# EVALUATION OF CONSTRAINTS TO PROFITABLE SMALLHOLDER ROOTS AND TUBER CROPS FARMERS' IN IKWUANO LOCAL GOVERNMENT AREA OF ABIA STATE, NIGERIA

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## ABSTRACT

The study was carried out to evaluate the constraints to profitable smallholder roots and tuber crops production in Ikwuano local government area (LGA) of Abia state with emphasis on cassava production. The study presented the results of data collected from 160 cassava farmers. A multi-stage random sampling technique was used to select respondents. Descriptive statistics, gross margin analysis and Stochastic Cobb-Douglas profit frontier model were used in analyzing data. The results showed that men constituted a greater percentage (62.5%) of those involved in roots and tuber production in Ikwuano LGA with age range of 31-60 years. Results also showed an estimated gross margin of ₦242,211.76 and profit of ₦228,922.59 which shows a confirmation of profitability of cassava production. This implied that cassava production was profitable by returning ₦1.41 for every ₦1.00. The stochastic profit frontier analysis for cassava farmers revealed a number of factors influencing profit efficiency. Variables influencing profitability of cassava farmers include: Labour($p<0.01$), fertilizer($p<0.01$), farm land size($p<0.01$) and capital inputs($p<0.01$) while the significant inefficiency factors were age($p<0.01$), education($p<0.05$), credit access($p<0.01$) and farming experience($p<0.01$). The most important managerial, financial, and institutional constraints were low use of plant protection products, limited finance, and unavailability of commercial banks, respectively. The study concluded that cassava production is profitable though practiced on a small scale. There is need therefore, for policies aimed at addressing these variables especially, the inefficiency variables for increased profitability in the study area. Government should provide land reform policies aimed at giving more farm lands to farmers. For experienced farmers to remain in farming, government should provide educational facilities at subsidized rates and provision of training facilities to enable farmers access information on innovation for increased profitability in the study area.

**Keywords**: Stochastic, profitability, efficiency, smallholder, constraints, roots and tubers

## INTRODUCTION

In Nigeria, smallholdings are usually farms supporting a single family with a mixture of cash crop and subsistence farming. As a country becomes more affluent and farming practices become more efficient, smallholdings may persist as legacy of historical land ownership practices and in more affluent societies smallholdings may be valued primarily for the rural lifestyle that they provide. Often the owners do not earn their livelihood from the farm (International Fund for Agricultural Development, 2011). There are an estimated 500 million smallholder farms in the world, supporting almost 2 billion people and some companies try to include smallholdings into their value chain. They provide them with seed, feed or fertilizer to improve their production, a model of which shows benefit for both parties (Bunnett, 2002).

Many development oriented policies have been implemented in Nigeria, especially in the agricultural sector since independence. The Federal Government has made some institutional and policy reforms targeted at improving the socio-economic status of the smallholder farmers. These include Agricultural Credit Guarantee Scheme Fund (ACGSF), River Basin Development Authorities (RBDAs), Agricultural Development Programme (ADP) and the Cassava Multiplication Programme (CMP), (ADP, 2005). Agwu *et al*. (2012) contended that these are farmer oriented programmes whose beneficiaries are poor households and smallholder farmers but the overall objective of these programmes are to enhance national food self-sufficiency, improve rural households' food security and income for poor farmers within the states in Nigeria.

Roots and tuber crops, most notably cassava, sweet potato, cocoyam, yam and potatoes are some of the most important primary crops grown in Nigeria. They play a critical role in the global food system, particularly in the developing world, where they rank among the top 10 food crops (Scott *et al*., 2000; Nweke, 2004). The production of roots and tuber in developing countries is projected to increase by 58% (232 million tonnes) to 635 million tonnes between 2003 and 2020, with cassava increasing by 44%, potato 29%, sweet potato 27% and yam 27% (Scott *et al*., 2000). About 55 percent of the nation's smallholder farmers are engaged in the production of roots and tuber and it is only appropriate to help them to optimize production, efficiency and profit (Akromah, 2015).

Technical efficiency is defined as the degree to which a farmer produces the maximum feasible output from a given bundle of inputs (an output-oriented measure), or uses the minimum feasible of inputs to produce a given level of output (an input-oriented measure).

Profit efficiency is defined as the ability of a farm to achieve highest possible profit given the prices and levels of fixed factors of that farm and profit inefficiency is defined as loss of profit from not operating on the frontier (Ali and Flinn, 1989). It should be noted that (Battese and Coellie, 1995) had extended the stochastic production frontier model by suggesting that the inefficiency effects can be expressed as a linear function of explanatory variables, reflecting farm-specific characteristics. The advantage of their model is that it allows estimation of the farm-specific efficiency scores and the factors explaining efficiency differentials among farmers in a single stage estimation procedure. This study therefore, used (Battese and Coellie, 1995) and model by postulating a profit function, which is assumed to behave in a manner consistence with the stochastic frontier concept of Coeli, (1995).

Efficiency analysis helps to identify the possibilities for increasing output and profit while the resources are conserved. Despite the development of various programmes on roots and tuber crops to increase efficiency and profit of farmers, there is need to have a look into the constraints to profitable cassava production as a major roots and tuber crop cultivated in the study area. Thus, the broad objective of the study is to ascertain factors influencing profit efficiency of smallholder cassava farmers'.

## MATERIALS AND METHODS

This study was conducted in Ikwuano Local Government Area of Abia state, Nigeria. It lies on the latitude of $5^0$ 26'N and longitude $7^0$ 34'E. It has an area of 281km$^2$ and a population of 137,993 according to 2006 census (NPC, 2006). It is made up of about 52 villages and 16 communities who are bounded by Ini Local Government Area of Akwa Ibom state by the west and Umuahia North. Ikwuano is referred to the food basket of Abia state basically because of rich agricultural produce it is endowed with. Ikwuano as the name implies is derived from the coming together of four-related brothers (clans) that make up of Ikwuano Local Government Area. The clans include Ibere, Ariam, Oloko, and Oboro. There are 16 autonomous communities in Ikwuano Local Government which make up the four clans and the people are majorly farmers.

**Sampling procedure**

A multi-stage random sampling technique was used to sample respondents for the study.

The first stage comprised random sampling of four communities (Iberenta, Ariam, Nchara Oloko and Umuigu) from the 16 communities that make up Ikwuano Local Government Area. The second stage comprised a random sampling of 4 villages from each of the communities, and the third stage comprised the random sampling of ten selected roots and tuber farming households for each of the four villages; making a sample size of 160 small holder cassava farmers. This was made possible through a compiled list of roots and tuber crop farmers from the Ikwuano ADP resident officer.

**Model specification and analysis**

**Gross Margin Analysis**

Cost and Returns analyses for cassava production

NR = GM -TFC

Where: NR = Net returns (in naira), GM = Gross Margin, TFC = Total Fixed Cost (in naira)

GM= GFI-TVC

Where: GFI=Gross farm income, TVC=Total variable cost

Return on capital invested (ROI) which measures profitability of an investment was also calculated. ROI greater than 1 indicates a potentially profitable venture and if less than 1, it indicates a potentially unprofitable venture (Nwaiwu *et al.*, 2012).

$$ROI = \frac{GM}{TVC}$$

Where: ROI= Return on capital invested, GM = Gross Margin, TVC = Total Variable Cost.

Gross Ratio(GR) of the farm was calculated. Gross ratio is a profitability ratio that measures the overall success of the farm. The lower the ratio, the higher the return per naira invested.

$$GR = \frac{TFE}{GI}$$ (Jirgi *et al*., 2010)

Where: GR = Gross ratio, TFE= Total Farm Expenses (i.e. Total Variable Cost), GI = Gross Income (Total revenue).

Operating Ratio (OR) of the farm: the operating ratio is directly related to the farm variable input usage. The lower the ratio, the higher profitability of the farm business.

$$OR = \frac{TOC}{GI}$$

Where: TOC = Total operating cost, GI=Gross income

**Stochastic frontier function**

$$ln(y_i)=f(x_i;\beta)-u_i \quad (1)$$

Where $y_i$ is output of the ith farm, $x_i$ is a vector of inputs used by the ith farm; β is a vector of parameters to be estimated. $u_i$ is a non-negative variable representing inefficiency in production (Coeli, 1995)

Therefore a normalized stochastic frontier cob-Douglas function will be empirically estimated. The model is estimated as

$$\ln Y = \beta 0 + \sum \beta i\, x_{ij} + vi - u_i \quad (2)$$

$$\text{And} \quad vi = \alpha_0 + \sum \alpha_i z_{ij} \quad (3)$$

Where Q is farm households' total income from productive activity,

$X_i$ is as defined (is a vector of conventional production variables and fixed factors), $u_i$ is the inefficiency measure; $Z_i$ is a vector of socio-economic factors affecting inefficiency. The $X_i$ variables are cost of larbour, fertilizer, planting materials etc.

**The stochastic frontier profit function is defined as:**

$\pi_i = f(X_i; \delta) + \varepsilon_i$ … … … … … … . . (4)

Where π is normalized profit of the ith farms, X is a vector of inputs used by farm *i*, and $\varepsilon_i$ is a "composed'' error term. The error term $\varepsilon_i$ is equal to $v_i - u_i$. The term $v_i$ is a two-sided ($-\infty < v_i < \infty$) normally distributed random error (v~ N[0, $a^2{}_v$]) that represents the stochastic effects outside the farmers' control. The term $u_i$ is a one-sided ($u_i \geq 0$) efficiency component that represents the technical inefficiency of farm. The distribution of the term $u_i$ can be half-normal, exponential, or gamma (Aigner *et al.*,1977; Meeusen *et al.*, 1977) and half-normal distribution (u ~ N[0, $a^2{}_u$]) is used in this study. The two components $v_i$ and $u_i$ are also assumed to be independent of each other.

**Empirical model specification for the determinants of profit efficiency is as follows**;

$ln\pi i= \beta 0+\beta_1 lnX_1 i+\beta_2 lnX_2 i + \beta_3 lnX_3 i + \beta_4 lnX_4 i + Vi - Ui$…..(5)

Where subscript i refer to the observation of ith farmers,

ln = Logarithm to base e,

πi = Profit of the ith farmers (₦)

$X_1$ = average cost of labour (₦)

$X_2$ = average cost of fertilizer (₦)

$X_3$ = average cost of planting materials (₦)

$X_4$ = average cost of farm size (₦)

$X_5$ = average cost of capital input (₦)

## RESULTS AND DISCUSSION

### Profitability Analyses of Cassava Production in the Study Area

The results in Table 1 showed the cost and returns analyses of cassava production in the study area. The results showed total revenue of ₦791,317.86 accruing from the roots (₦652,381.92) and stems (₦138,935.94).The stem production contributed about 17.56% of total revenue. Without the sale of stems, revenue from roots will be low.

The total variable cost was 549,106.10 and the fixed cost depreciated was ₦13,289.17. This gave a total cost of ₦562,395.27. Results also showed an estimated gross margin of ₦242,211.76 and profit of ₦228,922.59 which is a confirmation of profitability of cassava production.

**Table 1. Gross margin/Cost and Return Analysis of Cassava Production (1.22ha)**

| Items | Unit | Qty | Price | Value |
|---|---|---|---|---|
| **Revenue (A)** | | | | |
| Roots | Kg | 27,182.58 | 24.00 | 652,381.92 |
| Stem | Bundles | 192.83 | 720.51 | 138,935.94 |
| **Total** | | | | **791,317.86** |
| **Variable Costs** | | | | |
| Fertilizer | Kg | 152.61 | 142.97 | 21,818.65 |
| Herbicides | Li | 2.58 | 1924.10 | 4,964.18 |
| Manure | Kg | 218.23 | 5.16 | 1,126.06 |
| Stem Preparation | MD | 12.78 | 1,000 | 12,780.00 |
| Planting Material | Bundles | 62.41 | 720.51 | 44,967.03 |
| FertilizerApplication | MD | 32.70 | 1,000 | 32,700.00 |
| Herbicide Application | MD | 5.16 | 1,500 | 7,740.00 |
| Land Clearing | MD | 23.34 | 1,500 | 35,010.00 |
| Land Preparation | MD | 69.28 | 1,500 | 103,920.00 |
| Weeding | MD | 82.61 | 1,500 | 123,915.00 |
| Harvesting | MD | 102.6 | 1,500 | 153,945.00 |
| Transportation | | | | 6,220.18 |
| **Total Variable Cost(B)** | | | | **549,106.10** |
| **Total Fixed Costs (C) Depreciated** | | | | **13,289.17** |
| **Total Costs (B+C)** | | | | **562,395.27** |
| **Gross Margin (A-B)** | | | | **242,211.76** |
| **NFI=GM-TFC** | | | | **228,922.59** |
| **Profit (A-B+C)** | | | | **228,922.59** |
| **Return per Naira Invested (TR/TC)** | | | | **1.41** |
| **Gross Ratio** | | | | **0.71** |
| **Operating Ratio** | | | | **0.69** |

Source: Field Survey Data, 2018

The average rate of return per naira invested result shows that cassava production was profitable by returning ₦1.41 for every ₦1.00. Thus, it could be concluded that cassava production in the study area though on a small scale, was economically viable. This result is in line with Nwaiwu *et al.* (2012). Also, the entire operating ratios were less than one, indicating profitability of the farm and this result is in corroboration with Jirgi *et al*. (2010).

**Profit Efficiency and its Determinants among the Cassava Farmers**

**Factors influencing efficiency**

Factors that are important in influencing efficiency were computed with the Stochastic Cobb-Douglas profit Frontier Function. The frontier model was found to be significant in explaining the efficiency factors. This was because Wald Chi (LR) test was significant at 1% probability level. The gamma statistic was significantly different from zero thus indicating there was inefficiency. The resulting coefficients have either positive or negative signs which indicate the effect of the variable on efficiency. A positive sign indicates that the presence of the variable has an increasing effect on inefficiency while a negative sign indicates a reducing effect on inefficiency. All the hypothesized variables were analysed in the model, but some of them were dropped because of multicollinearity.

**Profit efficiency estimation**

**Maximum likelihood estimates (MLE) of profit frontier function**

Table 2 presents the ML estimates of equations (1) and (5). The Table shows the coefficient of estimated parameters of the normalized profit function based on the assumption of competitive inputs and output markets were positive except the cost of labour and fertilizer. This implies that a unit increase in the prices of inputs with positive coefficient will lead to increase in the normalized profit of cassava (profit efficiency) and vice verse.

The coefficient for costs of labour and fertilizer were negative and highly significant at 1% level respectively. This implies that increase in the costs of labour and fertilizer would decrease cassava output and profit by .1103% and .2994% respectively. Though this is against apriori expectation but the result is in line with Okoye *et al*. (2016). This result is also in line with Abdulrahman *et al*. (2015) in a similar study stated that, the negative sign of labour may be due to high cost of a negative relationship which do exist between family labour and hired labour among the resource-poor rural farmers because, the consumption of additional hired labour is meant to supplement available family labour such that as the availability of family labour decreases, additional hired labour is consumed at the limit of the lean resources of the farmers. Due to the high cost of hired labour, if additional hired labour must be consumed then additional cost must be incurred while the negative cost of fertilizer may perhaps be due to wrong use leading to too much application of fertilizer therefore resulting in extra cost sustained by the farmers. Therefore, if farmers make optimal use of these inputs and trained on the best and appropriate fertilizer use and application, this could increase their profitability.

**Table 2. Estimated Stochastic Frontier Cobb-Douglas Function for factor influencing profitability of smallholder Cassava farms in Ikwuano L.G.A.**

| Variables | Parameters | Coefficient | Std error | t-value |
|---|---|---|---|---|
| Constant term | $b_0$ | 5.17396 | 0.4603 | 12.4683*** |
| **Profit function** | | | | |
| Labour cost | $x_1$ | -0.1103 | 0.0158 | -6.9494*** |
| Fertilizer cost | $x_2$ | -0.2994 | 0.0786 | -3.8073*** |
| Planting materials cost | $x_3$ | 0.0485 | 0.0800 | 0.6072 |
| Farm size | $x_4$ | 0.5952 | 0.0622 | 9.4138*** |
| Capital | $x_5$ | 0.2976 | 0.0577 | 5.1588*** |
| **Infficiency factors** | | | | |
| Constant term | $z_0$ | 1.6696 | 1.8608 | 0.8972 |
| Age | $z_1$ | -0.0124 | 0.0028 | -4.3896*** |
| Education | $z_2$ | -0.0864 | 0.0295 | -2.9246** |
| Household size | $z_3$ | -0.15838 | 0.9252 | -0.9119 |
| Credit access | $z_4$ | 0.12771 | 0.0356 | 3.5890*** |
| Gender | $z_5$ | -0.1025 | 0.9252 | -1.1108 |
| Farming experience | $z_6$ | -0.00024 | 0.0005 | -4.6789*** |
| Farm size | $z_7$ | 0.0131 | 0.0029 | 0.4486 |
| **Diagnostic statistic** | | | | |
| Total variance (sigma) | $\sigma^2$ | 1.2854 | 0.0993 | 12.9504*** |
| Variance ratio (gamma) | r | 0.93956 | 0.0473 | 19.8334*** |
| LR Test | | 19.2922*** | | |
| Log likelihood function | | | | 126.8071 |

Source: Computed from frontier 4.1 MLE results

** and *** = significant at 5% and 1% level respectively

The coefficients for costs of farm size (0.59) and capital inputs (0.29) were positive and highly significant at 1% level, respectively. The result revealed that farm size and capital increase efficiency by 59% and 30%, respectively. In other words, a 1% increase in farm size and capital inputs will lead to a 0.595% and 0.297% increase in efficiency of cassava output and profit, respectively. This implies that any increase in farm size and capital inputs, the profit obtainable from cassava production will increase. This is in line with a priori expectations probably because of efficient use of these inputs. This finding is in corroboration with Oladeebo and Oluwaranti, (2012), who reported positive and significant coefficient of farm size at 5 percent level of significance points to the fact that cassava farmers were operating at small scale level; hence increasing their farm size will improve profit. This result also follows the findings of Okoye *et al.* (2016) in Madagascar.

In addition, the estimated determinants of profit efficiency of cassava production activities are represented in Table 2. However, the analysis of inefficiency model shows that the signs and significance of the estimated coefficient in the inefficiency model have important implication on the profit efficiency of the farmer. The results further showed that the profit inefficiency of the cassava farmers was negatively influenced by age, education, farming experience and positively influenced by credit access. Significance and negatively signed variables in the inefficiency model indicated that as these variables increase the profit efficiency of the cassava farmers' increases or the profit inefficiency of the cassava farmers decreases, while the coefficients with positive signs indicated that as these variables increase, the profit efficiency of the cassava farmers decreases or the profit inefficiency of the cassava farmers increases.

The coefficient of age was negative and highly significant at 1% level. This implies that an increase in age of the farmer will lead to increase in profit efficiency of cassava farmers and corresponding decrease in profit inefficiency. This implies that cassava farmers with more age exhibited significantly higher profit than farmers with less age. Similar findings were made by scholars (Ajibefun and Aderimha, 2004; Okoye *et al*., 2016).

The coefficient of education was negative and highly significant at 1% level. The result revealed that educated farmers are more efficient than their uneducated counterparts and the significance follows *a priori* expectation, given that education is an important factor in technology adoption. This also implies that any increase in educational level will lead to a corresponding increase in profit efficiency of farmers. This shows that with increase in education level, farmers will be able to access and process information on improved farm innovations and technologies thus, increasing their farm productivity and profit efficiency levels, and in line with the findings of Amaza and Olayemi (2000).

A positive and statistically significance is found between access to credit and profit inefficiency at 1% level. This indicates that farmers who have access to credit tend to exhibit higher levels of inefficiency. This is contrary to *a priori* expectations that the more credit the farmers' use, the more profit efficient they become. It might be as a result of credit received being misused or diverted to other uses. This result is consistent with Baruwa and Oke (2012).

The coefficient of farming experience was negative and highly significant at 1% level. This implies that any increase in years of cassava farming will lead to a corresponding increase in profit efficiency of farmers. Experience can have an influence in improving decision making and resource allocation as it can make it better as result a of the learning curve. This implies that cassava farmers with more years of experience exhibited significantly more profit than farmers with less years of experience. This could probably be explained by the fact farmers probably employ their experience over time as an opportunity to enhance more profit. This result is in consonance with Okoye *et al*. (2008), who reported that the more experienced farmers had higher level of profit efficiency than farmers with lower farming experience. This finding is also in line with the study of Birachi (2006), where he found the mean experience in dairy farming being fifteen years of operation. This finding is consistent with Ohajianya and Onyenweaku, (2002).

The estimated variance ($\sigma^2$) was statistically significant at 1% indicating goodness of fit and correctness of the specified distribution assumption of the composite error term. Gamma (r) was estimated to be 0.9395 and significant at 1% meaning that 93.95% of the discrepancies between observed profit from the maximum profit (frontier profit) is primarily due to factors, which are within the control of the cassava growers in the sample under study and differences' in farmers' practices rather than random variability.

**Constraints Militating Against Profitability of roots and tuber crop Production in the Study Area**

Table 3 presents the constraints militating against the profitability of roots and tuber production in the study area. The result showed that the most important managerial constraint was low use of plant protection products (86.25%) which ranked highest, followed by limited use of fertilizer (74.37%) and limited adoption of improved seeds (68.75%) which ranked second and third, respectively.

Among the financial constraints, limited access to finance (74.37%) ranked the highest, followed by unavailability of market for improved seeds (73.13%) and low use of mechanization (63.75%) which ranked second and third, respectively.

**Table 3. Constraints militating against the Profitability of Cassava Production in the Study Area.**

| Constraints | Frequency | Percentage | Rank |
|---|---|---|---|
| **A. Managerial** | | | |
| 1. Low use of plant protection products | 138 | 86.25 | 1 |
| 2. Limited adoption of improved seeds | 110 | 68.75 | 3 |
| 3. Limited use of fertilizer | 119 | 74.37 | 2 |
| **B. Financial** | | | |
| 4. Unavailability of market for improved seeds | 117 | 73.13 | 2 |
| 5. Limited access to finance | 119 | 74.37 | 1 |
| 6. Low use of mechanization | 102 | 63.75 | 3 |
| **C. Institutional** | | | |
| 7. Lack of cooperative membership | 35 | 21.87 | 5 |
| 8. Unavailability of commercial banks | 58 | 36.25 | 1 |
| 9. Inability to get collateral | 41 | 25.25 | 4 |
| 10. High transaction cost | 51 | 31.87 | 3 |
| 11. High interest rate | 52 | 32.50 | 2 |

Source: Field Survey Data, 2018

Unavailability of commercial banks (36.25%) was the most important institutional constraint militating against profitability followed by; high interest rate (32.50%), high transaction cost (31.87%), inability to get collateral (25.25%) and lack of cooperative membership (21.87%).

## CONCLUSION AND RECOMMENDATIONS

The stochastic Cobb-Douglas profit frontier analysis revealed a number of factors influencing profitability efficiency. Labour, fertilizer, farm size, capital input, age, education, credit access and farm experience were found to be factors influencing cassava farming profit efficiency. The study concluded that cassava production is profitable though practiced on a small scale. There is need therefore for policies aimed at addressing these variables especially, the inefficiency variables for increased profitability in the study area. Also, government should provide land reform policies aimed at giving more farm lands to farmers especially women, encouraging the experienced farmers to remain in farming, provision of educational facilities at subsidized rates and provision of training facilities to enable farmers' access information in innovation for increased profitability in the study area.

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