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Original Research Article

Cost and Returns on Investment Analysis of Pro-vitamin A Cassava Production Technologies among Farmers in Delta State Nigeria

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Abstract

The study investigated costs and returns of provitamin A cassava production among smallholder farmers in Delta State, Nigeria. By implementing bio-fortification, the prevalence of vitamin A deficiency can be reduced, considering the important role of pro-vitamin A cassava in the diets of rural households in Nigeria. Multistage, purposive, and simple random sampling techniques were used to select 120 respondents for the study. Structured questionnaires were used to collect data. Descriptive statistics and net farm incomes were used in analyzing the data. Results revealed that the majorities (62.5%) were females, 45.8% were within the age range of 31 years and 40 years, 37.0% were married, 41.7% had 31-40 years of farming experience, and the majority (50.0%) of the respondents had secondary school education. Out of the 15 variables investigated as regards the determinants of cassava production in Delta State, only six (6) variables were found to be statistically related to the factors influencing the determinants of cassava production in the study area. Those variables were family size, farming experience, annual income, educational level, farm size, and age. The enterprise was profitable based on the positive values of gross margin (₦3,602,575), net farm income (₦2,804,675), and net return on investment (₦1.53k). This implies that yam production is a profitable enterprise in the study area since RNI was greater than one. The constraints were: high cost of labor, pests/disease attack, low knowledge of improved yam, poor extension services, inadequate finance, poor road network, and high cost of local seed. Therefore, it is recommended that farmers should be encouraged to join cooperative society in order to pool their resources together to take advantage of economies of scale, especially in the purchase of inputs, thereby reducing the cost of production.

Keywords: *Costs benefit analysis, constraints, cassava production, small-holder, farmers.*

Introduction

Cassava (*Manihot esculenta*) production is essential to the economy of Nigeria since the country is the world's largest producer of the commodity with an annual output of about 63 million metric tons (FAO, 2020). The crop is produced in the 36 states of the country, and the average yield per hectare is 10.6 tons. Cassava was introduced to West Africa from Central America and North-Eastern Brazil by slave merchants about the 16th century ago, in Africa and Nigeria in particular (FAO, 2018; Udemezue *et al*., 2021; Agunannah, Njoku, Okechukwu, and Anyim, 2023). In Nigeria, cassava production is well developed as an organized agricultural crop. It has well-established multiplication and processing techniques for food products and animal feed (Udemezue *et al*., 2021).

Cassava plays an important role in Nigeria's agriculture and food security. It is a versatile crop that survives in various ecological zones, and this makes it suitable for cultivation across different regions of the country. The crop is highly valued for its starchy tuberous roots, which serve as a significant source of carbohydrates in the Nigerian diet. Cassava is also an essential food crop in other countries of Sub-Saharan Africa. Findings have estimated that more than 500 million people in this region consume cassava meals on a daily basis throughout the year. This shows the substantial

reliance on cassava as a major food source for a significant number of the population in Sub-Saharan Africa (Esuma*et al*., 2019). It is used to make varieties of food products, such as staple foods like fufu, garri, and tapioca, as well as processed products such as flour, starch, and animal feeds. The crop also has industrial applications, like the production of ethanol and biofuel (Agunannah, Njoku, Ikechukwu, and Anyim, 2023).

Vitamin A deficiency is a concerned issue working against public health development, especially in Africa; it can lead to various health problems, such as impaired vision, increased vulnerability to infections, and reduced immune function. It particularly affects vulnerable populations, such as young children and pregnant women. Nigeria is currently facing a significant issue of vitamin A deficiency (VAD). Research by Aghaji*et al*. (2019) and Ayinde&Adewumi (2016) has reported that over 20% of pregnant women and children under five years old in Nigeria are lacking vitamin A. This proves that Nigeria has a high occurrence of vision impairments, such as night blindness and xerophthalmia, which are linked to vitamin A deficiency (Ayinde&Adewumi, 2016; Aghaji*et al*., 2019). The primary cause of this deficiency is attributed to poor diet, particularly among rural dwellers and vulnerable groups like rural women of childbearing age and children who rely heavily on cassava and cassava by-products in their diets. To caution the effects, biofortification is essential for enhancing the micronutrient composition of food crops (Olatade*et al*., 2016; Saltzman *et al*., 2016), and this leads to the growing focus on developing and distributing vitamin-A-enriched cassava to replace the local varieties that have relatively low levels of micronutrients. However, research has indicated that a consistent availability of the Pro-Vitamin A variety, all year round, could boost food security and decrease the incidence of vitamin A deficiency among rural households in Nigeria as a whole, with a specific focus on the Niger Delta (Agunannah, Njoku, Ikechukwu, and Anyim, 2023). By implementing biofortification, the prevalence of vitamin A deficiency can be reduced, considering the prominent role of cassava in the diets of rural households in Nigeria (Oparinde*et al*., 2016; Garg *et al*., 2018). Therefore, it is crucial to invest in the crop sub-sector, particularly in provitamin A cassava farming.

Investment plays a crucial role in fostering the growth of provitamin A cassava, as research indicates that farmers are motivated to cultivate provitamin A cassava variants and consumers are enthusiastic about purchasing and consuming products made from vitamin A cassava (Ilona et al., 2017). Through investment, farmers can increase their production capacity to meet the needs of millions, thereby making a significant contribution to food security (Agunannah, Njoku, Ikechukwu, and Anyim, 2023). Researchers primarily concentrated research on factors such as consumer acceptance and demand for bio-fortified cassava varieties as well as the adoption pattern of bio-fortified provitamin-A cassava (Olatade*et al*., 2016; Ayinde, 2016). There is paucity of information regarding the investment decisions among households engaged in pro-Vitamin A cassava farming in the state. In view of this, this study investigated the cost and returns on investment analysis of provitamin A cassava production technologies among farmers in Delta State, Nigeria. The specific objectives were to examine the socio-economic characteristics of cassava farmers in the study area, determine the cost and returns associated with provitamin A cassava production, ascertain the determinants of cost and returns on provitamin A cassava production technologies in the study area, and estimate the constraints to provitamin A cassava production in the study area.

Methodology

The study area is Delta State of Nigeria. The state covers a landmass of about 18,050 km^2 (6,970 sq mi), of which more than 60% is land. The state lies approximately between 5°00' and 6°45' E and 5°00' and 6°30' N. It is geographically located in Nigeria's Midwest, bounded in the north and west by Edo State, the east by Anambra, Imo, and Rivers States, southeast by Bayelsa State, and on the southern extreme is the Bight of Benin, which covers about 160 kilometres of the state's coastline. There are 25 local government areas in the state, with headquarters at Asaba (Isorhovoja, 2015).

Multistage sampling techniques were used for the study. Three (3) local governments out of the 25 local governments in the state were used for the research based on their activities on yam production. Here, Aniocha North, Ndokwa East, and Ndokwa West were selected. These gave a total of three local governments used for the study. Two communities per L.G. were purposefully selected due to their active participation in farming activities. IseleAsagba and IseleUkwu, from Aniocha North; Obi-Igbo and Ashaka from Ndokwa East; Amoji and Ogbe-Ogume from Ndokwa West were used. This gave a total of 6 communities that were used for the study. Twenty (20) farmers each were randomly sampled from each community, and this gave a total sample size of 120 farmers that were used for the work. Data used for this research were collected through a structured questionnaire. Descriptive statistics, net farm income, and a regression model were used in analyzing the data.

Measurement of Variables

To determine cost and returns, Net Farm Income (NFI) will be used. The inputs used include seed yam, herbicides, and labor as variable inputs, and a machete, hoe, bicycle/motorcycle, head pan/basket, among others, as fixed inputs. The fixed inputs were depreciated. Gross margin is the excess of sales revenue over purchases or profit above variable cost, while net farm income is the difference between gross margin and total fixed cost. The average prevailing market prices of inputs and outputs were used to derive the relevant monetary values of inputs and outputs. These are mathematically represented as:

GM = TR – TVC

NFI = GM-TFC or TR-TC

NROI = NFI/TC

Where:

GM = Gross Margin

TR = Total Revenue

TVC = Total Variable Cost

NFI = Net Farm Income

TFC = Total Fixed Cost

TC = Total Cost

RNI = NFI÷TC, where RNI = returns per Naira invested

Decision Rule: RNI > 1 implies that the enterprise is profitable; RNI =1, implies that the farmer is operating at breakeven point; and RNI<1, that the farmer is operating at loss (Olukosi and Erhabor 1988 in Daniel and Akintunde, 2022).

To ascertain the determinants of cost and returns on cassava production among farmers. Multiple regression analysis was used to determine the independent variables that contributed significantly to explaining variation in the dependent variable, which stands as the total production output.

T = a+b1x1+b2x2+b3x3+b14x4+b5x5 ……. b13x15+μ
Where
T = Total output
(kg/ha)
a = constant term
b1-b15 = regression coefficients
μ = error term
X1 = age
X2 = educational level
X3 = Household size
X4 = Membership of social organization
X5 = Farm size
X6 = Farming experience
X7 = Training received
X8 = type of ecosystem
X9 = Tillage type
X10 = Soil fertility
X11 = income of the farmers
^{X12} = Constraints to use of the crop
X13 = Types of farming practice
X14= access to credit
X15= sex

Results and discussion

Data in Table 1 revealed that the majority (45.8%) of the cassava farmers fall within the age range of 31 and 40 years and have a mean age of 44 years. This implies that they were in their economic active age and productive, which can make a positive contribution to agricultural production. The result also revealed that 62.5% of the farmers were females, while 37.5% were males. This indicates that more females than females were involved in cassava production in the study area. This may be attributed to the masculine nature and belief people have for cassava production, which most males cannot comply with. The finding is in agreement with the finding of Daniel and Akintunde (2022), who observed that men dominated the activities of cassava production in their research. On an educational level, it was observed that few (26.7%) of the respondents had primary education, while the majority (50.0%) of the farmers had secondary school education. According to the finding, the result on household size indicated that the mean household size was 8 persons. This implies that there was a moderate supply of family labor for farm operations in the study area, as most respondents have relatively large families. This result is in line with the finding of Toluwase and Sekumde (2017) that indicated the relatively large family size in their study. In terms of access to credit loans, 29.2% of the cassava farmers had access to credit, while 70.8% had no access to credit. This implies that the majority of the farmers studied had no access to credit

facilities and were using their personal savings for farm operations. This could stem from the fact that the government hardly grants financial credit to farmers, and even when it does, it is mostly inadequate and inaccessible to rural farmers due to a lack of collaterals (Rukwe and Zubairu, 2019). On farming experience, 41.7% of the respondents had between 31-40 years of farming experience, while 25.0% of the farmers in the study area had between 1-10 years of farming experience, with a mean of 24 years. This implies that cassava farmers in the study area have a significant level of experience in cassava production and that the managerial ability of the farmers can be beneficial in cassava production.

Table 1: Socio-economic characteristics of cassava farmer in Delta state

Variables	Frequency	Percentage	
Age			
21-30	10	8.3	
31-40	55	45.8	44years
41-50	20	16.7	
51-60	12	10.0	
61-70	23	19.2	
Sex			
female	75	62.5	
male	45	37.5	
Marital Status			
married	45	37.5	
single	30	25.0	
Divorced/separated	25	20.8	
widowed	20	16.7	
Household size			
1-5	57	47.5	
6-10	39	32.5	8 persons
11-15	24	20.0	
Education Level			
Primary school	32	26.7	
Secondary school	15	50.0	
N.C.E./OND and HND	60	12.5	
Degrees	13	10.8	
Social organization			
Yes	90	75.0	
No	30	25.0	
Access to credit			
Yes	35	29.2	
No	85	70.8	
Source of capital			
Personal savings	35	29.2	
Isusu contribution	65	54.2	
Bank loan	11	9.2	
Friends/relatives	9	7.5	
Farming experience			
1-10	30	25.0	
11-20	11	9.2	
21-30	25	20.8	24years
31-40	50	41.7	
41-50	2	1.7	
51-60	2	1.7	

Source: field survey 2024

Cost and Returns of Cassava Production in the Study Area

The cost and returns on investment with cassava production in Delta State were carried out to determine the viability of the various cost components, such as the variable and fixed cost items used in cassava production. The total cost incurred on cassava production was ₦1,892,925. This shows that the farmers spent more money on cassava inputs. The total revenue obtained from the cassava business was ₦4,797,500. The total fixed cost of cassava production was ₦598, 000, while the total variable cost was ₦1,294,925. It was revealed that the total fixed cost accounted for only 31.6% of the

total cost of cassava production in the study area. This implies that variable costs (86.4%) were the highest cost items in cassava production in the study area compared to the fixed cost items. This result considerably agrees with the finding of Zaknayiba and Tanko (2015), who reported that cassava farmers spent over 78.9% of the total cost of production on variable inputs. The table further showed that the net farm income was ₦2,904,575. The return per naira invested (RNI) was ₦1.53k, which implies that cassava production is a profitable enterprise in the study area since RNI was greater than one.

Table 3: Estimated costs and returns for Cassavaproduction in Delta State, Nigeria

Variables	Amount(N)	Percentage
Total Revenue	4,797,500	
Variable Cost		
Cassava seeds	520,325	40.2
Pesticides	340,520	26.3
Labour	381,124	29,4
Transportation	31,445	2.4
Loading and off loading	21,511	1.7
Total variable cost	1,294,925	100
Fixed cost		
Machetes	67,000	11.2
Hoe	56,000	9.4
Rake	36,000	6.0
Baskets	39,000	6.5
Interest on loan	400,000	66.9
Total fixed cost	598,000	100
Total cost(TC)=TVC +TFC	1,892,925	
Gross margin(GM)=TR-TVC	3,502,575	
Net Farm Income(NFI)=TR-TC	2,904,575	
Return perN1 Invested=NFI/TC	1.53k	

Source: Field work, 2024.

Multiple regressions analysis showing determinants of cost and returns on cassava production in Delta State

The results of regression analysis of the independent variables (age, educational level, household size, farmers' group, farm size, farming experience, type of ecosystem used, types of tillage system used, access to credit, level of soil fertility, income of the farmers, perceived constraints, farming practice, training received, and sex) on determinants of the factors influencing cassava production among farmers show that a strong correction (R=0.987) exists between dependent variable and independent variables. These variables where able to explain 99% of the variation in determinants of yam production among farmers (R^2= 0.964). The adjusted R^2 also supported the claim with a value of 0.951, or 95.1%. This implies that the independent variables explain the behaviour of the dependent variable at 97 level of confidence.

Out of the 15 variables investigated as regards the determinants of yam production in Delta State, only six (6) variables were found to be statistically related to the factors influencing the determinants of yam production in the study area. Those variables were family size, farming experience, annual income, educational level, farm size, and age.

Table 2: Multiple regression analysis showing determinants of cost and returns on cassava production in Delta State

	Unstandardized Coefficients		Standardized Coefficients	
Model	B	Std. Error	Beta	T
Constant	5.7619	3.3890		5.225
House hold size	-9003.617	3400.451	-.084	-2.648
Farming experience	7335.673	817.258	.226	8.976
Income generated	.524	.013	1.056	40.094
Level of education	27837.365	4239.041	.179	6.567
Farm size	50256.340	14438.166	.184	3.481
Age	-4211.352	535.816	-.307	-7.860

Source: Field work, 2024. R^2= 0.964Adjusted R^2=0.951

Constraints faced by cassava Farmers in the Study Area

The constraints to cassava production in the study area were ranked according to their degree of importance. The constraints were as follows: high cost of labour, pest/disease attack, low knowledge of provitamin-A cassava variety, poor extension services, inadequate finance, poor road network, and high cost of cassava seed, respectively. The high cost of labour was top in the rank. This could be attributed to the migration of young people to urban areas in search of white collar jobs. This may also constrain smallholder cassava farmers from enhancing productivity. This is in agreement with the finding of Daniel and Akintunde (2022), who reported high cost of labour as a major constraint to cassava production. Poor extension service was considered the fourth major constraint. This was attributed to inadequate extension service in the study area, which may be due to the government's negligence on extension service in Nigeria. Cassava farmers' inadequate knowledge of new farming techniques has reduced their productivity. This agrees with the finding of Akerele*et al.* (2019), who reported lack of extension service as a major challenge to crop productivity.

Table4: Constraints to cassava production in the study area

Constraints	Mean	Ranking
High cost of labour	4.10	1st
Pests/disease attack	3.20	2nd
Low knowledge of improved cassava	3.14	3rd
Poor extension services	3.00	4th
Inadequate capital	2.40	5th
Poor road network	2.15	6th
High cost of cassava seeds	2.01	7th

Source: Field Survey, 2024.

Conclusion and Recommendations

Results showed that the majority (62.5%) were females, 45.8% were within the age range of 31 years and 40 years, 37.5% were married, 25% had 1–10 years of farming experience, and the majority (50.0%) of the respondents had secondary school education. Out of the variables investigated as regards the determinants of cost and returns on cassava production in Delta State, only six (6) variables were found to be statistically related to the factors influencing the determinants of cost and returns on cassava production in the study area. Those variables were family size, farming experience, income, educational level, farm size, and age. The enterprise was profitable based on the positive values of gross margin (₦3,602,575), net farm income (₦2,804,675), and net return on investment (₦1.53k). This implies that cassava production is a profitable business in the study area since RNI was greater than one. The constraints were: high cost of labor, pests/disease attack, low knowledge of improved cassava, poor extension services, inadequate finance, poor road network, and high cost of improved cassava seeds, respectively. The constraints were: high cost of labour, pests/disease attack, low knowledge of improved cassava variety, poor extension services, inadequate finance, poor road network, and high cost of inputs, respectively. Based on the findings of this study, the following recommendations were made:

The government should properly address the problem of the high cost of inputs in the country by placing subsidies on agricultural inputs.

There should be a momentary workshop for extension services in the state through which farmers will be updated on current knowledge of production techniques that will help to improve their yam output level.

Farmers should be encouraged to join cooperative societies in order to pool their resources together to take advantage of economies of scale purchases, thereby reducing the cost of production.Rehabilitation of rural roads is also necessary to enable the farmers to have access to their produce.

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