# EXPLORING THE DRIVERS OF INCOME DIVERSIFICATION AMONG OIL PALM FRUIT (*Elaeisguineensis*) FARMERS IN SOUTHERN NIGERIA

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*Abstract*

*The study delves into the extent and various factors influencing the drive for farm income diversification among small-scale oil palm fruit (Elaeis guineensis) farmers in Akwa Ibom State, Southern Nigeria. A structured questionnaire was utilized to gather data from 300 oil palm fruit farmers in the area. Descriptive tools, the Herfindahl index, and the Tobit model were employed to analyze the collected data. It was observed that the majority of oil palm fruit farmers were married women, educated but with limited social interactions, and had an average family size of 7 members. The research indicates that the average farm income diversification index was 0.73, suggesting that income diversification among oil palm fruit farmers in the region is a matter of concern.In addition, the results showed that oil palm fruit farmers' formal education, farming experience, socialization, household size, farmers' age, distance from the farm gate to the market and household expenditure were significant positive determinants of income diversification index; while land size and farmers' sex were negative determinants. For the improvement of farm income in small-scale oil palm fruit production in the southern region of the country, it is advised that stakeholders collaborate to allocate land for oil palm farmers. Furthermore, it is important to motivate youths to engage in oil palm fruit production in the region.*

*Key words*: *income, diversification, oil palm fruit, sustainability, Nigeria*

## INTRODUCTION

The oil palm tree (*Elaeis guineensis*) is one of the major economic tree crops in tropical regions of the World [41]. This monocotyledonous plant is a member of the palm family Arecaceae and Sub-family, Cocoideae [23], known for its versatility and economic value across all its parts. As of 2022, the country yielded 12.6 million metric tons of oil palm fruit from 4.91 million hectares of land [28]. One of the main outputs of the oil palm tree is the palm fruit. The fruit is customarily, processed to yield various marketable products, such as palm oil, palm kernel oil, and palm kernel cake [41]. Additionally, the tree is utilized for production of wine, which is often consumed locally, and is a valuable source for ethanol production among others [25, 48].

Palm oil is the most commonly used derivative of oil palm fruit, as it used for household consumption, pharmaceutical industry, toiletry and energy production among others [25]. In Africa, Nigeria is currently the leading consumer of palm oil, consuming about 1.8 million metric tons in 2023. With a population exceeding 200 million, Nigeria has historically played a crucial role in the global palm oil market. In the pre-independent era, the country accounted for nearly half of the world's palm oil exports. By the mid-1960s, Nigeria held a substantial 43% share of the global market, making a significant contribution to the nation's GDP [45]. In the recent years, Nigeria's position as a top palm oil producer has declined with the rise of Indonesia, Malaysia, and Thailand as industry leaders. This shift can be largely attributed to Nigeria's shift towards prioritizing crude oil extraction. As of 2023, Nigeria now ranks fifth in global palm oil production, producing approximately 1.50 million metric tons annually, and accounting for around 2% of the world's total output [28]. Despite being a major producer of oil palm derivatives in Africa, Nigeria's annual production falls short of domestic demand, leading the country to rely heavily on imports. This has significant financial implications for the Nigerian economy. Despite facing a supply

deficit in the sector, the importance of oil palm production is increasing due to its impact on job creation, industrialization, and rural income generation, among other factors [5, 47]. Palm oil is known for its rich content of carotenoids, vitamins, tocopherols, fatty acids, vitamin E, and emulsifiers, highlighting its nutritional value and versatility [30].

In the southern region of Nigeria, the production of oil palm fruit is primarily carried out by small-scale producers, comprising approximately 80.00% of the industry [4]. These small-scale farmers cultivate land area spanning from 1.04 to 1.33 million hectares, representing about 74.00% of the total production area in the region [37]. The remaining 26.00% of the production area is comprised of privately owned oil palm estates and other smallholder farmers who participate in government schemes like out-grower schemes, cooperative plantations, and other commercial ventures cultivating improved 'Tenera' varieties. According to MADE [37], the sub-sector provides employment opportunities for over one million smallholder plantation farmers, oil palm millers, processors, farm workers, and market agents, including wholesalers and retailers in the southern region of Nigeria.

The sustainability of oil palm fruit production in the southern region of Nigeria is a major concern due to increasing population density and poverty levels in the region. Farmers in this region face challenges such as rising input prices, income inequality, limited access to credit, price volatility, and an unfair marketing system [44, 10, 11]. Additionally, the remote location of oil palm farms, poor infrastructure, and lack of accurate market information hinder farmers from engaging in fair and competitive marketing activities [40]. These inefficiencies have a negative impact on farmers' incomes and livelihoods [32, 38].

Farm income diversification drive in small-scale farmers has become an effective way to reduce farm risk, provide cushion during economic downturn and pandemic, guaranteed farm financial security and create new opportunity for economic growth and innovation adoption. Income diversification among small-scale farmers also arose following the need by farmers to increase market share of their products and revenue opportunities as well as poverty mitigating strategy [12, 1, 35, 15]. Specifically in Nigeria, the inability of the government to provide adequate economic cushioning and security to farmers has persistently intensified the small-scale farmers' urge or yearning to diversify their farm likelihood income means [18, 34]. Documented evidence has shown that an average Nigerian farmer suffered low farm earnings, mounting risk in production and inefficient marketing environment [13, 6, 46, 49]. Additionally, factors such as population growth, deforestation, conflicts between herders and farmers, and unpredictable economic and political conditions, along with the impacts of climate change, have led to small-scale farmers in Nigeria diversifying their sources of income in various ways within the agricultural sector [27, 42].

While diversifying income streams can be beneficial for farmers in a stable economy by increasing their overall income [35, 1, 2], in Nigeria's current economic situation, it may connote persistent inefficiency in production and deteriorating well-being of farmers [15, 3]. It is worrisome that the persistency of livelihood/income diversification among resource poor small-scale farmers could further deteriorate the already flooded labour market in the country [3]. The situation could aggravate unemployment and further dwindles the efficiency of the agro-economy in the country.

The subject matter on income or livelihood diversification of oil palm fruit producers in the southern region of Nigeria is critical because the agro-enterprise is a significant employer of labour and a major contributor to the agricultural GDP of the region. This agro-enterprise is practiced mostly in rural areas, and is currently affected by increasing deforestation, seasonality in production, the nature of land ownership required for the establishment, high population density, urbanization and climate variability as well as pressure from alternative land uses [5, 12, 10, 4, 9]. The income diversification among oil palm fruit farmers in the region is exaggerated because evidence abound that farm resources

are seldom allocated efficiently in small-scale farm production [7, 12]. This is because the production system is still undeveloped and is characterized by using less efficient techniques than modern and improved methods. Despite these drawbacks in oil palm fruit production, several researchers have accredited the persistency in the production of oil palm fruit in the region to multidimensional factors connected to farmers' social and economic status as well as farm-specific features, among others [8, 39]. As part of the sustainability plan, an attempt to identify these key factors and their roles are critical in enunciating and implementing a workable policy framework that would fast track the overall development of oil palm fruit production and other tree crops in the region and Nigeria as a whole.

To chart a sustainable path for the sustainability of many agribusinesses in developing countries, several empirical studies have documented the relationship between the decision to diversify farm income and several categories of factors. In this regards, Edet and Etim [26] found family size, farming experience, social capital, non-farm income, farm income, asset base of farming household and farmers' access to farm credit as critical factors affecting likelihood diversification of rural farmers in Akwa Ibom State, Nigeria. According to Idris-Adeniyi et al. [33], income diversification among arable crop farmers in Osun State, Nigeria, is influenced by factors such as household age, access to credit, household size, and the frequency of extension visits. Crop. In a similar vein, Aynalem [19] provided documented evidence that revealed, educational status of household head, access to credit, access to electricity, distance to the nearest market, household head gender, yearly household income, entrepreneurial skill and household size were significant factors affecting income diversification of small holder farmers in Ethiopia. In a study conducted in Nigeria, Malami et al., [36] found that factors such as non-farm income, number of income sources, age of household head, and years of education were positively and significantly related to the income diversification index of smallholder farmers. Similarly, a study in India by Harishankar et

al., [31] identified determinants of income diversification among dairy farm households including education level of farmers, household size, land tenure, size of herd, proximity to agricultural or allied industry, access to farm credit, and membership in social organizations. In a related study conducted in Ethiopia, Getahun et al., [29] identified several key factors that influence income diversification among rural households, including farmers' age, ownership of livestock, farm size, years of formal education, food scarcity, adoption of sustainable farming practices, as well as climate factors such as rainfall and temperature. Similarly, Atalelech and Alula [17] found that factors such as farmers' age, household size, livestock ownership, availability of farm inputs, access to credit, and participation in training programs play a significant role in driving income diversification among small-scale farmers in Ethiopia. Moreover, Andualem and Umer [16] showed that male controlled household, land size, socialization, and participation in government program have positive correlation with the rural household income diversification, while distance to market has a negative relationship. Akpan *et al.,* [3] showed that, farmers' family size, hired labour and formal education are positive determinants of income diversification among fluted Pumpkin farmers in Akwa Ibom State, Nigeria. On the other hand, the negative determinants were farmers' age, extension services, socialization, farm size, fertilizer, manure, and family labour. Alemu, [4] in Ethiopia, reported that farmers' education level, household size, type of irrigation, soil conservation practice, extension services, livestock owned, and the quality of infrastructure affect the intensity of their livelihood diversification. Chukwu, and Chukwu, [24] found income diversification index among households in Nigeria was driven by farmers' own assets, family size, female control household, formal education, family dependency ratio, access to credit and distance from the farm gate to the tarred road.

From the pool of literature, most income diversification studies in developing countries are tailored on household income behaviour generally. That is, the whole household farm

income sources are treated as a common source in estimating income diversification index. Thought this technique is revealing, but it however will hardly expose the sustainability prospect of individual agro-enterprise within the household. Again, some of these studies emphasized on arable crop farmers without due consideration to cash crop farmers like oil palm fruit farmers. Based on the peculiar characteristic of cash crop such as seasonality in production and its declining outputs in recent years [28], cash crop subunit needs a special consideration in the country. Therefore, the study was designed to provide a deeper insight especially on cash crop farmers' income diversification options. The need to generate current policy variables based on the current realities is necessary to achieve sustainability and open the sub-unit for more investment opportunities. Hence, the study was specifically aimed at estimating income diversification index of oil palm fruit farmer and identified factors that influence it.

**MATERIALS AND METHODS**

**Area of study Description**
**Study Area** The research was carried out in the agricultural zones of Abak and Uyo in Akwa Ibom State, situated in the southern part of Nigeria. Akwa Ibom State, found in the coastal area, comprises six agricultural zones. Other agricultural zones in the State include: Oron, Ikot Ekpene, Eket, and Etinan zones. The Abak agricultural zone consists of five (5) local government areas namely: EtimEkpo, Abak, OrukAnam, Ukanafun, and Ika local government areas, while Uyo zone consists of Uyo, Uruan, IbesikpoAsutan, Ibiono Ibom and Itu local government areas.
**Sample Size Selection**
The study used the Yamane, [50] method of sample size selection. From the large population of small-scale oil fruit farmers in the study areas, the representative sample was derived using the formula given in equation 1.

$$S_y = \frac{W^2 \varphi (1 - \varphi)}{L^2} \dots \dots \dots \dots \dots \dots \dots \dots . \dots . (1)$$

Note, $S_y$ connotes sample size, W is 1.96 (that is 95% confidence interval); "$\varphi$" represents 80% (proportion in percentage of oil palm fruit farmers in the total population of cash crop farmers in the study areas); L represents the absolute error (at 5% probability level of type 1 error). The sample size was obtained using the formula presented in equation 2.

$$S_y = \frac{(1.96)^2 0.80 (1 - 0.80)}{(0.05)^2} = 246 \dots (2)$$

From the calculation, the total of two hundred and forty-six oil palm fruit farmers were needed for the study. However, for the purpose of equality in distribution of respondents across the study areas, the sample size was scaled up to three hundred. Hence, the total sample size used in the study was three hundred oil palm fruit farmers selected across the study areas.
**Sampling Technique and Method of Data Collection**
The oil palm fruit farmers in the study area were selected using a combination of sampling methods.
Initially, a purposive sampling technique was employed to choose four local government areas in the IkotEkpene agricultural zone and three local government areas in the Uyo agricultural zone during the first stage. A total of seven (7) local government areas were used in the study.
The essence of using a purposive sampling technique in this stage was to target and capture heavy production areas within the State. During the second stage of the analysis, high production intensity areas were pinpointed in the local government areas, and a ppredetermined number of villages were randomly sampled as depicted in Table 1. Note.
The number of villages and respondents were randomly selected proportionally to the total numbers to obtain equity in sampling.
The next phase was a random sampling of the oil palm fruit farmers in each of the selected villages.
A total of three hundred (300) oil palm fruit farmers were randomly sampled and used for the study.

Table 1. Distribution of respondents

| Sample Areas | No. of Villages | Farmers per village | Total sampled | % of total |
|---|---|---|---|---|
| Ukanafun | 7 | 10 | 70 | 23.33 |
| EtimEkpo | 6 | 10 | 60 | 20.00 |
| OrukAnam | 7 | 10 | 70 | 23.33 |
| Ika | 4 | 10 | 40 | 13.33 |
| Ibiono Ibom | 5 | 4 | 20 | 6.67 |
| IbesikpoAsutan | 5 | 4 | 20 | 6.67 |
| Itu | 5 | 4 | 20 | 6.67 |
| **Total** | **39** | | **300** | **100.0** |

Source: calculated by authors.

The primary data were extracted from the oil palm fruit farmers. Data were primarily gathered through a structured questionnaire, which was further supplemented by focus group discussions with multiple farmers' groups and key informants in villages. The questionnaire aimed to gather information on the socioeconomic profiles of the farmers, their marketing decisions, sources of income, as well as the various factors influencing their marketing strategies within the study area.

**Method of Data Analysis**

The data gathered from oil palm fruit farmers were analyzed in accordance with the study's objectives. Descriptive statistics such as means, standard deviation, and coefficient of variability were employed to investigate the socio-economic features of oil palm fruit farmers in the research area. Furthermore, diversification indices were generated using the Herfindahl index, while the Tobit model was utilized to ascertain the factors influencing farm income diversification among oil palm farmers in the region.

**Theoretical framework**

The theoretical framework of the study is based on the concept expected utility maximization concept of a rational farmer. The concept proposes that a farmer decision to maintain the current state of production is a choice among the alternatives. It is assumed that an oil palm fruit farmers has several options to earn income, and he would choose among the options based on the anticipated benefits or utility. Alternatively, the oil palm fruit farmer's option to participate in income diversification is conditioned by its expected satisfaction and the relationship can be expressed in utility function. Although the utility function is unobserved, the correlation between the expected utility corresponding to each of the alternative is assumed to be a function of the vector of observed explanatory variables and a stochastic error term [20]. In the case of utility maximization theory; an oil palm fruit farmer is assumed to have a full information about the various income sources available, with an infinite capacity to analyze the expected utility derivable from each of this option, and utilizing such information to maximize their expected utility from a set of decisions subject to budget constraint [21]. Hence, an econometric model such as Tobit can be employ to relate various variables from which marginal coefficients can be estimated [20].

**The Herfindahl Index**

Herfindahl Index (HI) is defined as the square of the proportion of farm income (oil palm fruit farming income) in the total income (both farm and non-farm income) of the oil palm fruit farmer. This index was computed with reference to one farming season preferably the last farming season at the point of interview to allow for fair comparison of income sources. The index is described as follows:

$$HI = \left( \frac{\sum_{i=1}^{n} oil\ palm\ fruit\ farm\ income}{\sum_{i=1}^{n} Total\ income} \right)^2$$
$$= \left( \frac{FI}{TI} \right)^2 \dots\dots\dots\dots\dots\dots\dots (3)$$

In the given formula, HI represents the Herfindahl Index, 'n' denotes the total number of income sources accessible to the oil palm fruit farmer during the previous production season, and FI signifies the total farm income acquired by the oil palm fruit farmer solely from production and processing of oil palm fruit in the last production season; TI is the total income including total farm income and total non-farm income accrued to an oil palm fruit farmer in the last production season. The Herfindahl index is also known as concentration/intensification index. The value ranges from zero to one. It measures the degree of concentration or intensification of a particular income source in the total income of a farmer at a particular period. The Herfindahl concentration index of zero and unity imply complete diversification and specialization

respectively. The Herfindahl index was transformed to measure income diversification index of oil palm fruit farmers as shown in equation 4.

$$DIN = 1 - (HI) \dots \dots \dots \dots \dots \dots \dots (4)$$

The Diversification Index (DIN) is a reverse of Herfindahl index (HI) and it takes the value of zero to one. A diversification index approaching zero implies increasing income intensification/specialization, while a diversification index of zero connotes complete specialization or intensification of farm income. On the contrary, a diversification index approaching one (1) indicates increasing diversification. While a diversification index of one, indicates complete income diversification.

**Determinants of income diversification among oil palm fruit farmers**

A Tobit model regression was specified to identify determinants of income diversification among oil palm fruit farmers. The standard Tobit model for this study is defined as follows:

$$Y_i^* = X_i \beta_i + U_i \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (5)$$

$$Y_i = Y_i^*, if \ Y_i > 0 \dots \dots \dots \dots \dots \dots \dots \dots \dots (6)$$

$$Y_i = 0, if \ Y_i \le 0 \dots \dots \dots \dots \dots \dots \dots \dots \dots (7)$$

Where Y* is the latent dependent variable, $Y_i$ is the observed dependent variable, $X_i$ is the vector of the independent variables, β is the vector of coefficients, and the $U_i$ is a stochastic error term and is assumed to be independent, normally distributed with zero mean and constant variance ($U_i \sim$ iid, N (0, $\sigma^2$).

The explicit form of the Tobit model is presented in equation 8.

$$DIN = Z_i = \beta_0 + \beta_1 \emptyset_1 + \beta_2 \emptyset_2 + \beta_3 \emptyset_3 + + \beta_4 \emptyset_4 \\ + \beta_5 \emptyset_5 + \beta_6 \emptyset_6 + \beta_7 \emptyset_7 + \beta_8 \emptyset_8 \\ + \beta_9 \emptyset_9 + \beta_{10} \emptyset_{10} + \beta_{11} \emptyset_{11} \\ + \beta_{12} \emptyset_{12} + \beta_{13} \emptyset_{13} \\ + U_i \dots \dots \dots \dots (8)$$

where DIN is the measure of farm income diversification index noted in equation 4. The marginal effect of the Tobit model captures an instant impact that a shock in independent variable has on the latent or dependent variable. It captures the percentage change in a dependent variable attributed to the same percentage change in an explanatory variable. It is computed as the first partial derivative with respect to each of the explanatory variable specified. Variables used in equation (8) are defined in Table 2.

Table 2. Description of explanatory variables

| S/n | Variable | Symbol | Unit | Expected sign |
|---|---|---|---|---|
| 1 | Marital status | $\emptyset_1$ | dummy (1 for married and 0 otherwise) | Positive or negative |
| 2 | Years of formal education | $\emptyset_2$ | Years | + or – |
| 3 | Farming experience | $\emptyset_3$ | Years | + or – |
| 4 | Socialization of farmers | $\emptyset_4$ | Years | + or – |
| 5 | Household size | $\emptyset_5$ | Number | + or – |
| 6 | Household Dependent ratio | $\emptyset_6$ | Ratio | + or – |
| 7 | Household expenditure | $\emptyset_7$ | Naira | + or – |
| 8 | Age of a farmer | $\emptyset_8$ | Years | + or – |
| 9 | Distance to market | $\emptyset_{10}$ | Dummy (far = 1 and 0 otherwise) | + or – |
| 10 | Hectare of land own by a farmer | $\emptyset_{11}$ | Hectares | + or – |
| 11 | Access to extension services | $\emptyset_{12}$ | Number of times | + or – |
| 12 | Access to farm credit | $\emptyset_{13}$ | Naira | + or – |
| 13 | Farmer's sex | $\emptyset_{14}$ | Dummy (1 for female and 0 otherwise) | + or – |

Source: Prepared by the authors. Note, dependent ratio = number of children less than 15 years plus number of adult greater than 65 years divided by the household size.

**RESULTS AND DISCUSSIONS**

**The social and economic features of oil palm fruit farmers**

The data in Table 3 showcases an overview of the socioeconomic characteristics of oil palm fruit farmers in the research area. It was found that the most of farmers in this sub-sector are women, who often engage in the business to supplement their family's income. The average age of oil palm fruit farmers was found to be

49.10 years, indicating a relatively young and active age bracket. It is essential to note the importance of encouraging more youth participation in oil palm fruit production based on these findings.

The data indicates that the most of oil palm fruit farmers are married, suggesting a strong appeal of oil palm fruit production to households with married couples. This is likely due to the advantage of having access to affordable family labor, which is beneficial in the semi-labor-intensive nature of oil palm fruit production in the research area. Furthermore, the study revealed that the average farming experience of oil palm fruit farmers in the region is 17.50 years. This implies that oil palm fruit production is a well-established agribusiness in the region. Furthermore, the distribution of membership in social organizations among showed a low participation profile with an average of 2.65 years. Over 50% of farmers in the study area are not affiliated with any social organization, indicating a lower level of social capital among oil palm fruit farmers in this region. About 83.00% of farmers confirmed to the fact that the distance to the market is far, while an average of 0.66 hectares of farmland was obtained for the group.

Table 3. The socio-economic characteristic s of oil palm fruit farmer

| Variable | Mean | Min | Max | Std. Dev. | C.V. |
|---|---|---|---|---|---|
| Marital status | 0.67 | 0.0 | 1.00 | 0.47 | 0.71 |
| Education | 9.20 | 0.0 | 16.0 | 3.52 | 0.43 |
| Farming experience | 17.50 | 2.0 | 50.0 | 7.19 | 0.44 |
| Socialization | 2.65 | 0.0 | 34.0 | 4.38 | 1.60 |
| Household size | 7.00 | 2.0 | 13.0 | 2.11 | 0.30 |
| Dependent ratio | 0.55 | 0.0 | 1.25 | 0.26 | 0.47 |
| Farmer's age | 49.10 | 29.0 | 70.0 | 8.28 | 0.17 |
| Distance to the market | 0.83 | 0.0 | 1.00 | 0.38 | 0.46 |
| Hectare of land | 0.66 | 0.23 | 2.03 | 0.22 | 0.33 |
| Access to extension services | 0.49 | 0.0 | 6.00 | 1.10 | 2.26 |
| Access to credit | 19333 | 0.0 | 120000 | 26216 | 1.36 |
| Household expenditure | 173740 | 50000 | 273000 | 48209 | 0.28 |
| Farmer's sex | 0.59 | 0.0 | 1.000 | 0.50 | 0.10 |

Source: Computed by authors and information derived from field survey 2023.

The household size distribution showed an average family size of seven (7) members. The importance of family labor in oil palm fruit production in the study area is further emphasized. Due to the inelastic demand for hired labor in rural communities and the trend of rural-urban migration among young people, family labor has become the primary source of labor for small-scale farmers in the region. Additionally, the findings indicate that over 90.00% of oil palm farmers have received some form of formal training. On average, farmers in the region have about 9.20 years of formal education, which falls within the realm of secondary education. This suggests that the most of oil palm fruit farmers are literate and skilled in reading and writing. The attainment of formal education is believed to enhance decision-making abilities and resource management in agribusiness.

**Diversification index of oil palm farmers**

The diversification indices for oil palm fruit farmers are presented in Table 4. The results indicate that 1.00% of oil palm farmers have reached a nearly ideal level of income intensification in the production of oil palm fruit. This means that only 1.00% of oil palm fruit farmers are heavily dependent on income solely from oil palm fruit production.

The result further showed that only 14.66% of oil palm farmers have diversification index less than or equal to 0.500. The range of diversification index spanning from 0 to 0.50 is considered as the region of decreasing diversification of income or region of increasing specialization of income generation. The findings suggest that fewer than 15.00% of oil palm fruit farmers actively seek to boost their income through oil palm fruit production. Alternatively, it is indicated that less than 15.00% of oil palm farmers are willing to focus solely on oil palm fruit production in the area. Conversely, approximately 85.34% of oil palm fruit farmers have a diversification index exceeding 0.50. A diversification index ranging from greater than 0.50 to 1.00 is seen as a region where income diversification is on the rise.

This suggests that a large number of oil palm fruit farmers in the region are exploring alternative sources of income on their farms. In other words, the most of oil palm fruit farmers in the area do not rely heavily on revenue generated solely from oil palm fruit

production. For example, approximately 13.00% of oil palm fruit farmers have a diversification index ranging from 0.900 to 1.00. This indicates that oil palm fruit income contributes minimally to their overall earnings. A higher income diversification index signifies that farmers are less reliant on the income generated from oil palm fruit production. These findings reveal that many oil palm fruit farmers in southern Nigeria are either diversifying their income sources or shifting their focus away from oil palm fruit revenue. The mean and maximum diversification indices were recorded at 0.730 and 0.996, respectively. This suggests that the sustainability of oil palm fruit production in the southern region of Nigeria may not be entirely assured in the future. The result connotes that oil palm fruit farmers are not generating sufficient income from the agribusiness compared to alternative livelihood activities in the region.

Table 4. Diversification index of oil palm fruit farmers

| S/n | Category | Frequency | Percentages |
|---|---|---|---|
| 1 | 0.000 – 0.100 | 3 | 1.00 |
| 2 | 0.101 – 0.200 | 21 | 7.00 |
| 3 | 0.201 – 0.300 | 3 | 1.00 |
| 4 | 0.301 – 0.400 | 10 | 3.33 |
| 5 | 0.401 – 0.500 | 7 | 2.33 |
| 6 | 0.501 – 0.600 | 20 | 6.67 |
| 7 | 0.601 – 0.700 | 45 | 15.00 |
| 8 | 0.701 – 0.800 | 140 | 46.67 |
| 9 | 0.801 – 0.900 | 12 | 4.00 |
| 10 | 0.901 – 1.000 | 39 | 13.00 |
| | **Total** | **300** | **100.00** |
| | Mean | 0.73047 | |
| | Standard deviation | 0.19789 | |
| | Median | 0.75000 | |
| | Minimum | 0.019417 | |
| | Maximum | 0.99556 | |
| | Coefficient of variability | 0.27091 | |
| | Skewness | -1.8973 | |

Source: Calculated by the authors using data obtained from a field survey in 2023.

Apart from the seasonality in production, the population density is mounting in the region thereby putting much pressure on land availability. Furthermore, the labor-intensive nature of oil palm fruit production and the limited availability of labor in rural communities have both played a role in the high level of diversification observed among oil palm fruit farmers in the area. This discovery aligns with previous research Harishankar et al., [31].

**Determination of income diversification among oil palm fruit farmers**

An important challenge in cross-sectional data analysis is the issue of multicollinearity. To determine the presence of this econometric issue, the variance inflating factor (VIF) was calculated and the results are displayed in Table 5. The result revealed that there is no serious or significant collinearity among explanatory variables specified. The VIF estimates for explanatory variables exceeded unity, but they fall below the threshold value of 10. The findings imply insignificant presence of multicollinearity among independent variables. This connotes that the Tobit model estimates are consistent, unbiased with minimum variance. Also, the choice of maximum likelihood estimation method over other estimation methods is appropriate.

The results showing the estimates of the Tobit model are presented in Table 5.

The diagnostic tests revealed the value of pseudo R-squared at 0.5045. This indicates that approximately 50.50% of the variation in income diversification indices among oil palm fruit farmers is linked to the independent variables. Therefore, the most of significant variables affecting income diversification among oil palm fruit farmers are incorporated in the specified Tobit model. Additionally, the calculated Chi square value of 39.48 and the sigma estimate suggest that the Tobit model estimates have a good fit.

The findings of the study suggest that an increase in formal education among oil palm fruit farmers has a significant impact on their income diversification. Specifically, for each unit increase in formal education, the income diversification index increases by 0.009 at a statistically significant level of 1%. This indicates that farmers with lower levels of education are more likely to rely solely on farm income, while those with higher levels of education are more inclined to diversify their income sources. Furthermore, obtaining additional formal training can also enhance the

chances of farmers connecting with other potentially profitable employment opportunities. Moreover, increase in years of formal education comes with more

responsibilities and the demand to expand the income sources became obvious in the long run. This result is in line with the findings of [19, 36, 31, 29, 3, 14, 24].

Table 5. Determinants of income diversification

| Variable | Coefficient (dy/dx) | Std. Error | Z | p-value | VIF |
|---|---|---|---|---|---|
| Constant | 0.75437 | 0.1079 | 6.9930*** | <0.0001 | - |
| Marital status of a farmer | 0.02671 | 0.0237 | 1.1258 | 0.2602 | 1.088 |
| Education | 0.00992 | 0.0034 | 2.9045*** | 0.0093 | 1.252 |
| Farming experience | 0.00308 | 0.0018 | 1.7569* | 0.0789 | 1.382 |
| Socialization | 0.00763 | 0.0026 | 2.9365*** | 0.0080 | 1.123 |
| Household size | 0.02399 | 0.0060 | 3.9772*** | 0.0000 | 1.401 |
| Dependent ratio | 0.02269 | 0.0470 | 0.4832 | 0.6290 | 1.262 |
| Age of a farmer | 0.00259 | 0.0016 | 1.6580* | 0.0973 | 1.448 |
| Distance to the market | 0.10886 | 0.0307 | 3.5517*** | 0.0004 | 1.171 |
| Hectare of land | -0.09623 | 0.0528 | -1.8240* | 0.0681 | 1.123 |
| Extension visits | 0.00159 | 0.0101 | 0.1590 | 0.8736 | 1.063 |
| Access to credit | -7.50E-07 | 0.0000 | -1.5483 | 0.1216 | 1.399 |
| Household expenditure | 2.98E-02 | 0.0156 | 1.9143* | 0.0556 | 1.316 |
| Sex of a farmer | -0.03986 | 0.0215 | -1.8554* | 0.0635 | 1.004 |
|  |  |  |  |  |  |
| Sigma | 0.18568 | 0.0076 | 24.4952 |  |  |
| Chi-square(13) | 39.47719 (0.0000) |  | Pseudo $R^2$ |  | 0.5045 |
| Log-likelihood | 79.37248 |  | Normality test Chi-square (2) |  | 169.23(0.000) |

Source: Computed using Gretl econometric software.
Asterisks *, ** and *** represent significant levels at 10%, 5% and 1% respectively.

The result also revealed that the farming experience has a positive significant relationship with income diversification index of oil palm fruit farmers. An increase of one year in the farming experience of an oil palm fruit farmer is associated with a 0.003 unit increase in the farmer's income diversification index, at a 10% probability level. This finding suggests that as the number of years of farming experience grows, the income diversification index of oil palm fruit farmers also increases. This result could be explained by the fact that, experienced oil palm farmers have good knowledge and information on income profile of the enterprise and challenges such as the seasonality and price volatility among others. As such, experienced oil palm farmers will adjust by diversifying income sources to avert the inherent risk in the enterprise. Edet and Etim[26] reported similar result.
Being a member of a social organization exposes one to variety of ideas, opportunities,

information and accumulated social capital. The above assertion was confirmed as the empirical evidence showed a significant positive correlation between the participation of palm oil fruit farmers in social organizations and their income diversification levels. Specifically, each year of membership in a social organization led to a 0.0076 unit increase in the income diversification index of oil palm fruit farmers. This indicates that continuous engagement with group members and exposure to diverse information sources contribute to the enhancement of income diversification. This finding suggests that oil palm fruit farmers that belong to social group are more susceptible to change and adopting innovation probably due to evidences/ testimonies on such innovation that abound among group members. The finding is supported by Edet and Etim [26], Harishankar et al. [31], Andualem and Umer [16] and Akpan et al. [3].

Furthermore, the findings revealed that, household size of oil palm fruit farmers has a direct relationship with the income diversification index. The result indicates that a unit increase in household size will increase income diversification index by 0.0239 at 1% probability level. This result suggests that larger farm households' size will probably increase household demand, which will consequently increase the household income need. The increase in farmers' household income demand will prompt them to look for other income sources to augment the farm income. The finding agrees with the works ofEdet and Etim [26], Idris-Adeniyi et al. [33], Aynalem [19], Harishankar et al. [31], Atalelech and Alula [17], Akpan *et al.* [3], Alemu [14] and Chukwu and Chukwu [24].

The slope coefficient for the age of oil palm fruit farmers is positive (0.00259), and it is statistically significant at the 10% probability level. This indicates that as the age of oil palm fruit farmers increases, so does their income diversification index. The correlation between age and income diversification may be attributed to the experience and household income demands of older farmers. Older oil palm fruit farmers likely require more resources compared to younger farmers, as the production of oil palm fruit in the region is labor-intensive and requires the payment of wages.In order to meet the recurrent expenditures including household expenses and the cost of labour, an aged oil palm fruit farmer will need more income to finance his/her expenditure. Surely these and more reasons will intensify income source diversification. The finding corroborates Edet and Etim [26], Idris-Adeniyi et al. [33], Malami et al. [36], Getahun et al. [29], Atalelech and Alula [17] and Akpan *et al.* [3].

The marginal effect of the distance to the local market is positive (0.10886) and is found to be statistically significant at a conventional level of 1%. This connotes that, the longer or farer the distance from the oil palm fruit farm to the local marketplace, the more oil palm fruit farmers diversify their farm income sources. This suggests that farer distance would induce additional cost to the production process through transportation cost. Since the production is small-scale, increase in transaction cost could reduce the net income and gross margin of farmers. Hence, the option of income diversification will increase with an increase in the distance from farm gate to marketplace. In the same fate, Aynalem [19] and Harishankar et al., [31] have submitted similar results earlier.

The findings also demonstrated a positive correlation between household expenditure and income diversification among oil palm fruit farmers. This means that as household expenditure rises, the diversification index of the farmers also increases. The result is in line with the expectation, since an upsurge in household expenditure will obviously expand the resource needs of the household. To finance the mounting household expenditure will require diversifying from the primary source of income.

On the contrary, the estimated coefficient of land size has a significant adverse correlation with the income diversification indices of oil palm fruit farmers in the southern region of Nigeria. The finding entails that as land size increases, the income diversification index diminishes, or specialization is intensified. Currently, the population density of the region is mounting with increasing alternative land uses. The increase in urban areas and the development processes in the region have resulted in the destruction of a large quantity of wild oil palm trees. Hence, any farmer who is able to harnesses land will likely intensified production. This result corroborates Harishankar et al. [31], Getahun et al. [29], Andualem and Umer [16], Akpan et al. [3] and Chukwu, and Chukwu [24].

Additionally, the number of female oil palm fruit farmers is significantly correlated with a decrease in income diversification index. Specifically, a 10% increase in the number of female oil palm fruit farmers is associated with an average decrease of approximately 0.399 unit in their income diversification indices.

The high level of unemployment among youths might help to explain this result. Also, women folk are more patient than the male and would likely endure a prolong production process of

oil palm fruit compared to the male counterparts. The finding corroborates the empirical finding of Aynalem [19], Andualem and Umer [16], Chukwu, and Chukwu [24].

## CONCLUSIONS

Income diversification among farmers in developing countries has continued to draw the attention of the policy makers in the region. The situation is compounded by increasing youth unemployment, poverty and food insecurity. Farm income diversification occurs because farmers feel that there are better and efficient alternatives elsewhere. In the southern region of Nigeria, the production of oil palm fruit and its associated value chain play a significant role in providing livelihoods for a large number of individuals. Over one million Nigerians are engaged in various aspects of the oil palm fruit production value chain in this region.

Palm oil, one of the derivatives of the oil palm fruit production is a major constituent in the daily dietary intake of Nigerians, hence its sustenance in production is of upmost importance to the country. Investigating income diversification among oil palm fruit farmers in the southern region of the country is vital, especially considering the historical significance of the subsector to the Nigerian economy in the 1960s. This research focuses on analyzing the income diversification index and the factors that influence it among oil palm fruit farmers in Akwa Ibom State, a prominent producing area in Nigeria.

The Herfinhdal index and Tobit model were employed to analyze information collected from oil palm fruit farmers. The outcome showed that income diversification indices had a mean of 0.731, a minimum value of 0.019, and a maximum value of 0.996. Factors positively influencing income diversification among oil palm fruit farmers include level of formal education, farming experience, socialization, household size, age of the farmers, proximity to the market, and household expenditure. On the contrary, land size and farmers' sex were negative determinants. To reduce income diversification among oil palm fruit farmers in the State, all stakeholders should work together to provide land for oil palm farmers. Again, youths should be encouraged to participate in oil palm fruit production in the region

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