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Analysis of determinants and profitability of cassava production in Enugu state, Nigeria

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Abstract
This study assessed the determinant and profitability of cassava production in Enugu State of Nigeria. Multi-stage random sampling technique was used to 120 respondents for the study. A structured questionnaires, was used to collect the primary data. Percentage response and gross margin analysis were used to capture the objectives of the study. Results of Table 1showed that most respondents are aged, well-educated and had poor extension contact. Also, cassava farming is profitable in the study area. The determinants to the profitability of cassava in the study area were household size, extension services and farming experience. Major constraints to cassava production were access to credit, poor access to extension contact and high cost of labour. The need to enhance farmers' access to credit, extension and labour saving devices should be encouraged.

Keywords: Determinant, profitability, cassava, gross margin, Enugu state, Nigeria

Introduction
Cassava is among important staple and cash crops grown in Nigeria, particularly in the Southern part in terms of area devoted to it and the number of farmers growing it (FAO, 2019) [3]. Apart from for human and livestock consumptions, cassava and its derivatives are used as by- product in industrial manufacturing of finished products (Ano, 2015) [1] and it contributes positively to poverty alleviation through income generation (Nzeakor and Ume, 2021) [7]. Africa is the largest producer of cassava, with Nigeria leading the world with about 47,274,320 metric tons per annum in total land area of about 3.60 million hectares and of which south east agricultural zone accounts for more than 37% of the nation's production (Okoye, Okoye and Ume, 2021) [12]. In Nigeria, cassava production is mainly produced by small holder farmers that constitute more than 80 – 90% of the farming population (Onunka, *et al*; 2021) [13]. Cassava production is endeared to this farming class because of certain attributes according to Anon, (2015) [1], included thrives in marginal soil, ease of cultivation and high multiplication of the stem cutting and tolerant to drought. The other intrinsic features are survival under marginal rain fall, ability to store well in the soil for several months and relative ease of growing cassava with otheryd crops (Anyanwu, 2014, Ume, *et al*, 2022) [2, 14].
The production feat of cassava in Nigeria, could be attributed to notably promulgation of law mandatory bakers to include at least 10% of cassava flour into their bakery, cassava multiplication projects (CMP), root and tuber expansion programme (r-tep), presidential initiative on cassava production, processing and exporting and partnership initiatives in the Niger Delta (PIND) sponsored by chevron (FAO, 2005) Furthermore, the efforts of Agricultural Development Programmes (ADPs) Ministries of Agriculture and Natural Resources (MANRS), United State Agency for International Development (USAID) in collaboration with National Root Crop Research Institute (NRCRI) Umudike –Abia State, Nigeria, and international institute for tropical agriculture (IITA) help in cassava genetic improvement and many improved cultivars currently in use by farmers in the country (Okonkwo, *et al*; 2017; NRCRI, 2021) [8]. In recent time, cassava production can no longer meet up with domestic demand, in effect, the nation spends millions of Dollars importing some cassava derivatives to the detriment of the nation dwindling foreign reserved (FAO, 2021). The low production of cassava can be related to high cost of fertilizer and labour, poor soil fertility, use of local cassava varieties, pests and diseases problem, storage problem of cassava tubers, processing problem and land fragmentation which do not encourage

mechanization (NRCRI, 2021) [8]. Therefore, it becomes paramount to determine factors that affect their performance in farming and their productivity in terms of profit accruing from the crop production in the study area. Literatures show that determinant factors can classified into socioeconomic characteristics and other factors (non-socioeconomics). Studies (Ugwumba and Omojola, 2012, Anyanwu, 2014; Ume and Kaine, 2021) [16, 2, 15] show stated among the socioeconomic determinants to profitability of crop production, included source of age of the farmer, labour source, household size, educational level, farming experience, farm size and production objectives. Others are documented significant influence of labour in manday, area planted, planting material, fertilizer and manure (FAO, 2019) [3]. This could lead to formulation and implementation of polices that would enable them to improve on their performances. However, to the best knowledge of the researchers, no known published work in the study area, hence the need for this work to bridge the gap is imperative. Specifically, the objectives of the study are to describe the socioeconomic characteristics of the farmers, estimate the profitability of cassava production, determinant to the profitability and constraints to cassava production in the study area.

Material and Methods

Study Area

Enugu State is the study area and is located between latitudes 6°30' N and 7°10'N of Equator and longitudes 6°35/ E and 7°30'E of Greenwich Meridian. Enugu State has eighteen Local Government Areas with an estimated population of about 4, 1671 million people (NPC, 2006) [6]. The state has a land area of 16,727 square km^2, three Agricultural zones (Enugu West, Enugu South and Enugu East). The State shares boundary with Abia State and Imo State in the south, Ebonyi State in the east, Benue State to the northeast, Kogi State to the northwest and Anambra State to the west. Enugu State has two major seasons in the year, the rainy season which last from the month of April – October and the dry season that lasts from November to March. The temperature of the area ranges from 18 °C – 34 °C. About 60 – 70% of the inhabitants engage in agriculture mainly crop farming, agricultural produce marketing and animal rearing. Other non-agricultural activities engaged by people for sustenance include civil service, petty trading, vulcanizing, driving, carpentry, mechanics and others.

Sampling Technique and Sampling Size

Multi-stage random sampling technique was used to select communities' villages and respondents. In stage 1, 10 communities were randomly selected out of fifteen. Secondly, 6 villages were randomly selected from each of the communities. This brought to a total of sixty villages. Finally, two cassava farmers were selected from each of the sixty villages and this brought to a total of one hundred and twenty farmers for detailed studied.

Method of Data Collection

Structured questionnaires and informal or oral interview were used to collect primary data, while secondary ada were derived from journals, proceedings, the internet and other related iteratures.

Method of Data Analysis

The objectives of the study were addressed using percentage responses, multiple regression, gross margin analysis and principal component analysis were used to address the objectives of the study.

Model Specification

Gross margin analysis.

Gross margin =g.m.=tr -tvc……………………………(1)

i.e.G.m= $\sum_{1-1}^{n} P_1 Q_1 - \sum_{j-i}^{m} r_i x_i$ …………………………… 2

The Net farm income can be calculated by gross margin less fixed input. The net farm income can be expressed as thus:

NFI= $\sum_{1-1}^{n} P_1 Q_1 - \left[\left(\sum_{j-i}^{m} r_i x_i \right) + k \right]$ ……...……………3

Where

Gm = Gross Margin (n), NFI = Net farm income (n), p1 = market (unit) price of output (n), q = quantity of output (kg), Ri = unit price of the variable input (kg), xi = quantity of the variable input (kg), k = annual fixed cost (depreciation) (n), I = 1 2 3 …….. N, J = 1 2 3

Ordinary Least Squared Regressions Method,

Four functional forms of the multiple regressions were employed in order to select the one that has provided the best fit. The functional forms tried were:

Linear function $Y = b_0 + b_1 x_1 b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + ei$ ………………………… (4)

Double log function:-$\ln(y) = \ln b_0 + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + b_5 \ln x_5 + ei$ …………(5)

Semi log; $Y = \ln b_0 + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + b_5 \ln x_5 + ei$ ………………… (6)

Exponential function; $\ln Y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + ei$ ………………..…(7)

The choice of the best functional form was based on the magnitude of the R^2 value, the high number of significance, size and signs of the regression coefficients as they conform to *apriori expectation*.

The ordinary least squared regressions method, explicit production function was estimated by

$Y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + e$ ………… (8)

Where:

Y = value of cassava output (N), X_1 = Gender (Dummy), X_2 = Age of the farmer,

X_3 = Educational level (Years),

X_4 = Farming experience (Years),

X_5 = Access to Credit (Access 1, otherwise; 0),

X_5 = Membership of Organization (Member; 1and otherwise; 0),

X_6 = Access to Extension Services (Access; I and otherwise; 0)

$x_1 - x_5$ = coefficient of the parameters to be estimated, while e_1 was the error term and b_0 was the coefficient.

Principal Component Analysis (PCA)

The Model of Principal Component (PCA) is stated thus:

$x = x^{1,2}, x^3, \ldots, xp$ ……..(8)

$$\propto_k = \propto_{1k1}, \propto_2 K, \propto_3 k, \ldots, \propto pk \quad \text{……(9)}$$

$$\propto_K^T x = \sum_{j=1}^{p} \propto_{KjXj} \quad \text{……(10)}$$

$$Var = [\propto_K^T X] \text{ is maximum} \quad (11)$$

Maximise subject to

$$\propto_K^T \propto_K = 1 \quad \text{……..(12)}$$

$$Cov = [\propto_1^T \propto - \propto_2^T \propto] = 0 \quad \text{……(13)}$$

The Variance of each of the Principal Component:

$$Var[\propto_k X] = \lambda_k \quad \text{……(14)}$$

$$S = \frac{1}{n-1}(X - \bar{X})(X - \bar{X})^T \quad \text{……(15)}$$

$$S_i = \frac{1}{n-1}\sum_{i=1}^{n}(X_i - \bar{X}_i)(X_I - \bar{X}_i) \quad \text{…… (16)}$$

Where

X = vector of 'P' Random Variables; $\propto k$ = Vector of 'P' Constraints; $\nwarrow k$= Eigen Value; T = Transpose; S = Sample Covariance Matrix.

Results and Discussion

Table I: Distribution of Respondent According to Socioeconomic Characteristics

Variables	Frequency	Percentage
Gender		
Male	28	25
Female	92	75
Age		
Less than 20	3	2.5
21-40	35	29.17
41-60	60	50
62 and above	22	18.33
Level of Education		
No formal education	35	29.17
Primary school	60	50
Secondary school	20	16.67
Tertiary	5	4.17
Access to Credit Use (dummy)		
Yes	20	16.7
No	100	83.3
Farming Experience		
1-10	11	9.17
11-20	26	21.67
21-30	52	43.33
31-40	31	25.83
Household Size		
1-5	22	18.3
6-10	35	29.2
11-15	34	28.3
16-20	17	14.2
Extension Services		
Had Access	40	33.3
No access	80	66.7

***Sources*:** Field survey, 2021

Table 1 indicates that75% of the respondents were females, while only 25%, females. This is in line with the finding of Anyanwu, (2014) [2], who reported that cassava production is gender stereotyped. However, in recent times, men are diving into the business because of economic depression in the country and economic gain accruing from its sales (Okonkwo, *et al*; 2017). Further, 68.33% of the respondents were above 41 years old, 31.67% were below 41 years in the study area. This infers that most respondents were aged, thus could translate to be more years of farming experience to enhance their farm profit through efficient resource utilization. Also, majority (71.93%) of the respondents attained various forms of formal education, while 29.17% had no formal education. Education attainment enhances individual's resource prudency and risk averse in adopting improved technologies to boost their outputs (Ume and Kaine, 2021) [15].

Moreover, 83.33% of the populations studied were members of different cooperative organizations, while only 18.67% were not. Interaction by the way of exchange of ideas in agricultural technologies among cooperative members could facilitate in boosting their income through enhancing their

outputs (Onunka, *el al*; 2021) [13]. Besides, 69.16% of the sampled farmers had farming experience of 21-40 years, while the least (30.84%) had experience of 1 -20 years. Years of farming experience aids farmers in surmounting intricacies in farming, leading to high profit accruing from high productivity (Nnadozie, *et a;* 2015) [9].

More so, the result of household size showed that majority (29.2%) of the farmers had household size of 6 – 10 people, while the least (14.2%) had household size range of 16 – 20. Large household members of labour age are often engaged by poorer households into hired labour in order to generate income for improvement of family welfare through improvement in farm work (Ogisi, Begho and Alimeke, 2013) [10]. More so, only 16.7% of the sampled cassava farmers had access to credit through any of the lending institutions. The vast majority of the farmers (83.3%) did not have access Nzeakor and Ume, (2021) [7] reported that scarcity of fund for adoption of technology had been a persistent problem in the adoption process, leading to low farm profit as farm outputs decline Table 1 explained that only 35.3% of the respondents had contacts with extension agents, while the greater majority (66.7%) had no extension contact. The indication was poor extension outreach, which adversely affected innovation adoption, leading to low crop profitability. The work of Kingley, Eucharia and Emmanuel, (2014) [5] is in consonance with the above statement. They posited that through extension services, the potential gains of improved agricultural technology are inculcated into the farmers for high farm output to accrue.

Cost and Return of Cassava Production

Table 2: Cost and Return of Cassava Production

Items	Units	Quantity	Cost per unit	Total cost	Revenue	%
Revenue	Kg	4500	200		900,000	
Cassava	Bundle	20	700		14,000	
Cassava Cutting	Bundle	70	700	49000		12.15
Fertilizer	Bags	8	9000	72,000		17.85
Transportation				5000		1.24
Miscellaneous				10000		2.48
Total physical cost		4598	10600	136,000		33.72
Total Labour						
Clearing	Md 10	(48) man hrs	3000	30000		7.44
Land preparation	Md 20	(96) man hrs	4,000	80000		19.84
Planting	Md 6	(40) man hrs	2000	12,000		2.98
Weeding	Md 15	(80) man hrs	3000	45,000		11.16
Fertilizer app	Md 10	(56) man hrs	2000	20000		5.00
Harvesting	Md 10	(56) man hrs	2000	20,000		5.00
Total labour	71	376	16,000	180,000		44.63

Total Variable cost = 316,000 78.35
Bank lending rate 27% =27 x 316, 000 = 85,320
TVC =316000+85, 320 = 401, 320 99.50
GM = TR – TVC = 914000 - 316000 = 512,680
Total fixed cost depreciation on (hoe, cutlass and basket)= N2000
Total cost (TVC + Depreciation) = 403, 320
Total farm income = TR – TC = 510, 680
Return on investment (BCR) = 2.27
Source: Field Survey, (2021)
N/B kg kilogram, MD = man-day

The physical input used in cassava production as contained in Table 2 included cassava cutting, fertilizer (NPK), transportation and other miscellaneous. Among all the physical inputs, the cost of fertilizer (N72,000) constituted the highest proportion, constituting about 5.0% of total cost of production. Fertilizer constituted the highest cost of physical inputs used in cassava production as contained in Table 2. The high cost of the resource could be ascribed to withdrawal of fertilizer subsidy programme by Federal government of Nigeria and as well as the diversion of fertilizers main for the farmers' use to the neighbouring states and countries where it commands higher price (Ume, *et al*; 2022) [14]. The cost of transportation (N 5000) was the least. The total cost of the physical inputs was N 136,000, which constituted 33.72% of the total cost. Among the labour items considered in Table 2, cost of labour for land preparation (N80, 000) was highest and constituted about 19.84% of the total cost of production, the least cost was cost of planting, N 12000, (2.98%). The total number of man days of labour employed in cassava production in the study area was 376 with total variable costs of N 401320 (99.50%). Furthermore, Table 2 revealed that the total revenue for cassava production per hectare was N 914,000 with the total cost of N 403, 340 with Benefit cost ratio of 1:2.27.

Determinants to profitability of Cassava Farmers

Table 3: Estimated Multiple Regression Production Function for Cocoyam

Variable	Linear	Exponential	Double Log + (Cobb Douglas)	Semi Log
Constant	9.864(4.744)***	6.5064(3.229)***	6.001(3.511)***	4.109(3.288)***
Gender	1.564(0.137)**	0.241(0.442)	0.275(1.191)	0.612(0.097)
Age	0.670(0.617)	0.623(0.441)	0.901(2.171)**	1.311(-0.109)
Education	0.553(-1.666)	0.337(2.007)**	0.476(0.991)	-2.104(2.314)**

Household size	0.002(3.099)***	0.118(4.236)***	0.227(4.268)***	-0.215(0.443)
Organization	-0.544(2.203)**	-0.109(-1.096)	0.173(0.036)	0.014(0.029)
Extension Serv.	-0.511 (-0.103)	-0.599(-1.046)	0.433(2.016)*	0.014(0.029)
Farm. experience	0.843(0.007)	2.091(2.0113)**	0.115(2.254)**	3.930(3.558)***
R^2	0.6543	0.5614	0.8267	0.4784
F Value	4.486***	6.641***	92.64***	4.771***

***Source*:** Field Survey, 2012
***, **, *** significant at 1.0%, 5.0% and 10.0% levels of probability respectively
The figure in parenthesis is the t-ratio

Because of high statistical and econometric criteria, Cobb - Douglas was chosen as lead equation. The coefficient of multiple determination, R^2 was 0.8267 implying that 82.67% of the variation in the dependent variable were accounted by the variables included in the model, while the remaining 17.33% were due to error term. The coefficient of the age of the farmer was positive and significant at 5%level. The implication is most farmers were youthful, dynamic and actively productive working class. The aged cassava farmer would not easily adopt productivity enhancing technology and modern farming practices which are needed for transformation in cassava production (FAO, 2020) [4]. The finding of Kingley, *et al*; (2014) [5] agreed with above assertion. They asserted that aged farmers are usually embodiment of knowledge acquired through years of observations and experimentation, leading to high far output The extension services coefficient more-so had a positive significant influence on the profitability of cassava at 10% alpha level. Extension services aids in enhancing the farmers' profit by increasing output through motivation, information dissemination, education on method of farming, introduction of modern farm, practices supply of Inputs, technical assistance and advise and prompt delivery of inputs (Okoye, Okoye and Ume, 2021) [12]. Also, the estimated coefficient of household size was positive in line with *apriori* expectation and significant at 1.0% risk level. Owing to the intensiveness and subsistence farming landscape of most countries in sub-Saharan, Africa, Nigerian inclusive, use of manual labour being prominent, then, importance of household' size in that zone cannot be overstressed. As farming in that zone requires more human efforts, it is anticipated that, a farming household with larger household size is likely to have more helping hands on the family farm. This could impact positively to the farmers' profitability, since cost of labour constitutes more than 45% of total cost of production (Nzeakor and Ume, 2021) [7]. Further, the coefficient for farming experience had positive correlation with the dependent variable and significant at 5% level. Experienced farmers are well acknowledged to have better understanding and process new farming information from extension agents and other sources. With the aforesaid attributes, such farmer's capability of improves their farm profitability likelihood through enhanced efficiency in resource use is certainly (Okoye *et al.* 2021) [12].

Constraints to Cassava Production

Table 4: Results of the Principal Component Analysis on Constraints to Cassava Production

Constraints	Eigen-Value	Difference	Proportion	Cumulative
Credit problem	3.6732	0.35764	0.1567	0.2612
High cost of labour	3.4311	1.15632	0.3466	0.3412
Poor soil fertility	2.2931	0.3558	0.2006	0.4532
Poor access to land	2.1778	0.3098	0.0091	0.4424
Poor access to information	2.0009	0.2789	0.2689	0.8112
High cost of fertilizer	2.0532	0.2609	0.2450	0.4567
Poor access to extension services	1.0678	0.24509	0.1577	0.8055
Bad Road	0.0877	0.22378	0.0587	0.8773
KMO	0.8123			
Chi-Square	3.0076***			
Rho	1.00000			

Bartlett Test of Sphericity
***Source*:** Field Survey, 2021

The result in Table …. shows that the number of principal components retained using the Kaiser Meyer criterion were four in line with Eigen-values greater than 1. The retained components explained 0.8123% of the differences of the components integrated in the model. The Kaiser-Meyer-Olkin which measures sampling adequacy (KMO) contributed a value of 0.8123 and the Bartlett test of sphericity of 3.0076*** was perceived to be significant at 1% alpha level. This suggests the important of utilizing the set of information for factor analysis. The problem of credit access had an Eigen-value of 3.6732 and was ranked 1st in the order of importance as reported by respondents. The poor access to credit may be corrected with high interest rate and high collateral as demanded by lending agencies (Ume, *et al;* 2020) [14]. This is followed by high cost of labour with Eigen value –value of 3.4311 The high cost of labour could be related to urban drift of most able-bodied youths in search of greener pasture, thus making labour scare and expensive (Ume and Kaine, 2021) [15]. The least of importance among the factors considered was order of importance was bad road with Eigen-values of 0.0877 and ranked 8th. This could be related to the fact that most rural roads lining to urban and rural markets are in very deplorable conditions, leading to fewer vehicles plying the roads during rainy season (Nnadozie, *et al*, 2015) [9].

Conclusion and Recommendations

The following conclusion were deduced

Most respondents were aged, well educated and had poor extension contact. Furthermore, cassava production is profitable in the study area. Also, the major constraints to cassava production in the study area were poor access to credit, poor access to extension contact, poor soil fertility and high cost of labour.

Based on the findings, the following major recommendations were proffered;

1. Credit should be made available to farmers through micro-finance banks; agricultural credit scheme and commercial banks at reduce interest rate and affordable collaterals.
2. Policy options that aimed at improving the extension agents' effectiveness in the discharge of their duties through payment of salaries and other local transport allowance incurred when doing job.
3. Fertilizer subsidy policy of Federal Government of Nigeria should be sustained in order to improve farmers' output.
4. The land use art of 1978 should be put in place in order to enable genuine farmers have access to land for high production.
5. High cost of farm labour could be reduced bythe farmers through application of improved inputs such as herbicide

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