PRODUCTION EFFICIENCY OF IMPROVED AND NON-IMPROVED CASSAVA VARIETIES IN SOUTH-SOUTH, NIGERIA

***ISONGUYO, R.G.,[1], YISA, E. S.,[1] KEHINDE, M. O. [2]**

[1]*Department of Agricultural Economics, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Nigeria*

[2]*Department of Agricultural Economics and Farm Management, Federal University of Agriculture, Abeokuta, Nigeria*

risonguyo@yahoo.com

+2348035955945

ABSTRACT

Production efficiency of improved and non-improved cassava varieties in South-South, Nigeria was carried out with the use of multi-stage random sampling method to select 240 respondents from both the improved and non-improved cassava varieties farmers from Akwa Ibom, Edo and Rivers States in South-South, Nigeria. Descriptive statistics was used in analysing the socio-economic characteristics of the farmers; costs and return structure was assessed using the gross margin analysis of farm budgetary technique. The input-output relationships and resource use efficiency were estimated with the use of Cobb-Douglas production function and the ratio of marginal value product to marginal factor cost of cassava production, respectively. The coefficients of determination (R^2) indicated that 72% and 56% variabilities in cassava output of both the improved and non-improved varieties' farmers, respectively, were explained by the explanatory variables. The analysis also revealed that labour was under-utilised while fertilizer and land were over-utilised by improved cassava varieties farmers. However, non-improved varieties farmers under-utilised cassava stem cuttings and land but over-utilised fertilizer and labour. Cassava stem cuttings was efficiently allocated by the improved varieties farmers. The study, therefore, recommends that the improved cassava varieties farmers should increase their farm sizes, reduce the quantity of fertilizer and increase labour, while the non-improved varieties farmers should increase the cassava stem cuttings, reduce the farm size and the amount of fertilizer used in order to increase their output and production efficiency. The extension service providers should train cassava farmers on how to allocate the production resources to achieve more efficiency.

Keywords: Cassava, Production Efficiency, South-South Nigeria,

INTRODUCTION

Agricultural production efficiency is the ability of a farmer to cultivate crops or raise farm animals using the least available resources to achieve maximum output. It relies on the theory of production economics, which refers to the combination of variable production inputs with a fixed input to produce output. This relationship is referred to as the production function, which Ojo (2013) defined as a quantitative description of input-output relationship in the production process. It provides direct measurement of such production parameters as marginal products, among others, which enable the minimization or maximization of inputs and output, respectively, in the production process.

Production efficiency, is the ability to maximize output level using minimum level of inputs, given their respective prices and available technology leads to economic efficiency. A less than expected frontier output is referred to as inefficiency.

Cassava is one of the major food crops in Nigeria and other countries of the world, such as Brazil, and India, among others. It is a highly edible starchy tuberous root of a woody shrub that provides carbohydrates for humans, animals and industrial use. It does well on poor soils and is a prolific, perennial crop that plays important roles in developing countries' economy (Food and Agriculture Organization (FAO), 2016). Raw cassava tuber contains cyanogenic glucosides (linamarin and lotaustralin) which are toxic and is often processed through grating, fermenting, drying or cooking into chips, flour and starch prior to consumption or industrial use. It serves as a major source of income for the rural and subsistence farmers in South-South Nigerian, as it contributes to the Gross Domestic Product (GDP). Its production in Nigeria has increased since 1960 and the country is the world's largest producer. About 56 million metric tonnes was produced in 2014, which rose to about 59.5 million tonnes in 2018 (FAOSTAT, 2019). Its benefit-cost ratio is assumed to be as high as 3:1 in Nigeria but Ogunleye *et al.* (2014) purported that cassava yield from the smallholder farmers in Nigeria remains abysmally low. Cassava has multi-dimensional usage and its high demand as an export crop has heightened it into great economic potentials as foreign exchange in the nation's economy.

However, cassava production in the country has regressed in recent time, due to the cultivation of low-quality varieties, which are susceptible to pests and diseases (FAO, 2016). This non-improved cassava varieties' production quantity is estimated at about 0.5 to 1.0 tonnes per hectare (FAO), 2017), which is yet to meet the demand of the current over 200 million Nigerians (United Nations Estimate, 2018). The cultivation of improved cassava varieties could have significant positive influence on the productivity (Tarawali *et al.*, 2017). A brief summary of the cassava production trend from 2000 to 2018 in Nigeria is as shown in Table 1.

Table 1. Cassava Production Output Trend in Nigeria from 2000 to 2017

Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Cassava Output (Tonnes)	32,010	32,068	341,120	36,304	38,845	41,565	45,721
Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Cassava Output (Tonnes)	43,410	44,582	36,822	42,533	46,190	50,950	47,407
Year	**2014**	**2015**	**2016**	**2017**	**2018**		
Cassava Output (Tonnes)	56,328	57,643	59,566	59,486	59,475		

Source: Compiled by authors from FAOSTAT, 2019

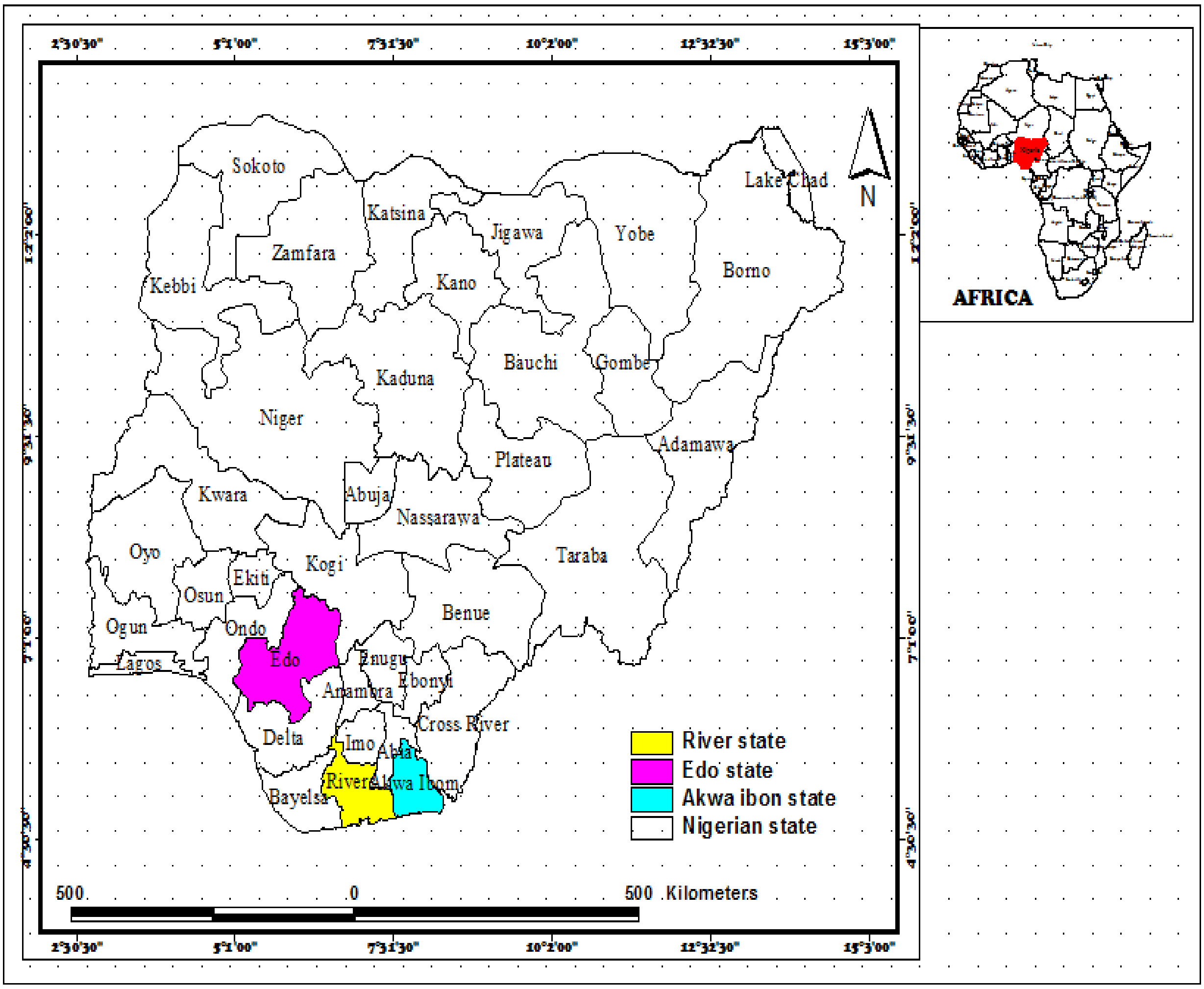
Although, the trend fluctuates, the efficiency of the improved and non-improved cassava varieties production is yet to be established. The presence of pests and diseases among the non-improved cassava varieties and the resultant low yield are sources of concern to the farmers, policy makers and the government. The dearth of adequate data on the performance of the improved and non-improved cassava varieties in Nigeria, especially in the South-South in terms of production efficiency necessitates this study. Such information will guide investors in their investment decisions, as it indicates the economic potentials of the improved over non-improved cassava varieties production in South-South, Nigeria. Knowledge seekers, policy makers and rural farmers are provided with useful information to satisfy their curiosities, formulate data-based policies worth implementation and judiciously allocate scarce resources for efficiency, respectively. The study, thus, described the socio-economic characteristics of the farmers; examined the input-output relationship of the cassava varieties' productions; estimated the costs/returns of the productions as well as assessed the resource-use efficiency in the cassava production for both group of farmers in the study area.

MATERIALS AND METHODS

The study was carried out in Akwa Ibom, Edo and Rivers States in South-South, Nigeria because of the massive production of cassava in the zone. The zone is located between longitudes 5°00' – 8°30' E and latitudes 4°33' – 6°30' N (National Bureau of Statistics, 2016). It is about 63,753.9km^2 (NBS, 2016) and is populated with about 23 million people as at 2016 based on 2016 population estimate at 2.5% growth rate. South-South, Nigeria, has a temperature range of 25 – 38 °C, and a relative humidity range of about 60 – 100 % (NBS, 2016). It lies within the humid rainfall zones of Nigeria on a gently undulating plains, with sandy, loamy, well-drained soil derived from alluvium and coastal deposits.

Akwa Ibom as one of the States in the zone is about 7,245,935 square kilometers in land area, located between longitudes 7°35' – 8°25'E and latitudes 4°33' – 5°33'N (FOS, 2015). It is divided into 31 Local Government Areas (LGAs) with a population of about 3,920,208 people as at 2016, based on the population growth rate of 2.6% (United Nations Worldometer, 2016). Its temperature varies between 28 and 30 °C, with a relative humidity of 63% in December to February and 79% in June to September. The State is bounded by Abia State in the North-East and West; Cross River State in the South-East; Rivers State in the South-West; and the Atlantic Ocean in the South-South. The Ibibio, Annang and Oron people are the major ethnic groups of the State, who are mostly Christians of various denominations.

Edo State is about 19,281,930 square kilometres in land area and is located within Longitude 5°37' – 5°89' E and Latitude 6°32' – 6°54' N. It is divided into eighteen Local Government Areas with a total population of about 3,218,3332 based on the 2016 population estimate growth rate of 2.6% (UN Worldometer, 2016). The State has a rainfall range of about 1,400 to 2,780 millimetres with double maxima in July at 344.7mm and September at 457,2 mm. The mean monthly temperatures of the State are about 29.1 °C in March and 24.4 °C in June. The State is bounded by Kogi, Delta and Ondo States in the North, South and West, respectively, and



Region of South-South, Nigeria
Source: Field Survey, 2020

the vegetation is that of equatorial rain forest (Emeribe *et al.*, 2017).

Rivers State occupies about 11,077 square kilometres, located within Longitude 6°50' – 6°59' E and Latitude 4°45' – 4°47' N. The State is divided into 23 Local Government Areas and is populated with about 5,185,400 people according to 2016 population estimate at the growth rate of 2.6% (UN, Worldometer, 2016). The State has double maxima rainfall with annual mean of about 2,300 to 2,500 millimeters and a relative monthly humidity of about 78 to 85% (Benson *et al.*, 2015). Rivers State is bounded by Imo, Abia and Anambra in the North; Akwa Ibom in the East; Bayelsa and Delta in the west and the Atlantic Ocean in the South. The ethnic groups in the State are the Ikwerre, Kalabaris, Okirikas and Ogonis among others.

Farming, fishing petty trading and civil service work are the main occupations of the people of South-South Nigeria.

Method of Data Collection

Multi-stage sampling procedure was used to select the respondents for this study. Firstly, two Local Government Areas (LGA) were purposively selected from each of the three States, based on their proficiency in cassava production. Secondly, two villages in each of the selected LGAs were randomly selected. Thirdly, the cassava farmers were stratified into the improved and non-improved cassava varieties farmers and random sampling method was used in selecting 10% of each group of farmers from the 12 villages to arrive at the 120 respondents of improved and non-improved cassava varieties farmers across the three states as shown in Table 2.

Table 2. Distribution of the Cassava farmers in the Study Area

Selected States	Selected LGA	Villages Chosen	Population of Registered Cassava Farmers			
			ICV Farmers	10% ICV Farmers	Non- ICV Farmers	10% Non-ICV Farmers
Akwa Ibom	Ini	Ifa Nkari	80	8	90	9
		Mbiabong	90	9	100	10
	Obot-Akara	Mbat Esifon	90	9	100	10
		Ikot Ukana	100	10	110	11
Edo	Estako West	Auchi	110	11	120	12
		Agbede	100	10	100	10
	Esan West	Ekpoma	120	12	100	10
		Iruekpen	100	10	100	10
Rivers	Emohua	Elibrada	100	10	90	9
		Oduoha	100	10	90	9
	Khana	Bori	110	11	100	10
		Zaakpon	100	10	100	10
Total			**1,200**	**120**	**1,200**	**120**

Note: ICV = Improved Cassava Variety Farmers; % = percentage
Source: Field survey, 2018.

Analytical Techniques

Descriptive statistics was used in describing the socio-economic characteristics of the farmers. Ordinary Least Square method and Cobb-Douglas production function analysis were used in establishing the relationship between the socio-economic characteristics of the farmers and the production of the cassava varieties. Gross Margin (GM) and Net Farm Income (NFI) of the farm budgetary analysis were used in determining the cost and returns of the cassava varieties' production, while the ratio of marginal value product to marginal factor cost of the cassava indicates either the efficiency or inefficiency of the cassava varieties productions. Descriptive statistics involved the use of frequency counts and percentages. The Gross Margin model is specified thus:

$$GM = TR - TVC \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$NFI = TR - TVC - TFC \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

$$PI = {}^{NI}/_{TR} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

$$RRI = \frac{NI}{TC} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

where,
GM = Gross Margin;
TR = Total Revenue (₦);
NFI = Net farm Income (₦);
PI = Profitability Index; and
RRI = Rate of Return on Investment;
TVC = Total Variable Cost (₦); and
TFC = Total Fixed Cost (₦) (cutlasses, hoes, axes and rakes).

Net Farm Income was based on projected prices and yields at both the State and national levels for this study.

Ordinary least square model used for establishing the relationship between the output and the socio-economic characteristics of the farmers in its implicit form is expressed as:

$Y_i = f(X_1X_2X_3X_4X_5X_6X_7X_8X_9X_{10}U_i)$ …(5)

where,

Y_i = Output (kg/ha);

X_1 = Gender;

X_2 = Age of farmer;

X_3 = Marital Status;

X_4 = Educational Level;

X_5 = Household Size;

X_6 = Farming Experience;

X_7 = Number of Extension Contact;

X_8= Farm Size (ha);

X_9 = Reason for Preference;

X_{10} = Cropping System.

The explicit form of Cobb-Douglas Production function used in analysing the input-output relationship of the cassava production in the study area in its implicit form is:

$Y = f(X_1, X_2, X_3, X_4, U)$……………….. (6)

While the explicit form is specified as:

$InY_i = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 ln_3 + \beta_4 lnX_4 + U_i$…………………………… (7)

where,

Yi = Cassava Output (kg);

β = Parameter to be estimated;

Ln = log value;

X_1 = Cost of cassava stem (kg/ha);

X_2 = Rent of farmland/ha;

X_3 = quantity/cost of fertilizer (kg/ha);

X_4 = cost/units of labour (man-day/ha), and

U = error term.

The inefficiency model U_i is defined as:

$U_i = \delta + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + \delta_8 Z_8 + \delta_9 Z_9 + \delta_{10} Z_{10}$ ………………………………..(8)

where,

z_1 = Gender (1 for male and 0 for female);

z_2 = Age (Years); z_3 = Marital Status;

z_4 = Educational Level (Years of formal education);

z_5 = Household Size (Number);

z_6 = Farming Experience (years);

z_7 = Number of Extension Contact;

z_8 = Farm Size (hectares);

z_9 = Reason for Preference and

z_{10} = Cropping System.

Resource use efficiency of cassava production was achieved by determining the Marginal Value Product (MVP) of cassava output and the marginal factor cost of the inputs. The MVP of any resource is the product of Marginal Physical Product (MPP) and the unit price of output (P_y), thus:

$MVP = MPP.P_y$. The MVP obtained is:

$MVP = b_i \bar{Y} P_y \big) X_i$.

Resource use efficiency formula is stated as:

$$r = \frac{MarginalValueProduct}{MarginalFactorCost} = \frac{MVP}{MFC}$$

where,

r = resource-use efficiency ratio;

MFC = Marginal factor cost. When:

$r = 1$ implies efficiency in resource use;

$r > 1$ implies under-utilization of resource; and

$r < 1$ implies over-utilization of resource.

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics of Respondents

The result of the socio-economic characteristics of both the improved and non-improved cassava varieties' farmers is as shown in Table 3a and 3b. Agricultural activity in any developing country, such as Nigeria is traditional and strenuous, thus, the consideration of the gender of the farmer is important as men are known to possess more physical strength and are more efficient in performing farm work with ease than the women. The result revealed that 58% of improved cassava varieties' and 53% non-improved cassava varieties' farmers were male, which suggests that more of the male gender is involved in the production of cassava the study area. Men are often ascribed with ownership title of farm activities in South-South Nigeria since they own the major factors of production, such as farmland and other inputs. This result agrees with the findings of Akerele *et al.* (2018), where males were found to dominate cassava production in Southern Nigeria.

Most (36%) of the improved cassava varieties' farmers were within the active age bracket of 31 – 40 years old, indicating that they are young adults and more energetic for increased production efficiency. Age is an important determinant of agricultural production efficiency, and the younger the farmer, the more efficient he is. This agreed with the findings of Akerele *et al.* (2018) and Ebukiba (2010), where young and active working age of a farmer was found to positively translate to high efficiency in cassava production in Nigeria. However, the highest population of the non-improved cassava varieties' farmers (40%) were within the age bracket of at most 51 years old, which indicate they were much older and more conservative.

Table 3a. Socio-Economic Characteristics of the Farmers

	Improved Cassava Varieties Farmers		Non-improved Cassava Varieties Farmers	
Variable	**Frequency**	**%**	**Frequency**	**%**
Gender				
Male	70	58	64	53
Female	50	42	56	47
Age of farmer (years)				
Less than30	26	21.7	10	8.3
31 – 40	43	35.8	18	15
41 – 50	28	23.3	44	36.7
51 and above	23	19.2	48	40
Marital Status				
Married	74	61.7	72	60
Single	19	15.8	10	8.3
Divorced	11	9.2	15	12.5
Widowed	16	13.3	23	19.2
Educational Level				
No formal education	30	25	58	48.3
Primary Education	43	35.8	42	35
Secondary Education	49	40.8	20	16.7
Tertiary Education	16	13.4	0	0
Household Size (No.)				
At most 5	51	42	34	28
6-10	45	38	53	44
11 and above	24	20	33	28

Source: Data analysis, 2018

More than 62% improved and 60% non-improved cassava varieties' farmers were married, connoting their responsibility and dependency on the family for farm labour.

This result is in agreement with the findings of Eze and Nwibo (2014), where it was found that cassava farmers in Delta State, which is one of the States in South-South Nigeria depends on the marital status of their families for farm labour to increase the cassava production efficiency as their means of livelihood. About 75% and 52% improved and non-improved cassava varieties' farmers had formal education. This implies that greater percentage of improved cassava varieties farmers were more educated and enlightened and probably encouraged the adoption of improved cassava varieties production in the study area. This result agrees with the findings of Eze and Nwibo (2014), where education level of cassava farmers was found to significantly improve the quality of the farmer's labour and enhance accurate and meaningful decisions. These add up to increase the production efficiency of the farmer. Majority (42% and 44%) of the improved and non-improved cassava varieties' farmers respectively had household sizes of less than 5 and 6 to 10 members respectively as shown in Table 3a. These are manageable household sizes which could serve as sources of ready and cheap family labour that contributes to the cassava production efficiency. This result conforms with the findings of Oladeebo and Oluwaranti (2012), where average household size of cassava farmers in South-west Nigeria was found to be 6. This indicates that large households adopted less innovations than smaller households.

Table 3b. Socio-Economic Characteristics of the Farmers

	Improved Cassava Varieties Farmers		Non-improved Cassava Varieties Farmers	
Variable	**Frequency**	**%**	**Frequency**	**%**
Farming Experience (years)				
Less than 10	35	29	22	18
11-20	47	39	25	21
21-30	25	21	33	28
Above 30	13	11	40	33
No of Extension Contact				
1 Time	20	17	40	33
2 Times	23	19	38	32
3 Times	40	33	22	18
4 Times	37	31	20	17
Farm Size (ha)				
Less than 1.0	44	37	52	43
1.1 – 2.0	41	33	35	29
2.1 – 3.0	21	18	19	16
3.1 and above	14	12	14	12
Reasons for Preference:				
High Yield	67	56	10	8
High Starch Content	26	22	35	29
Better Taste	13	10	29	24
Matures Early	14	12	5	4
Last Longer in farm	0	0	31	25
Cropping System				
Sole Cassava	33	27.5	33	27.5
Cassava / Maize	27	22.5	17	14.2
Cassava/ Yam	14	11.7	25	20.8
Cassava/ Plantain	11	9.2	13	10.2
Cassava/ Vegetables	15	12.5	18	15
Cassava/ Palm Fruit	20	16.6	14	8.3

Source: Data analysis, 2018

Majority of the improved and non-improved cassava varieties' farmers (39 and 33 % respectively) had more than 10 years of cassava farming experience as shown in Table 3b. This suggests that the cassava farmers in the study area were experienced and had enough knowledge which contributed to their cassava production efficiency. The result complies with the findings of Ifeanyi *et al.* (2018), where it was found that cassava farmers in South-South Nigeria had more than 10 years of cassava production experience. Ogisi *et al*. (2013) also found farming experience to significantly influence cassava production efficiency in Delta State in South-South, Nigeria.

About 33% each of both improved and non-improved cassava varieties' farmers had 3 and 1 visits respectively, from the extension officers during the cassava production period as shown in Table 3b. This implies that while the improved cassava varieties farmers had sufficient contacts and information from the extension officer, which probably led to the adoption of improved variety, their counterpart had insufficient contact and information from extension agents and hence, lack the awareness of improved cassava varieties. This result is in agreement with the findings of Ogunleye *et al.* (2020), where it was found that access to extension services was one of the major socio-economic factors that determine farm level efficiency of cassava farmers in Osun State in South-West Nigeria. Majority (37%) improved and 43% non-improved cassava varieties' farmers cultivated their cassava on less than 1 hectare of land, implying that both groups were small-scale farmers. Majority (56%) of the improved cassava varieties' farmers adopted improved varieties to achieve high yield, while 29% non-improved cassava varieties farmers adopted theirs to get high starch contents. Average number (28%) of both farmers were sole cassava producers, while the least (9.2% and 8.3%) improved and non-improved cassava varieties farmers cultivated cassava/plantain and cassava/palm fruit respectively, for food supply, revenue and avert risk.

Input–output Relationships for the Production of Improved and Non-Improved Cassava Varieties Farmers

Input–output relationships for the production of both varieties as best explained by the Cobb-Douglas production function is as shown in Table 4.

Table 4. Production Function Result for Cassava Production.

Variables	Improved Cassava Varieties Farmers Double-log	Non-Improved Cassava Varieties Farmers Double-log
Constant	2.160 (0.314) ***	3.732 (0.573) ***
Cost of Cassava Stem (X_1)	0.007 (0.063)	-0.101 (0.102)
Cost of Fertilizer (X_2)	0.589 (0.047) **	0.437 (0.048) **
Cost of Labour (X_3)	0.192 (0.123)	0.213 (0.201) **
Cost of Farm Size. (X_4)	0.085 (0.118) *	0.611 (0.205) *
R^2	0.721	0.562
R^2–Adjusted	0.712	0.541
F – Value	81.02***	35.47***

Note: R^2 = Co-efficient of determination; *** = significance at 1%; ** = significance at 5%; * = significance at 10%

Source: Data analysis, 2018

The coefficient of determination (R^2) for improved and non-improved cassava varieties were 0.721 and 0.562, respectively, indicating that 72% and 56% changes in cassava output were explained by the input variables. The F-value of 81.02 and 35.47 for improved and non-improved cassava varieties farmers were significant at 1% level of significance. This indicates that the input variables included in the models were important in explaining the variations in the incomes of both farmers. Cassava stem-cutting, fertilizer, labour, and farm size coefficients were positive, and fertilizer application was statistically significant at 5% for both farmers. Labour was significant at 5% for only the non-improved cassava varieties farmers while farm size was significant at 10% for both farmers, meaning that a unit increase in the quantity of fertilizer, labour workday and farm size in hectare will increase the farmers' incomes.

Costs and Returns Structure of Cassava Production

Average costs and returns of cassava production for both varieties are presented in Table 5.

Table 5. Costs and Returns of Improved and Non-Improved Cassava Varieties Production

Categories		Improved Cassava Varieties Production			Non-improved Cassava Varieties Production		
A.	**Inputs/Costs:**	**Quantity**	**Cost/Value**	**%**	**Quantity**	**Cost/Value**	**%**
I.	Variable Inputs:		(₦)			(₦)	
	Cassava-stem Cuttings (Kg)	2,023	4,046	6	1,870	4,350	6
	Fertilizer (Kg)	185kg	12,950	18	112kg	7,840	11
	Labour (man-day):	(200)			(210)		
	Family labour	100	2 2,000	32	160	32,300	44
	Hired labour	100	30,150	44	50	28,150	39
	Farm Size (ha)	1	0	0	1	0	0
a	***Total Variable Cost (TVC)***		***69,146***	***100***		***72,640***	***100***
2	Fixed Inputs:						
	Farm land (Rent)	1ha	10,000		1ha	10,000	
	Fixed Cost (FC)		***10,000***			***10,000***	
b	***Total Cost (TC=a+b)***		***79,146***			***82,640***	
B	Outputs/Revenue:						
	Tubers (Kg)	15,860	317,200		11,345	226,900	
	Stem (Bundles)	815	81,500		634	63,400	
C	***Total Revenue (Naira)***		***398,700***			***290,300***	
	Gross Margin *(C – a)*		***329,554***			***217,660***	
	Net Farm Income(C-b)		***319,55***			***207,660***	
	Average Rate of Return (ARR = (TR/TVC)		***5.8***			***3.9***	

Note: cost of fertilizer = ₦3,500 per 50 kg bag

Source: Field survey, 2018

About 2,023kg improved cassava varieties stem cuttings (at ₦20/kg), valued at about ₦40,460; 185kg of fertilizer valued at about ₦12,950; 200 man-days/hectare valued at about ₦52,150, making up a total of about ₦69,146 total variable cost (TVC) were incurred by the improved cassava varieties farmers to produce about 15,860kg of cassava tubers, valued at ₦317,200 at ₦20/kg; 815 bundles of cassava stem, valued at ₦81,500, at ₦100/bundle to generate ₦398,700 Total Revenue (TR), ₦329,554 Gross Margin (GM) and ₦319,554 Net Farm Income (NFI). The non-improved cassava varieties farmers utilised 1,870 kg cassava stem cuttings (at ₦0.50/kg), 112 kg of fertilizer and 210 man-days/hectare, all together valued at about ₦72,640 TVC to produce 11,345kg cassava tubers valued at ₦226,900 and 634 bundles of cassava stem valued at ₦63,400, to generate ₦290,300 TR, ₦217,660 GM, and ₦207,660 NFI. Farmland was valued at ₦10,000/ha according to prevailing rent value for both farmers. The improved varieties farmers generated 5.8 average rate of return (ARR), while non-improved cassava varieties farmers generated 3.9 ARR. Thus, the improved varieties farmers earned ₦5.9 to every ₦1 invested, while, ₦3.9 was earned by their counterpart. Comparatively, therefore, the production of improved cassava varieties was more profitable than non-improved cassava varieties.

Resource use efficiency

Resource use efficiency of this study is shown in Table 6, which revealed that the improved cassava varieties farmers were efficient in the use of cassava stem cuttings at 1.00 efficiency ratio. They over-utilised fertilizer (0.76) and farm size (0.74), and under-utilised labour (1.12). The non-improved cassava varieties farmers, alternatively, under-utilised cassava stem cuttings (1.4) and farm size (1.53), and over-utilised fertilizer (0.40) and labour (0.83). Over-utilisation of fertilizer, labour, and farm size by the cassava farmers implies that the cassava farmers were generally inefficient in the use of these resources. The inefficient use of labour was probably due to excessive use of labour over what is required; it may also be as a result of farmers spending more man-days of labour performing the same tasks on repeated basis on cassava farms.

Marginal Value Productivity (MVP) has been described as the yardstick for measuring the efficiency of resource used at a given level of technology and prices of both inputs and outputs. The result in Table 6 shows that labour is the most productive resource for the improved cassava varieties farmers followed by fertilizer and stem for improved and non-improved varieties respectively. The positive sign of the MVP for all the resources further confirms that increasing the level of use of the resources can increase cassava output and production efficiency.

Table 6. Estimated Marginal Value Product and Marginal Factor Cost

Production Resources	Improved Cassava Varieties Farmers			Non-Improved Cassava Varieties Farmers		
	MVP	MFC	r=MVP/MFC	MVP	MFC	r=MVP/MFC
Stem (Kg)	59,630	59,630	1.00	49,657	36,438	1.4
Fertilizer (Kg)	72,540	95,815	0.76	34,685	87,500	0.40
Labour(manday)	194,230	172,580	1.12	162,720	196,350	0.83
Farm Size(ha)	4,900	6,600	0.74	2,750	1,800	1.53

Source: Data analysis, 2018

Therefore, for optimal level of efficiency to be attained, the farmers must reduce the amount of labour by increasing their scale of operation and also reduce the kilogram of fertilizer used, in order to make more income. Underutilisation of labour by improved varieties farmers and the cassava stem cuttings and farm size by non-improved cassava varieties farmers connotes that additional income could be made from the production of cassava by using more of these inputs. This is in line with the findings of Ogunniyi *et al*. (2012), where it was found that farm size, labour, fertilizer and cassava cuttings were underutilised by cassava farmers in South-West Nigeria. The underutilisation of farmland may be attributed to the cultivation of small farm size due to farm fragmentation.

Therefore, to increase the output of cassava, more land should be cultivated and this can be accomplished if farmers are provided with modern farm tools and other production resources at affordable prices.

CONCLUSIONS AND RECOMMENDATIONS

This study attempted to provide some useful information on production efficiency of the improved and non-improved cassava varieties production in South-South, Nigeria. The data collected were analysed with the use of descriptive and quantitative techniques. The result of the analysis showed that labour was under-utilised while fertilizer and land were over-utilised by the improved cassava varieties farmers. The non-improved cassava varieties farmers, on the other hand, under-utilised cassava stem cuttings and farm size and over-utilised fertilizer and labour. Cassava stem cuttings was efficiently allocated by the improved cassava varieties farmers.

Based on the result of this study, therefore, it is recommended that the improved cassava varieties farmers should increase their farm sizes, reduce the quantity of fertilizer used and increase the farm labour, while the non-improved cassava varieties farmers should increase the cassava stem cuttings, reduce the farm size allocated to cassava production and reduce the amount of fertilizer used in order to increase the cassava output and the production efficiency. Also, the extension service providers should sensitize and enlighten the cassava farmers on how to allocate the production resources to achieve more efficiency.

REFERENCES

Akerele, E. O., Idowu, A. O., Oyebanjo, O., Ologbon, O. A. C. and Oluwasanya, O. P. (2018). Analysis of cassava production in Ogun State, Nigeria. *Acta Scientific Agriculture*, 2(8); 4 – 50.

Benson, D. N., Ebong, V. O. and Ukoha, H. (2015). Socio-Economic Impacts of Crude Oil Exploration and Production on Farmers in Khana Local Government Area of Rivers State, Nigeria: *Agricultural Economics and Extension Research Studies (AGEERS)*, 6(2): 86 – 98.

Ebukiba, E. (2010). Economic analysis of cassava production (farming) in Akwa Ibom State. *Agricultural Biology Journal, North America*. Pp 2151 – 7517. http://www.scihub.org/ABJNA

Emeribe, C. N., Uwadia, N. O., Umoru, G.I. and Efegoma, R. O. (2017). Suitability of large scale jatropha *curcus* cultivation in Edo State: A preliminary assessment using the Analytical Hierarchy Process (AHP) method.

International Journal of Science and Technology (STECH), 6(2): 21 – 35.

Eze, A. V. and Nwibo, S. U. (2014). Economic and technical efficiency of cassava production in Ika North East Local Government Area of Delta State, Nigeria. *Journal of Development and Agricultural Economics*, 6(10): 429 – 463.

FAOSTAT (2019). Food and Agriculture Organization of the United Nations, 2019. Production Crops, -References- Scientific Research Publishing (scirp.org). *http://faostat.fad.org* and *https://www.scirp.org/references/referencespaper.aspx?referenced=2617723* Accessed on April 03, 2021

Food and Agriculture Organization (FAO) (2017). FAOSTAT. Food and Agriculture Organization of the United Nations. In: http://faostat.fao.org/site/339/default.aspx. Accessed on November 8, 2017.

Food and Agriculture Organization (2016). Cassava Production: The Trend for Cassava Production, Tropical Root Crop in Developing Economy, Rome. E-ISBN 978-92-5-107442-2 (PDF). Available on *http://www.fao.org/3/a-j3278e.pdf, accessed on March 1, 2017.*

Ifeanyi, A. O., Tarawali, G., Okechukwu, R. U., Chianu, J., Ezedinma, C. and Edet, M. (2018). Efficiency and its determinants among smallholder farming units supplying cassava to commercial starch processors in Nigeria: Data Envelopment Analysis Approach. *Journal of Economics and Sustainable development*, 9(16): 120 – 134.

National Bureau of Statistics (2016). Economic Outlook of Nigeria: World Data Atlas: Nigeria. Knoema Corporations, USA. *https://knoema.com/*. 2016. Accessed on 28/11/2018

Ogisi, O. D., Begho, T. and Alimeke, B. O. (2013). Productivity and profitability of cassava (Manihot Esculenta) in Ika South and Ika north East Local Government areas of Delta State, Nigeria. *IOSR. Journal of Agriculture and Vertinary Science*, 6(1): 52 – 56.

Ogunleye, A., O., Ayedemo, R., Bamire, A.S. & Ayodeji, K. (2020). Assessment of profitability and efficiency of cassava production among government and non-government assisted farmers' association in Osun State, Nigeria. *https://www.researchgate.net/publication343501531_assessment_of_profitability_and_efficiency_of_cassava_production_among_government_qnd_non_government_assisted_farmers_association_in_osun_state_nigeria* p.224-234. Accessed on March 1, 2017.

Ogunleye, A. S., Adeyemo, R., Bamire, A. S. and Binuomote, S. O. (2014). Cassava production and technical efficiency in Ayedaade Local Government Area of Osun State, Nigeria. *Elixir International Journal of Agriculture*, 64: 24465 – 24468.

Ogunniyi, L. T., Ajao, A. O., Olapade-Ogunwole, F. and Ganiyu, M.O. (2012). Resource-use Efficiency of Cassava Production in Atakunmosa Local Government Area of Osun State. *Prime Journal of Social Science*, 1(2), 27 – 30.

Ojo, M. A. (2013). Analysis of production efficiency among small scale yam and cassava farmers in Niger and Kogi States, Nigeria. *Unpublished PhD Thesis*. Submitted to Federal University of Technology, Minna in May, 2013. 48-94

Oladeebo, J. O and Oluwaranti, A. S. (2012). Profit efficiency among cassava producers. Empirical evidence from South Western Nigeria. *Journal of Agricultural Economic Development*, 1(2): 46 – 52.

Tarawali, G., Okechukwu, R. U. and Chianu, J. (2017). Determinants of productivity of smallholder farmers supplying cassava to starch processors in Nigeria: a baseline evidence. *Russian Journal of Agricultural and Socio-Economic Sciences*, 62(2): 184.

United Nations: Nigeria Population. Worldometers: (2016). *http://www.worldometers.info/world-population/2016.* Accessed on March 8, 2017

United Nations: Population of Nigeria (1950-2016). Department of Economic and Social Affairs, Population Division. Worldometers: *www.worldometers.info.* Accessed on 28/09/2020