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DETERMINANTS OF OUTPUT OF CASSAVA (MANIHOT SPECIES) PRODUCTION IN ABUJA, NIGERIA

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ABSTRACT

This research study focused on determinants of the output of cassava (Manihot species) production in Abuja, Nigeria. Multi-stage method of sampling was used. One hundred (100) cassava farmers were sampled and selected. Primary data were obtained through the use of a well-designed and also well-structured questionnaire. Data were analyzed using econometrics and statistical tools. The results show that 87% of cassava producers were between 31 to 50 years of age. About 72% had formal education and were literate. Averagely, they had 4.76 hectares of cassava farmland. The estimated gross margin (GM) and net farm income (NFI) of cassava production per hectare were 1,464, 162.72 Naira and 1, 453, 752.49 Naira respectively. This implies that cassava production was profitable and worthwhile. Farm size and fertilizer input were statistically significant factors influencing the output of cassava production. Age, labour input, and cassava cuttings were statistically significant factors influencing the output of cassava production. While chemical input statistically and significantly influenced the output of cassava production. The constraints facing cassava producers were the unavailability of improved cassava cuttings, the high cost of farm inputs, insecurity, inadequate extension services, and inadequate finances. The research study recommends that improved cassava cuttings should be made available to farmers for increased productivity. Extension officers should be employed to disseminate innovations, research findings, and new farm technologies to cassava farmers. Credit or loan facilities should be made available to cassava producers at low-interest rates.

INTRODUCTION

Cassava (*Manihot species*) belongs to *Euphorbiaceae,* and it a major and important source of carbohydrate. It is second important staple food crop after maize in terms of energy or calories consumed. Nigeria is the largest producer of cassava in the world with estimated production of 60,001,531 tonnes in 2020 (FAO, 2020). Cassava production in Nigeria in 2018 and 2019 were 55, 867, 727 tonnes and 59, 411, 510 tonnes respectively. The total land area for cassava production in Nigeria was 7,737, 846 ha, with annual yield of 77, 543hg/ha, and the average yield of cassava was 10.6 tonnes per hectare in 2020 respectively (FAO, 2020). The tuber of cassava contains 2% protein, 62% water content, 20 – 30 % starch, 1 – 2% fiber, traces of minerals, and vitamins (Akerele et al., 2018). Cassava tolerates wide ranges of climatic and soil conditions; it yields properly on poor soils with low rainfall. Cassava has tolerance to drought and has capacity to yield under marginal soil conditions. In Nigeria, cassava can be grown in all ecological zones, and when moisture is available, it is planted all the year round. Cassava can be consumed when properly prepared and processed. Cassava products include: flour, chips, starch, pellets, alcohol, and adhesives, Cassava products are vital raw materials for the following industries: livestock feed, wood, textile, confectionary, pharmaceuticals, soft drink and food, and ethanol/alcohol industries respectively. They are tradeable in international markets, and plays a significant role in increasing income, and food production in Nigeria (Aboajah et al., 2018). Cassava especially the roots and leaves when compares with other staple food can generates more cash incomes and provides calories for largest number of farming households (Sanusi et al., 2020). About 250 million people in sub-Saharan Africa (SSA) derive their daily calories or energy from cassava, the leaves are consumed as vegetables (Oladoyin et al.,

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2022). It is forecasted that by 2025, close to 62% of global cassava production will come from sub-Saharan Africa (Okorie et al., 2021). Cassava has many uses and this made the crop a potential and major foreign exchange earner in Nigeria. Cassava is cultivated by smallholder farmers who are resource poor farmers, having low resources. Cassava ensures food security, plays significant role in alleviating poverty, and helps in environmental protection. Cassava production over the years is faced with problems such as poor storage facilities, pests and diseases, price fluctuations, urbanization, and low capitalization. The high costs of processing, production, transportation, and the deficit in infrastructures in Nigeria makes it difficult to add value to cassava in terms of quality, safety, quantity and shelf life, as this can encourage export and increase foreign earnings.

Objectives of the Study

This research study focused on determinants of output of cassava (*Manihot species*) production in Abuja, Nigeria. Specifically, the objectives were:

- Identify the socio-economic profiles of cassava farmers,
- Determine the profitability, costs and returns of cassava production,
- Evaluate factors influencing or affecting output of cassava production, and
- Determine the constraints faced by cassava farmers in the study area.

MATERIALS AND METHODS

The research study was conducted in Abuja, Nigeria. Abuja is located between Latitudes $9^0\ 4|20||$ North and Longitudes $7^0\ 29|28||$ East. Abuja has three weather conditions annually, they are: rainy season, dry season and the harmattan period. The brief harmattan period comes in between the rainy and dry seasons. Abuja falls within the savannah zone vegetation, the vegetation in the territory are classified into three (3) savannah types: firstly, grassy savannah; secondly, savannah woodland; and thirdly, the shrub savannah. Abuja has population of about 776,298 people (NPC, 2006). The population of Abuja in 2022 is about 3,652,000 people which is 5.43% increase over the population of 3,464,000 people in 2021. The people are engaged in agricultural production activities. They are involved in animal production and growing crops. Crops grown include: cassava, maize, millet, soybean, garden egg, beans, rice, yam, groundnut, sorghum. Animal reared include: poultry, goats, sheep, cattle, rabbit and turkey. Multi-stage method of sampling was used. Sample size of 100 cassava farmers were selected. Data obtained were those from primary sources. Data were collected through the use of well-designed and also well-structured questionnaire. The questionnaire was administered to the cassava farmers through the help of well-trained enumerators. Data were analyzed using the following analytical tools:

Descriptive Statistics: This involves the use percentages, mean, range and frequency-distributions. This was used specifically to achieve objective one (i).

Farm Budgetary Technique: The gross margin model is stated thus:

$$GM = TR - TVC \dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

$$GM = \sum_{i=1}^{n} P_i Q_i - \sum_{j=1}^{m} P_j X_j \dots\dots\dots\dots\dots\dots (2)$$

$$NFI = TR - TC \dots\dots\dots\dots\dots . (3)$$

$$NFI = \sum_{i=1}^{n} P_i Q_i - \left[\sum_{j=1}^{m} P_j X_j + \sum_{k=1}^{k} GK\right] \dots\dots\dots . (4)$$

Where

P_i = Price of Cassava ($\frac{₦}{Kg}$),

Q_i = Quantity of Cassava (Kg),

P_j = Price of Factor Inputs ($\frac{₦}{Unit}$),

X_j = Quantity of Factor Inputs (Units),

TR = Total Revenue obtained from Sales from Cassava (₦),

TVC = Total Variable Cost (₦),

GK = Cost of all Fixed Inputs (Naira)

NFI = Net Farm Income (Naira)

This was used specifically to achieve objective two (ii).

Financial Analysis: Gross margin ratio according to Ben-Chendo *et al*. (2015) is defined as:

$$Gross\ Margin\ Ratio = \frac{Gross\ Margin}{Total\ Tevenue} \dots\dots\dots\dots . (5)$$

The operating ratio (OR) according to Olukosi and Erhabor (2015) is defined as:

$$Operating\ Ratio = \frac{TVC}{GI} \dots\dots\dots\dots\dots\dots\dots (6)$$

Where,

TVC = Total Variable Cost (Naira),

GI = Gross Income (Naira),

The rate of return per naira invested (RORI) in cassava production is defined as:

$$RORI = \frac{NI}{TC} \dots\dots\dots\dots\dots\dots\dots\dots\dots (7)$$

Where,
$RORI =$ Rate of Return per Naira Invested (Unit)
$NI =$ Net Income (Naira)
$TC =$ Total Cost (Naira)
This was used specifically to achieve objective two (ii).

Cobb-Douglas Production Function Model: The model is defined as follows:
$Log\ Y = \alpha_0 + \alpha_1 Log\ X_1 + \alpha_2 Log\ X_2 + \alpha_3 Log\ X_3 + \alpha_4 Log\ X_4 + \alpha_5 Log\ X_5 + \alpha_6 Log\ X_6 + U_i$……(8)
$Y =$ Output of Cassava (Kg),
$X_1 =$ Age of Cassava Farmers in Years,
$X_2 =$ Farm Size in Hectares
$X_3 =$ Labour − Input in Mandays
$X_4 =$ Fertilizer − Input in Kg
$X_5 =$ Cassava − Cuttings in Kg
$X_6 =$ Chemical − Input in Litres
$U_i =$ Error Term,
$\alpha_1 - \alpha_6 =$ Regression Coefficients,
$\alpha_0 =$ Constant Term,
This was used specifically to achieve objective three (iii).

Principal Component Model: The constraints faced by cassava farmers were subjected to principal component analysis. This was used specifically to achieve objective four (iv).

RESULTS AND DISCUSSIONS

Socio-Economic Profiles of Cassava Farmers

The summary statistics of socio-economic profiles of cassava farmers are presented in Table 1**.** Gender classifications show that 71% of cassava farmers were male, while 29% were female. This signifies that cassava farming was dominated by male counterparts, this might be due to strength and rigors involve in activities of cassava farming. Majority (87%) cassava producers were between 31 to 50 years of age. This age range of cassava producers are likely to be more energetic and be willing to take risks in cassava farming. The average age of cassava producers was 42 years. This implies that cassava producers were active, resourceful, and energetic in their youthful age. Age of cassava producer's influences physical work and productivity, as cassava farming is believed to be labour intensive. Furthermore, 72% of cassava producers attended formal education and were literate, while 28% had non-formal education. Education increase farmers' understanding and knowledge of new farm technologies, and it is a significant factor that facilitates adoption of improved farm technologies among cassava producers. In addition, 84% of cassava producers had between 1 to 10 years' experience in cassava farming. Farmers with long years of experience in cassava farming would be more conversant with the problems and this would increase the farmer's level of acceptance of innovations and new ideas as a method of overcoming the constraints (Ashaye *et al*., 2018). The average farm size was 4.76 hectares, this signifies that cassava producers were smallholder, resource poor, small-scale farmers. Averagely, there are 5 people per household, this signifies that availability of family labour for activities of cassava production and this will reduce amount spent on hired labour.

Table 1. Socio-Economic Profiles of Cassava Farmers

Socio-Economic Profiles	Frequency	Percentage	Mean
Gender			
Male	71	71.00	
Female	29	29.00	
Age in Years			
31 – 40	50	50.00	
41 – 50	37	37.00	42.00
51 – 60	13	13.00	
Educational Level in Years			
Non-Formal	28	28.00	
Tertiary	31	31.00	
Secondary	23	23.00	
Primary	18	18.00	
Experience in Farming Years			
1 – 5	21	21.00	
6 – 10	63	63.00	7.85
11 – 15	14	14.00	
16 – 20	02	02.00	
Farm Size in Hectares			
1 – <5	73	73.00	
5 – <10	19	19.00	4.76
10 – <15	05	05.00	
15 – <20	03	03.00	
Size of Household (Units)			
1 – <5	67	67.00	5.00

5 – <10	22	22.00
10 – <15	11	11.00
Total	100	100.00

Source: Field Survey (2021)

Financial Position and Profitability Analysis among Cassava Producers per Hectare

The financial analysis, costs and returns, profitability of cassava production per hectare was presented in Table 2. The costs incurred and revenue obtained in cassava production per hectare was based on the prevailing market price as the time of the field survey. The total variable cost (TVC) estimated was 89,966.96 Naira and this accounted for about 89.63% of total cost involved in cassava production per hectare. The total variable cost includes: cost of labour (16.49%), cost of fertilizer (29.35%), cost of cassava cuttings (21.49%), transportation (05.65%), rent on land (12.86%), loading and offloading cost (03.79%). The total fixed cost was estimated at 10, 410. 23 Naira and this accounted for 10.37% of total cost of cassava production per hectare. The total cost of cassava production per hectare was evaluated at 100, 377.19 Naira. The total revenue was calculated at 1, 554, 129.68 Naira per hectare. The gross margin and net farm income of cassava production per hectare were 1,464, 162.72 Naira and 1, 453, 752.49 Naira respectively. This means that cassava production was profitable. The gross margin ratio was calculated at 0.94, this implies that for every one (1) Naira invested in cassava production per hectare, 94 kobo covered interest, profits, taxes, depreciation, and expenses. Operation ratio in financial analysis is used to measure operating efficiency and financial position of an enterprise. It is preferable and worthwhile to have low values of operating ratio for an enterprise. The calculated operating ratio was 0.058, this signifies that 5.8 % of returns from cassava produce was used to cover cost of cassava sold and other operating expenses. The calculated rate of returns was 14.48, this signifies that for every one (1) Naira invested in cassava production 1448 kobo was realized.

Table 2. Financial Analysis, Costs and Returns, Profitability of Cassava Production per Hectare

Variable		Value (₦)	Percentage
(a)	Variable Cost		
	Cost of Labour	16,550.00	16.49
	Cost of Fertilizer	29,456.09	29.35
	Cost of Cassava Cuttings	21,576.87	21.49
	Transportation Cost	05,670.00	05.65
	Rent on Land	12,907.00	12.86
	Loading/Offloading Cost	03,807.00	03.79
(b)	Total Variable Cost	89,966.96	89.63
(c)	Fixed Cost		
	Depreciation of Assets/Farm Tools	5,500.23	05.47
	Taxes	3,709.00	03.70
	Interest	1,201.00	01.20
(d)	Total Fixed Cost	10,410.23	10.37
(e)	Total Cost of Production	100,377.19	100.00
(f)	Total Revenue	1,554,129.68	
(g)	Net Farm Income(NFI)	1,453,752.49	
(h)	Gross Margin	1,464,162.72	
(i)	Gross Margin Ratio	0.94	
(j)	Operating Ratio	0.058	
(k)	Rate of Return on Investment	14.48	

Source: Field Survey (2021)

Determinants of Output of Cassava Production

The result of Cobb-Douglas production function model showing factors influencing output of cassava production was presented in Table 3. The exogenous factors under considerations were age, farm size, labour-input, fertilizer-input, cassava cuttings and chemical – input. The regression coefficients of all predictor variables were positive and significant. Farm size (X_2) and fertilizer input (X_4) were statistically significant regressor variables influencing output of cassava production at ($P < 0.01$). A 1% increase in fertilizer factor input will lead to 22.98% increase in output of cassava production. Age (X_1), labour-input (X_3), and cassava cuttings (X_5) were exogenous variables influencing output of cassava production at ($P < 0.05$). As cassava producers advanced in age, additional of one year in age will lead to 12.46% increase in output of cassava production. Also, chemical input (X_6) was statistically significant at ($P < 0.10$). The return to scale is the summation of all elasticities of production for predictor factors included in the Cobb-Douglas production function model. The return to scale was calculated at 1.373, which means increasing return to scale, this means that for every additional unit to production inputs in cassava production will lead to more than proportionate increase in output of cassava production. The coefficient of multiple determinations (R^2) was 0.891, this means that 89.1% of variations in output of cassava production was explained by the predictor variables included in the Cobb-Douglas production function model. The F-value of 247.82 was significant at ($P < 0.01$), this signifies that the model is of good fit. This result is similar to findings of Nandi *et al*. (2011) who reported that farm size, labour input, and cassava cuttings had positive coefficients and were statistically and significantly predictor factors influencing output of cassava production.

Table 3. Result of Multiple Regression Analysis of Cobb-Douglas Production Function Model

Variable	Parameter	Regression Coefficient	Standard Error	t-Statistics
Age ($\boldsymbol{X_1}$)	α_1	0.124660**	0.04516	2.76
Farm Size ($\boldsymbol{X_2}$)	α_2	0.157761***	0.04370	3.61
Labour-Input ($\boldsymbol{X_3}$)	α_3	0.100184**	0.00041	2.51
Fertilizer-Input ($\boldsymbol{X_4}$)	α_4	0.22985***	0.06162	3.73
Cassava-Cuttings ($\boldsymbol{X_5}$)	α_5	0.27828**	0.10344	2.69
Chemical-Input ($\boldsymbol{X_6}$)	α_6	0.48236*	0.24485	1.97
Constant	α_0	8.9927**	3.55442	2.53
RTS = 1.373				
$\boldsymbol{R^2}$ = 0.891				
Adjusted $\boldsymbol{R^2}$ = 0.852				
F-Value = 247.82***				

Source: Data Analysis (2021)

*-*Significant at*($P < 0.10$) **-*Significant at* ($P < 0.05$)

***-*Significant at* ($P < 0.01$)

Problems Facing Cassava Producers in the Area of Study

The constraints facing cassava producers were subjected to principal component model or factor analysis and was presented in Table 4. Constraints facing cassava farmers with Eigen-values greater than one or unity were retained and used for further analysis by the model. Problems with Eigen values less than one or unity were discarded by the model. Unavailability of improved cassava cuttings was ranked 1st with Eigen-value of 1.9013 and this problem explained 18.24% of all constraints retained in the model. High cost of farm input was ranked 2nd among all constraints retained in the model, and this constraint explained 17.35% of all constrained retained in the model. All the retained problems in the model explained 69.53% of all constraints facing cassava producers that was included in the principal component analysis. The chi-square value of 671.27 was statistically significant at ($P < 0.01$), this signifies that the model is of good fit.

Table 4. Principal Component Analysis of Constraints Facing Cassava Farmers

Constraints	Eigen-Value	Difference	Proportion	Cumulative
Unavailability of Improved Cassava Cuttings	1.9013	0.623	0.1824	0.1824
High Cost of Farm Input	1.827	0.304	0.1735	0.3559
Lack of Extension Services	1.724	0.207	0.1224	0.4783
Inadequate Finances	1.702	0.167	0.1148	0.5931
Insecurity	1.535	0.094	0.1022	0.6953
Bartlett Test of Sphericity				
KMO	0.7221			
Chi Square	671.27***			
Rho	1.00000			

Source: Computed from Data Analysis (2021)

***-*Significant at* ($P < 0.01$)

CONCLUSIONS

This research study has established that cassava production is profitable and worthwhile in the area of study. The cassava producers were resourceful, active, energetic, and young farmers. The mean age was 42 years. Most cassava producers had formal education and were literate. They had long years of experiences in cassava farming and are smallholder, resource poor, small scale farmers. The gross margin and net farm income of cassava production per hectare were 1,464,162.72 Naira and 1,453,752.49 Naira respectively. Financial analysis shows gross margin ratio and operation ratio of 0.94 and 0.058 respectively. The statistical and significant predictor variables influencing output of cassava production were age of cassava producers, farm size, labour-input, fertilizer input, cassava cuttings and chemical-input. The constraints faced by cassava producers were unavailability of improved cassava cuttings, high cost of farm inputs, and lack of extension services, inadequate finances, and insecurity. Based on the results, the following points were recommended:

- Improved cassava cuttings should be made available for cassava producers for increased productivity.
- Extension officers should be employed by government to disseminate innovations, research findings, and new farm technologies to cassava producers.
- Credit or loan facilities should be made available by government to cassava producers at low interest rate.
- Farm inputs such as fertilizers, chemicals, and land should be adequately provided for cassava producers for increased productivity.
- Security should be provided to protect lives and properties of farmers' family, farm produce and farm land.

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