handle large-scale processing, leading them to sell raw products instead. Household income aligns with the argument by IFAD (2016), which suggests that higher-income farmers often diversify their income streams and may not see processing as a necessary investment. Access to loans is linked with FAO (2020), which highlights that credit facilities for smallholder farmers often prioritize production expansion rather than investment in processing equipment and technology. Processing costs were revealed by the IFAD (2016), which states that the high cost of processing equipment, labour, and maintenance is a significant barrier for small-scale farmers in developing countries. Reducing these costs through subsidies or cooperative processing facilities could encourage more farmers to add value. Farm size was supported by Doss (2018) that farmers with extensive landholdings often prioritize maximizing production efficiency over investing in processing infrastructure. Lastly, labour availability FAO (2020) emphasizes that in many rural settings, labour is often allocated to core farming activities rather than post-harvest processing due to economic and logistical constraints. However, labour availability may be influenced by social or cultural contexts, even though they have economic effects (Ringhofer et al., 2014; Marewo, 2023).

The findings of this study support the rational choice theory, which posits that individuals make decisions based on maximizing utility within resource constraints. The significant positive influence of drivers such as production size, access to loans, household income, farm size and labour availability on the likelihood of selling FFB rather than processing indicates that farmers are making economically rational decisions. Wealthier households and larger producers may perceive selling FFB as offering faster, less risky returns compared to processing. Access to loans appears to facilitate expansion in production rather than investment in value addition, reflecting a rational allocation of financial resources toward activities with more immediate returns. Similarly, the negative influence of high processing costs supports the notion that farmers ignore processing when input costs reduce profitability. Labour availability further reinforces the focus on primary production over processing, suggesting that available human capital is optimally allocated where marginal returns are highest. Collectively, these decisions reflect farmers' rational evaluations of cost, benefit, and risk in a situation where structural and financial constraints shape value chain participation.

5. Conclusions

Oil palm farmers in Kigoma District decide to sell Fresh Fruit Bundles (FFBs) instead of processing them, driven by various interconnected economic drivers. Financial constraints, including limited household income and restricted access to formal credit, hinder farmers' ability to invest in value-added processing activities. High processing costs and the availability of labor further exacerbate the challenge, particularly for smallholder farmers. Larger farm sizes and increased production volumes incentivise bulk sales due to economies of scale. To address these issues, the study recommends that the Kigoma District Council, as well as non-governmental organisations, promote value addition by investing in local processing facilities and providing affordable tools and technologies tailored for smallholder farmers. Establishing training programs aimed at improving farmers' knowledge of oil palm processing techniques, pricing strategies, and market trends will enhance their decision-making capabilities and business profitability. Lastly, private sector involvement in investing in processing facilities is recommended. These measures can foster sustainable development within the palm oil sector, contributing to farmers' economic empowerment and the industry's overall growth in the country.

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