

Gender-based production and income gaps: Empirical evidence from oil palm farmers in Ondo State, Nigeria

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Abstract

Background

Oil palm is a productive and profitable tropical crop that produces palm oil. Oil palm and its products have economic potential to improve farmers' incomes and livelihoods. Empirical data on current oil palm fruit output, palm oil production, and income along the gender line are scarce. Hence, this study provides an empirical overview of production quantity and income among oil palm farmers in Ondo State, Nigeria.

Methods

Quantitative data were collected using a questionnaire from 180 oil palm farmers randomly sampled across oil palm-producing local government areas (3) and communities (6). Quantities of oil palm fruits and palm oil produced were collected for the years 2024 (January-December) and 2025 (January-October). Data were analysed using means, frequencies, percentages and t-tests. More males than females engaged in oil palm production, and not all oil palm farmers produce palm oil, whether male or female.

Results

The quantity of oil palm fruits harvested ranges from 360 to 8200 bunches in 2024 and the same in 2025. The average quantity of oil palm fruits harvested in 2024 and 2025 was $2,692.33 \pm 1,694.98$ and $2,624.00 \pm 1,658.84$ bunches, respectively. The average quantity of palm oil produced in 2024 and 2025 was $3,767.98 \pm 1,904.00$ and $3,113.10 \pm 1,489.51$ litres, respectively. The t-test analysis shows no significant difference in oil palm production between males and females for both years. Males significantly produced more palm oil than females in 2024 and 2025. Females significantly realised more income from the sales of oil palm fruits than males in 2024. In 2025, there was no significant difference in sales of oil palm fruit between males and females. Income from palm oil sold in 2024 did not significantly differ between males and females. But males significantly realised more income from palm oil sales than females in 2025.

Conclusions

Though more males than females engaged in oil palm production, oil palm production cannot be said to be gender-specific. Both genders produced oil palm fruits and processed these fruits into palm oil for public consumption. Interventions targeted at oil palm farmers should favour both genders. More importantly, women and youth should be encouraged to go into oil palm farming.

Introduction

Agriculture continues to matter for economic stability in agrarian societies. Farming activities extend beyond crop production; they also support processing, transport, storage, and small trading businesses. These activities provide additional income opportunities for rural households. Agriculture also helps reduce reliance on food imports and cushions the effects of global price shocks [1]. After 2020, many governments and donors increased their spending on agriculture because it proved important for recovery and resilience [2]. Where such support is sustained, rural incomes tend to rise gradually, and local economies become more secure. These gains also strengthen food value chains and domestic supply. Crops such as oil palm have economic potential to improve farmers' incomes, irrespective of gender. Oil palm, botanically named *Elaeis guineensis*, is a tropical tree crop largely cultivated for the production of vegetable oil. It is a perennial tree crop cultivated by farmers in different countries of the world, including Nigeria. The oil palm can live for up to 200 years; however, its commercial yield decreases greatly after 30 years of age [3]. The declining yield owing to the ageing of trees implies a reduction in the quantity of palm oil produced by the palm tree. Palm oil is the most traded vegetable oil in the world [4]. The global increase in the demand for palm oil is driven by the rise in the human population and the potential of the oil palm crop for biofuel purposes [5]. So, it is expedient for oil palm farmers to maximise their production of oil palm and palm oil for enhanced income.

Nigeria is one of the world's leading producers of palm oil, and its palm oil production has consistently increased from 2014 to 2023 [6]. Palm oil is the oil extracted from oil palm fruits after processing. Compared to other oil-producing crops in Nigeria, oil palm produces more oil per hectare [5, 7]. Palm oil is notable for its wide domestic consumption in Nigeria. According to a report by Price Waterhouse Coopers (PWC), Nigeria is the largest consumer of palm oil in Africa [8]. Palm oil is an important ingredient of most diets in Nigerian homes. In the 2021/2022 crop year, about 1.8 million metric tons of palm oil were expected to be consumed in Nigeria [6]. The different parts of the oil palm crop have economic importance. Aside from the palm oil extracted from the fruits, palm kernel oil and palm kernel cake are economically significant products obtained from the oil palm fruits. Palm oil production in Nigeria transcends domestic consumption, as palm oil is used for industrial purposes such as the manufacturing of soaps and detergents.

In addition, research has shown that oil palm is the most productive and profitable tropical crop essential for biofuel production [9]. The palm oil milling industry offers strong prospects for oil palm profitability and growth in Nigeria [10]. Oil palm farmers remain central to the domestic edible oil supply and agro-processing activities. Globally, palm oil production reached about 76.09 million metric tons in 2023/2024, confirming its dominance among vegetable oils [11]. In Nigeria, output was estimated at 1.5 million metric tons in 2023/2024, with growth linked to an expanded harvested area and increased private investment [12]. At the community level, however, little information exists on how production is shared between men and women working under similar conditions. Gender-disaggregated data remain scarce. This limits understanding of who contributes most to output and who benefits from sector growth. It also makes it harder to assess whether production growth leads to shared economic gains.

Studies engendering oil palm fruit bunch output, palm oil processing output and income are scarce. Therefore, this study provides empirical data on oil palm fruit yield, quantity of palm oil produced and income for the years 2024 and 2025 along the gender line. The outcomes of this study are poised to inform stakeholders, development practitioners, and policymakers about the gender dynamics in oil palm production. This will help to maximise the full potential of oil palm production, contribute to sustainable development goals and improve the livelihoods of oil palm farmers. The study hypothesised that males and females significantly differed in their oil palm fruit output, palm oil output, income from oil palm fruit sales and income from palm oil sales. Also, the study hypothesised that production quantity does not significantly relate to income among males and females.

Methods

Study area

The study was conducted in Ondo State, Southwest Nigeria. Ondo State, nicknamed the 'sunshine state', is the 19th most populous state in Nigeria with an estimated population of about 5.3 million (2022 estimate), a GDP of \$12 billion (2022 estimate) and an approximate land area of 15,500 km² [13, 14]. Ondo State lies between latitudes 5°45" and 8° 15" North of the Equator, and longitudes 4°30" and 6° East of the Greenwich Meridian [15]. The state is dominated by the Yoruba ethnic group, with an Ijaw ethnic minority in the coastal southern parts. The state is largely engaged in agriculture, especially in the rural areas. Predominant crops grown include oil palm, rubber, cocoa, plantain, banana, walnut, oranges, maize, cassava, yam, cocoyam, and timber, among others. Agriculture serves as the pillar of the State's economy, and it provides a livelihood for most inhabitants of the State. Oil palm plantations are largely found in the southern and south-central local government areas of the state. These areas in Ondo State feature major oil palm estates and operations.

Research aims and design

The study garnered empirical data on the gender dimensions of current oil palm fruit output, palm oil quantity and income among farmers. The cross-sectional research design was used in this study. Data were collected once from oil palm farmers with the aid of a questionnaire. The questionnaire was most suitable for collecting quantitative data on fresh oil palm fruit output, palm oil output and income for easy computation and inferences.

Sampling procedure and sample size

The population of the study consists of oil palm farmers in Ondo State, Nigeria. Ondo State is a major oil palm producing hub in Nigeria. A three-stage sampling procedure was employed for this study. In the first stage, three (3) oil palm farming local government areas (LGAs) were purposively selected, being notable for their increasing oil palm cultivation and abundance of oil palm trees. The selected LGAs were Irele, Ese-Odo and Okitipupa LGAs. In the second stage, two (2) oil palm farming communities notable for oil palm cultivation were purposively selected from each LGA, making a total of six communities. From each community, thirty (30) oil palm farmers were selected, making a total of 180 oil palm farmers sampled for this study. Equal sample size across communities reduces bias and prevents a particular community from dominating the results. To ensure high response rates and data precision, farmers were visited to obtain their responses using a questionnaire. Personal visits to farmers are a built-in quality control check during data collection, ensuring the genuineness of responses from active farmers in the oil palm economy of the selected LGAs in Ondo State, Nigeria. The questionnaire was divided into sections based on the objectives of the study. The questionnaire captures the volume of production and economic returns of male and female oil palm farmers in the study area.

Measurement of variables

The study was carried out in November 2025. The quantity of production was determined for 2024 (January - December) and 2025 (January - October). The quantity of oil palm fruits produced was measured in bunches, as oil palm fruits are usually harvested in bunches. The study collected data on the number of bunches harvested, sold, given out and consumed for each oil palm farmer. The quantity of palm oil produced by farmers was first recorded in kegs during data collection, as this was the unit used by local oil palm farmers for palm oil sales. One keg of palm oil is equivalent to 25 litres. For this study's report, the quantity of palm oil produced, sold, given out and consumed was computed in litres. The number of kegs produced by each oil palm farmer was multiplied by 25 litres to obtain the total quantity of palm oil in litres. The quantity of palm oil produced, sold, given out and consumed was determined for each farmer who processed their oil palm fruits into palm oil. Gender, as used in this study, referred to male and female, which are the recognised binary genders in Nigeria. Hence, results were disaggregated by gender for reporting. Results were also reported as a whole for both males and females. Oil palm is a tropical tree crop from which palm oil is produced. Oil palm farmers are those who engage in oil palm tree cultivation. Oil palm production is the production of oil palm fruits, usually harvested in bunches from the oil palm tree. Palm oil production is the production of palm oil from the oil palm fruits after processing. Palm oil is the oil extracted from the oil palm fruits after processing. Oil palm fruits are the fruits produced by the oil palm tree, which are usually in bunches. The quantity of oil palm fruits is also referred to as the quantity of harvested bunches. The quantity of oil palm fruits produced refers to the total quantity of harvested bunches. The quantity of oil palm fruits sold refers to the total quantity of harvested bunches sold by oil palm farmers (some oil palm farmers do not sell their harvested bunches). The quantity of palm oil produced refers to the total quantity of palm oil after processing the oil palm fruits. The quantity of palm oil sold refers to the total quantity of palm oil sold out of the total quantity of palm oil produced. Invariably, the sum of the quantities sold, given out and consumed equals the total quantity produced.

Data analysis

Data were analysed with the aid of Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistical tools used to summarise the results of the study were frequencies, percentages, mean scores, standard deviation, minimum values and maximum values. Frequencies and percentages were used to summarise production and income categories of oil palm farmers. Mean scores, standard deviation, minimum values and maximum values give an overview of the average and range of production and income for both genders. The inferential statistical tool used was t-test. The study's hypotheses were tested using an independent-samples t-test. The independent-samples t-test is used to compare two group means, usually unrelated groups [16, 17]. The independent-samples t-test was most suitable in this study because males and females are two unrelated and unmatched groups. Males and females were adjudged significantly different when the p-value (sig. 2-tailed) is significant at 5% level of significance ($p \leq 0.05$), otherwise, there is no significant difference. This level of significance (α) assists in determining the point at which the null hypothesis is rejected or accepted [18]. A significant difference between the two years reported in this study was not tested because data were not gathered for November and December 2025 production. Moreover, the focus of the study was on gender disparities.

Results

Oil palm fruit production and income realised in 2024 by gender

As shown in Table 1, oil palm fruits harvested by most males (35.4%) fall within the 3001–4500 bunches range, while most females (43.3%) are within the range of 1500–3000 bunches. More females sell oil palm fruits < 1500 bunches (22.4%) and between 1500–3000 bunches (26.9%) compared to males (< 1500–15.0%; 1500–3000–25.7%). More females (9.0%) than males (0.9%) produce and sell oil palm fruits above 6000 bunches. As shown in Table 1, a large proportion of male and female oil palm farmers realised less than or equal to ₦11,000,000.00 annually from oil palm fruit sales, with more females (59.3%) concentrated in this category than males (38.0%). Only a few males (15.0%) and females (14.9%) appear in the highest income category above ₦11,000,000.00. From the results in Table 2, the average oil palm fruits harvested was slightly higher for females (2738.21 ± 2029.77) than for males (2665.13 ± 1470.29), but the wider standard deviation shows more variability. Females' oil palm fruit production ranges from 480 to 8200 bunches, compared to 360 to 8200 for males, again pointing to a broader spread. The same trend appears in sales of bunches, where females (2796.74 ± 2464.77) show more variation than males (2247.67 ± 1291.69). In terms of average annual income from fresh fruit bunches sold, females record a higher income (₦11,201,627.90 $\pm$ 9,864,054.01) compared to males (₦7,967,000.00 $\pm$ 5,835,274.18), reinforcing the idea of mixed performance within each gender income group. All female farmers (64.2%) who sell their oil palm fruits sell one (1) harvested bunch of oil palm fruits at a rate $\geq$ ₦4,000, while male farmers sell one (1) harvested bunch at $\geq$ ₦4,000 (38.9%) and < ₦4,000 (14.2%) rates. The average price per one harvested bunch sold was higher for females (₦4004.65 $\pm$ 21.31) compared to males (₦3624.55 $\pm$ 1542.53).

Oil palm fruit production and income realised in 2024 overall

As shown in Table 1, the largest proportion of oil palm farmers harvested oil palm fruits between 1500 and 3000 bunches (35.0%), while 27.8% harvested below 1500 bunches and 27.8% harvested between 3001 and 4500 bunches. Only a small proportion produced at very high levels, with 5.6% harvesting between 4501 and 6000 bunches and just 3.9% harvesting above 6000 bunches. Among those who sold fresh oil palm fruit bunches, the highest proportion sold between 1500 and 3000 bunches (26.1%), followed by those who sold below 1500 bunches (17.8%). Very few oil palm farmers sold beyond 4500 bunches, and only 3.9% sold above 6000 bunches. More oil palm farmers (25.6%) earned between ₦1,000,000–6,000,000, 16.7% earned between ₦6,000,001–11,000,000, while 15.0% earned above ₦11,000,000 from the sales of oil palm fruit bunches annually. The descriptive statistics in Table 2 show that, on average, oil palm farmers harvested 2692.33 ± 1694.98 bunches of oil palm fruits and sold an average of 2476.89 ± 1881.66 bunches in 2024. The quantity of oil palm fruits produced and sold ranges from 360 to 8200 bunches. The annual income from the quantity of oil palm fruits sold was ₦9,317,378.64 $\pm$ ₦7,894,919.56, with the income ranging from ₦1,440,000.00 to ₦32,800,000.00.

Palm oil production and income realised in 2024 by gender

The distribution of oil palm farmers based on their palm oil production and sales is shown in Table 1. For both the quantity of palm oil produced and sold, results show that males are more present in the 4001–6000 litres (28.3%) and 2000–4000 litres (27.4%) categories, while more females are concentrated within the 2000–4000 litres (40.3%) category. More male farmers consumed between 50–75 litres (21.2%) of palm oil annually, while more female farmers consumed between 76–100 litres (26.9%) annually. Few male farmers gave out between 25–60 litres (8.8%), likewise females (6.0%). The average quantity of palm oil consumed by males (86.46 ± 26.28 litres) and females (88.00 ± 20.56 litres) did not differ much, but the average quantity of palm oil given out by females (66.67 ± 39.53 litres) was more relative to male (31.82 ± 22.61 litres). The quantity of palm oil produced by males (4100.97 ± 2127.82 litres) surpassed female (3185.23 ± 1252.39 litres), likewise, the quantity of palm oil sold (see Table 2). But the average price per 25 litres (1 keg) of palm oil sold in 2024 for males (₦45,454.55 $\pm$ 10,038.80) and females (₦45,068.18 $\pm$ 10,102.72) was about the same. More males (40.7%) than females (37.3%) realised annual income between ₦5,000,001–10,000,000 from the sales of palm oil. The average annual income realised from the sale of palm oil by males (₦7,196,298.70 $\pm$ 3,977,985.67) outstands female (₦5,645,909.09 $\pm$ 2,821,290.79).

Palm oil production and income realised in 2024 overall

Table 1 shows that a higher proportion of oil palm farmers produce and sell between 2000–4000 litres (32.2%) and between 4001–6000 litres (23.3%) of palm oil in 2024. From the results in Table 2, the average quantity of palm oil produced and sold was 3767.98 ± 1904.00 litres and 3707.64 ± 1913.31 litres, respectively. The average quantity of palm oil consumed was 86.99 ± 24.33 litres, while 47.50 ± 35.26 litres was given out on average. The average price per keg (25 litres) was ₦45,314.05 $\pm$ 10,021.67, with values ranging from ₦30,000.00 to ₦65,000.00. On average, oil palm farmers earned ₦6,632,520.66 $\pm$ 3,665,403.86 from the sales of palm oil, with a minimum of ₦855,000.00 and a maximum of ₦18,000,000.00.

Table 1
Quantity of oil palm production and income realised in 2024

Variables	Male		Female		Overall	
	Freq.	%	Freq.	%	Freq.	%
Oil palm fruits production (in bunches)						
Quantity of harvested bunches (n = 180, Male = 113, Female = 67)						
< 1500	31	27.4	19	28.4	50	27.8
1500–3000	34	30.1	29	43.3	63	35.0
3001–4500	40	35.4	10	14.9	50	27.8
4501–6000	7	6.2	3	4.5	10	5.6
> 6000	1	0.9	6	9.0	7	3.9
Quantity of harvested bunches sold (n = 103: Male = 60, Female = 43)						
< 1500	17	15.0	15	22.4	32	17.8
1500–3000	29	25.7	18	26.9	47	26.1
3001–4500	11	9.7	1	1.5	12	6.7
4501–6000	2	1.8	3	4.5	5	2.8
> 6000	1	0.9	6	9.0	7	3.9
Price per one harvested bunch sold (₦)						
< 4000	16	14.2	0	0.0	16	8.9
≥ 4000	44	38.9	43	64.2	87	48.3
Annual income (₦) from the quantity of harvested bunches sold (n = 103: Male = 60, Female = 43)						
1000000–6000000	31	27.4	15	22.4	46	25.6
6000001–11000000	12	10.6	18	26.9	30	16.7
> 11000000	17	15.0	10	14.9	27	15.0
Palm oil production (in litres)						
Quantity of palm oil produced (n = 121: Male = 77, Female = 44)						
< 2000	8	7.1	7	10.4	15	8.3
2000–4000	31	27.4	27	40.3	58	32.2
4001–6000	32	28.3	10	14.9	42	23.3
8001–10000	6	5.3	0	0.0	6	3.3
Quantity of palm oil sold (n = 121: Male = 77, Female = 44)						
< 2000	8	7.1	7	10.4	15	8.3
2000–4000	31	27.4	27	40.3	58	32.2
4001–6000	32	28.3	10	14.9	42	23.3
> 6000	6	5.3	0	0.0	6	3.3
Quantity of palm oil consumed (n = 73: Male = 48, Female = 25)						
50–75	24	21.2	7	10.4	31	17.2
76–100	15	13.3	18	26.9	33	18.3
> 100	9	8.0	0	0.0	9	5.0
Quantity of palm oil given out (n = 20: Male = 11, Female = 9)						
25–60	10	8.8	4	6.0	14	7.8
> 60	1	0.9	5	7.5	6	3.3
Price (₦) per 25 litres (1 keg) of palm oil sold (n = 121)						
30000.00	9	8.0	8	11.9	17	9.4
35000.00	5	4.4	3	4.5	8	4.4

Variables	Male		Female		Overall	
40000.00	26	23.0	8	11.9	34	18.9
45000.00	7	6.2	6	9.0	13	7.2
> 45000.00	30	26.5	19	28.5	49	27.3
Annual income (₺) from the quantity of palm oil sold (n = 121)						
< 1000000	1	0.9	6	9.0	7	3.9
1000001–5000000	16	14.2	13	19.4	29	16.1
5000001–10000000	46	40.7	25	37.3	71	39.4
10000001–15000000	8	7.1	0	0.0	8	4.4
> 15000000	6	5.3	0	0.0	6	3.3

Source: Field survey 2025

Table 2
Descriptive statistics of oil palm farmers based on their production and Income in 2024

Male	N	Minimum	Maximum	Mean	Std. Dev.
Oil palm fruit production (in bunches)					
Quantity of harvested bunches produced	113	360.00	8200.00	2665.13	1470.29
Quantity of harvested bunches sold	60	360.00	8200.00	2247.67	1291.69
Price (₦) per one harvested bunch sold	60	1200.00	9555.56	3624.55	1542.53
Annual income (₦) from the quantity of harvested bunches sold	60	1440000.00	32800000.00	7967000.00	5835274.18
Palm oil production (in litres)					
Quantity of palm oil produced	77	625.00	10000.00	4100.97	2127.82
Quantity of palm oil sold	77	475.00	10000.00	4042.53	2132.00
Quantity of palm oil consumed	48	50.00	125.00	86.46	26.28
Quantity of palm oil given out	11	25.00	100.00	31.82	22.61
Price (₦) per 25 litres (1 keg) of palm oil sold	77	30000.00	65000.00	45454.55	10038.80
Annual income (₦) from quantity of palm oil sold	77	855000.00	18000000.00	7196298.70	3977985.67
Female					
Oil palm fruit production (in bunches)					
Quantity of harvested bunches produced	67	480.00	8200.00	2738.21	2029.77
Quantity of harvested bunches sold	43	480.00	8200.00	2796.74	2464.77
Price (₦) per one harvested bunch sold	43	4000.00	4100.00	4004.65	21.31
Annual income (₦) from the quantity of harvested bunches sold	43	1920000.00	32800000.00	11201627.90	9864054.01
Palm oil production (in litres)					
Quantity of palm oil produced	44	475.00	5250.00	3185.23	1252.39
Quantity of palm oil sold	44	475.00	5125.00	3121.59	1276.71
Quantity of palm oil consumed	25	50.00	100.00	88.00	20.56
Quantity of palm oil given out	9	25.00	100.00	66.67	39.53
Price (₦) per 25 litres (1 keg) of palm oil sold	44	30000.00	65000.00	45068.18	10102.72
Annual income (₦) from the quantity of palm oil sold	44	855000.00	9900000.00	5645909.09	2821290.79
Overall					
Oil palm fruit production (in bunches)					
Quantity of harvested bunches	180	360.00	8200.00	2692.33	1694.98
Quantity of harvested bunches sold	103	360.00	8200.00	2476.89	1881.66
Price (₦) per one harvested bunch sold	103	1200.00	9555.56	3783.2332	1188.27
Annual income (₦) from the quantity of harvested bunches sold	103	1440000.00	32800000.00	9317378.64	7894919.56
Palm oil production (in litres)					
Quantity of palm oil produced	121	475.00	10000.00	3767.98	1904.00
Quantity of palm oil sold	121	475.00	10000.00	3707.64	1913.31
Quantity of palm oil consumed	73	50.00	125.00	86.99	24.33
Quantity of palm oil given out	20	25.00	100.00	47.50	35.26
Price (₦) per 25 litres (1 keg) of palm oil sold	121	30000.00	65000.00	45314.05	10021.67
Annual income (₦) from the quantity of palm oil sold	121	855000.00	18000000.00	6632520.66	3665403.86

Source: Field survey 2025

Oil palm fruit production and income realised in 2025 by gender

The results in Table 3 show that in 2025, among males, a larger proportion harvested between 2000–4000 bunches (57.5%), while among females, a bigger share harvested below 2000 bunches (46.3%). However, more female farmers still appeared in the top category of 8001–15000 bunches (9.0%) than males (0.9%). Similarly, the quantity of harvested bunches sold follows much the same pattern. More male farmers sold between 2000–4000 bunches (32.7%), while more female farmers sold below 2000 bunches (37.3%). Females again appeared more in the higher sales group of 6001–8200 bunches (9.0%) than males (0.9%). Most males (46.0%) and females (62.7%) sell one harvested bunch of oil palm fruits at the rate $\geq \text{₦}4000$. A higher percentage of females (52.3%) than males (38.9%) earned annual income between $\text{₦}1,000,000$ – $11,000,000$ from the sales of oil palm fruits. From the results in Table 4, the average oil palm fruits harvested by males was 2590.80 ± 1388.95 bunches, while females harvested 2669.09 ± 2059.25 bunches. The quantity of oil palm fruits sold by females (2680.00 ± 2331.67) was higher than male (2437.67 ± 1392.03) in 2025. Also, females ($10,788,297.87 \pm 9,368,913.52$) realised higher income from the sales of oil palm fruits than males ($9,281,450.00 \pm 5,901,907.80$).

Oil palm fruit production and income realised in 2025 overall

From Table 3, oil palm fruits produced mostly range between 2000–4000 bunches (51.1%), followed by those producing below 2000 bunches (38.9%) in 2025. Very few of the oil palm farmers produced between 4001–6000 bunches (6.1%) and 8001–15000 bunches (3.9%). Similarly, the largest share of oil palm farmers sold between 2000–4000 bunches (27.8%), while 25.0% sold below 2000 bunches. Very few oil palm farmers sold between 4001–6000 bunches (2.8%) and above 6000 bunches (3.9%). The average price per bunch of oil palm fruits was mostly at the rate of $\geq \text{₦}4,000$ in 2025. The average oil palm fruits produced was 2624.00 ± 1658.84 bunches, and the average sold was 2544.11 ± 1858.08 bunches. More oil palm farmers earned between $\text{₦}1,000,000$ – $6,000,000$ (24.4%) from oil palm fruit sales, 19.4% earned between $\text{₦}6,000,001$ – $11,000,000$, while 15.6% earned above $\text{₦}11,000,000$. On average, oil palm farmers earned $\text{₦}9,943,336.45 \pm 7,618,671.84$, with income values ranging from $\text{₦}1,000,000.00$ to $\text{₦}32,800,000.00$.

Palm oil production and income realised in 2025 by gender

Table 3 shows that a higher percentage of males (32.7%) and females (40.3%) were concentrated within 3001–4500 litres palm oil production category. While males were spread more into higher production categories of 4501–6000 litres (10.6%) and 6001–7500 litres (5.3%), females were not. The results on the quantity of palm oil sold follow a similar pattern to production. The result in Table 4 shows that the male farmers produced 3709.42 ± 1597.39 litres of palm oil, while female farmers produced 3113.10 ± 1489.51 litres in 2025. In sales, males recorded 3649.03 ± 1605.52 litres, compared with 3052.98 ± 1502.15 litres for females. In 2025, the average quantity of palm oil consumed by males (87.23 ± 16.38) was higher than female (83.75 ± 27.24). However, females (106.25 ± 85.30) gave out more palm oil than males (45.83 ± 20.87). Males earned $\text{₦}7,554,025.97 \pm 3,496,964.66$ from palm oil sales, while females earned $\text{₦}6,526,785.71 \pm 3,335,384.17$. The price per 25 litres (1 keg) was fairly close for both groups, with males at $\text{₦}52,818.18 \pm 4,241.79$ and females at $\text{₦}51,904.76 \pm 6,803.19$.

Palm oil production and income realised in 2025 overall

According to the results in Table 3, more oil palm farmers produced palm oil within 3001–4500 litres (35.6%), followed by below 1500 litres (10.6%) and 1500–3000 litres (10.0%) categories. Only a few oil palm farmers produce above 4500 litres (10.0%) of palm oil. A similar pattern of production categories appears in the volume of palm oil sold. The average palm oil produced in 2025 was 3498.95 ± 1579.94 litres, and the average sold was 3438.66 ± 1589.36 litres. The modal income category was $\text{₦}7,000,001$ – $10,500,000$ (30.0%). On average, oil palm farmers earned an annual income of $\text{₦}7,191,470.59 \pm 3,461,873.96$ from the sales of palm oil in 2025, with income values ranging from $\text{₦}200,000.00$ to $\text{₦}15,600,000.00$. The average price per 25 litres was $\text{₦}52,495.80 \pm 5,278.47$, with values ranging from $\text{₦}40,000.00$ to $\text{₦}70,000.00$ in 2025. The quantity of palm oil consumed averaged 86.19 ± 20.08 litres, and an average of 70.00 ± 62.09 litres was given out.

Table 3
Quantity oil palm production and income realised in 2025

Variables	Male		Female		Overall	
	Freq.	%	Freq.	%	Freq.	%
Oil palm fruit production (in bunches)						
Quantity of harvested bunches (n = 180)						
< 2000	39	34.5	31	46.3	70	38.9
2000–4000	65	57.5	27	40.3	92	51.1
4001–6000	8	7.1	3	4.5	11	6.1
8001–15000	1	0.9	6	9.0	7	3.9
Price (₦) per one harvested bunch sold						
< 4000	8	7.1	5	7.5	13	7.2
≥ 4000	52	46.0	42	62.7	94	52.2
Quantity of harvested bunches sold (n = 107, Male = 60, Female = 47)						
< 2000	20	17.7	25	37.3	45	25.0
2000–4000	37	32.7	13	19.4	50	27.8
4001–6000	2	1.8	3	4.5	5	2.8
6001–8200	1	0.9	6	9.0	7	3.9
Annual income (₦) from the quantity of harvested bunches sold (n = 107, Male = 60, Female = 47)						
1000000–6000000	25	22.1	19	28.4	44	24.4
6000001–11000000	19	16.8	16	23.9	35	19.4
> 11000000	16	14.2	12	17.9	28	15.6
Palm oil production (in litres)						
Quantity of palm oil produced (n = 119: Male = 77, Female = 42)						
< 1500	8	7.1	11	16.4	19	10.6
1500–3000	14	12.4	4	6.0	18	10.0
3001–4500	37	32.7	27	40.3	64	35.6
4501–6000	12	10.6	0	0.0	12	6.7
6001–7500	6	5.3	0	0.0	6	3.3
Quantity of palm oil sold (n = 119: Male = 77, Female = 42)						
< 1500	8	7.1	11	16.4	19	10.6
1500–3000	21	18.6	4	6.0	25	13.9
3001–4500	30	26.5	27	40.3	57	31.7
4501–6000	12	10.6	0	0.0	12	6.7
6001–7500	6	5.3	0	0.0	6	3.3
Quantity of palm oil consumed (n = 67: Male = 47, Female = 20)						
50–70	4	3.5	5	7.5	9	5.0
71–90	16	14.2	7	10.4	23	12.8
91–110	27	23.9	4	6.0	31	17.2
> 110	0	0.0	4	6.0	4	2.2
Quantity of palm oil given out (n = 20: Male = 12, Female = 8)						
25–55	11	9.7	3	4.5	14	7.8
> 55	1	0.9	5	7.5	6	3.3
Price (₦) per 25 litres (1 keg) of palm oil sold (n = 119: Male = 77, Female = 42)						
40000	1	0.9	6	9.0	7	3.9

Variables	Male		Female		Overall	
50000	45	39.8	20	29.9	65	36.1
> 50000	31	27.5	16	23.9	47	26.2
Annual income (₹) from the quantity of palm oil sold (n = 119: Male = 77, Female = 42)						
< 3500000	10	8.8	13	19.4	23	12.8
3500001–7000000	25	22.1	3	4.5	28	15.6
7000001–10500000	28	24.8	26	38.8	54	30.0
10500001–14000000	8	7.1	0	0.0	8	4.4
> 14000000	6	5.3	0	0.0	6	3.3

Source: Field survey 2025

Table 4
Descriptive statistics of oil palm farmers based on their production and Income in 2025

Male	N	Minimum	Maximum	Mean	Std. Dev.
Oil palm fruit production (in bunches)					
Quantity of harvested bunches	113	360.00	8200.00	2590.80	1388.95
Quantity of harvested bunches sold	60	360.00	8200.00	2437.67	1392.03
Price (₦) per one harvested bunch sold	60	1123.81	7200.00	3908.2672	1161.14524
Annual income (₦) from the quantity of harvested bunches sold	60	1512000.00	32800000.00	9281450.00	5901907.80
Palm oil production (in liters)					
Quantity of palm oil produced	77	575.00	7500.00	3709.42	1597.39
Quantity of palm oil sold	77	475.00	7500.00	3649.03	1605.52
Quantity of palm oil consumed	47	50.00	100.00	87.23	16.38
Quantity of palm oil given out	12	25.00	100.00	45.83	20.87
Price (₦) per 25 litres (1 keg) of palm oil sold	77	40000.00	60000.00	52818.18	4241.79
Annual income (₦) from the quantity of palm oil sold	77	920000.00	15600000.00	7554025.97	3496964.66
Female					
Oil palm fruit production (in bunches)					
Quantity of harvested bunches	66	480.00	8200.00	2669.09	2059.25
Quantity of harvested bunches sold	47	480.00	8200.00	2680.00	2331.67
Price (₦) per one harvested bunch sold	47	1000.00	5111.11	3995.37	552.34
Annual income (₦) from the quantity of harvested bunches sold	47	1000000.00	32800000.00	10788297.87	9368913.52
Palm oil production (in litres)					
Quantity of palm oil produced	42	475.00	4500.00	3113.10	1489.51
Quantity of palm oil sold	42	475.00	4500.00	3052.98	1502.15
Quantity of palm oil consumed	20	50.00	125.00	83.75	27.24
Quantity of palm oil given out	8	25.00	300.00	106.25	85.30
Price (₦) per 25 litres (1 keg) of palm oil sold	42	60000.00	70000.00	51904.76	6803.19
Annual income (₦) from the quantity of palm oil sold	42	200000.00	9900000.00	6526785.71	3335384.17
Overall					
Oil palm fruit production (in bunches)					
Quantity of harvested bunches	180	360.00	8200.00	2624.00	1658.84
Quantity of harvested bunches sold	107	360.00	8200.00	2544.11	1858.08
Price (₦) per one harvested bunch sold	107	1000.00	7200.00	3946.53	940.60
Annual income (₦) from the quantity of harvested bunches sold	107	1000000.00	32800000.00	9943336.45	7618671.84
Palm oil production (in litres)					
Quantity of palm oil produced	119	475.00	7500.00	3498.95	1579.94
Quantity of palm oil sold	119	475.00	7500.00	3438.66	1589.36
Quantity of palm oil consumed	67	50.00	125.00	86.19	20.08
Quantity of palm oil given out	20	25.00	300.00	70.00	62.09
Price (₦) per 25 litres (1 keg) of palm oil sold	119	40000.00	70000.00	52495.80	5278.47
Annual income (₦) from quantity of palm oil sold	119	200000.00	15600000.00	7191470.59	3461873.96

Source: Field survey 2025

Relationship between the production quantity sold and income from sales in 2024 and 2025

It is shown in Table 5 that a significant relationship exists between the quantity of oil palm fruits sold in 2024 and income for males ($r = 0.884$, $p \leq 0.01$), females ($r = 1.000$, $p \leq 0.01$) and overall ($r = 0.963$, $p \leq 0.01$). Similarly, there was a significant relationship between the quantity of oil palm fruits sold in 2025 and income for males ($r = 0.946$, $p \leq 0.01$), females ($r = 0.997$, $p \leq 0.01$) and overall ($r = 0.980$, $p \leq 0.01$). Table 6 shows that a significant relationship exists between the quantity of palm oil sold in 2024 and income for males ($r = 0.426$, $p \leq 0.01$), females ($r = 0.347$, $p \leq 0.01$) and overall ($r = 0.247$, $p \leq 0.01$). Likewise, there was a significant relationship between the quantity of palm oil sold in 2025 and income for males ($r = 0.962$, $p \leq 0.01$), females ($r = 0.908$, $p \leq 0.01$) and overall ($r = 0.945$, $p \leq 0.01$).

Table 5
Relationship between the quantity of oil palm fruits sold and income from sales in 2024 and 2025

Variables	r-value	p-value	Remarks
Quantity of oil palm fruits sold in 2024 and income from sales			
Male	0.884**	0.000	Significant
Female	1.000**	0.000	Significant
Overall	0.963**	0.000	Significant
Quantity of oil palm fruits sold in 2025 and income from sales			
Male	0.946**	0.000	Significant
Female	0.997**	0.000	Significant
Overall	0.980**	0.000	Significant

$p \leq 0.01$ = Significant at 0.01

Source: Field survey 2025

Table 6
Relationship between the quantity of oil palm fruits sold and income from sales in 2024 and 2025

Variables	r-value	p-value	Remarks
Quantity of palm oil sold in 2024 and income from sales			
Male	0.426**	0.000	Significant
Female	0.347*	0.021	Significant
Overall	0.247**	0.006	Significant
Quantity of palm oil sold in 2025 and income from sales			
Male	0.962**	0.000	Significant
Female	0.908**	0.000	Significant
Overall	0.945**	0.000	Significant

$p \leq 0.01$ = Significant at 0.01; $p \leq 0.05$ = Significant at 0.05

Source: Field survey 2025

Difference in oil palm production and palm oil production between males and females in 2024 and 2025

The t-test analysis results in Table 7 show that in 2024, male and female farmers do not differ significantly ($t = 0.279$, $p > 0.05$) in the quantity of oil palm fruits produced. However, male farmers produced significantly more palm oil than female farmers ($t = 2.606$, $p \leq 0.05$) in 2024. Similarly, in 2025, there was no significant difference between male and female farmers ($t = 0.348$, $p > 0.05$) oil palm fruit production. But a significant difference existed between males and females ($t = 1.992$, $p \leq 0.05$) in their palm oil production in 2025.

Table 7
Independent t-test analysis of the differences in oil palm production and palm oil production between males and females

Variables	Gender	N	Mean	Std. Dev.	Mean Diff.	Std. Error Mean	df	t-value	p-value
Quantity of oil palm fruits harvested (in bunches) in 2024	Male	113	2665.13	1470.30	73.08	138.31	178	0.279	0.781
	Female	67	2738.21	2029.78		247.98			
Quantity of palm oil produced in 2024	Male	77	4100.97	2127.82	915.75	242.49	119	2.606	0.010
	Female	44	3185.23	1252.39		188.80			
Quantity of oil palm fruits harvested (in bunches) in 2025	Male	113	2590.80	1388.95	89.20	130.66	178	0.348	0.728
	Female	67	2680.00	2045.54		249.90			
Quantity of palm oil produced in 2025	Male	77	3709.42	1597.39	596.32	182.04	117	1.992	0.049
	Female	42	3113.10	1489.51		229.84			

$p \leq 0.01$ = Significant at 0.01; $p \leq 0.05$ = Significant at 0.05

Source: Field survey 2025

Difference in income from oil palm fruits and palm oil production between males and females in 2024 and 2025

From the t-test analysis results in Table 8, in 2024, there was a significant difference in income from oil palm fruits sold between males and females ($t = 2.084$, $p \leq 0.05$). But in 2025, males and female do not significantly differ in their income from oil palm fruit sales ($t = 1.016$, $p > 0.05$). Income from palm oil production in 2024 did not significantly differ between males and females ($t = 1.323$, $p > 0.05$). But in 2025, males significantly earned more income from palm oil sales than females ($t = 2.043$, $p \leq 0.05$).

Table 8
Independent t-test analysis of the differences in income from oil palm production and palm oil production between males and females

Variables	Gender	N	Mean	Std. Dev.	Mean Diff.	Std. Error Mean	df	t-value	p-value
Income from oil palm fruits (in bunches) sold in 2024	Male	60	7967000.00	5835274.18	3234627.91	753330.66	101	2.084	0.040
	Female	43	11201627.90	9864054.01		1504254.13			
Income from oil palm fruits (in bunches) sold in 2025	Male	60	9281450.00	5901907.80	1506847.87	761933.02	105	1.016	0.312
	Female	47	10788297.87	9368913.52		1366596.49			
Income from palm oil sold in 2024	Male	77	7909051.95	7829430.13	3929016.23	892246.37	119	1.323	0.188
	Female	44	11838068.18	23986861.40		3616155.42			
Income from palm oil sold in 2025	Male	77	7554025.97	3496964.66	1360573.59	398516.11	117	2.043	0.043
	Female	42	6193452.38	3422307.11		528073.45			

$p \leq 0.05$ = Significant at 0.05

Source: Field survey 2025

Discussion

Oil palm fruit production and income realised in 2024 by gender

Both male and female farmers are actively harvesting oil palm fruit bunches, but the way production is distributed across them is quite different. A larger share of males were within the 3001–4500 bunches range, while most females were within 1500–3000 bunches. The greater capacity of men in oil palm cultivation than women can be attributed to men's access to productive resources such as land, credit, equipment, and technology [19]. However, what stands out in this study is that females appear more often in the very top category, above 6000 bunches, than males. So, while many female farmers operate at moderate levels, a small group is clearly producing at a very large scale. This kind of spread points less to differences in effort or skill and more to resource access. Farmers who can secure more land, labour, or inputs are likely to push into higher output levels, indicating that production gaps are linked to resource access. Among indigenous rural farmers engaging in oil palm production in Karonga district, Malawi, it was reported that women were consistently marginalised in their control over income and access to land inheritance [20]. Considering the quantity of bunches sold, both genders are engaged in the market, but not in the same way. More female farmers are clustered around the ≤ 3000 bunches category than male. The distribution of male and female oil palm farmers based on the quantity of oil palm fruit sold indicates that their market participation is uneven. Some are clearly operating at a more commercial

level, while others are still selling at moderate volumes. This explains why some oil palm farmers are doing very well while others are not. Oil palm farmers' volume of production is a major factor if increased income is to be achieved. Increased income is a motivating factor for farmers to continue production, which invariably ensures the sustainability of the oil palm enterprise. As rightly noted, financial growth is one of the triad factors driving sustainability of the oil palm industry [21]. The distribution of oil palm farmers based on the income realised from oil palm fruits sold shows a mix of low- and high-income earners within the same group. This indicates that while many male and female farmers are earning less than their counterparts, a few of them are breaking through and earning income at very high levels. In real terms, this could mean that those few have better access to land, processing equipment, or stronger market connections. Income variation like this is common in rural systems where opportunities are not evenly distributed [22]. Narrowing that gap would likely require targeted support, especially in access to inputs and finance. When both genders are compared more broadly, both male and female farmers appear more consistent across production and income categories. Uneven distribution in both production and income categories hints at untapped potential. Some male and female oil palm farmers are already performing at very high levels, so the issue might not be capability, but more about removing the barriers that hold others back. A previous study points out that when constraints like limited credit or restricted land access are reduced, productivity gaps tend to shrink [23]. This submission agrees with what is observed in this study. Female farmers recorded a slightly higher mean harvest than males. Similarly, the quantity of oil palm fruits sold by females was higher than that of males. This explains why females realise more annual income than males.

Oil palm fruit production and income realised in 2024 Overall

Generally, the quantity of oil palm fruits produced in 2024 was fairly concentrated within the lower and middle output categories. This pattern shows that most oil palm farmers were producing at moderate levels rather than on a large scale. This kind of distribution spread in oil palm fruit production obtained in this study is common in smallholder systems where production is shaped by farm size, labour, and access to inputs. This aligns with previous research that the oil palm industry in Nigeria is dominated by smallholder farmers, accounting for nearly eighty percent of Nigerian production of palm oil domestically [4]. Similar to the quantity of oil palm fruits produced, the distribution pattern of oil palm fruits sold also points in the same direction. This shows that a large share of oil palm farmers is not only producing at moderate levels, but is also marketing moderate quantities. This is an important indication of the structure of the oil palm enterprise in the study area. Many oil palm farmers are active in the market, but most are not yet operating at a scale that would place them among large commercial producers. Despite the potential of oil palm enterprise in improving rural livelihoods, a review study in Indonesia attributed smallholder oil palm farmers' challenges to limited land size, poor agricultural practices, and inadequate institutional support, among others [24].

Income from the sale of fresh oil palm fruit bunches reflects the same structure observed in production. Very high income from bunch sales was not common among most oil palm farmers in 2024. For most farmers, fresh fruit bunch sales brought in income, but not at exceptionally high levels. In practical terms, this suggests that income from raw bunch sales alone may not be enough to create strong financial gains for many farmers, especially where production remains moderate. Income differences among rural farmers often widen when some farmers can combine larger output with stronger market access, while others remain in lower earning brackets [22]. That observation helps explain why only a very small proportion of oil palm farmers reached the upper income ranges. Additionally, the income range of ₦1,440,000.00 to ₦32,800,000.00 from the sales of oil palm fruits implies that the oil palm enterprise is not uniform. Some oil palm farmers are clearly able to push beyond the common range, while many remain clustered in lower to moderate output and income levels. Wide variations in output and income within the same farming system usually point to unequal access to productive resources, support services, and market opportunities [22].

Palm oil production and income realised in 2024 by gender

Processing activities bring out the differences between males and females more clearly. More male farmers dominate the higher processing categories. Processing requires equipment, labour, and sometimes capital, so farmers who have these can handle larger volumes. Previous research highlights that access to processing technology strongly shapes output levels [25]. Sales of processed palm oil follow naturally from processing capacity. Farmers who process more tend to sell more, and this is reflected in the higher sales figures among male farmers. Female farmers, on the other hand, are more concentrated in moderate sales ranges. In practical terms, this implies that improving access to processing facilities could have a direct effect on income. Value addition is one of the most reliable ways to increase earnings [26]. Findings from this study show that farmers consumed about the same quantity of palm oil annually, regardless of gender. Household needs seem fairly stable. However, differences show up in what is given out. Female farmers gave out more palm oil on average than male farmers. This likely reflects social roles within households and communities, where women are often more involved in sharing food and supporting extended family. This kind of behaviour is linked to social obligations, which helps explain why this difference exists [23]. Pricing, however, is almost identical for both genders, with most selling at about ₦45,000 per keg (25 litres). So, income differences observed between males and females in this study are not due to price variations but to how much is produced and sold. Male farmers have higher average outputs in palm oil production compared to females. This confirms that males were more active at larger processing scales. Sales of palm oil follow the same direction, with higher averages for male farmers. Similarly, income from processed palm oil was higher for male farmers than for female farmers, and this ties back to processing scale. Findings from this study agree with a past study among oil palm fruit processors in Southwest Nigeria where male processors realise significantly more income and profit than female [27]. Farmers who can process more palm oil tend to earn more from its sales.

Palm oil production and income realised in 2024 Overall

Processing activities show that oil palm farmers were strongly involved in value addition, but mostly at moderate levels. This indicates that processing was widespread, but most oil palm farmers remained within the moderate production range. The same trend appears in sales. Thus, oil palm farmers were not only producing oil palm fruits, but were actively converting them into palm oil and participating in the palm oil market. Value addition through processing improves the income potential of oil palm producers because a large share of sampled oil palm farmers moved beyond raw bunch sales to processing of oil palm fruits and marketing of palm oil. The quantity of palm oil produced was slightly greater than the quantity sold, indicating that oil palm farmers do not sell all palm oil output. But a larger share of what was produced was sold by oil palm farmers. This close relationship between the quantity of palm oil produced and the quantity sold implies that most of what is produced actually goes to the market, reinforcing the importance of processing as a key income

activity. Once farmers can process their produce, they are more likely to participate actively in the market and improve their earnings [26]. In this study, certain quantities are consumed, while some are given out. The quantity of palm oil consumed suggests that part of the processed oil was retained for household needs, which is expected in farming households where production serves both market and family use. A smaller group of oil palm farmers also gave out palm oil, though the quantity seems small compared to total output, but it still points to the social use of produce beyond direct sales and household consumption. In many rural settings, farm output is not treated only as a market commodity. It also supports family ties and social obligations. A past study discussed this social dimension of farm produce and noted that distribution within family and community networks remains an important part of rural livelihood practices [23]. This line of thought helps explain why some of the palm oil produced is consumed or given out. In this study, household use of palm oil remains relatively stable when compared to production and sales. Only a small portion of total output is retained for household use or social sharing. Still, the fact that some quantity is consistently given out suggests that oil palm production is not purely commercial but also supports social and household obligations. In many rural communities, part of farm output is used to maintain social ties and support extended family networks, and this helps explain why distribution remains part of the production system [23]. The price per 25 litres (1 keg) of palm oil ranges from ₦30,000.00 to ₦65,000.00. This relatively narrow range shows that farmers are operating within a common market structure, where prices are largely determined externally rather than individually. So, differences in income are less about price differences and more about how much each farmer is able to produce and process. Income from processed palm oil reflects this clearly. The wide spread in income values shows that while processing contributes significantly to income, not all farmers benefit equally. Those who are able to process larger quantities are in a better position to earn more, while those with limited capacity remain in the lower income ranges. A study explained that access to processing equipment and other productive resources strongly influences both output and income [25]. This helps better understand the variations in production and income obtained here.

Oil palm fruit production and income realised in 2025 by gender

Oil palm fruit production in 2025 remained centred on the lower and middle output groups, but the spread between male and female farmers was not the same. More males than females were found in the higher production categories. Notwithstanding, more female farmers still appeared in the top category of 8001 to 15000 bunches. This indicates that while many females were still producing at low levels, a smaller group had already moved into very high output levels. So, the difference is not simply about participation. It is more about the uneven scale of production. Evidence from a study showed that women in the oil palm value chain in Ondo State, Nigeria, are active participants, but their level of involvement is shaped by the resources and opportunities available to them [28]. In another study, it was found that oil palm smallholders do not respond to production conditions in the same way because their resilience and productive capacity differ across households [29]. The quantity of oil palm fruits sold follows the same pattern observed in production. Few females appeared in the higher sales group. This indicates that while some females are still selling at low levels, a few others are clearly marketing at a much bigger scale. Similarly, while most male farmers earned low income, some were found in higher income groups. Female farmers were more concentrated in the lower income group, with fewer reaching the top end. The implication of the outcome of this study is that market participation is stronger and more stable among men, even though some women are doing extremely well. This can be explained by the fact that output, market access, and processing capacity often move together. Female farmers sold more oil palm fruits and earned more income on average than males in this study. This gap may come from stronger market positioning, better timing of sales, or lower transaction constraints. A study reported that women's involvement in the oil palm value chain is strong, but the returns they get are still shaped by the limitations around their participation [28].

Oil palm fruit production and income realised in 2025 overall

Oil palm fruit production in 2025 is heavily concentrated at moderate output levels. Only a small proportion of oil palm farmers moved beyond these levels. This suggests that although production is active across the study area, most oil palm farmers remain within moderate output rather than operating at large scale. A similar pattern is common in smallholder systems, where production is shaped by farm size and available resources. Previous research stated that oil palm production in Ondo State, Nigeria remains largely driven by small and medium-scale farmers [28]. The quantity of harvested bunches sold mirrors the quantity of bunches produced, indicating that most oil palm farmers not only produce at moderate levels but also sell within the same range. This points to a production system in which output and market participation move together. When production is limited, sales naturally remain limited as well. This is supported by previous research, which explained that inefficiencies in the oil palm value chain often constrain how much farmers can bring to the market, especially when processing and transportation are constrained [30]. In this study, higher income levels were achieved by only a small proportion of oil palm farmers. There was a wide gap between the minimum and maximum income, and the large spread observed shows that income is not evenly distributed among farmers. Some farmers earn much more than others, even within the same system. This kind of variation has been highlighted by a past study, which explained that differences in resilience and production capacity among oil palm farmers often lead to wide differences in income outcomes [29].

Palm oil production and income realised in 2025 by gender

In 2025, male farmers were more prevalent in the higher processing categories, while no female farmers appeared in the top category. Female farmers were more prevalent in the low-to-moderate categories of palm oil production. This suggests that, although female farmers were active in processing, male farmers had more room to scale upwards. Although women are believed to dominate the palm oil processing industry, past studies have established that men were increasingly processing oil palm fruits [19]. When palm oil sales are considered, the same pattern was observed. Male farmers were more represented in higher sales bands, while female farmers remained in low-to-moderate palm oil production sales categories. This is crucial because processing is where more value is created, and production scale at that stage usually affects earnings directly. When access to processing capacity is limited, income also becomes limited. Furthermore, differences in production capacity are reflected in income from palm oil sales. Male farmers sold more palm oil and earned more income than female farmers because they processed more. Women's inability to maximise profit in palm oil sales was likely attributed to inequalities in access to productive resources and technical skills [31]. The average price per keg (25 litres of palm oil) in this study was fairly

close for both gender groups. This indicates that the income gap is not really coming from price differences, but from the volume of production. A study argued that smallholder outcomes in oil palm depend strongly on the ability to cope with structural and production challenges [29]. In essence, farmers with stronger capacity would also be the ones moving more volume and earning more. With respect to household use and the social distribution of palm oil, household consumption of palm oil remained fairly close across both gender groups. But the difference between genders came out more strongly in the quantity given out. Female farmers gave out more palm oil relative to male farmers. This suggests that women are carrying a heavier share of the social side of the oil palm enterprise, where produce is also used to support family ties and obligations. This kind of role is not always visible when people talk only about output and income, but it matters because it can reduce how much is finally sold. A study shows that women's involvement in the value chain is strong but shaped by gendered responsibilities [28]. Overall, the 2025 results show that both male and female farmers were fully active in palm oil production, sales, and processing, but the scale of participation still differed. Male farmers were more stable in the middle and upper production and processing categories, while more female farmers were in lower groups, and a smaller number were doing very well. That makes the gender story less about a simple difference and more about uneven opportunity within the same system. Output and income are shaped not only by participation, but by the resources and operating conditions behind participation.

Palm oil production and income realised in 2025 overall

Findings from this study established that oil palm farmers engaged in processing activities, which affirms their active involvement in value addition. However, processing activities are still mostly at moderate levels in 2025. The level at which oil palm farmers are producing palm oil is a function of their production capacity. There was a close margin between the quantity of palm oil produced and sales, indicating that farmers who process more can sell more. As observed in a study, value chain efficiency plays a key role in determining how much palm oil produced reaches the market [30]. The quantity consumed was low, implying that only a small portion of palm oil output is retained for household use. Similarly, the quantity given out is also relatively small. The range of 25 to 300 litres of palm oil (see Table 4) indicates a large spread, showing that some oil palm farmers gave out much more than others. This reflects the social role of agricultural produce, where part of the output is used for family support and community relationships. This aligns with a previous observation that oil palm production in the region serves both economic and social purposes [28]. Price and income from processed palm oil provide a clearer picture of returns from value addition. The average price per 25 litres obtained in this study indicates a fairly stable market for palm oil. Findings from this study established that processing oil palm fruits into palm oil contributes significantly to farmers' earnings, though not all oil palm farmers benefit equally. Those operating at higher processing levels are clearly earning more. Differences in production scale and resource access among oil palm farmers directly affect income outcomes [29], and this is strongly reflected in the results of this study. Generally, in 2025, palm oil production and income are largely centred within moderate levels. The oil palm enterprise is clearly active, with farmers involved in harvesting, processing, selling, and even sharing their produce. However, the wide variation in output, processing levels, and income shows that performance is not the same. Some farmers are operating far above the average, while many remain in lower to moderate levels. This indicates that the palm oil enterprise has strong potential, but that potential is not realised among farmers in the same way.

Relationship between the production quantity sold and income from sales in 2024 and 2025

In 2024 and 2025, there was a positive and significant relationship between the volume of harvested fresh palm fruits sold by oil palm farmers and the income realised from sales. The relationship between production quantity and income was significant for males, females, and overall. This indicates that the volume of production substantially drives higher economic returns from direct sales of fresh palm fruit bunches. Farmers who produce more oil palm fruits equally realised increased income after sales. The study submitted that male and female oil palm farmers' financial capability can be greatly enhanced if favourable conditions necessary for increased production are satisfied. Oil palm is a cash crop with promising livelihood security, food security and income potential for households. A previous empirical study establishes that cash crop cultivation exerts a positive and statistically significant influence on household income [32, 33]. The volume of marketable crop output has a statistically positive and significant effect on income generated [34, 35]. A positive and significant relationship exists between the volume of palm oil sold by oil palm farmers and the income realised from sales in 2024 and 2025. The correlation was significant and positive for males, females and overall, indicating the proportionality of production quantity with financial earnings irrespective of gender. This implies that the higher the quantity of palm oil produced and sold by farmers, the more income they realise. Invariably, higher production capacity of farmers significantly boosts their economic returns from palm oil sales. The commensurate relationship between production and income has important implications for the oil palm enterprise sustainability. A systematic review shows that interventions targeted at increasing the quantity of agricultural output sold would lead to a significant and measurable rise in farm income [36]. Empirical evidence from Edo State, Nigeria shows that oil palm production and processing is profitable [37]. The profitability of the oil palm enterprise reinforces that higher output is crucial to substantial economic gains.

Difference in oil palm fruit production and palm oil production between males and females in 2024 and 2025

There was no significant difference in the quantity of oil palm fruits harvested between male and female farmers in 2024. Females recorded a slightly higher mean harvest, but the difference is too small to be statistically significant. This suggests that both male and female farmers operate at roughly the same level when harvesting fresh oil palm fruit bunches. It reflects a kind of balance at the production stage, where access to trees and routine harvesting activities may not differ much by gender. Factors like labour and experience might influence production across both gender groups. Similar observations have been made where gender gaps are less visible at the primary production stage, especially in smallholder systems where family labour is shared [38]. A different result was obtained when looking at palm oil output in 2024. A clear difference exists, with male farmers having higher palm oil output than their female counterparts. This shift from bunches to processed output is important. It suggests that while both groups may harvest similar quantities, the ability to convert those bunches into palm oil is not the same. Processing requires additional inputs, labour, and sometimes better access to equipment, which may favour male farmers. The gap in palm oil production likely reflects differences in control over processing resources rather than farming ability itself. A study

shows that access to processing facilities and technical capacity plays a major role in determining final output in palm oil production [39]. In 2025, males and females do not differ significantly in oil palm fruit production. This indicates that harvesting activities are fairly similar across genders. It points to a stable structure in the production system where both gender groups engage equally at the farm level. In many rural production systems, such uniformity in harvesting has been linked to shared household roles and similar exposure to farming practices [40]. Palm oil production was significantly higher for males than females in 2025. It can be inferred that structural constraints may result in uneven production among oil palm farmers. Processing remains a critical stage where disparities become visible, reinforcing earlier evidence that access to resources, especially labour and processing capacity, shapes production outcomes. Similar trends have been reported by a past study where gender differences become more pronounced at post-harvest stages rather than at the farm level itself [41].

Differences in income from oil palm fruits and palm oil production between males and females in 2024 and 2025

Females significantly realised more income from the sales of oil palm fruits than males in 2024. Earlier results in this study reveal that oil palm fruits harvested by females in 2024 were higher than male, though not significantly. Thus, higher production and favourable prices put female oil palm farmers at a better advantage in income realisation than their male counterparts. However, in 2025, there was no significant difference in income earned from the sales of oil palm fruits between males and females. Though in 2025, oil palm fruit production was, on average, higher for females than males (the difference was not statistically significant), the difference in production does not translate into a higher income for females. It can also be inferred that both males and females sell at relatively similar prices, resulting in a close margin in income between both genders. Income from palm oil sold in 2024 did not significantly differ between males and females. Unfortunately, the significant production of palm oil by males in 2024 did not translate into significant income. This implies that sometimes, higher production might not necessarily mean higher income if market conditions and strategies are not favourable. But males significantly realised more income from palm oil sales than females in 2025. The significant realisation of income by males from palm oil production can be attributed to their significantly higher palm oil production than females, as found in this study, coupled with a favourable market price.

Conclusion

The study provides an engendered perspective of the oil palm enterprise, specifically production and income indices of males and females. Males and females are actively involved in oil palm production in the study area. However, more males than females dominate oil palm production. Both genders engaged in oil palm farming largely for commercial purposes. Males and females realise a higher income from the sales of oil palm fruits in 2024 and 2025. Though both genders harvested their oil palm fruits, not all the farmers sell them off. The majority of the oil palm farmers added value to the oil palm fruits by processing them to extract the oil known as 'palm oil'. A larger share of the palm oil produced is sold by oil palm farmers, thereby providing additional income for the farmers. Very small proportions of palm oil produced are consumed and/or given out. The majority of the oil palm farmers made good income from oil palm fruit sales and palm oil production, indicating that the oil palm enterprise is a very profitable venture for males and females, whether youth or adult. In this study, males do not significantly differ from females in their oil palm fruit production for both years assessed. However, in palm oil production, males significantly produced more palm oil than females in 2024 and 2025. In 2024, income realised by females from the sales of oil palm fruits significantly outstands male. However, in 2025, there was no significant difference in income from the sale of oil palm fruits between males and females. Income from palm oil sold in 2024 did not significantly differ between males and females, even though production was significantly higher for male same year. But males significantly realised more income from palm oil sales than females in 2025. The study concluded that though more males than females engaged in oil palm production, oil palm fruits and palm oil production are not exclusively gender-specific, and not all oil palm farmers, whether male or female, engage in palm oil production. Both genders produced oil palm fruits and processed these fruits into palm oil for public consumption. Interventions targeted at oil palm farmers should favour both genders, with more emphasis on females, and youth should be encouraged to go into oil palm farming.

Declarations

Ethics approval and consent to participate

The research was approved by the Research Ethics Committee, Olusegun Agagu University of Science and Technology, Nigeria, with the assigned number OAUSTECH-REC 2025-0097. The study does not require any experiment. Consent to participate in the study was obtained from all the individual participants included in this study.

Consent for publication

Not Applicable

Availability of data

The data for this study are available upon request from the corresponding author.

Competing interests

The authors hereby declare that the article is devoid of any competing interests.

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Authors' contributions

OOA - Conceptualisation, Literature review, Instrument development, Data collection coordination, Data curation, Formal analysis, Report writing (Original draft), Writing (Review and editing)

FOA - Supervision, review and editing.

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