RESOURCE USE EFFICIENCY AND PROFITABILITY OF PRO-VITAMIN A CASSAVA PRODUCTION IN ANAMBRA STATE, NIGERIA.

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ABSTRACT
Resource use efficiency and profitability of Pro- vitamin A cassava technology in Enugu State, Nigeria was studied. Multistage random sampling technique was used to select one hundred and twenty respondents. A structured questionnaire and oral interview schedule were used to gather primary data. Percentage responses, allocative efficiency model and gross margin analysis were used to address the objectives of the study. The result shows that the pro vitamin A cassava farmers were unable to attain optimum resource allocation (r=1) as most of their resources such as farm size (0.761) and planting material (0.579) were under- utilized (r <1), while labour (0.601), fertilizer (0.776) and capital input (0.433) were over -utilized (r>1). Pro vitamin A cassava is profitable in the study area with Gross margin, Net Farm Income (NFI) and Benefit Cost Ratio of ₦ 780,252 and₦ 792,800 and 1.67 respectively. Also, the limitations to pro vitamin A cassava variety production in the study area were fertilizer(85%), poor access to extension services(83.33%), high cost of labour (76.67%) and high cost of pro vitamin A cassava variety(56.67%).There is need to enhance farmers' access to extension services and the pro vitamin A cassava variety at moderate cost.

Keywords: resource use, efficiency, profitability, pro- vitamin A, cassava, production

INTRODUCTION
In Nigeria and many countries in sub Saharan Africa, where cassava is a staple food, Vitamin A deficiency continues to be a noteworthy public health problem. This is notwithstanding the improving diets owing to rising incomes and administration of vitamin A capsule and fortification programmes in these countries over the previous decade (Food and Agriculture Organization (FAO) 2020). Cassava root is relatively low in micronutrients and protein, hence predisposing the consumers to health risks. Prominent among the health risks, included stunted growth, reduced capacity for physical activity, and in extreme cases, a high incidence of anaemia, corneal blindness, and compromised immunity (Aghaji, Dute and Aghaji, 2019). The most vulnerable group to these diseases are pregnant women and children under five years in most rural areas of the country (National Root Crop Research Institute (NRCRI) 2019).Studies show that nearly one in three Nigerian children under five and one-quarter of all pregnant women in the country are vitamin A deficient (Egesi and Eke-Okoro,; 2013, Ume; et al; 2020a). FAO, 2020).

The pro vitamin A, cassava varieties were developed by Federal government of Nigeria in collaboration with International Institute for Tropical Agriculture (IITA), Ibadan and National Root Crops Research Institute (NRCRI), Umudike to cushion the effects of vitamin A deficiency, a micronutrient. The developed improved varieties, including NR07/0326, NR07/0506,NR07/0497,NR07/0499,NR07/0427, NR07/0432(Egesi and Eke- Okoro,; 2013, NRCRI, 2019). These cultivars, apart from having abovementioned characteristic have features of being high in dry matter content, high leaf retention in dry season and possess high quality flour for confectionaries (Egesi and Eke,- Okoro, 2013; Onunka; *et al;* 2017). Nigeria's yield per hectare for cassava ranges between 10 and 15 metric tonnes per hectare, Thailand records average of 40 tonnes per hectare. The yield potential of cassava under optimum conditions is about 90 tons of fresh roots per hectare, which is equivalent to 30 tons of cassava dry matter per hectare (NRCRI, 2019).

Many factors may have contributed to the low yields experienced in vitamin A cassava varieties. One of the major causes is resources (material farm inputs, labour and capital) misallocation by the smallholder farmers, the farming population which results into inefficiency in their production. Allocative efficiency according to Farrel, (1957) relates to the ratio of the technically maximum output at the farmer’s level of resources to the output obtainable at the optimum level of resources. Allocative efficiency deals with the extent to which farmers make efficient decisions by using inputs up to a level where their marginal contribution to production value is equal to the marginal factor cost (Ume; *et al*; 2020a). Studies revealed that majority of small holder farmers depend on the trial and error methods of resource allocation resulting into either resource under-allocation or over-allocation. In the long run, they suffer from huge losses (Uwandu; *et al*; 2019, FAO, 2020, Ume; *et al;* 2020a). Land, labour and capital have been found to be the major resource in which decision have to be made; When these resources are well allocated, farmers achieve full efficiency (Ume, *et al;* 2020b). It is imperative to state that literatures showed that for cassava production to flourish , it desires to attain among others high level of allocative efficiency which is indispensable for nutrition, enhances food security, employment opportunities and improve the efficiency of utilization of labour (Ume; *et al*; 2020a). It is against this background that this study intends to assess the resource use efficiency and profitability of pro vitamin A cassava farmers in Enugu State, Nigeria. Specifically, the objectives of the study are to: describe the socioeconomic characteristics of the farmers and determine the allocative efficiency of the vitamin A cassava varieties, estimate the costs and return of pro vitamin A cassava production and identify the constraints to pro vitamin A cassava variety production.

METHODOLOGY

Anambra State is located between longitude 6^0 36`E to $7^0$ 21`of Greenwich Meridian and latitude $5^0$38`N to $6^0$ 47`N of Equator. The State is bounded in the North by Kogi State, in the west by River Niger and Delta State, in the south by Imo State and on the east by Enugu State. It has twenty one (21) Local Government Areas with Awka as the State Capital. The State has a population figure of 3.467 million people (National Population Commission, (NPC), 2006) and land mass of 4415.54 square kilometers (Km^2). It has four agricultural zones; Aguata, Anambra, Awka and Onitsha. The zones are delineated into extension blocks. Farming is the predominant occupation of the people, with crops such as yam, cassava, rice, maize, cocoyam, cowpea, tomatoes and vegetables grown, while poultry, sheep, goats and pig reared. The people also engage into other economic activities, included trading, saloon, automobile, vulcanizing, bricklaying, tailoring and among others.

One hundred respondents were selected using multi stage random sampling technique. In stage 1, the four out of five agricultural zones of the State were purposively selected on the basis of the intensity of pro vitamin A cassava varieties production. The selected agricultural zones were Anambra, Onitsha, Awka and Aguata. In stage 2, three extension blocks were purposively selected from each zone based availability of Block Extension Supervisors (BES).The three extension blocks purposively selected were Aguata, Orumba North and Orumba south from Aguata zone, Awka North, Awka South and Anaocha from Awka zone, while Oyi, Anambra East and Anambra from Anambra, Onitsha North, Onitsha South and Idemili South from Onitsha zone. These brought to a total of twelve Block Extensions. In the 3 stage, five circles were selected from each of the twelve blocks and these brought to a total of sixty circles. In stage 4, from the lists provided by the extension agents covering those circles, two pro vitamin A cassava farmers were randomly selected from sixty circles. This brought to a total of one hundred and twenty respondents for the detailed study.

A structured questionnaire and oral interview were used to elicit information on primary data. Percentage responses and allocative efficiency model were used to analyse the data. The allocative efficiency indices b_i coefficient was estimated using ordinary least squared regressions method. The explicit production function was estimated by

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + e \qquad (1)$$

Where:

Y = pro vitamin A cassava output (Tons), x_1 = farm size (ha), x_2 = labour (manday), x_3 = planting material (kg), x_4 = fertilizer (kg), x_5 = capital (₦)

$x_1 – x_5$ = coefficient of the parameters to be estimated, while e_1 was the error term and b_0 was the coefficient. 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 ; $Y = b_0 + b_1 x_1 b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + ei \qquad (2)$

Double log:- $\ln(y) = \ln b_0 + b_1\ln x_1 + b_2\ln x_2 + b_3\ln x_3 + b_4\ln x_4 + b_5\ln x_5 + ei$ (3)

Semi log $Y = \ln b_0 + b_1\ln x_1 + b_2\ln x_2 + b_3\ln x_3 + b_4\ln x_4 + b_5\ln x_5 + ei$ (4)

Exponential ; $\ln Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + ei$. (5)

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 estimated coefficients of the inputs in the lead equation formed the basis for the analysis of the farmers' allocative efficiency.

The Allocative efficiency was determined by equating the marginal value product of the resource to its unit price.

$MVP = p_y f_i = p_{xi}$ (6)

$f_i = dy/dx$ which is the marginal physical product of the resource. The models were specified as follows:

$r = MVP/MFC$ (7)

$MVP = mpp_{x1}py$ (8)

(Double log as lead equation)
$Mppy_1 = {}^{dy}/_{dx} = {}^{b1y}/_{x}$ (9)

Semi log form the lead equation = $Mpp_1 = \frac{dy}{dx} = b_1 y$ (10)

$Mppi = {}^{dy}/_{dx} = b_i$ (11)

(linear form is the lead equation)
$D_1 = (1 - {}^{1}/r_1)\ 100$ (12)

(Simonnyan and Balogun,2010).
r = efficiency ratio notation, MVP = marginal value product, MFC = marginal factor cost (cost of unit price of a particular input), MPP = marginal physical product and are arithmetic means of the yield, Py = unit price of output, x_1 = various input 1 to n = absolute value of % change in MVP of 1^{th} resource, r_1 = ratio of MVP to MFC for i^{th} resource, 100 = factor (percentage)

D_1 = Absolute value of % change in MVP of ith resource; Px_i is the unit price of the i^{th} resource; $\overline{Y}$ and $\overline{X}$ = are arithmetic mean of the yield and inputs considered respectively.
If r = 1, it implies that resources are efficiently used i.e. MVP = MFC = 1
r > 1, implies that resources are under-utilized
r < 1, implies that resources are over-utilized.

Gross Margin Analysis Model

The cost and returns was estimated using gross margin analysis, which is the difference between the total revenue (TR) and the total variable cost (TVC)

$$G.M. = TR - TVC \quad (13)$$

$$\text{i.e. } G.M = \sum_{1-1}^{n} P_1 Q_1 - \sum_{j-i}^{m} r_i x_i \quad (14)$$

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

$$NFI = \sum_{1-1}^{n} P_1 Q_1 - \left[\left(\sum_{j-i}^{m} r_i x_i\right) + k\right] \quad (15)$$

Where:

GM = Gross margin of TMS cassava production measured in Naira (₦)

RESULTS AND DISCUSSION

The socioeconomic characteristics of pro vitamin A cassava farmers were analyzed and the results presented in Table 1.

Table 1 Socioeconomic Characteristic of Pro Vitamin A Cassava Farmers

Variable	Frequency	Percentage
Age		
24 – 40	48	40
Above 40	72	60
Mean	46	
Educational Level		
None	20	16.7
Primary	50	41.7
Secondary	40	33.3
Tertiary	10	8.3
Mean	6.7	
Household Size		
1 – 6	40	33.3
7 and above	80	66.7
Mean	7	
Farming Experience		
1 -10	38	31.7
11- 40	82	68.3
Mean	14	
Extension Services		
Access	44	38.33
Non access	76	61.67

Table 1 showed that 60% of the respondents were above 40 years dominated farming with mean age of 46 years in the study area. Aged people are noted to be often conservative to technology adoption tends among others reduces their inefficiency (Ume.*et al;* 2020a). Majority (83.3%) of the respondents had formal educated, while 16.7% had no formal education. Educated people tends to be more receptive to innovations, risk averse and prudent in resources management than less educated ones (Ekwe, 2013). Most of the sampled farmers (66.7%) had large household size ranging from 7 persons and above, which could implies a potential source of easy labour availability, hence reducing labour cost (Ekwe, 2013). The result in Table 1 showed that average household size was 7 persons per household. In addition, 68.3% of the respondents had farming experience of 11-40 years, while the least (31.7%) had an experience of 1 -10 years. The average number of years of farming experience of the farmer was 14 years. Experienced farmers are capable of having exposure in varied farming techniques and receptiveness to new idea, hence improving their resource uses (Ume, *et al*; 2020). Table 1 showed further that majority (61.67%) of the farmers had no contact with extension agent, while 38.33% had contact. The implication was that the farmers in the study area had poor extension outreach and this situation had negatively influenced agricultural development (NRCRI, 2019). An extension service is a major medium in developing countries through which innovations could be transferred to farmers in order to improve on their allocative efficiency (Odoemelam and Anyim, 2020).

Determine the Allocative Efficiency of the Vitamin A Cassava Varieties.

The multiple regression production function analysis was used in determining the bi-coefficients of allocative indices of the crop farmers and were summarized and presented in Table 2.

Table 2:Estimated Multiple Regression Production Function for Vitamin A Cassava Varieties

Variable	**Linear**	**Exponential**	**+Double Log**	**Semi Log**
Constant	8.004	5.8223	6.3872	5.1007
	(4.456)***	(3.115)***	(3.227)***	(3.321)***
Farm size	1.303	0.441	0.761	0.442
	(2.900)**	(0.002)	(1.321)*	(0.557)
Planting material	0.519	0.227	0.579	1.077
	(0.006)	(0.500)	(2.091)**	(-0.177)
Fertilizer	0.523	0.017	0.776	-2.104
	(-1.266)	(2.447)**	(3.190)***	(2.348)**
Labour	0.382	0.518	0.601	-0.475
	(3.434)***	(4.032)***	(1.096)*	(0.101)
Capital	-0.322	-0.599	0.433	0.014
	(-2.098)	(-1.336)	(0.074)	(0.559)
R^2	0.623	0.536	0.889	0.607
F Value	4.721***	6.601***	9.774***	4.111***

Source: Field Survey, 2021

*****, **, *** significant at 1.0%, 5.0% and 10.0% levels of probability respectively

The figure in parenthesis is the t-ratio

In Table 2, the double log analysis was chosen as lead equation based on statistics criterion. The coefficient of multiple determination, R^2 was 0.889, suggesting that 88.9% in the variation of dependent variable was accounted for by the included independent variable, while the remaining 12.1% were due error term As expected, the coefficient of fertilizer (0.776) was positive and statistically significant at 1.0% alpha level. This conformed to the findings of (Ume; *et al;* 2020a), who reported that fertilizer is an important input factor that greatly influences farmers' output. The coefficient of planting material (0.579) was positive and statistically significant at 5.0% risk level. This was in agreement to *apriori* expectation that increase in planting material would result in increase in the farmers' crop output. The coefficients of labour (0.601) and farm size (0.761) were positive in line with *apriori* expectation and significant at 10% risk levels each. These inferred that any increase in individual or collectively would increase the farmers' output.

The allocative efficiency indices were summarized and presented in Table 3.

Table 3:Allocative Efficiency Indices of Pro vitamin A cassava Farmers

Variable	$\overline{Y}$	$\overline{X}$	Bi	MPP	MVP	MFC	R	(D)%
Farm size	840	64.8	0.761	639.24	41422.8	20000	2.07	51.7
Planting Material	840	6.57	0.579	486.36	3195.4	1000	3.20	68.8
Fertilizer	840	12.6	0.776	651.84	8213.2	9000	0.913	-9.53
Labour	840	8.90	0.601	504.84	4,493.1	4500	0.998	-0.020
Capital	840	-17.80	0.433	363.72	-6,474.2	2000	-3.237	13.09

Source: Field Survey, 2021

Table 3 shows that none of the variables considered had efficiency ratio that was equal to 1 (one), which implied efficient utilization of resources. Additionally, the ratio of marginal value production (Mvp) and Marginal Factor Cost for farm size and planting material were 2.07 and 3.195, which were greater than 1. This indicated under-utilization of the resource in pro vitamin A cassava varieties production by the farmers. This finding was in agreement with (Ume *et al.* 2020b), who reported that high cost of the resource (planting material) could be the reason for the under-utilization of the resource, especially by the poor farmers. The underutilization indicated that more than profit maximization levels of resources were used (Ume *et al*; 2019). Therefore, for profit to be optimized in vitamin A cassava varieties production in Anambra State, Nigeria, farm size and planting materials should be reduced from their current level by 82.6% and 76.4%, while fertilizer, labour and capital should be increased from their current levels by 54.8%, 46.9% and 36.4% respectively.

The elasticity of vitamin A cassava varieties production and return to scale are summarized and presented in Table 4 above statement. The low resource endowment of most of the farmers could be because of poor financial base, hence, resulting to under-utilization of resources. The effects of under-utilization of resources are that farming remains in rudimentary and traditional levels (Ekwe, 2013).

The allocative efficiency indices of fertilizer labour and capital were 0.913, 0.998 and -3.327respectively, which were less than unitary. These implied that the resources were over-utilized. The over-utilization of resource implied that less of the profit maximization of the resource was used. The possible reasons for the over utilization of the resources of fertilizer, labour and capital as shown in Table 3, were variously discussed. The limitless use of animal manure as fertilizer by farmers from their farms for the crop production which has no significant cost implication could be the reason for over-utilization of the resources (Uwandu *et al*; 2019). Edoh; *et al*; (2016) reported that the employment of large number of labour in particularly by family labour that is not put into cost in a small sized farm could result to over-utilization. Ume; *et al;* (2020b) finding was in consonance to this assertion especially where the wage is poor.

Table 4.Elasticity of Production and Return to Scale

Variable	Elasticity of Production
Farm size	0.761
Planting materials	0.579
Fertilizer	0.776
Labour	0.601
Capital	-0.433
Return to Scale	2.284

Source: Field Survey, 2021

The elasticity of production shows the change in output relative to unit change in input (Ume; *et al;* 2020b). The elasticity of production of pro vitamin A cassava was estimated directly from Cobb Douglas coefficients. Table 4 shows a production elasticity of less than one for each of the individual input resources used. These indicated that all the factor inputs with exception of capital and vitamin A cassava varieties output had inelastic relationship and hence, implied over-utilization of these inputs. However, the return to scale, which is the sum of the elasticity of all inputs, used in vitamin A cassava varieties production (2.284) was greater than 1, indicating that vitamin A cassava varieties production plan was elastic and thus the farmers were in stage 3 of production function. This implied that when all factor inputs were varied by 1%, the responsiveness of pro vitamin A cassava varieties output to such input variation would be 2.284%. This finding is similar to (Ume *et al;* 2018), who farmers were in stage 3 of production function.

Costs and Return of Pro- Vitamin A Cassava A Production

The costs and return of pro – vitamin A cassava production is shown in Table 5.

Table 5 Cost and Return of Pro – Vitamin A Cassava Production

Item	Unit	Quantity	Price/unit	Cost/value
Revenue				
Roots	Kg	4500	250	1,125,000
Sales of cassava stem cutting	bundle	200	900	180, 000
Total Revenue				1,305,000
Total Physical input				
stem cutting	Bundle	80	900	72, 000
Fertilizer	Kg	8	12,500	100,000
Miscellaneous				35,000
Total				207,000
Clearing	Md	12	3200	38,400
Mounding / ridging	Md	30	4500	135,000
Cutting of stem and planting	Md	6	2500	15,000
Fertilizer application	Md	10	2,500	25,000
Weeding	Md	20	3500	70,000
Harvesting and Bagging	Md	7	2500	17500
Transportation				4,800
Total labour costs		85		305, 700
Total variable costs				512,200
Gross Margin				792, 800
Depreciation of fixed assets excluding land				12,548
Total cost (TVC+TFC)				524, 748
Farm income (TR-TC)				780,252
Benefit cost ratio				1.67

Field Survey; 2021

The farm tools (cutlasses, spade, basket and hoes) used were depreciated. On cost of inputs**,** the average quantity of pro vitamin A cassava stem cutting per hectare used was 200 bundles (50 sticks per bundles costing ₦900 per bundle), totally ₦ 180,000. Additionally, eight (8) bags of fertilizer (NPK) costing ₦ 100,000 at N12,500/bag was applied to a hectare of cassava. The total cost of physical inputs was ₦ 207,500. On labour cost, hours worked by men women and children were converted into a common frame following Ume, et al; (2020). A total number of 85 man-day was used to produce a hectare of pro vitamin A cassava. Mounding /ridging had the highest mandays, (30.0). In peasant agriculture, this farm activity (mounding/ridging) has common features such as usually manual, more man hours required to accomplish, drudgery and energy sapping, usually accomplish by able-bodied people and commands more wage rate (NRCRI, 2019). The total cost of labour was ₦ 305,700, constituting about 48.9 % of the total cost of production. The scarcity and high cost labour could be cited to be responsible for high cost of cost of production in most countries in sub Saharan Africa (FAO 2020).Table 5 shows a Gross margin and Net Farm Income (NFI) ₦ 780,252 and ₦ 792,800 respectively Also, the Benefit Cost Ratio (BCR) was 1.67, implying that in every ₦ 1 invested in pro vitamin A cassava production 67 kobo is gained. Simonyan and Balogun, (2010) reported similar finding.

Constraints to pro vitamin A cassava production

Men score distribution on constraints to pro vitamin production is presented in Table 6.

Table 6: Constraints to pro vitamin cassava production

Variable	*Frequency	Percentage	Ranking
Credit	94	78.33	3
Land	64	53.33	7
High cost of labour	92	76.67	4
High cost of fertilizer	102	85	1
High cost of pesticides	87	72.5	5
Theft	54	45	8
High cost of improved cassava	68	56.67	6
Extension service access	100	83.33	2
Fulani herders	38	31.33	9

*Multiple Responses
Source Field Survey, 2021

Fertilizer is the highest constraints to pro vitamin A production in the study area, as reported by 85 % of the total respondents. Ekwe, (2013) is of the view that fertilizer is among major factors limiting productivity growth of agriculture in sub-Saharan Africa countries. They maintained that fertilizer effect on crop yield is positive and immediate; hence, the most readily adopted technology. However, the price of the input is high at the farm level and in effect, most farmers does their planting of the crop without the input leading to poor farm yield (Ayinde, 2016). Also, this was followed by poor access to extension services. 83.33% of the sampled farmers reported about the variable. The poor access could be linked to wide ratio between extension services and the farmers. This is capable of affecting innovation dissemination and technical assistant to the farmers by the change agent, thus affecting their farm output (Ayinde, 2016). The least factor was problem of Fulani herders, (31.33%). The serious security mounted in the area by the local vigilantes could be associated to that.

CONCLUSION AND RECOMMENDATION

The pro vitamin A cassava farmers in the study area failed to attain optimum resource allocation (r=1) as most of their resources such as farm size and planting material were under- utilized (r <1), while labour, fertilizer and capital input were over -utilized (r>1). Furthermore, pro vitamin A cassava was profitable in the study area with high Gross margin, Net Farm Income (NFI) and Benefit Cost Ratio. The constraints to production of pro vitamin A cassava variety production were high cost of fertilizer, poor access to credit, poor access to extension services, high cost of labour and high cost of improved pro vitamin A cassava variety.

Based on the finding, the following recommendations were proffered;

1. In view of that fact that some production inputs were under-utilized, hence to achieve optimum or absolute allocative efficiency and hence, maximum profit, the farmers should be encouraged to increase the use of these under-utilized resources such as farm size and planting material. This can be achieved through appropriate policies that would enhance their access to these production inputs.
2. Government should put fertilizer subsidy policy to ensure that the resource price becomes affordable to poor resource farmers.
3. There is need to ensure farmers' access to labour saving devices such as hand driven plough to curtail minimally cost of production.
4. There is need to enhance farmers' access to credit through commercial banks, microfinance banks and other lending agencies by government agencies concerned at low interest rate.
5. The extension agents should be adequately mobilized to be active in their duties through timely payment of their salaries and other allowances by the government.

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