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Economic and technical efficiency of cassava production in Ika North East Local Government Area of Delta State, Nigeria

Eze, A. V.* and Nwibo, S. U.

Department of Agricultural Economics Management and Extension, Ebonyi State University, Abakaliki, Nigeria.

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Cassava production seems to be economically viable but there seems to exist no empirical documented evidence to this effect in Ika North East L.G.A of Delta State, Nigeria. In view of this, the study analyzed the economic and technical efficiency of cassava production in Ika North East Local Government Area of Delta State. A multistage random sampling was used to select a total of 120 respondents used for the study. Data used for the study was from primary source, which was collected using a well structured questionnaire. Both descriptive and inferential statistics were used to analyze the data based on the objective of the study. The result obtained showed that females (52.5%) are more than males. Majority (50%) of the respondents are married with an average household size of 6. The result further showed that the farmers were in their middle age (42 years) and had acquired reasonable years of farming experience of 10 years. More than half of the farmers had attended formal educational and earn average annual income of ₦180,000.00. The production systems practiced by the farmers was mono cropping. Cassava production was profitable in the area with a profit margin of ₦200,400.00 per a hectare. The Benefit Cost Ratio shows that in every ₦1.00k invested by farmers, ₦1.00k was realized as profit. The multiple regression result showed R^2 value of 0.833 or 83.3%. The coefficients of farm size, labour and cassava stem were positively signed. Farm size, labour, fertilizer and cassava cuttings were underutilized because their efficiency index was greater than one. The cassava farmers identified some of the factors that constrained their farming activities to include: lack of access to credit, high cost of transportation, poor extension services, among others. Based on the findings, it is therefore recommended that farmers should organize themselves into cooperative societies so as to access credit; viable extension service should be provided bridge the extension need of the farmers and effective transportation system to ease evacuation of cassava produce to urban centre where the demands are high.

Key words: Costs and returns, profitability, production system, constraints, input/output.

INTRODUCTION

Cassava (*Manihot* spp.) is important not only as food crop but moreso as a major source of income for rural households. According to Ogunniyi et al. (2012), cassava has some inherent characteristics, which makes it

Corresponding author. E-mail: ezeanayochukwu09@gmail.com Tel: +2348036718919.

attractive especially to the smallholder farmer in Nigeria. Firstly, it is rich in carbohydrates, which make it useful in some industries and consequently has a multiplicity of end uses. Secondly, it is available all year round compared to other crops as it is more tolerant to low soil fertility and resistant to drought, pests and diseases. These attributes combined with other socio-economic considerations are therefore what IFAD has recognized in the crop as lending itself to a commodity-based approach to poverty alleviation (FAO/IC, 1995).

The comparative production advantage of cassava over other staples has made the government to encourage its cultivation even by the resource poor farmers. The crop production is generally thought to require less labour per unit of output than other major staples. It is a good staple whose cultivation if encouraged can provide the nationally required food security minimum of 2400 calories per person per day (FAO, 2000).

In 2002, cassava suddenly gained prominence in Nigeria following the pronouncement of a presidential initiative on the crop. The initiative was aimed at using cassava production as the engine of growth in Nigeria. In recent times, government has encouraged the use of the crop to produce a wide range of industrial products such as ethanol, glue, glucose syrup and bread. The Nigerian government has also promulgated a law, making it compulsory for bakers to use composite flour of 10% cassava and 90% wheat for bread production. The new regulation which came into effect January 2005, stipulated that the large flour mills that supply flour to bakeries and confectioneries must pre-mix cassava flour with wheat flour (Technical for Agricultural and Rural Cooperation (CTA), 2005).

Cassava has been reported as the chief source of dietary food energy for the majority of the people living in the lowland tropics, and much of the sub-humid tropics of West and Central Africa (Tsegia et al., 2002). Therefore, its production and utilization must be given prime attention in food policy. Even though farmers have not yet attained the desired technical efficiency in cassava production as a result of weak access to external inputs such as fertilizers and herbicides (Ezedinma et al, 2006), the wide scale adoption of high yielding varieties and the resulting increase in yield have shifted the problem of the cassava sector from supply (production) to demand issues, such as finding new uses and markets for it.

Nigeria produces more than 45 million metric tons (MT) of cassava, thus emerging as the world's largest producer (USAID, 2010). In spite of this volume, the full yield potential has not been realized since smallholder production rarely exceeds 11 MT per hectare as against 25 to 40 MT per hectare recommended by experts. This yield per hectare is indicative of the yields experienced in the south-south region of Nigeria including Ika North East L.G.A of Delta State. This region is one of the most productive in the country with respect to cassava. The national average is somewhat lower at 10.0 tonnes/ha. In contrast, Thailand national experienced yields of 17.1 tonnes/ha in 2002. Regional yields in countries such as India, Laos, Thailand and Barbados have been estimated as high as 25 to 40 tonnes/ha. Obviously, Nigeria's highest productivity yields fall short of these rates and this situation is due to a number of factors including small scale farming (on plots that are usually less than 1 ha), manual operation, little or no use of fertilizers and limited knowledge in the use of high yielding roots (Olomola, 2007). Farming at this level makes it difficult to achieve efficiency and economies of scale.

At the farm level, production costs for cassava are high relative to those in other countries. Production is not oriented towards commercial use; instead, farmers produce and process cassava as a subsistence crop. The Nigerian cassava system, is characterized by small-scale farmers/holdings cultivating less than 2 ha of cassava (average of 0.5 ha), primarily cultivated for the traditional food market, is subsistence in nature and not oriented to the industrial market. Any surplus cassava is either processed on the farm, or sold to local processors. The average production figures per hectare in Nigeria were 10.5 MT/Ha in the early 1970s, 11.5 MT/Ha in the 1980s, 10.5 MT/Ha by the end of 1980s, and 11.5 MT/Ha in the 1990s and up to 17.3 MT/Ha was achieved in Ondo State in 2004.

It is also important to note that cassava production is mostly done by rural smallholder farmers using low-level production techniques (Omonona, 2009; Oyegbami et al., 2010; Nweke et al., 2002). Though government at various levels has been trying in various ways to encourage rural farmers to adopt the modern cassava production technologies in order to increase the rural farmer's productivity (Frescro, 1993; Otoo, 1994), there are constraints to adoption in rural farming communities (Nweke et al., 2002; Teklewold et al., 2006). In some instances, farmers reject some of modern technology due to their cultural background and inhibitions due to perhaps illiteracy and religious beliefs. Nevertheless, credit constraint has been singled out as a major factor militating against adoption of modern cassava production techniques (Nweke et al., 2002). The technologies are herbicides application, use of hybrid cassava stake, use of insecticides, use of inorganic fertilizer, use of tractor, appropriate spacing, planting date and tillage practices. The adoption of modern cassava production technologies is an important route out of poverty and enhancing productivity for many in the developing world including Nigeria because of the major role cassava play in food security. Many studies have noted poor technology adoption in cassava production as a serious factor constraining outputs (Barham and Boucher, 1994; Ogboso, 2005).

Despite the importance of cassava as a means of livelihood of farmers in Nigeria, the dearth of empirically documented data on the economic and technical efficiency in the Ika North East L.G.A of Delta State

necessitated this study. It is in view of the foregoing that the following specific objectives were addressed:

i) Describe the socio-economic characteristics of the farmers in the area;
ii) Identify the production system employed by the farmers;
iii) Determine the technical efficiency of production in the area;
iv) Analyze the costs and returns of production in the area; and
v) Analyze the constraints to production in the area.

METHODOLOGY

The study was carried out in Ika North East Local Government Area of Delta State, Nigeria. It has an area of 463 km² and a population of 183,657 (NPC, 2006). There are nine communities, namely; Owa, Ute-Ogbeje, Ute-Okpu, Umunede, Idumuesah, Igbodo, Otolokpo and Mbiri spread out into fourteen wards in the area. The Local Government Area has natural vegetation that supports agricultural activities such as crop production, fishing etc. thus; agriculture is the major activities of the people of this area. The principle crops grown in this area are: yam, cassava, melon, maize, tomatoes, plantain, among others.

A multiple-stage random sampling techniques was employed in selecting the respondents. This involves the random selection of four communities from the nine communities in the area. From the four randomly selected communities, three villages were randomly selected to give a total of 12 villages. Finally, ten cassava farmers were randomly selected from the 12 villages to give rise to 120 farmers. Thus, a total of 120 cassava farmers were randomly selected for the study. Primary data was used for the study. The data was collected through the use of structured questionnaire that was administered to the 120 randomly selected respondents. Data used for the study was analyzed using descriptive statistics such as mean, frequency distribution tables, percentages and inferential statistics. Descriptive statistics was used to analyze objective (i) and (ii); objective (iii) was analyzed using multiple regression analysis while objective (iv) was achieved using gross margin analysis and objective (v) was analyzed using mean score derived from 4 point likert scale.

Model specification

Multiple regression model

$Y = f(X_1, X_2, X_3, X_4, X_5)$ - - - - - implicit form

$Y = a_0 + a_1x_1\ a_2X_2, + a_3X_3, + a_4X_4, X_4, + a_5X_5, +$ et ---- Explicit stochastic form

Where
Y=total output of cassava (tonnes)
X_1 = farm size (ha)
X_2 = labour used in man-days
X_3 = fertilizer used (kg)
X_4 = cassava cuttings (kg)
X_5 = herbicide used (litre)
et = Stochastic error term
$a_1 – a_5$ = Parameters estimate
a_0 = constant

Technical efficiency of each parameter was estimated using efficiency index Rxi = biPy/Pxi,

Where
pxi = unit price of input (N),
Py = unit price of output (N),
bi = marginal productivity of the input and
Rxi = Technical efficiency index of the input.

Model for gross margin

The model used for the estimation of the gross margin according to Olukosi and Ernabor (1988) is stated as:

GM = TR – TVC (GI – TVC)

Gross margin = Total revenue – Total variable cost

٢ = GM – TFC

Profit = Gross margin – Total fixed cost

Where
GM = Gross Margin
TR = Total Revenue
GI = Gross income
TVC = Total variable cost
٢ = Profit

Model for Likert scale

$$\overline{Xs} = \frac{\sum fn}{Nr}$$

Where:

$\overline{X}$ s	=	mean
$\sum$	=	Summation
Fn	=	frequency of respondents responses
Nr	=	number of response of respondent

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

Table 1 shows the age distribution of the famers. The result indicated that more than half (70%) of the respondents are between 31 to 50 years of age, which is regarded as economically active age according to FAO (1992). At this stage in life, Anyanwu et al. (2001) recognised that people are more likely to be energetic and have the capacity to use innovation. This justified the findings of Ebukiba (2010), who reported that 76% of the cassava farmers in Akwa Ibom State were aged between 31 to 50 years.

The results equally revealed that majority (52.5%) of the farmers are female while 47.5% are male. This implies that women participate more actively in cassava production than their men counterpart. This collaborate the findings of Ebukiba (2010), who reported that 60% of the cassava farmers in Akwa Ibom State were females.

Table 1. Percentage distribution of the farmers according to their socio-economic characteristics.

Characteristics	Description	Frequency (n=120)	Percentage	$\bar{X}$
Age (years)	20 - 30	24	20	42
	31 - 40	12	10	
	41 - 50	72	60	
	51 and above	12	10	
Gender	Male	57	47.5	
	Female	63	52.5	
Marital status	Single	27	22.5	
	Married	60	50	
	Separated	10	8.3	
	Divorced	8	6.7	
	Widowed	15	12.5	
Household size	1 - 4	48	40	5
	5 - 8	48	40	
	9 - 12	18	15	
	13 and above	6	5	
Educational level	Non-formal	15	12.5	
	Primary	26	21.7	
	Secondary	41	34.2	
	OND/NCE	27	22.5	
	HND/B.Sc	9	7.5	
	M.Sc	2	1.7	
Annual income	≤50,000	6	5	180,000
	50,001 - 100,000	36	30	
	100,001 - 150,000	30	25	
	150,001 - 200,000	12	10	
	200,001 - 250,000	6	5	
	250,001 - 300,000	18	15	
	300,001 and above	12	10	
Farming experience	1 - 5	24	20	10
	6 - 10	66	55	
	11 - 15	12	10	
	16 - 20	18	15	
Farm size	3 - 5	54	45	6
	6 and above	66	55	

Source: Field Survey (2012).

It was noted that most (60%) of the cassava farmers were married, 22.5% were single, 8.3% were separated while 6.7% were divorced and 12.5% were widowed. This is justified on the ground that the majority of respondents who engaged in cassava farming are married people. It also implies that cassava production is the means of livelihood for these households.

Household size is a very important factor especially in determining labour for farm work. A farmer with a large household size has the chance of using them as their farm labour. This will affect the size of land cultivated and enhance returns. From the result, it was observed that

Table 2. Percentage distribution of respondents according to production system.

Production system	Frequency (n=120)	Percentage
Mono cropping	93	77.5
Mixed cropping	15	12.5
Inter-cropping	12	10.0

Source: Field Survey (2012).

the farmer had an average household size of 6. This conforms to the findings of Oladeebo and Oluwaranti (2012), who reported average of 8 persons per cassava farmers in South Western, Nigeria.

Again most (34.2%) of the respondents had attended secondary school education, 21.7% of them had attended primary school and 31.7% of them had acquired post secondary school education, while a few (12.5%) of them did not acquire formal education. By implication, a reasonable number of farmers in the area should be able to understand the use of improved technologies and apply it to achieve increased production. Through education, the quality of labour is improved and with it the propensity to adopt new techniques (Tijani et al., 2006; Hyuha, 2006). Thus, cassava farmers in the study area would easily adopt new technologies which could improve their level of profit *ceteris paribus.*

The result reveal an average income of ₦180,000.00 per annual. The breakdown shows that most (45%) of the farmers earned an annual income of between ₦100,000 to ₦150,000, 12% earned between ₦150,001 to ₦200,000, 30% of them earned above ₦200,00 per annual income. Signifying that the respondents are low income earners and this will have a negative effect on the rate of adoption of improve cassava technologies in the area, since capital is needed to procure most of the modern cassava technologies.

The result equally showed that most of the farmers had been in the business of cassava farming for up to 10 years. This is an indication that majority of the farmers has taken into cassava farming for quite a while in the area. This is also in consonance with the findings of Oladeebo and Oluwaranti (2012), who reported average of 13 years farming experience for cassava farmers in South Western, Nigeria.

The result of the farm size as held by the farmers on average was 5 ha, while majority (45%) held a size of between 3 to 4 ha. This followed the study of Oladeebo and Oluwaranti (2012), who reported average of 4 ha farm size for cassava farmers in South Western, Nigeria.

Cassava production system

The result in Table 2 shows that majority (77.5%) of the cassava farmers practiced mono cropping production system, while few (12.5%) of them practiced inter-cropping and 10% practiced inter cropping production system in the area. It is justifiable to say that mono cropping system is the cassava production system practiced by the farmers in the area.

Relationship between inputs and outputs of cassava production

Table 3 shows the result of multiple regression analysis of the relationship between inputs used and outputs from cassava production in the study area. The multiple regression co-efficient (R) was 0.912 or 91.2%. The implication is that the included independent variables (farm size, labour, fertilizer used, cassava stem and herbicide used) were highly correlated with the farmers' outputs. Also the coefficients of multiple determination (R^2) was 0.833 or 83.3%, signifying that 83.3% of total variation in dependent variable (total outputs) was explained by the explanatory variables, that is, inputs (x_1-x_5) included in the model. The fitness of the model was confirmed by the low value of the overall standard error of the estimate (Std. error = 5.27849) and the Durbin-Watson value of 2.356, indicating absence of autocorrelation in the model.

Farm size (x_1): the coefficient of farm size was positively signed and statistically significant at 1%. This implies that increasing the farm size cultivated by the farmers will lead to proportionate increase in total cassava outputs. Again, the statistical significance indicated by farm size of the farmers signifies that farm size contribute to outputs of the farmers. This conforms to the *a priori* expectation.

Labour used (x_2): the coefficient of labour used in cassava production was negatively signed and statistically insignificant. This implies that a unit increase in labour used in cassava production will not contribute to total cassava output. This conforms to the a priori expectation, because increasing labour used in cassava production will add additional cost to total cost of production which will reduce the returns of the farmers.

Fertilizer used (x_3): by the farmers was negatively sign, but was statistically significant at 1%, indicating an

Table 3. Relationship between inputs and total outputs from cassava production in the area.

Variables	Coefficient	Standard error	t-value	Sig
Constant	-18963.514	2191.241	-8.654	*
Farm size (x_1)	0.580	0.200	2.904	*
Labour used (x_2)	-0.231	0.249	0.926	NS
Fertilizer used (x_3)	-5.145	0.378	-13.613	*
Cassava stem (x_4)	0.939	0.262	3.583	*
Herbicide used (x_5)	-5.022	0.883	-5.689	*
R	0.912			
R^2	0.833			
D.W	2.356			
F-statistics	113.432			
Standard error	5.27849			

Source: SPSS Analyzed Data (2012). NS = Non significant; NS = Non significant, *indicate significance at 1% level

Table 4. Technical efficiency of cassava production in the area.

Resource	MVP (N)	MFC (N)	Efficiency Index
Farm size (X_1)	16436.3	1524.5	10.8
Labour (X_2)	17945.4	2846.7	6.3
Fertilizer (X_3)	21050.0	16450.0	1.3
Cassava cuttings (X_4)	4360.0	1405.2	3.1
Herbicide (X_5)	1235.4	1846.1	0.07

Source: Computed Field Survey (2012).

inverse relationship between the fertilizer used and the total cassava output in the area. In other words, increasing fertilizer used for cassava production will lead to decreasing outputs. However, the statistical significance implies that fertilizer used contributes to total cassava outputs. This is in conformity to the *a priori* expectation, because the continued application of fertility to farm will lead to soil acidity and binding of certain important micro and macro nutrients which are needed for optimum crop growth. In addition to the cost it will impute to the overall production cost. Although, fertilizer is required in its optimal level for the improvement of soil fertility, its over-use is damaging to soil.

Cassava stem (x_4): used by the farmers was positively related to total output and statistically significant at 1%. This signifies that increasing use of cassava stem will result to a unit increase in total cassava output. Again, statistical significance indicated that the use of cassava stem is associated with outputs of farmers. Thus, the *a priori* expectation was met.

Herbicide used (x_5): the coefficient of herbicide used was negatively related to the total output but statistically significant at 1%. This implies that increasing the use of herbicides in cassava production will lead to decreasing cassava production output in the area. While the statistical significance signifies that herbicide application contributes to cassava outputs, this agrees with the *a priori* expectation because increasing herbicide used will add additional cost to the overall cost of production and decrease returns accruing to the farmer.

Technical efficiency

From the result in Table 4, it was observed that the farmers were not efficient in the utilization of all the specified resources as far as cassava production is concerned in the study area. Farm size had the highest efficiency index of 10.8, followed by labour (6.3), cassava cuttings (3.1), fertilizer (1.3) and herbicide (0.07). Farm size, labour, fertilizer and cassava cuttings were underutilized since the efficiency index was greater than one. This indicates that additional income can be made from the production of cassava by using more of these inputs efficiently by the farmers. There was over utilization of herbicide since the efficiency index is less than one. Therefore reducing the litres of herbicide used can lead to more income. It should be noted that the MVP's of all the inputs used were not negative, indicating that cassava farmers still use the resources within the

Table 5. Analysis of cost and returns of cassava production per hectare.

Items	Unit	Quantity	Unit Price	Total
A. Revenue				
Cassava tubes	tonnes	14.5	25,000	362,500.00
Cassava stems	tonnes	7	4,500	31,500.00
Total Revenue				**394,000.00**
B. Variable Cost Inputs				
Cassava stems (Cuttings)	tonnes	4	4,500	18,000.00
Fertilizers	Bag	3	5,000	15,000.00
Total Cost				**33,000.00**
C. Cost of Labour	**Mandays**			
Land preparation (Clearing, ploughing and harrowing)		18	750	15,000.00
Planting	mds	10	750	7,500.00
Weeding	mds	30	750	30,000.00
Harvesting	mds	10	750	7,500.00
Transportation				50,000.00
Miscellaneous cost				20,000.00
Total Cost				**130,000.00**
D. Total Variable Cost				**163,000.00**
Fixed Cost				
Depreciation on farm tools (hoes, matches) @ 10				5,600.00
Depreciation on land @ 5%				25,000.00
E. Total Fixed Cost				**30,600.00**
Total variable cost (TVC) = B + C				163,000.00
Gross margin = TR – TVC = A – D				231,000.00
Total cost = TFC + TVC = E + D				196,000.00
Benefit Cost Ration (TR/ TC)				2.0:1.0

Source: Computed From Field Survey (2012).

economically range even though they were not optimally used. This justifies the finding of Ogunniyi et al. (2012),who reported that cassava farmers in Atakunmosa Local Government Area of Osun State underutilized farm size labour, fertilizer and cassava cuttings, while herbicide, was over-utilized.

Cost and returns

From the result in Table 5, total cost of producing cassava per hectare was ₦196,000.00, the total revenue obtained was ₦394,000.00 and the gross margin was ₦231,000.00. The profit of ₦200,400.00 was actualised, this implies that cassava production in the area was profitable. Also the Benefit Cost Ratio was ₦2.00, indicating that for every ₦1.00k expended in cassava production, ₦1.00k was realized as a profit. This follows the findings of Ebukiba (2010) who reported BCR of N1.9:1.0 for cassava farmers in Akwa Ibom State.

Constraints militating against efficient cassava production

The farmers were constrained by the following factors: lack of access to credit facilities (3.8), lack of ready market (2.5), poor storage facilities (2.8), high cost of transportation (3.2), high cost of labour (3.4), inadequate supply of fertilizer (3.5), poor extension services (3.6), problems of pests and diseases (2.9) and poor road network (3.0). This follows the findings of Ebukiba (2010), who reported that cassava farmers in Akwa Ibom State face problems such as inadequate capital, lack technical, lack of government support, lack of improve cuttings and poor market, among others (Table 6).

Conclusion

The finding of this study shows that cassava production in the area is very lucrative, inspite of the inefficient use

Table 6. Mean score distribution of respondents according to constraints militating against cassava production.

Constraints	Mean score (xs)	Decision
Lack of ready market	2.5	Accepted
Lack of access to credit facilities	3.8	Accepted
Poor storage facilities	2.8	Accepted
High cost of transportation	3.2	Accepted
Lack/ inadequate improved varieties	2.0	Rejected
High cost of labour	3.4	Accepted
Inadequate supply of fertilizer	3.5	Accepted
Land fragmentation	2.2	Rejected
Poor extension services	3.6	Accepted
Problems of pests and diseases	2.9	Accepted
Poor road network	3.0	Accepted

Source: Field Survey (2012).

of certain factors of production by the farmers. Hence, the farmers should be encouraged through technical training on production techniques/ practices that will improve their productivity especially in those areas were the study identified inefficiency and underutilization of production resources. These are: farm size, fertilizer and cassava cutting. It is therefore recommended that more farmers should be encouraged to go into cassava farming since it is profitable and can tolerate soil with low fertility.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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