# ALLOCATIVE EFFICIENCY OF PRO VITAMIN A ODOURLESS CASSAVA *FUFU* PROCESSING IN ANAMBRA STATE, NIGERIA.

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## ABSTRACT

*Allocative efficiency of pro-vitamin A cassava odourless fufu processing in Anambra State, Nigeria using one hundred and twenty processors was studied. The respondents were selected using a multi-stage random sampling technique. A structured questionnaire and oral interview were used to elicit information for the study. Percentage responses, allocative efficiency indices and the Tobit regression model were used to capture the objectives of the study. The result showed that none of the fufu processors achieved allocative efficiency by equating the value marginal product (VMP) to their factor prices. Additionally, the determinant factors to fufu processing were household size* (0.0017) *and membership of organization* (0.0023). *There is a need to encourage fufu processors to form or join cooperatives and advise households with large members to engage in fufu processing enterprise because of the use of readily available labour.*

Keywords: Allocative Efficiency, Odourless, Pro Vitamin A, Cassava, *Fufu*, Processing

## INTRODUCTION

*Fufu* is a smooth-textured cassava derivative with the singular characteristic of having a repulsive odour that may repel both consumers and potential ones alike. However, with the advent of odourless fufu through research, courtesy of the International Institute for Tropical Agriculture (IITA), Ibadan and National Root Crops Research Institute (NRCRI), Umudike, has proven to be a remedy (NRCRI, 2017), As result, preview enormous consumers of the food are making reversal, typified by its high acceptability in many homes, social functions and eateries (Achi, 2006, IITA, 2014).

Generally, cassava derivatives, fufu inclusive are high-energy food and extreme consumption, could cause the consumer to vitamin A dietary-related diseases (NRCRI, 2017). According to (Egesi and Eke – Okoro, (2013) the worst affected are pregnant and children under 5 years. However, through bio-fortification by International Institute for Tropical Agriculture (IITA), Ibadan and National Root Crops Research Institute (NRCRI), Umudike, pro-vitamin A cassava varieties, precursor to vitamin A, including NR07/0326, NR07/0506, NR07/0497, NR07/0499, NR07/0427, NR07/0432 were developed to mitigate against the deficiency (Egesi and Eke-okoro, 2013).

The technology of odourless fufu production according to the Food and Agriculture Organization (FAO), (2017) includes Sorting – Weighing - peeling – Washing – Soaking - Pulping and Sifting – Sedimentation – Dewatering - Granulating – Drying – Sieving – Milling Blending – Packaging. The processing technology was spread to the processors in the Anambra State by the State Agriculture Development Programme (ADP) extension officers (Ume, Okoye, Onwujiariri, and Achebe, 2020). In recent times, empirical studies (Achi, 2006, Ayinde, 2006; Ume, *et al*; 2020) showed low consumption of fufu occasioned by the resurfacing of the offensive odour. This connotes the discontinuation adoption of the technology, leading to low productivity. The low productivity could be correlated with allocative inefficiency and among other factors (Achi, 2006). Allocative efficiency (AE) according to Okoye, Onyenweaku and Asumugha, (2007) is achieving maximum potential output at the least cost. Ume, *et al*;(2020) reported that allocative efficiency is the ratio of the technically maximum output at the fufu level of resources to the output obtainable at the optimum level of resources. It is imperative to state that proper allocative efficiency in fufu processing leads to improved nutrition, enhances food security, creates employment opportunities and improves the efficiency of utilization of labour (Okoye; *et al;* 2007).

However, among processors in sub-Saharan Africa, nevertheless, the common practice of trial-and-error methods on resource use by most processors in the region has attendant consequences of either under or overutilization of resources, leading to enormous losses in quantity and quality of fufu-produced with attendant poverty ensuing (Ume, Isiocha, Ochiaka, Aja, and Chukwu, 2016). The aforesaid scenario has made many processors jettison the business with the erroneous concept that processing enterprise, odourless fufu inclusive is not profitable. Therefore, to maximize fufu production, the need to achieve allocative efficiency in the major resources used in fufu processing, including cassava roots, labour and capital is very vital. Against this background, this study was carried out in Anambra State to ascertain how efficient the fufu processors are in the use of vital resources in fufu production. This research is very imperative, as to the best knowledge of the researchers; there is a paucity of information in the subject area in the study area. Specifically, the study's objectives are to describe the socioeconomic characteristics of the respondents; determine the allocative efficiency of odourless fufu processors and determine to allocative efficiency of odourless fufu processing technology in the study area.

## METHODOLOGY

Anambra State lies between latitude $5^0$38 'N and $6^0$47 'E of the Equator and longitude $6^0$36 'N and $7^0$21 'E of Greenwich Meridian. Anambra State shares a boundary with Enugu and Delta States in the East and West respectively. While bordered in the South by Imo State and in the North by Kogi State. Awka is the capital of Anambra State. The State has an estimated population figure according to the National Population Census of 4.184 million people (NPC, 2006). The State is blessed with cassava derivatives processor, fufu type included. Bricklayers, auto motor mechanics, salons and trading were among the off-farm income activities engaged by the people.

First, twelve Local Government Areas (LGA) were randomly selected from seventeen. Second, ten towns were randomly selected from each LGA. These brought to a total of one hundred and twenty towns. Third, one processor was selected from each town from the lists of extension agents residing in the town and this brought to a total of one hundred and twenty fufu processors for a detailed study.

The primary data used in analyzing the objectives of the study were obtained using well-structured questionnaires and an oral interview schedule. Descriptive statistics such as Frequency Distribution Table and mean were used to describe the socio-economic characteristics of the respondents, allocative efficiency indices were used to determine the allocative efficiency of odourless fufu processors, while Tobit regression model analysis was used to access the determinants of allocative efficiency of odourless fufu processing technology in the study area.

The ordinary least square regression method was used to obtain the bi of the allocative efficiency. This can be explicitly represented as:

$$Y = b0 + b1\ X\ 1 + b2\ X\ 2 + b3\ X\ 3 + \ldots + b6\ X\ 6 + e \quad \ldots\ldots(1)$$

Where Y = Output of cassava processing (Kg)

$X_1$ = Water (Litters); $X_2$ = labour (man-day); $X_3$ = processing equipment (Workforce); $X_4$ = cassava roots(kg); $X_5$ = capital input (₦); $b_1 - b_5$ = coefficient of the parameter; $b_0$ = intercepts; e = error term (Ayinde, *et al:* 2005).

Allocative efficiency of a resource is given as;

$$r = \frac{MVP}{MFC} \quad \ldots\ldots(2)$$

Where: r = Allocative Efficiency Coefficient = Marginal Value Product. MFC = Marginal Factor Cost.

Following Haruna, Al-hassan, and Sarpong, (2011), the decision rule for allocative efficiency analysis is given as:

r = 1; efficient resource use.

r >1; underutilization of resource

r <1; overutilization of resource

If the resources were unproductively assigned, the essential variations in marginal value product were predictable to certify that r = 1 or MVP = MFC. The virtual percentage change in the marginal value product (MVP) of each resource necessary to realize the best factor allocation was calculated as:

$$D = \left(1 - \frac{MFC}{MVP}\right) * 10 \quad \ldots\ldots(3)$$

Or $$D = (1 - r^{-1}) * 100$$

$$D = \left(\frac{1}{1} - \frac{1}{r}\right) * 100 \quad \ldots\ldots(4)$$

Where:

D = absolute value of percentage change in MVP of each input (resource) (Okoye, *et al;*2007)

MVP = marginal value product

MFC = marginal factor cost

r = allocative efficiency coefficient

Following Okoye *et al*. (2007), the study used a Tobit regression to analyze the factors affecting allocative efficiency. The model has an advantage over the ordinary least squares (OLS) method since it determines allocative efficiency by its results having both the lower and upper bounds (AE value ranges from 0 to 1). The use of the ordinary least squares (OLS) method in determining factors influencing allocative efficiency, could cause errors in predictions

Following Wooldridge (2002), the Tobit regression model is specified as in Eq. (5):

$$AE_i^* = \boldsymbol{X}_i\boldsymbol{\beta} + u_i \quad \ldots\ldots(5)$$

$$AE_i = 0 \ \ if \ \ AE_i^* < 0$$

where Y∗ is the dependent variable which has values inside definite bounds, Xi is a vector of independent variables that are likely to affect the dependent variable, β is a vector of boundaries that were assessed by the Tobit model, and ui is an error term. The model specification in Eq. (5) was transformed to suit the objective of accessing the determinant of allocative efficiency of smallholder farmers as in Eq. (6):

$$AE_i^* = \boldsymbol{X}_i\boldsymbol{\beta} + u_i \quad \ldots\ldots(6)$$

$$AE_i = 0 \ \ if \ \ AE_i^* < 0$$

$$AE_{ij} = AE_i^* \ if \ 0 \le AE_i^* \le 1$$

$$AE_{ij} = AE_i^* \ if \ 0 \le AE_i^* \le 1$$

$$AE_i = 1 \ if \ AE_i^* > 1$$

where AE_ij is an underlying factor signifying allocative efficiency scores as valued in Eq. (6).

## RESULTS AND DISCUSSION

### Socioeconomic Characteristics of the Fufu Processors

The socioeconomic characteristics of the processors are presented below in Table 1

Table 1 Continuous Economic Characteristics of the Fufu processors

| Variable | Unit | Mean (Standard Deviation) |
|---|---|---|
| Age | Years | 42.8(12.26) |
| Household Size | No. | 6.67(2.09) |
| Experience | Years | 12.25(1.32) |
| Labour | Manday | 6.09(4.09) |
| Cassava roots | Kg | 12.03(2.90) |
| Water | Litres | 2.46(3.08) |

Source; Field Survey, 2023

Table 1 shows that the average processor was 37 years old, implying that the respondents were youths. Youthful processors are usually innovative and motivational compared to their counterparts, aged processors that may not have the ability to withstand stress and strains associated with processing (Haruna, Al-hassan and Sarpong, 2011). Also, an average processor had a household size of 7 persons, connoting labour proxy to carry out the activities of the enterprise (Ume; *et al;* 2016). Also, an average processor has processing experience of 12 years, connoting the ability to combine their scarce resources efficiently to achieve high output. The findings of Ume, Nweke, Ucha and Idahosa, (2018) concurred to the above assertion. Further, the mean of labour spent in cassava processing was 4.09. The level of available labour, especially family labour by the processors increases the processors' outputs at reduced cost since fufu processing in this part of the world is less mechanized (Achi, 2006). More so, the mean of cassava tuber was 12.03. The type and quantity of cassava tubers available affects the quality of fufu produced, all things being equal. (Ume, *et al;* 2020). Additionally, the mean of water was 2.47. Hassan, *et al;* (2011) reported on the importance of water in reducing cyanide and in the removal of dirt to ensure a clean cassava fufu mash

Table 2 Dummy variables of socioeconomic characteristics of fufu processors

| Variable | Frequency | Percentage |
|---|---|---|
| Membership of Cooperative | | |
| Member | 54 | 45.0 |
| Non-member | 66 | 55.0 |
| Access to extension services | | |
| Access | 40 | 33.33 |
| No access | 80 | 66.67 |
| Access to processing Equipment | | |
| Access | 115 | 95.84 |
| No access | 05 | 4.2 |

Source: Field Survey; 2023

Table 2 above shows that most (55%) of the respondents were not members of cooperatives, while 45% were members. Cooperatives, for instance, could enhance their member farmers' efficiency through manpower development and training (Okoye, Okoye and Ume, 2020). Additionally, 66.67% of the respondents had no access to extension services, while .40% had access. Extension services enhance processors' efficiency by providing technical assistance with a given technology (Ayinde *et al.* 2005). Also, 95.8 % of the respondents had access to processing equipment, while only,4.2 did not. The fufu processing under the traditional method requires simple equipment like a knife, basin and pot, not machinery as seen in gari processing (Ume, *et al;* 2020).

**Ordinary Least Square (OLS) estimates for the fufu Processing enterprise**

The result of OLS estimates for the fufu processing enterprise is presented in Table 3.

Table 3 Ordinary Least Square (OLS) estimates for the fufu Processing enterprise

| **Variable** | **Linear** | **Exponential** | **Cobb- Douglas+** | **Semi Log** |
|---|---|---|---|---|
| Labour | 1.0098(2.0009)** | 0.6611(1.2255)* | 1.5211 (2.0088)** | 1.99432(0.1778) |
| Water | 0.0013(1.04411)* | 0.4570(2.8802)** | 0.2377(2.7999)* | 1.0098(2.1128)** |
| Cassava roots | 0.6511(0.4532) | 2.6210(0.9431) | 1.5439(4.0722)*** | 1.7201(0.5221) |
| Processing Equipment | 1.0832(0.6541) | 0.0043(1.0721)* | 0.3366(-1.4457)* | 0.2211(0.0044) |
| Capital | 0.04387(0.6544) | 1.5670(0.5411) | 0.5409(0.8316) | 1.0097(0.8970) |
| $R^2$ | 0.6546 | 0.7653 | 0.8967 | 0.4564 |
| F- Ratio | 1.5489 (3.0091)*** | 0.5432(1.0987)* | 2.6521(4.8712)*** | 0.6009(3.0245)*** |

Source: Field Survey, 2023

***, **, * significant at 1.0%, 5.0% and 10.0% levels of probability respectively. The figure in parenthesis is the t-ratio.

The model was estimated in four functional forms. Based on statistical and *apriori* expectation criteria, the Cobb – Douglas (Double-log) equation was chosen as the lead equation. In the Cobb-Douglas model, the coefficient of determination was 0.897, implying that 89.7% of the variations in output were explained by the explanatory variables included in the model. The remaining 10.3% were explained by the error term. The coefficient of labour (1.5211), cassava roots (1.5439) and coefficient of water (0.2377) were positive and significant at different probability levels. Nevertheless, the coefficient of processing equipment (0.3366) was negatively signed to Fufu's output. The allocative efficiency indices are presented in Table 4.

Table 4. Distribution of Allocative Efficiency Indices of Odourless Fufu Processing

| Variable | $\overline{Y}$ | $\overline{X}$ | Bi | MPP | MVP | MFC | R | (D)% |
|---|---|---|---|---|---|---|---|---|
| Labour | 1,000 | 700 | 1.5211 | 2.173 | 1738.400 | 800 | 2.173 | 54.00 |
| Water | 1000 | 1000 | 0.3277 | 0.328 | 16.400 | 50 | 0.328 | -204.90 |
| Cassava roots | 1000 | 750 | 1.5439 | 2.059 | 370.620 | 180 | 2.059 | 51.4 |
| Processing equipment | 1000 | 0.411 | 0.3366 | 818.978 | 28009.048 | 34.2 | 818.978 | 99.9 |
| Capital | 1000 | -490 | 0.5409 | 1.104 | 496.800 | 450 | 1.104 | 94.00 |

Source, Field Survey; 2023. MVP = marginal value product; MFC= Marginal factor cost; MPP; Marginal physical product.

The result of the estimated Cobb Douglas production function, as shown in Table 1 as lead equation was used to compute the allocative efficiency indices $b_1$ coefficient. The ratios of the marginal value product (MVP) of each input to their respective acquisition cost were computed to obtain the relative efficiency of odourless pro-vitamin A cassava processors in Anambra State, Nigeria. The result in Table 2 indicated that none of the variables considered had efficiency ratio that is equal to 1 (one), which implied efficient utilization of resources. The ratio of marginal value product to marginal factor cost of resources of labour, (2.173), cassava root (2.059), processing equipment (818.978) and capital 1.104) were under-utilized as they had allocative efficiency indices which are greater than 1. These indicated that more than profit maximization levels of resources were used. IITA, (2014) findings concurred with these assertions. The low resource endowment of most of our processors, according to them could be because of a poor financial base, hence, resulting in the under-utilization of resources. The effects of under-utilization of resources are that processing remains in rudimentary and traditional levels, IITA added. The resource of water was over-utilized by fufu processors as they had an allocative efficiency index of 0.328, which is less than 1. The over-utilization of resources implied that less of the profit maximization of the resource was used This finding agreed with Ayinde, *et al;* (2005), who asserted that the abundance of many sources of water such as streams, rivers and boreholes for fufu processing in the study area may be responsible for overutilization of the resource in the study. Therefore, for-profit to be optimized in the odourless fufu processing in Anambra State, Nigeria, labour, cassava roots, processing equipment, and capital should be increased from their current level by 54.00%, 51.4%, 99.9% and 94.00% while water should be reduced from its current levels by -204.90%.

Table 5: Elasticity of Production and Return to Scale of Cassava Fufu processing

| **.Variables** | **Elasticity of Production** |
|---|---|
| Labour | 1..5211 |
| Water | 0.2377 |
| Cassava roots | 1.5439 |
| Processing Equipment | 0.3366 |
| Capital | 0.5409 |
| Return to Scale | 5.5544 |

Source: Computed from Table 1.

The elasticity of processing shows the change in output/ processing relative to a unit change in input (Ume, *et al*; 2016). The elasticity of processing of odourless fufu was estimated directly from Cobb-Douglas coefficients. When the individual input resource used is less than one, indicates that the factor inputs and cassava processing derivatives output had an inelastic relationship. This implied the under-utilization of the input. An inverse relationship (that is when the individual input resource used is greater than one (1)), implies over-utilization. Therefore, over-utilized inputs were Labour (1.5211); and cassava root (1.5438). Furthermore, the under-utilized resources were water (0.2377), processing equipment (0.3366) and capital (0.5409). However, the return to scale, which is the sum of the elasticity of all inputs used was 5.5544, greater than 1, indicating that fufu processors were in stage 2 of production function. This implied that when all factor inputs were varied by 1%, the responsiveness of fufu output to such input variation was 5.5544%.

Table 6 Result Tobit regression model of factors affecting allocative efficiency of Pro Vitamin A cassava Odourless Fufu

| **Allocative efficiency** | **Coefficient (robust standard error)s** |
|---|---|
| Age of the processor in years | − 0.0214* (0.0267) |
| Household size in number | 0.0024** (0.0017) |
| Experience in years | 0.0001 (0.0004) |
| Member of Organization(dummy) | 0.0015*** (0.0023) |
| Hired Labour (dummy) | − 0.0362 (0.0028) |
| Access to extension services(dummy) | 0.0007 (0.0013) |
| Constant | 0.8246***(0.0242) |
| Sigma | 0.0648 (0.0021) |

F(12, 188) 23.4000, Pseudo R square − 1.0501, Log-likelihood 204.4382
VIF test had a mean VIF of 1.36. All the variables in this model had VIF values of less than 3, which is highly acceptable. *10%; **5%, ***1% level of significance
Source; Field; survey, 2023

There was an inverse relationship between the age of the processor and allocative efficiency (AE) of fufu processing. As processors advance, it is more likely that there will be a reduction in AE for fufu processing by 0.027%. It is not debatable that youthful processors are more productive than relatively aged processors. This could be ascribed to the efficiency of resource use that youthful processors can accomplish (Haruna, *et al*; 2011). More so, the coefficient of household size was significant and had a positive influence on AE. This could be attested to the fact that household size influences families and hired labour supply in carrying out activities in agro-processing enterprises (Ume, *et al* 2018). On the contrary, Okoye, et al; (2007) reported a negative relationship between household size and AE. They linked the sign identity of the coefficient to situations where household members are dependent populations and are more consumers than productive individuals.

Besides, the coefficient of a member of the organization coefficient had a direct relationship with AE. In other words, processors who are organisation members had 0013% higher AE than non-members. The organization gives training and credit to its members to enhance their allocative efficiency. Haruna, et al; (2011) and Ume, *et al;* (2018) independently reported positive relationships between members of the organization and AE. They opined that interactions among members of cooperatives will enrich their resource use commendably.

## CONCLUSION AND RECOMMENDATIONS

Based on the results, the following conclusions were deduced; none of the respondents achieved allocative efficiency. Further, the factors influencing the allocative efficiency of fufu processing technology in the study area were the household size and membership of the organization. Based on the results, the following recommendations were proffered.

1. Farmers should be encouraged to form or join cooperatives using appropriate policies since the benefits are enormous.
2. Processors with large household sizes should be encouraged to join or remain in the business since members of the household could serve as a source of available family labour in implementing fufu processing technology.
3. The requisite skills to inspire the reorganization and reallocation of odourless fufu processing inputs are imperative through appropriate policies and programmes.

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