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# Gender differential in allocative efficiency of oil palm processors in Southwest, Nigeria

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## Abstract

The study evaluates the gender differential in the allocative efficiency of oil palm processors in Nigeria. A survey was conducted using a well-structured questionnaire while a multistage sampling technique was used to select 320 (160 males and 160 females) oil palm processors. Descriptive statistics, stochastic frontier model and Ordinary Least Squares (OLS) were used for the analysis. The results showed that there is clear evidence of variations in the AE of male (63%) and female (54%) processors. Female processors were still less efficient than male counterparts in terms of technical efficiency (TE), cost efficiency (CE) and allocative efficiency (AE). The value of AE is low compared with TE and CE with the female processors, having about 9 percent less than the male processors. There is more room for female processors to increase their AE than the male counterparts if cost is minimized and input resources are appropriately combined. Education and experience are the key drivers of AE for both genders, while age and family size drive the AE of the female processors more in the area. The study concludes that males are more efficient than females, but there are more opportunities for females to increase efficiency if given access to information and training with gender-specific technologies.



## Introduction

Several studies in Nigeria and other sub-Sahara Africa (SSA) countries (Agwu et al., 2017; Koledoye & Deji, 2015; Udume et al., 2021) have reported that the region is naturally endowed in terms of resources and human capital but fails in the appropriation of the available resources for maximum production. Despite the improved technologies and other innovations in agriculture, small-scale producers still do not get it right not only in technical efficiency but also in the allocative efficiency that has to do with the ability to use

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resources in optimal proportion given their market prices. Recent research such as Bankole et al. (2018) and Osei-Mensah et al. (2021) have raised the problem of inefficiency in processors' resource utilization. Some processors may ignore certain factors that are paramount to production and overuse some consequently, which would affect their efficiency and productivity. Lawal et al. (2013) stated that an efficient technique implies that inputs are used in a manner that gives a maximally efficient product from given resources. This will ensure sustainable output over time.

Exploring the efficiencies especially the allocative efficiency using the case of oil palm processors in Nigeria is well taught due to its economic importance and smallholder population in the enterprise (Osei-Mensah et al., 2021). Koledoye and Deji (2015) reported that small-scale processors in the palm oil industry contribute about 80 percent of Nigeria's total output while small-scale agricultural processors constitute nearly 90 percent of the farming households. The usefulness of palm oil in income generation, human nutrition, job creation, and industrial use makes it an indispensable economic product that needs urgent attention for research. Also, oil palm production forms the main occupation of the rural dwellers using traditional methods (Onu et al., 2021), and there is a large market that has meant the smallholders unable to meet the demand resulting in importation as a supplement. Despite the relevance of this product, its production and processing confront numerous problems, the most significant of which is low productivity due to technical and allocative inefficiencies. Therefore, the efficiency in oil palm processing cannot be overlooked and overemphasized for the processors. This is because processors are expected to operate rationally, maximizing profit and minimizing cost (Adegunsoye & Mafimisebi, 2019). Many studies on oil palm focused on the production, profitability, marketing and technology adoption (Ikuenobe et al., 2021; Koledoye & Deji, 2015; Koyenikan & Anozie, 2017) while few studies that worked on efficiency only focused mostly on the technical efficiency, and many of them lumped men and women as a pool in data analysis (Abdulsalam et al., 2014; Adanguidi 2019; Adeniyi et al., 2014; Bankole et al., 2018; Lawal et al., 2013; Osei-Mensah et al., 2021). The studies on efficiency with gender differentials are very few in the literature, and they are mostly limited to the technical efficiency component. This study, therefore, aims to fill this research gap by exploring not only the technical efficiency but also the allocative efficiency of the processors as an entrepreneurial enterprise. Again, several studies in the literature (Adegunsoye & Mafimisebi, 2019; O'Sullivan et al., 2014; Sarku, 2016) have established a strong relationship between gender and agricultural productivity. Thus, this study will also contribute to the body of knowledge by analysing allocative efficiency based on men and women processors, which has not been found in the literature, especially among oil palm processing enterprises. The gender differentials are very paramount because women's contributions to men are not being objectively assessed and they are gradually forming the majority in the agribusiness population of the rural areas (Abiola & Omoabugan, 2001; Igbaroola & Oladunni, 2021). According to Adegunsoye and Mafimisebi (2019), females dominate agricultural value addition activities from production to marketing though with low productivity. Anaglo et al. (2014) observed a significant relationship between gender and access to resources while women are increasingly becoming principal stakeholders in agricultural and entrepreneurial development in most developing countries (Okorie et al., 2020). Udume et al. (2021) stated that women make important contributions to agricultural and rural economies in all developing countries, and households, where women are more active in agriculture than men, are more likely to engage in agricultural commerce (Akter et al., 2020) and generate more enterprises (Agwu et al., 2017). As a result of this research, processors (both male and female) would adopt good management techniques and practices that will ensure efficient utilization of current and available resources (Adeniyi et al., 2014). It will provide pertinent information for policies that will enhance the production value chain and gender-responsive processing technologies. The study will also give more insight into socio-economic factors driving the gender implications for allocative efficiency and the responses by the processors' communities. It will also serve as a gap bridging effort to identify hindrances that create unequal opportunities for both genders as a measure to enhance overall efficiency in entrepreneurial practices.

Thus, it is against this background that the study specifically determines and compares the efficiencies of male and female oil palm processors; describes the level of allocative efficiency of males and females, and determines the factors influencing the allocative efficiency of male and female oil palm processors. The hypothesis was also conducted if there is a significant difference between male and female allocative efficiency of the processors.

## Literature Review

Gender is used to explain and analyse the responsibilities, activities, needs, constraints and opportunities of males and females (Buckland & Haleegoah, 1996; Ejembi et al., 2008) with their roles in society. According to Angya (2008), gender division of labour exists in the course of agricultural production, and this has implications on the physical and social well-being of the farmers. Agriculture is a dynamo for socio-economic development in most agrarians' developing countries. However, low productivity is evident despite its dominant contribution to development. This has inferences on income generation and food security for most of its practitioners (Sarku, 2016). The general argument has shown that increase in overall agricultural productivity, empowering women and reducing poverty could only be realized by increasing women's agricultural productivity (Doss, 2018). Gender is an essential analytic category for understanding the impacts of agricultural development investments, irrespective of those (women or men) focused as technology users or beneficiaries (Doss, 2018), especially in an agrarian community. Farming and food preparation are highly gendered activities. The gendered patterns of agricultural labour, household enterprises, family food consumption decisions, and social structures inevitably filter the consequences of agricultural technologies and development interventions. Agricultural technologies are not, in general, gender-neutral. Thus, a gender lens is essential for assessing the effectiveness and impact (whether ex-ante or ex-post) of agricultural technology or intervention (Doss, 2018). According to Kanesathasan et al. (2012), the contribution of women to agricultural production around the world has been on the increase over the past decade. Despite this, many agricultural programs struggle to capture the different gender effect on key output and outcomes in agriculture, that is, different roles that women and men play in farming. Therefore, it is undeniable that equal integration and participation of both genders in agriculture and other enterprises is critical to resolving the food issue (Akter et al., 2020).

## Methodology

### *Data Collection*

The study conducted a survey using two major palm oil producing states in the Southwest zone of Nigeria: Ekiti and Ondo in 2020. The two states were purposively selected because of their predominance in oil palm processing enterprises in the region. The Agricultural Development Project (ADP) in each state provided information on the concentration of processing units and based on the information, four (4) Local Government Areas (LGAs) were purposively selected due to the availability of processing units. The next stage involved a random selection of four (4) communities from each LGA, while ten (10) processors (5 males and females each) were selected from each community using the snowball sampling technique. This is required to overcome terrain obstacles and identify the main male and female processors in each community. This totaled 320 respondents, but only 275 copies of the questionnaire were accurately answered and valid for the data analysis.

### *Data Analysis*

Apart from descriptive statistics to examine the behaviour of the data collected, the stochastic frontier production function was the main analytical tool used in this study. The study adopted the approach of Coelli and Battese (1996) as also used in several studies in agriculture (Bankole et al., 2018; Ogundari & Ojo, 2007).

### *Model Specification for the Stochastic Frontier Production Function (SFPF)*

*1. Technical Efficiency (TE) function model*

Stochastic Frontier Production Function was used to estimate the level of efficiency between the male and female processors as well as determine factors influencing the efficiency of the two groups. The stochastic frontier production function model of the oil palm processors is specified in Equation (1) by the Cobb-Douglas production function specified as follows:

$$\ln QOP_i = \gamma_0 + \gamma_1 FFB_{il} + \gamma_2 LBM_{2i} + \gamma_3 DFA_{3i} + \gamma_4 TPC_{4i} + \gamma_5 DSL_{5i} + \gamma_6 HOT_{6i} - (Vi + Ui) \quad (1)$$

The labels are: Quantity of Oil Palm (QOP), Quantity of Fresh Fruit Bunch (FFB), Labour (LBM), Depreciation cost (DFA), Transport cost (TPC), Volume of diesel (DSL), and Volume of water (HOT). Vi = random errors; Ui = A non-negative random variable; Ln = natural logarithm, $\gamma_0 - \gamma_6$ = estimated coefficients.

Technical efficiency (TE) is defined in terms of the observed output ($QOP_i$) to the frontier output ($QOP_i$*). The $QOP_i$* is the maximum output achievable given existing technology and assuming 100% efficiency, Xi is the independent variable. It is denoted in Equations (2) and (3) as;

$$QOP^* = f(X_i \gamma_i) + e \quad (2)$$

$$\text{That is, } TE = \frac{QOP_i}{QOP_i^*} \quad (3)$$

where, $0 \leq TE \leq 1$

*2. Cost Efficiency (CE) function model*

The Cobb-Douglas cost frontier function for the palm oil processors is specified in Equation (4) as:

$$\ln TIC_i = \theta_0 + \theta_1 QOP_{il} + \theta_2 COL_{2i} + \theta_3 COD + \theta_4 COW4i + \theta_5 DPC_{5i} + \theta_6 TPC_{6i} + \theta_7 FFB_{7i} + (V_i - U_i) \quad (4)$$

where the label is stated as Total cost (TIC), palm oil produced (QOP), labour cost (COL), cost of diesel (COD), cost of water (COW), and depreciation cost (DPC).

The cost efficiency (CE) of individual producers is defined in terms of the ratio of the observed total cost ($TIC_i$) to the corresponding frontier minimum total cost ($TIC_i$*).

The cost-efficiency of the producer is expressed in Equation (5) as:

$$CE = \frac{TIC_i}{TIC_i^*} \quad (5)$$

where TICi is the observed total cost and $TIC_i$* is the frontier cost. The CE ranges from 1 to ∞ i.e. $1 \leq CE \geq \infty$

*3. Economic efficiency (EE) estimation*

The economic efficiency is the ratio of minimum observed total production cost (TIC*) to actual total production cost (TIC). That is:

The economic efficiency (EE) was estimated as the inverse of cost efficiency (Equation (6)) i.e.,

$$EE_i = 1/CE_i \quad (6)$$

where, the EE also has values in the range of 0 and 1

*4. Allocative Efficiency (AE) Estimation*

The allocative efficiency was obtained from technical efficiency (TE) and economic efficiency (EE) estimated in Equation (7) as follows:

$$AE = EE/TE \quad (7)$$

This implies that $0 \leq AE \leq 1$.

*5. Factors influencing allocative efficiency (AE)*

The factors influencing allocative efficiency (AE) were determined using Ordinary Least Squares (OLS) regression with AE as the dependent variable and the independent variables as the selected socioeconomic factors of the processors. The explicit function of the model is defined in Equation (8) as:

$$AE_i = \delta_0 + \delta_1 EDL_{il} + \delta_2 EPR_{2i} + \delta_3 AGE_{3i} + \delta_4 HHS_{4i} + \delta_5 AES_{5i} + \delta_6 ATC_{6i} + \delta_7 MTS_{7i} + \delta_8 APD_{8i} + \varepsilon i \quad (8)$$

where the label is stated as: education (EDL), experience (EPR), age (AGE), household size (HHS), extension services (AES), credit (ATC), marital status (MTS), and technology adoption decision (APD).

Lastly, the hypothesis was tested using independent sample test.

## Results and Discussion

### *Determine and Compare the Efficiency between Female and Male Oil Palm Processors*

*Estimation of stochastic production function*

Table 1 shows the Maximum Likelihood (ML)

**Table 1** Maximum Likelihood Estimates of Stochastic Production Function

| Variable | Female | | Male | |
|---|---|---|---|---|
| | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | 2.18 | 1.01 | 8.93 | 3.55 |
| Quantity of FFB | 0.80** | 2.17 | 0.44*** | 7.18 |
| Labour | -0.05 | -0.70 | 0.16 | 0.77 |
| Depreciation costs on Asset | 0.02 | 0.51 | -0.02 | 0.39 |
| Transportation cost | 0.13*** | 6.22 | -0.31 | 0.11 |
| Diesel | 0.60* | 1.70 | 0.05 | 0.01 |
| Water | 0.01 | 0.37 | 0.26*** | 5.31 |
| Sigma-squared ($\sigma^2$) | 1.12*** | | 0.22*** | |
| Gamma ($\gamma$) | 0.96*** | | 0.54*** | |
| LR Test | -283.01 | | -153.03 | |

*Note*: $*p < .1$, $**p \leq .05$, $***p < .01$.

**Source:** Field Survey (2021)

estimations of the stochastic frontier production function parameters for oil palm processors by gender differential. The statistical significance of sigma-square ($\sigma^2$) indicated the goodness of fit and correctness of the specified assumption of the composite error terms distribution as depicted in the Table. Again, the values of gamma ($\gamma$) for the female and male results revealed that 96 percent, and 54 percent of the variations in the output of the female and male processors respectively were accounted for by the technical efficiency. The results found that a unit increase in the quantity of FFB will result in about 80 percent and 44 percent increase in the quantity of palm oil produced by female and male respondents, respectively. It was discovered that female's contributions to productivity were nearly twice as large as their male counterparts, if other variables held constant. A positive and significant relationship was also found in the studies of Abdulsalam et al. (2014) among the processors in Cross River State, Nigeria. This is also in line with Bankole et al. (2018) and Ogundari and Ojo (2007) research carried out in Nigeria among small-scale farmers. Processor's output was positively and significantly affected by the addition of a unit of transportation cost. This means that a naira increase in the cost of transportation will increase output by 12 percent for the female respondents. This is contrary to *apriori* expectation, but the probable reason is that the majority of the outfits are located very near oil palm plantations thereby reducing transportation costs of short distances. The output of female processors was positively and significantly elastic to additional use of a volume of diesel, meaning that increasing the volume of diesel used by one litre will improve output by 60 percent. Likewise, the output of male processors was positively and significantly elastic to additional use of a volume of water, meaning that increasing the volume of water used in oil palm processing by one litre would result in a 26 percent increase in the amount of palm oil produced.

### *Technical Efficiency (TE) Estimates*

Given the specification of the Cobb-Douglas stochastic frontier model in Table 2, the predicted technical efficiency varies widely among the sampled processors. The gender differentials revealed that the mean technical efficiency of female and male respondents was 0.58 and 0.77 respectively. This suggests that female and male processors might increase their TEs by an average of 42 percent and 23 percent, respectively, by reducing technological inefficiencies. Adanguidi (2019) observed an average TE of 0.891 in his study of factors affecting the technical efficiency of oil palm fruit processing units in South-East Benin. This figure is higher than both TE figures (female and male) realized in this study.

### *Estimation of Stochastic Cost Function*

The Maximum Likelihood (ML) estimates of the parameters of the stochastic frontier cost function for the oil palm processors by the gender differentials are presented in Table 3. The statistical significance of sigma-square ($\sigma^2$) indicated the goodness of fit and correctness of the specified assumption of the composite error terms distribution as depicted in the Table.

**Table 2** Gender distribution of processors by technical efficiency estimates

| Efficiency Range | Female | | Male | |
|---|---|---|---|---|
| | Frequency | Percent | Frequency | Percent |
| ≤0.20 | 11 | 6.04 | - | - |
| 0.21–0.30 | 25 | 13.74 | - | - |
| 0.31–0.40 | 22 | 12.09 | - | - |
| 0.41–0.50 | 19 | 10.44 | 1 | 1.08 |
| 0.51–0.60 | 23 | 12.64 | 4 | 4.30 |
| 0.61–0.70 | 13 | 7.14 | 9 | 9.68 |
| 0.71–0.80 | 14 | 7.69 | 45 | 48.39 |
| 0.81–0.90 | 21 | 11.54 | 27 | 29.03 |
| 0.91–1.00 | 34 | 18.68 | 7 | 7.53 |
| Total | 182 | 100.00 | 93 | 100.00 |
| Mean | 0.58 | | 0.772 | |
| *SD* | 0.26 | | 0.090 | |
| Minimum | 0.091 | | 0.483 | |
| Maximum | 0.977 | | 0.927 | |

**Source:** Field Survey (2021)

**Table 3** Maximum Likelihood Estimates of Stochastic Cost Function

| Variable | Female | | Male | |
|---|---|---|---|---|
| | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | 0.16 | 0.39 | 2.17 | 2.53 |
| Palm oil quantity | 0.04 | 0.59 | 0.44*** | 4.17 |
| Labour cost | 0.99*** | 31.32 | 0.47*** | 9.41 |
| Diesel cost | 0.02 | 0.61 | 0.03 | 0.57 |
| Water cost | 0.04 | 0.13 | -0.47 | 1.01 |
| Depreciation cost on asset | -0.33 | 0.92 | 0.14*** | 2.68 |
| Transportation cost | 0.05*** | 3.45 | 0.08*** | 2.75 |
| Cost of FFB | 0.06*** | 2.45 | 0.07** | 2.16 |
| Sigma-squared ($\sigma^2$) | 6.95*** | | 2.11*** | |
| Gamma ($\gamma$) | 0.92*** | | 0.52*** | |
| LR Test | -131.99 | | -148.76 | |

*Note*: $*p < .1$, $**p \leq .05$, $***p < .01$.
**Source:** Field Survey (2021)

Again, the gamma ($\gamma$) values for the female and male results revealed cost inefficiency accounts for almost 92 percent and 52 percent of the variations in the output of the female and male respondents, respectively. The results revealed that both female and male quantity of palm oil produced had positive and direct relationship with total cost, but only the male processors' coefficient was statistically significant at 1 percent. It was discovered that the male respondent's magnitude (44%) is greater than the female counterpart's (4%), implying that the variable has a greater impact on males than females. Furthermore, both female and male respondents' labour cost coefficients were positive and statistically significant at the 1 percent level. Going by the results, the magnitude of female's coefficient is greater than that of male, therefore, making the variable have more impact among females than males. The male's depreciation cost was positive and statistically significant in affecting the total cost. This implied that the variable has a stronger effect among the male than the female counterpart. The coefficients of transportation cost were positive and significant at 1 percent apiece for both male and female respondents. One can deduce that an increase in fuel prices will be translated into transportation cost and thereby increase the cost incurred by the processors in conveying FFB from the farm gate to the processing centres. The cost of FFB coefficients were positive and significant at the 1 percent and 5 percent levels for female and male respondents, respectively. The results revealed that female and male respondents generate about 6 percent and 7 percent respectively of increase in the total cost incurred for every 1 percent change in the cost of FFB. The result conformed with the findings of Lawal et al. (2013) carried out among oil processors in Benue State.

### *Cost Efficiency (CE) Estimates*

Given the specification of the Cobb-Douglas stochastic frontier model, the predicted cost efficiency varies among the sampled processors as shown in Table 4. The gender differential results revealed that the mean cost efficiency of female and male respondents was 0.71 and 0.80 respectively. On average, the male respondents were more cost efficient than the female counterpart with a difference of 9.5 percent.

**Table 4** Gender distribution of processors by cost efficiency estimates

| Efficiency Range | Female | | Male | |
|---|---|---|---|---|
| | Frequency | Percent | Frequency | Percent |
| ≤0.40 | 17 | 9.34 | - | - |
| 0.41–0.50 | 16 | 8.79 | 1 | 1.08 |
| 0.51–0.60 | 17 | 9.34 | 6 | 6.45 |
| 0.61–0.70 | 21 | 11.54 | 20 | 21.51 |
| 0.71–0.80 | 35 | 19.23 | 23 | 24.73 |
| 0.81–0.90 | 53 | 29.12 | 10 | 10.75 |
| 0.91–1.00 | 23 | 12.64 | 33 | 35.48 |
| Total | 182 | 100.00 | 93 | 100.00 |
| Mean | 0.708 | | 0.803 | |
| SD | 0.190 | | 0.150 | |
| Minimum | 0.219 | | 0.459 | |
| Maximum | 0.966 | | 1.000 | |

**Source:** Field Survey (2021)

### *Estimates of Allocative Efficiency*

The allocative efficiency estimates are presented in Table 5. The mean allocative efficiency of male respondents was 0.63, and that of their female counterparts was 0.54. It implied that male was 63 percent efficient in allocating their resources effectively while female was 54 percent efficient in allocating their resources. The result of this study is contrary to the findings of Lawal et al. (2013), which was carried out among oil palm processors in Benue State, Nigeria, where it was noted that allocative efficiency varied widely among processors ranging between 1.02 and 1.99 with a mean efficiency of 1.05.

### *Factors Affecting Allocative Efficiency of the Oil Palm Processors*

Factors determining the allocative efficiency in oil palm processing are presented in Table 6. The analysis starts by resolving the problems of multicollinearity using variance inflation factor (VIF) for the continuous variables, and contingency coefficient (CC) for the dummy variables. The values gotten were less than 5.00 and 0.61 for VIF and CC, respectively, making the predictors desirable for the model. The values of $R^2$ were 0.83 and 0.87 indicating that the total variations in the AE of female and male processors are explained by 83 percent and 87 percent respectively of the explanatory variables. The F-statistics of values of 17.39 and 43.13 were statistically significant for the female and male processors, respectively showing that the models have goodness of fit and are desirable for predictions.

The coefficient of educational status had a direct relationship with the allocative efficiency. This means that education will bring about a 4.9 percent and 1.4 percent increase in the allocative efficiency of the female and male respondents, respectively. Likewise, the direct relationship between allocative efficiency and experience indicates that experienced processors would efficiently allocate resources better than their inexperienced counterparts.

**Table 5** Gender distribution of allocative efficiency for oil palm processors

| Efficiency Range | Female | | Male | |
|---|---|---|---|---|
| | Frequency | Percent | Frequency | Percent |
| ≤0.50 | 60 | 32.97 | - | - |
| 0.51–0.60 | 36 | 19.78 | - | - |
| 0.61–0.70 | 30 | 16.48 | 72 | 77.42 |
| 0.71–0.80 | 22 | 12.09 | 13 | 13.98 |
| 0.81–0.90 | 11 | 6.04 | 3 | 3.23 |
| 0.91–1.00 | 23 | 12.64 | 5 | 5.38 |
| Total | 182 | 100.00 | 93 | 100.00 |
| Mean | 0.54 | | 0.63 | |
| *SD* | 0.38 | | 0.51 | |
| Minimum | 0.18 | | 0.23 | |
| Maximum | 1.00 | | 0.98 | |

**Source:** Field Survey (2021)

**Table 6** Gender distribution of the determinants of allocative efficiency in oil palm processing

| Variable | Female | | | Male | | |
|---|---|---|---|---|---|---|
| | Coefficient | *SE* | *p*-value | Coefficient | *SE* | *p*-value |
| Education | 0.049*** | 0.008 | .000 | 0.014* | 0.008 | .094 |
| Experience | 0.019*** | 0.002 | .000 | 0.005*** | 0.002 | .004 |
| Age | -0.009*** | 0.001 | .000 | 0.001 | 0.001 | .508 |
| Household size | 0.011** | 0.005 | .031 | -0.008 | 0.005 | .143 |
| Extension services | -0.008 | 0.025 | .729 | -0.045** | 0.022 | .051 |
| Association | 0.011 | 0.061 | .813 | -0.067 | 0.046 | .151 |
| Credit | 0.004 | 0.267 | .900 | 0.078** | 0.031 | .014 |
| Marital Status | 0.017 | 0.015 | .313 | 0.008 | 0.043 | .855 |
| Technology adoption | 0.027 | 0.041 | .549 | 0.159** | 0.080 | .048 |
| Constant | 0.441 | 0.102 | .000 | 0.537 | 0.118 | .000 |
| $R^2$ | | 0.526 | | | 0.587 | |
| *F*-value | | 21.24*** | | | 4.313*** | |

*Note*: $*p < .1$, $**p \le .05$, $***p < .01$.
**Source:** Field Survey (2021)

Despite the small effect, the magnitude of the female respondents was also greater than male respondents in respect to years of processing experience. In the case of females, the coefficient of age was negative and statistically significant at 1 percent. However, the results of age were mixed in the literature, but it can be argued that the inverse relationship between age and allocative efficiency could be as a result of old age, which incapacitated the processors from being efficiently allocative (Abdulsalam et al., 2014; Adanguidi, 2019). The coefficients of household size for female respondents were significant implying that an increase in household size will increase female allocative efficiency by 1.1 percent. Extension services' coefficient had an inverse relationship with the allocative efficiency of the male and female respondents which was also observed in the study of Agwu et al. (2017). Again, the male respondents' access to credit will result in a 7.8 percent rise in allocative efficiency. This implied that access to credit by male processors tends to increase the opportunities of purchasing better technologies, thereby, having higher allocative efficiency. The adoption decision coefficient for males was positive and significant. Hence, adopters would more efficiently allocate resources than non-adopters, based on the direct relationship between allocative efficiency and adoption decision. The probable reason might be because the innovative technologies will process faster, minimize cost and save time, thereby making them efficiently allocative. The study shared similar view with the findings of Agwu et al. (2017), who found a positive and significant association between allocative efficiency and processing methods. Abdulsalam et al. (2014) observed that the determinants of allocative efficiency for firms are experience, educational level and access to extension services.

### *Hypothesis Testing Results*

Table 7 presents the independent samples test's result for the hypothesis, which stated that there is no significant difference between the efficiency (TE, CE and AE) of the female and male processors in the study area. Again, the results of independent samples test for significant difference between the efficiency of the female and male processors showed that TE (8.66), CE (4.49) and AE (1.79) was significant at a 5 percent level, therefore, the null hypothesis was rejected in favour of the alternative.

## Conclusion and Recommendation

This paper empirically evaluates the gender differences in allocative efficiency of small-scale oil palm processors, which serves as a key entrepreneurial activity in the rural areas of Southern Nigeria. This enterprise forms about 60 percent of the rural dwellers' occupation and is a major component of the small-scale processing unit in Nigeria. Quite different from the previous studies, the idea is to explore the efficiency of men and women processors by estimating the relationship between technical efficiency (TE) and cost efficiency (CE) to attain the allocative efficiency (AE) using oil palm enterprise as a case study. The findings unveil that there are degrees of TE, CE and AE for both genders with certain socioeconomic drivers that could be of interest for policy implications. The similarity is observed in the quantity of FFB as the determinants of TE for both genders, but female processors had greater magnitude. It makes a difference when transportation cost and energy (volume of diesel) used significantly affect female productivity whereas the volume of water used is the only difference in the case of male productivity. Likewise, the similarity is noticed as the costs of labour, transportation and FFB significantly affect both genders. The difference is recorded as the quantity of palm oil and depreciation cost on the assets have significantly influenced the male's cost efficiency.

However, despite both experiencing a certain level of TE, male processors are about 19 percent more technically efficient than female processors. Both genders still have

**Table 7** Result of the hypothesis using independent *t*-testing in the efficiency of respondents

| Parameters | | *t* | *df* | *p*-value |
|---|---|---|---|---|
| CE | Equal variances assumed | -4.16** | 273.00 | .000 |
| | Equal variances not assumed | -4.49 | 226.63 | .000 |
| TE | Equal variances assumed | -6.66 | 273.00 | .000 |
| | Equal variances not assumed | -8.66** | 248.21 | .000 |
| AE | Equal variances assumed | 1.93 | 273.00 | .000 |
| | Equal variances not assumed | -1.79** | 204.68 | .037 |

*Note:* Female: Mean CE: 0.71, TE: 0.58, AE: 0.54; Male: Mean CE: 0.80, TE: 0.77, AE: 0.63.
$^{*}p < .1$, $^{**}p \leq .05$, $^{***}p < .01$.
**Source:** Field Survey (2021)

opportunities to improve their TE by reducing technical inefficiencies. As a result, the female processors can still lower inputs twice as much as the male processors in order to attain the same level of output. Again, the male's CE is 9 percent higher than their female counterparts. The findings also give opportunities to both genders to be more cost-efficient. Therefore, both processors will still achieve the same level of output if the overall production cost can be reduced through cost minimization. Female processors, on the other hand, will save roughly 9 percent over male processors. The AE is low compared with TE and CE with the female processors having nearly 9 percent less than the male processors' AE although, there is room for both genders to increase their AE through cost minimization and an appropriate combination of input resources. Despite the similarities, the female processors could still maintain the current level of output if one-third of the overall cost of production is technically reduced with minimizing of costs. The efficiencies estimate indicate that CE appears to be more significant than AE and TE for both genders while the AE constitutes the least estimates for males and females.

Economic efficiency is achieved when a firm is producing a given output at the minimum total cost of production, that is, the product of allocative and technical efficiencies (Mishra, 2007). This proves that allocative efficiency is an integral part of economic growth and development. Therefore, the educational level and processing experience affect the genders' allocative efficiency alike. It does not matter whether male or female, an educated and experienced processor will be allocatively efficient with the rightful combination of inputs at a minimum cost. The difference is seen as age of the processor and household size significantly forming a driver for the female's allocative efficiency whereas, access to extension services, access to credit and adoption of technologies are the main driver of male's allocative efficiency.

The findings of this study on TE and CE are not far from the previous studies, but we have been able to established that the AE of the small-scale processors is relatively above average giving their operating circumstances. The male processors are significantly more allocative efficient than the female processors. Female processors still have more room to be efficient than the male counterparts if given access to credit, education, and improved technologies. This further reiterates the presence of gender gaps despite the increasing women involvement in the entrepreneurial businesses and becoming a bread winner in most homes especially in Africa and Nigeria inclusive.

Based on the findings of this study, we recommend that any policy directed toward managerial performance and gender specific innovative technologies should be embraced since there is clear evidence of variations between male and female processors. Again, the processors' education and experience have a considerable impact on both genders' allocative efficiency. Thus, revamped educational sustainability by the Government will increase the efficiency and performance of the processors. This can be achieved through entrepreneurial training courses on resource utilization for the processors couple with the practical on-site training on the use of modern technologies. The practical experience could increase the processing methods, solve technical problems and also boost productivity. Due to relatively low AE especially for women processor, more information and training on how to appropriately process for quality output should be organized by the Government. This can be done through the extension agents who work closely with the processors. The information of the best practice processor can also be disseminated for all other processors since experience has significant relationship with the allocative efficiency. Women make essential contributions to entrepreneurial and agricultural enterprises across the developing world (Udume et al., 2021). Age of the female processor and family size have a significant influence on their allocative efficiency. Thus, the government should provide incentives to young female processors, such as an affordable family planning policy and subsidized input resources. This will encourage the youths to take advantage of the expanding industry and to claim their space in the palm oil sector.

## Conflict of Interest

The authors declare that there is no conflict of interest.

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