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*Research Paper*

# Cost of Production and Resource – Use Efficiency among Small Scale Cassava Farmers in Igbo Etche Rivers State, Nigeria

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This study focused on cost of production and resource use efficiency among small scale cassava farmers in Igbo Etche in Rivers State, Nigeria. A total of 102 questionnaires were returned for data analysis using descriptive statistics, stochastic cost and production function models. The results showed high cost of hired labour, land preparation, lack of high yielding varieties, as farmers' major challenges. About 73.86% of total cost of cassava production was labour cost. The coefficients of costs of hired labour, planting and cassava cuttings were negative, significant between 1%-10%. Costs of fertilizers, pesticides and purchasing farmland were positive, statistically significant between 1-10%. All variables used in stochastic production function were statistically significant at 1%. If fertilizer input was increased by 10%, output will increase by 29.49%, while cost of hired labour, if reduced by 10%, will reduce output by 13%. The variations experienced in cost and production output were due to differences in farmers cost and technical inefficiency. All variables were inefficiently utilized, while farm size, hired labour, fertilizers and cuttings were underutilized; pesticides were over utilized. Therefore, opportunity exists to improve cassava output by 21.44% if resources are used efficiently. Consequently, small scale farmers in the study area should be prudent in managing their costs and endeavour to increase their efficiency in resource use.

**Key words**: Production cost, cassava output, small scale farmers, resource –use efficiency, hired labour, fertilizer usage, Igbo Etche, Rivers State Nigeria.

## INTRODUCTION

Cassava is one of the most important staple food crops grown in tropical Africa. Because of its efficient production of food energy, year – round availability, tolerance to extreme stress conditions and sustainability for present farming and food systems in Africa, cassava is playing a major role in efforts to alleviate the African food crisis and endemic poverty (Hahn, 1997; Ekanayake et al., 1997; Carter et al., 1997; Abass et al., 2014). World cassava production was forecasted to reach 288 million tonnes in 2016, thereby making cassava status as one of the world's fastest expanding staple crops, with sub-Saharan Africa still the world's largest cassava growing region, producing 157 million tones, about 54.5% of the total world production (Ekanayake et al., 1998; Howeler, 2006; FAO, 2016).

Nigeria is the world's largest producer of cassava, producing about 20% of world's total output (Olaniyan, 2015; Fregene et al., 2015; Obasi et al., 2015; FAO, 2016), with Thailand as the largest exporter and China as the leading importer. The crop is the object of many expansion programmes in the sub-Saharan Africa, as commercialization of cassava remains a key objective of many West African governments. Nigeria is projected to harvest around 58 million tonnes in 2016 (FAO, 2016).

Under its 2016 – 2020 Agriculture Promotion Policy, the country will continue to provide preferential loans to producers and grants to processors for the expanded uptake of domestic cassava and to sustain the continued propagation of improved varieties. Indeed, with consumer purchasing power being negatively affected by high inflation and a falling currency, many have turned to cassava as a more affordable staple than imported rice, providing a further stimulus to national cassava output in the future.

Cassava has become a staple of choice across cultures and social divides in Nigerian households. The majority of the tuber produced is consumed locally as traditional meals. It is the most important crop by production and the second most important by consumption (FAO, 2014). Nevertheless, Nigeria's average yield of 7.7 metric tonnes (MT) per hectare, is very low compared to the 23.4MT and 22.2MT average yield per hectare (ha) produced respectively in Indonesia and Thailand, the other leading cassava producers of the world (Eze and Nwibo, 2014; FAO, 2014). Despite being the world's biggest producer of cassava, Nigeria's yield levels showed that its farming techniques are inefficient compared to world's best practices.

Cassava is grown in all agro-ecological zones of Nigeria, but thrives in the rainforest and derived savannah areas. Production is highest in the North Central and South-South regions. About one-third of the total national output came from the Niger Delta (South-South) region where many livelihoods depend on cassava as a main source of food and income (Daniels et al., 2011). The yield of cassava in the Niger Delta was about 11MT per hectare (ha) as against 25 to 40MT per hectare recommended by experts (Eze and Nwibo, 2014). This yield per hectare is indicative of the yields experienced in the south-south region of Nigeria including Igbo Etche, in Etche Local Government Area (LGA) of Rivers State, Nigeria.

Cassava production is characterized by small – holder subsistent farmers, who accounts for about 95% of total cassava farmers, planting 0.2 – 1 hectare (ha) usually intercropped with maize, melon, vegetables etc. The comparative production advantage over other staples serves to encourage its cultivation by these resources poor farmers (Fakayode et al., 2008; Ogunniyi et al., 2012). Most cassava farmers are either not aware of available modern technologies for growing and processing cassava or lack the availability to use them (Abass et al., 2014).

Inspite of the fact that these small scale farmers occupy a unique and pivotal position, they still belong in the poorest group of the population and as such cannot invest much on their farms (Ojimba, 2017). The vicious circle of poverty among these farmers has led to the unimpressive performance of the agricultural sector. Thus, resources must be used more efficiently, which entails eliminating waste, thereby leading to increase in productivity and incomes (Ochi et al., 2015).

The cost of farm production are payments made to inputs employed on the farm such as labour, rent for land, interest for borrowed capital, prices of stems, fertilizers, herbicides, weedicides, cost of planting and other farm inputs. Some of the major cost components of subsistence and commercial cassava production are labour which accounts for about 70%, manual harvesting (25 -30%) and manual weeding (about 40%) of total cost of production (Daniels et al., 2011; Audu et al., 2013; Fregene et al., 2015). Cassava farms in Nigeria are the small – scale types which are characterized by low productivity. The crucial issue in the Nigerian agriculture is that of low productivity. Therefore, farmers output must be increased using existing levels of conventional inputs to produce more efficiently. Despite the fact that Nigeria is the world's largest producer of cassava, its production is still largely by small scale illiterate and conservative farmers who cultivate the soil with rudimentary implements (Fakayode et al., 2008; Obasi et al., 2015)

Cassava production in Nigeria is plagued with problems of inefficiency in production and distribution of quality stems. According to Sahel, (2016), over 90% of the 6 million small holders cassava farm families in Nigeria used informal seed system whereby stem from the previous farms were recycled. Only about or less than 5% buy new stem cuttings leading to poor yield of the farms.

This plaguing situation is due to a number of factors including small scale size of farming, manual operations, little or no usage of fertilizers and other chemicals because of high costs and non-availability and limited knowledge, in the use of high yielding stems, coupled with high cost of transporting the fresh tubers, weeding etc. Cassava farming at this level makes it difficult to attain resource-use efficiency and economies of scale (Eze and Nwibo, 2014; Fregene et al., 2015). Therefore, this study aim to determine the cost of cassava production and resource use efficiency among small scale farmers in Igbo Etche in Etche LGA of Rivers State, Nigeria using Cobb – Douglas stochastic cost and production frontier functions respectively.

The Nigerian government at various levels has been trying in many ways to encourage rural farmers to adopt the modern cassava production technologies in order to increase the rural farmers productivity, the constraints of adoption in rural communities not withstanding (Teklewold et al., 2006). These technologies include herbicides application, use of inorganic fertilizers, hybrid cassava stems, insecticides, tractor, appropriate spacing, planting date and tillage practices. Efficiency study has assumed important dimension in cassava production as scarce resources are combined to produce output. The ability of a farmer to produce the minimum level of output possible with a minimum quantity of inputs under a given technology is his technical efficiency (Adeoti, 2006). Cost efficiency is the ability of a farmer to produce the maximum level of output possible at a minimum cost outlay under a given technology (Anyaegbunam et al., 2009). A cost efficient operation results in large profit for the farmer.

Despite the increasing importance of cassava production as a means of livelihood of farmers in Rivers State, Nigeria and Etche LGA in particular, there is a dearth of empirically documented data on cost of production and resource - use efficiency among small scale cassava farmers in Igbo Etche. Literature exist on cost of cassava production at national and international levels which include Guobadia (1993), Ogundari and Ojo, (2007), Audu et al. (2013), Afreen and Haque, (2014), Itam et al. (2014), Emokaro and Oyoboh, (2016). On the area of resource – use efficiency in cassava production the following studies exists: Nandi et al. (2011), Aboki et al. (2013), Eze and Nwibo (2014), Ochi et al. (2015) to mention but a few. Of these studies mentioned, none had researched into the current topic in the study area, hence the significance and need of the study. The beneficiaries of the study include cassava farmers in Rivers State and other parts of Nigeria, policy makers at the government and private sectors levels, researchers, students, agro-allied industries etc.

The main objective of the study is to determine the cost of production and resource-use efficiency among small scale cassava farmers in Igbo Etche in Rivers State, Nigeria. The specific objectives are as follows:

(i) Analyse the cost characteristics of small scale cassava farmers in Igbo Etche, Rivers State, Nigeria.
(ii) Determine the factors affecting cost of cassava production by small scale farmers in Igbo Etche.
(iii) Evaluate the resource-use efficiency among small scale cassava farmers in the study area.

## MATERIALS AND METHODS

### The study area

Etche Local Government Area of Rivers State, Nigeria is made up of five traditional clans including Mba, Okehi, Ulakwo-Umueselem, Ozuzu and Igbo, consisting of several villages and towns. Etche LGA is currently divided into two state political constituencies. Constituency 1 is made up of Mba and Ozuzu clans, while Okehi, Ulakwo-Umueselem and Igbo clans shared Constituency 2. This study focused on Igbo Etche clan occupying the southern part of Etche LGA, sharing boundaries with Oyigbo and Obio/Akpor LGAs of Rivers State, Nigeria. Etche LGA is characterized with heavy rainfall most of the year with a short dry season which favours the growth of tropical crops such as yam, cassava, timber, oil palm, rubber, plantain, banana, assorted fruits and vegetables as export and food crops. Igbo Etche clan is chosen base on the fact that it was one of highest concentration of cassava production in the LGA and due to its nearness to Port Harcourt municipality, it had a high demand for land for both urban expansion, agricultural production and establishment of agro-allied industries.

### Data collection

Data was collected through primary sources basically by interviews and personal discussions with the cassava farmers and finally structured questionnaire was distributed among the small-scale cassava farmers in the seven principal communities that make up Igbo Etche clan in Etche LGA. These seven communities were Igbo, Egwi, Chokocho, Umuechem, Umuebulu, Opiro and Ikwerengwo. The questionnaire was specifically designed to elicit information from small scale cassava farmers on costs involved in cassava production, factors influencing the yield in cassava production and other socio-economic variables affecting the production of the crop in the study area. The sampling procedure used to obtain data from small scale cassava farmers was multi stage sampling technique. Out of the five traditional clans in Etche LGA, Igbo Eche clan was selected for its high concentration of small scale cassava farmers compared to other clans. Secondly, sampling of data was only done in the seven principal communities in Igbo Etche clans as listed above. Thirdly, 15 small scale cassava farmers were randomly selected from each of the seven principal communities being the centres of activities in the clan giving a total of 105 samples drawn. However, out of the 105 questionnaires retrieved from the small scale cassava farmers, 102 questionnaires were actively used for data analysis as 3 questionnaires were poorly filled.

### Data analysis

In this study, objective one was captured using descriptive statistical analysis, objective two was achieved using Cobb-Douglas stochastic cost function and objective three was attained with the help of stochastic production frontier function.

### Stochastic cost function model

The Cobb – Douglas stochastic frontier cost function model for estimating farm level overall cost efficiency is implicitly specified (Ogundari and Ojo, 2007; Emokaro and Oyoboh, 2016).

$C_i = g(X_i, \alpha)\, e^{v_i + u_i}$ i = 1,2, … ,n………………….Eq. (1)

where,

$C_i$ = total production cost

$X_i$ = cost of input
α = parameters of cost function
$\varepsilon_i$ = the error term that is composed of two elements (vi and ui)

The explicit functional form of Cobb – Douglas stochastic frontier cost function is expressed as follows (Audu et al., 2013; Afreen and Haque, 2014; Emokaro and Oyoboh, 2016).

$$\ln C_i = \alpha_0 + \alpha_1 \ln X_{1i} + \alpha_2 \ln X_{2i} + \alpha_3 \ln X_{3i} + \alpha_4 \ln X_{4i} + \alpha_5 \ln X_{5i} + \alpha_6 \ln X_{6i} + \alpha_7 \ln X_{7i} + V_i + U_i \quad \text{Eq. (2)}$$

where,
$C_i$ = Total cost of annual cassava production (₦)
$X_1$ = Cost of hired labour per farmer (₦)
$X_2$ = Cost of planting a ha of cassava per farmer (₦)
$X_3$ = Cost of cassava stems per farmer (₦)
$X_4$ = Cost of fertilizers per farmer (₦)
$X_5$ = Cost of pesticides and other chemicals per farmer (₦)
$X_6$ = Cost of renting farm land (₦)
$X_7$ = Cassava yield (kg)
In = Natural logarithm
$\alpha_0$ = constant
$\alpha_1 - \alpha_7$ = parameters to be estimated
$v_i$ = Random error due to statistical noise, weather, diseases etc. which are outside the control of the farmers.
$u_i$ = Randomness (inefficiency effect) due to small scale cassava farmers' socio-economic characteristics.

In the stochastic frontier cost function, error components have a positive sign because inefficiency increases cost of production (Battese et al., 1995; Coelli et al., 1998)

## Cobb Douglas Stochastic frontier production function

(a) The stochastic frontier production function model for estimating farm level technical and resource – use efficiency is specified as follows (Ogundari and Ojo, 2007).

$$Y_i = f(X_i; \beta) + \varepsilon_i \quad i = 1,2, \ldots, n \quad \text{Eq. (3)}$$

where,

$Y_i$ = cassava output (kg)
$X_i$ = actual input vector
β = vectors of production function
$\varepsilon_i$ = as defined in Eq. (1) above
The explicit form of the Cobb – Douglas stochastic frontier production function model is specified as follows (Ogundari and Ojo, 2007; Aboki et al., 2013; Afreen and Haque, 2014; Ochi et al., 2015).

$$\ln Y_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + \beta_7 \ln X_{7i} + \beta_8 \ln X_{8i} + \beta_9 \ln X_{9i} + v_i - u_i \quad \text{Eq. (4)}$$

where,

$Y_i$ = Cassava output produced (kg per ha)
$X_1$ = Farm size (ha)
$X_2$ = Cost of hired labour (₦)
$X_3$ = Quantity of fertilizers used (kg/ha)
$X_4$ = Quantity of cassava cuttings (stem) used (bundles/ha)
$X_5$ = Quantity of pesticides used (litres)
$X_6$ = Cost of planting a ha of cassava farm (₦)
$X_7$ = Family labour used (mandays/ha)
$X_8$ = Age of farmer (years)
$X_9$ = Farming experience (years)
In = Natural logarithm
$\beta_0$ = Constant term to be estimated
$\beta_1 - \beta_9$ = Coefficient of the independent variables to be estimated
$v_i - u_i$ = Error terms as earlier defined

(b) Resource – use efficiency was determined by the ratio of marginal value product (MVP) to marginal factor cost (MFC) of inputs based on the estimated stochastic frontier coefficients. Following Rahman and Lawal, (2003), Aboki et al. (2013), Ochi et al. (2015), efficiency of resource-use is given as:

$$r = MVP/MFC \quad \text{Eq. (5)}$$

where,

r = efficiency of resource-use.

The rule provides that when r = 1, there is efficient use of resources by the farmer, r>1 indicates underutilization of resources, while r< 1 shows over utilization of resources. The value of MVP and MPC were estimated as:

$$MVP = MPP.\ P_y$$
$$b_i = Y/X_i \quad \text{Eq. (6)}$$
$$MFC = P_{xi}$$

where,

MPP = Marginal physical product
$P_{xi}$ = Unit price of input $X_i$
Y = Arithmetic mean value of output
$X_i$ = Arithmetic mean value of input,
$P_y$ = Unit price of output

## RESULTS AND DISCUSSION

The results of the data collected were analysed using descriptive statistics, Cobb-Douglas stochastic frontier cost and production functions to estimate the determinants of cost variables and resource – use

**Table 1**. Cost characteristics of small scale cassava farmers in Igbo Etche.

| Variables | Frequency | Percentage |
|---|---|---|
| Source of planting materials (cuttings) | | |
| From previous farm | 52 | 50.98 |
| Purchased from market | 22 | 21.57 |
| Gotten from friends/relatives | 17 | 16.67 |
| Purchased from A.D.P | 11 | 10.78 |
| Total | 102 | 100 |
| Number of hired labour per farmer | | |
| Less than 3 persons | 11 | 10.78 |
| 3 – 4 persons | 30 | 29.41 |
| 5 – 6 persons | 42 | 41.18 |
| 7 persons and above | 19 | 18.63 |
| Total | 102 | 100 |
| Forms of payment of labour employed | | |
| Cash | 47 | 46.08 |
| Kind | 22 | 21.57 |
| Both kind and cash | 33 | 32.35 |
| Total | 102 | 100 |
| Cost of hired labour per day | | |
| ₦500 – ₦1000 | 22 | 21..57 |
| ₦1,100 – ₦2,000 | 46 | 45.10 |
| ₦2,100 – ₦3,000 | 34 | 33.33 |
| Total | 102 | 100 |
| Cost of weeding cassava farm per ha | | |
| ₦ 10,000 - ₦20,000 | 16 | 15.69 |
| ₦21,000 - ₦30,000 | 56 | 54.90 |
| ₦31,000 and above | 30 | 29.41 |
| Total | 102 | 100 |
| Challenges encountered in cassava farming | | |
| Inadequate planting materials | 6 | 5.88 |
| High cost of planting materials | 17 | 16.67 |
| High cost of land preparation | 18 | 17.65 |
| High cost of hired labour | 29 | 28.43 |
| Land tenure | 15 | 14.71 |
| High cost of land purchase and rentage | 8 | 7.84 |
| High cost of fertilizer | 6 | 5.88 |
| High cost of other agro – chemicals | 3 | 2.94 |
| Total | 102 | 100 |

Source: Field Survey, 2016. Note: All costs were valued in Nigerian currency (Naira).

**Table 2.** Average estimated cost of small scale farmers cassava production in Igbo Etche.

| Costs involved in cassava production | Average cost per farmer (₦) | Average cost per day per farmer (₦) | Percentage of total cost |
|---|---|---|---|
| Estimated cost of preparing a hectare of farmland | | | |
| Clearing | 36,705.88 | 2,915.48 | 16.27 |
| Burning | 632.35 | 632.35 | 0.28 |
| Tilling/ploughing | 21,470.58 | 2,094.69 | 9.52 |
| Total | 58,808.81 | 5,642.52 | 26.07 |
| Cost of planting a ha of cassava farm | 34,607.84 | 3,937.18 | 15.34 |
| Estimated cost of weeding a ha of cassava farm | 26,794.12 | 1,116.42 | 11.87 |
| Cost of harvesting and transportation of cassava tubers | 46,432.69 | 4,149.48 | 20.58 |
| Cost of purchasing agro-chemicals | 22,500.00 | - | 9.97 |
| Cost of farm tools per farmer | | | |
| Cutlass | 3,545.10 | 886.28 | 1.57 |
| Hoe | 3,619.61 | 452.45 | 1.61 |
| Basins/baskets | 3,725.49 | 931.37 | 1.65 |
| Wheel barrow | 9,027.94 | 9,027.94 | 4.00 |
| Other tools | 230.39 | 230.39 | 0.10 |
| Total | 20,148.53 | 11,528.43 | 8.93 |
| Estimated fixed costs | 16,347.00 | 544.90 | 7.24 |
| Total cost of cassava production | 225,638.99 | 26,374.03 | 100 |
| Number of man days spent on preparing farmland (Average number of man days/farmer) | | | |
| Clearing | 12.59 | - | - |
| Planting | 8.79 | - | - |
| Burning | 1.00 | -` | - |
| Weeding | 24.00 | - | - |
| Tilling/ploughing | 10.25 | - | - |
| Harvesting and transportation | 11.19 | - | - |

Source: Field survey, 2016. Note: All costs are valued in Nigerian currency (Naira). A manday is equivalent to 8 hours per day work on the farm or farming activities.

**Table 3**. Estimates of Cobb Douglas stochastic cost function analysis.

| Variable | Parameters | Coefficients | Standard Errors |
|---|---|---|---|
| Constant | $\alpha_0$ | 0.3749*** | 0.000008 |
| Cost of hired labour (₦) | $\alpha_1$ | -0.3667*** | 0.0945 |
| Cost of planting a ha of cassava farm (₦) | $\alpha_2$ | -0.0370* | 0.0187 |
| Cost of cassava cuttings (stem) (₦) | $\alpha_3$ | -0.0738*** | 0.0168 |
| Cost of fertilizers (₦) | $\alpha_4$ | 0.2565*** | 0.0585 |
| Cost of pesticides and other chemicals (₦) | $\alpha_5$ | 0.0744** | 0.0280 |
| Cost of purchasing farmland (₦) | $\alpha_6$ | 0.1789* | 0.0889 |
| Cassava yield (kg) | $\alpha_7$ | 0.2538*** | 0.0111 |
| Variance parameters | | | |
| Sigma-square | $\sigma^2$ | 0.7374*** | 0.1432 |
| Gamma | $\gamma$ | 0.9374*** | 0.2370 |
| Log likelihood | | -3.9389 | - |

Source: Computed from field survey 2016. **** - significant at 1%; ** - significant at 5%; * - significant at 10%.*

**Table 4**. Estimates of stochastic frontier production function analysis.

| Variables | Parameters | Coefficients | Standard Errors |
|---|---|---|---|
| Constant | $\beta_0$ | 6.5384*** | 1.5470 |
| Farm size (ha) | $\beta_1$ | 0.1388*** | 0.0271 |
| Cost of hired labour (₦) | $\beta_2$ | -1.3064*** | 0.2241 |
| Quantity of fertilizer used (kg/ha) | $\beta_3$ | 2.9490*** | 0.9082 |
| Quantity of cassava cuttings (bundles/ha). | $\beta_4$ | 0.1738*** | 0.0488 |
| Quantity of pesticides used (litres) | $\beta_5$ | 0.1886*** | 0.0168 |
| Cost of planting a hectare of cassava farm (₦) | $\beta_6$ | -0.1813*** | 0.0311 |
| Family labour used (mandays/ha) | $\beta_7$ | 0.1584*** | 0.0145 |
| Age of farmer (years) | $\beta_8$ | 0.1783*** | 0.0130 |
| Farming experience (years) | $\beta_9$ | 0.1881*** | 0.0157 |
| Variance parameters | | | |
| Sigma-square | $\sigma^2$ | 0.6187*** | 0.1389 |
| Gamma | $\gamma$ | 0.8717*** | 0.1748 |
| Log likelihood | - | 226.9261 | - |

Source: Computed from field survey 2016. **** - significant at 1%; ** - significant at 5%; *- significant at 10%.*

**Table 5**. Estimated resource-use efficiency among small scale cassava farmers in Igbo Etche.

| Resource used | MVP (₦) | MFC (₦) | Efficiency rate |
|---|---|---|---|
| Farm size ($X_1$) | 6,837.44 | 632.24 | 10.81 |
| Hired labour ($X_2$) | 8,222.80 | 2,044.85 | 4.02 |
| Fertilizer usage ($X_3$) | 9,593.29 | 610.37 | 15.72 |
| Cassava cuttings ($X_4$) | 2,565.28 | 1,654.16 | 1.55 |
| Pesticides usage ($X_5$) | 41.33 | 1,218.10 | 0.03 |

Source: Field survey, 2016. Note all figures are valued in Nigerian currency (Naira).

efficiency as presented in (Tables 1 – 6).

## Cost characteristics of farmers

The cost characteristics of small scale cassava farmers' in Igbo Etche was presented in Table 1. The results showed that about 89.22% of the farmers interviewed sourced their planting materials (cassava stems) from previous farms, friends and/or relatives or had purchased their cassava cuttings from local markets available. Only 10.78% of the farmers had purchased their planting materials from reliable sources such as the A.D.P (Agricultural Development Programme) in the state. These results are similar to Nandi et al. (2011) and the report of Sahel (2016) on sourcing of planting materials. Table 1 also showed the results of number of hired labour employed per farmer in the study area. The results indicated that about 41.18% of the farmers hired 5 – 6 persons for their farming operations, 29.41% hired 3-4 persons and 18.63% of the small scale farmers hired 7 persons and above. This means that about 70.59% of the cassava farmers depended on hired labour employing a minimum of 3 persons and up to 6 persons in their production activities. This means that cost will increase as the number of hired labour increased.

Many small scale farmers paid their hired labour either by cash or kind (32.35%), though majority settled their employees by cash (46.08%). About 45.10% of the hired labour received between ₦1,100 – ₦2,000 per day, while 33.33% received between ₦2,100 – ₦3,000 per day. The cost of weeding cassava farms varied between ₦21,000 – ₦30,000 (54.90%), ₦31,000 and above (29.41%) and only 15.69% of the small scale cassava farmers paid the least amount between ₦10,000 – ₦20,000 to weed a hectare of cassava farm in Igbo Etche, Rivers State, Nigeria. Because of the high cost of weeding, most farmers weed their farm plot once leading to poor yield. Hired labour was expensive in Igbo Etche may be because of its location at the outskirt of the state capital, Port Harcourt, where labour is on high demand.

High cost of labour was the highest challenge encountered by small scale cassava farmers in Igbo Etche as claimed by 28.43% of the respondents. This was followed by high cost of bush clearing (17.65%), cost of planting materials (16.67%) and the problem of land tenure system (14.71%). If a small scale cassava farmer who is resource poor can spend above ₦30,000 to weed a hectare of cassava farm, the labour cost was truly a high challenge. This result on high cost of labour observed in challenges encountered is similar to the result of Eze and Nwibo, (2014), and also similar to the result of Zaknayiba et al. (2014) on high cost of planting materials.

Table 2 shows the average estimated costs of cassava production by a small scale farmer in Igbo Etche in Etche LGA of Rivers State, Nigeria. The results of the table showed that a total of ₦58,808.81 was spent on land preparation to plant a hectare of cassava farm, which was 26.07% of average total cost of cassava production (₦225,638.99) in the study area. Clearing, tilling and ploughing formed the bulk of the land preparation activities with 16.27% and 9.52% of the total cost of production. The estimated average cost of land preparation (26.07%) is higher than the results of Ebukika (2010) which was 11.76%, Eze and Nwibo, (2014) which was 7.75%. The average cost of planting a hectare of cassava farm was ₦34,607.84 which was 15.34% of the total cost. This result is similar to the results of Fakayode et al. (2008) in cassava/maize combination (14.86%) and cassava/cowpea combination (15.59%). But this study result is higher than the results of Nandi et al. (2011) which was 9.7%, Ogundari and Ojo, (2007) had 8.25%, Afreen and Haque, (2014) that ranged from 3.43 – 7.62%. The higher value obtained in this study could be because costs of planting and stem cuttings were added together.

Table 2 also shows that the estimated average cost of weeding a hectare of cassava farm by the small scale farmers was ₦26,794.21, 11.87% of the total cost of production in Igbo Etche. This result on weeding cost is

**Table 6**.The production elasticity and return to scale (RTS).

| Resources used | Elasticity of production |
|---|---|
| Farm size ($X_1$) | 0.1388 |
| Hired labour ($X_2$) | -1.3064 |
| Fertilizer usage ($X_3$) | 2.9490 |
| Cassava cuttings ($X_4$) | 0.1738 |
| Pesticides usage ($X_5$) | 0.1886 |
| Return to scale (RTS) | 2.1438 |

Source: Field survey, 2016

lower than the results of Ebukiba, (2010) which was 20.57%, Eze and Nwibo, (2014) whose results was 15.5%. Fregene et al. (2015) reported that manual weeding could be as high as 40% of total cost.

The average cost of harvesting and transporting harvested cassava tubers was ₦46,432.69 which was 20.58% of the total average cost of production. For the reasons that cassava tubers are heavy and bulky to convey, coupled with the distance of the farms from the cassava processing units and sales markets, this cost took a fairly high proportion of the average total cost of production in the study area. However, this study result (20.58%) was lower when compared to Ebukiba, (2010) which was 44.45%, Eze and Nwibo, (2014) who had 29.70%, Fregene et al. (2015) who reported 24-30%.

The results of Table 2 further showed that total cost of labour which included cost of land preparation, planting a hectare of cassava farm, weeding, harvesting and transportation of harvested tubers was ₦166,643.46, constituting a proportion of about 73.86% of the total cost of production. This proportion is lower than the proportion of labour in the studies of Fakayode et al. (2008) results which ranged from 76.76% - 84.85%, Ebukiba, (2010) whose result was 80.89%, Afreen and Haque, (2014) result on Jhinaigah, Bangladesh (82.33%). This study result was however higher than the results of Guodadia (1993) who obtained 64.3%, Ogundari and Ojo, (2007) which was 71.90%, Nandi et al. (2011) who reported 65.20%, Eze and Nwibo, (2014) who obtained 67.15%, Afreen and Haque, (2014) whose labour cost result in Sreebardi, Bangladesh was 66.73%.

Furthermore, Table 2 showed the cost of purchasing agro-chemicals which was ₦22,500 (9.97%) while cost of farm tools and implements was ₦20,148.53 (8.93%). These results are similar to the results of Ogundari and Ojo, (2007) which were 9.35% and 10.50% respectively for agro – chemical and farm tools. The cost of fertilizers were lower in Eze and Nwibo, (2014), 7.75%; Fakayode et al. (2008) had quite considerably lower results ranging from 4.36%, - 4.77% as compared to the results of this study on cost of fertilizers..

Therefore, the major components of cost of cassava production in Igbo Etche were cost of land preparation (26.07%), harvesting and transportation (20.58%), planting and stem cuttings (15.34%) and weeding (11.87%). These costs made up 73.86% of the total average cost of cassava production in the study area. If these costs are controlled and/or reduced, cassava production by small scale farmers will be more viable and profitable in the study area.

Table 2 also indicated the average number of mandays spent by cassava farmers in clearing (12.59 mandays), weeding (24 mandays), harvesting and transportation (11.19 mandays), tilling/ploughing (10.25 mandays). These results were similar to Eze and Nwibo (2014) results. These mandays were used to derive most of the estimates on the column on average cost per day per farmer. A manday is equivalent to 8 hours work per day by a man/woman on the farm or farming activities.

## Cost function analysis

The estimated results of Cobb-Douglas stochastic cost function analysis as in Eq.2 are presented in Table 3. The results showed that all the variables used were statistically significant at least at 10% level, meaning all variables used in the cost analysis were important. The apriori expectation is that if costs of variable decreases total cost will decrease, if the variable cost increases total costs will also increase (i.e. directly proportional relationship). The results on Table 3 showed that the coefficients of cost of hired laour (-0.3667), cost of planting cassava (-0.0370) and cost of purchasing cassava stems (-0.0738) were negative and statistically significant at 1%, 10% and 1% level respectively, showing their relevance in cost of cassava reduction. This is to say that for a 10% decrease in the cost of hired labour, total cost of cassava production will decrease by 3.68%. If the costs of planting and purchasing stems were decreased by 10%, total cost of production will decrease by 0.37% and 0.74% respectively. These reductions though inelastic are necessary as labour cost alone constituted more than 73% of the total cost of cassava production by small scale farmers. Reduction in the cost of production will lead to higher profit level for these resources poor small scale farmers.

However, the following costs had positive coefficients: cost of purchasing fertilizer (0.2565), significant at 1%; cost of purchasing pesticides and other agro - chemicals (0.0744), significant at 5% and cost of purchasing farmland (0.1789), significant at 10%. These results showed that if their costs were increased, cost of production of cassava in Igbo Etche will definitely increase by 2.57%, 0.74% and 1.79% for a 10% increase in cost of fertilizers, pesticides and purchasing farmland respectively. Any decrease in cost of production will make cassava production in the study area to be more viable. These positive coefficients are similar to the results of Ogundari and Ojo, (2007), Audu et al. (2013), Afreen and Haque, (2014).

The estimated sigma-square ($\sigma^2$) was 0.7374 (Table 3) and statistically significant at 1% level, thereby confirming the model used to be a good fit. The gamma ($\gamma$) coefficient was 0.9374 and was also statistically significant at 1%. The implication of the value of the estimated gamma value is that 93.74% of the cost of production incurred by the small scale cassava farmers in Igbo Etche was due to differences in their cost inefficiency. These results are similar to the results obtained by Ogundari and Ojo (2007), Audu et al. (2013), Afreen and Haque, (2014) using stochastic cost function analysis. Other results of the cost function analysis revealed that the major cost components were hired labour, cassava cutting (stems), fertilizers, pesticides and other agro chemicals for their high level of significance which conformed to the outcome of the earlier analysis on Table 2 on average cost of cassava production of this study.

## Productivity analysis

The estimates of Cobb – Douglas stochastic frontier production function analysis as stated in Eq. (4) are presented in Table 4. The results showed that all the variables used in analysis were statistically significant at 1% level, meaning they were all relevant. The a priori expectations were that increase in costs variables will decrease cassava output, while increase in the remaining input variables will lead to increase in cassava output. The results in Table 4 showed that farm size, quantity of fertilizers applied, cassava stems, quantity of pesticides used, family labour, age of farmer and farming experience all had positive coefficients, meaning for an increase in each variable, output will increase consequently according to the value of the coefficient of the variable. Of particular interest was the case of fertilizer usage whose coefficient was very elastic (2.9490) and was significant at 1% level. This means that if fertilizer usage by the small scale cassava producers in Igbo Etche in Etche LGA was increased by 10%, cassava output will increase by 29.49% (an elastic increase in production). This showed how important is this variable (fertilizer) in cassava production and its effect on yield and hence output in the study area. However, the costs of hired labour and planting a hectare of cassava farm had negative coefficients of -1.3064 and -0.1813, all statistically significant at 1% level. This explains that if the cost of hired labour is increased by 10%, output of cassava will reduce by 13.06% (an elastic reduction in output).

The sigma-square ($\sigma^2$) estimated coefficient was 0.6187 (as in Table 4) and was statistically significant at 1%, indicating that this model used was also of a good fit. The estimated production function gamma ($\gamma$) coefficient was 0.8717 and statistically significant at 1% level. This implies that 87.17% of the variation on cassava output produced by small scale cassava farmers in Igbo Etche was due to their technical inefficiency. All the variables conformed to the a priori expectations. The a priori expectations were that the cost variables will reduce output if increased, whereas all other input variables will increase output if increased. The results further confirmed hired labour cost, fertilizers usage, farming experience, quantity of pesticides used and cost of planting played vital role in predicting the level of cassava production in the study area using the stochastic frontier production function model. These results are similar to the results of (Nandi et al., 2011; Aboki et al., 2013; Afreen and Haque, 2014; Ochi et al.,2015).

## Resource – use efficiency

The economic efficiency of resource – use ratio (r) of various factors of production used in cassava production by small scale cassava farmers in Igbo Etche clan in Etche LGA of Rivers State, Nigeria was obtained using the ratio of the marginal value product (MVP) to the marginal factor cost (MFC) all valued in Nigerian currency (Naira) and are presented in Table 5. The results on the table showed that all inputs used by the small scale cassava farmers were inefficiently utilized, since all the estimated resource-use efficiency ratios calculated were significantly different from unity. The results also showed that farm size (10.81), hired labour (4.02), fertilizer usage (15.72) and cassava cuttings (1.55) were all higher than unity. This indicates that if the quantity of these production inputs were increased, output of cassava will definitely increase in Igbo Etche. The result further showed that pesticides were over utilized with the value of 0.03, meaning a decrease in the use of pesticides will increase cassava output in the study area. Therefore, majority of the inputs used in production of cassava in Igbo Etche were underutilized, meaning if they are efficiently utilized, more output and hence income could accrue to the resource – poor farmers in the study area. These results are similar to the results of Aboki et al. (2013), Eze and Nwibo, (2014), Ochi et al. (2015) in relationship to hired labor, farm size and fertilizer usage respectively. The production elasticity and return to scale (RTS) of the stochastic production function analysis is presented on Table 6. Returns to scale measured the proportionate change in output of production if all the resources are changed simultaneously by 1%. Return to scale represents the total of all elasticity of production with respect to all the actual factors used in production (Nandi et al., 2011). Returns to scale can be expressed as follows: increasing (Elasticity of production ie $Ep > 1$, greater than unity); constant ($Ep = 1$) and decreasing ($Ep < 1$).

The total elasticity of production with respect to actual inputs used in this study was 2.1438. This means that small scale cassava farmers in Igbo Etche of Etche LGA in Rivers State, Nigeria operated in increasing returns to scale region where $Ep > 1$ which is called the stage 1 of production process. This indicated that if these inputs were increased simultaneously by 10%, cassava output will increase accordingly by 21.44% (elastic increase) in the study area. Therefore, it was still possible to increase output of cassava for a higher profitability level. This result agrees with the results of Nandi et al. (2011), though it is far from Ogundari and Ojo, (2007) result which was in the third state (decreasing stage) of production,. Therefore, the study found out that because majority of the inputs used in cassava production were underutilized, the returns to scale is still in the first stage, where more of these resource used could still be employed to increase output capacity.

## Conclusion

The results of the analysis of cost characteristics of small scale cassava farmers in Igbo Etche revealed that 89.22% of the respondents sourced their planting materials (cassava stems) from previous farms, friends and/or relatives or had purchased their cuttings from local farmers in local markets; only about 10.78% sourced their planting materials from authentic sources. The results also showed that about 70.59% of the farmers hired between 3-6 persons extra for their farming operations and were paid either by cash or kind. High costs of labour, land preparation and lack of high yielding varieties of planting materials were the major challenges encountered by the farmers in Igbo Etche in Etche LGA of Rivers State, Nigeria. The results also showed that cost of labour for land preparation was 26.07%, cost of planting (15.34%), weeding cost (11.87%), harvesting and transportation (20.58%), which summed up to 73.86%, and formed the total cost of labour in cassava production in the study area. Secondly, the stochastic cost function analysis estimated in this study showed all variables were statistically significant, indicating their relevance in the cost analysis. The coefficients of hired labour, cost of planting and cassava cuttings were negative and statistically significance at 1% and 10% respectively, meaning that for a unit decrease in these costs, total cost of production will decrease proportionately. The cost of purchasing fertilizers, pesticides and other agro-chemicals, and purchasing farmland, all had positive coefficients, significant at 1%, 5% and 10% respectively. This means that if these costs were increased, total cost of production of cassava by small scale farmers will definitely increase. The coefficient of gamma in cost analysis was 0.9374 significant at 1%, meaning that 93.74% of variations in the cost of production incurred by the respondents were due to differences in their cost inefficiency. The cost function analysis confirmed that hired labor, cassava stem (cuttings), fertilizers, pesticides and other agro-chemicals were the major cost components of the cassava farmers in Igbo Etche. Thirdly, the estimated productivity analysis using stochastic frontier production function showed that all variables were statistically significant at 1% level depicting their relevance. The results showed that farm size, quantity of fertilizer used, quantity of cassava cuttings, quantity of pesticides used, family labour, age and farming experience were all positively correlated, meaning, an increase in the variables will increase the output of cassava production proportionately. Fertilizer usage showed an elastic increase in output by 29.49% if its usage was increased by 10%. However, costs of hired labour and planting were negatively correlated, indicating that if these costs were increased by 10%, cassava output will reduce by almost 13% as shown by the case of hired labour. The results further depicted that about 88% of the variations in cassava output was due to technical inefficiency.

Fourthly, the economic efficiency of resource – use ratios indicated that all inputs used in cassava production in the study area were inefficiently utilized. Farm size, hired labour, fertilizers and cassava cuttings were underutilized, therefore, to increase productivity their quantities need to be increased. The results also showed that pesticides were over utilized, meaning less of it could be used more efficiently to increase productivity. Therefore, there is need for the farmers to be more efficient in their use of resources. The results further showed that the small scale cassava farmers in Igbo Etche in Etche LGA of Rivers State, Nigeria operated in increasing returns to scale region (i.e. stage 1) meaning there is still room, for cassava output expansion up to 21.44% above the level produced during the survey in 2016. In conclusion, the small scale cassava farmers in Igbo Etche were cost and technically inefficient. Hence, they were inefficient in their resource – use. Therefore, there is the need for small scale cassava farmers in the study area to be more prudent in managing their costs of production and efficiently utilize their available resources in cassava production paying particular attention to hired labour.

## Recommendations

The following recommendations were made based on the revelation and findings of this study.

(i) Hired labour and other input costs were found to be major sources of high costs of cassava production among the small scale cassava farmers in Igbo Etche in Rivers State, Nigeria. Therefore, it is being recommended that credit institutions in Rivers State should make credit/loans available to cassava farmers to enable them pay for hired labourers, purchase fertilizers and other agro-chemicals, and buy improved cassava stems from authentic sources when needed for more efficient productivity.

(ii) Now that cassava is officially recognized as food and cash crop by the Nigerian government (FAO 2016), we are of the opinion that government should reconsider the policy of subsidizing agricultural production. This will enable the resource – poor small scale cassava farmers to be able to afford the purchase of fertilizers, pesticides, weedicides, herbicides and other relevant inputs in cassava production. This will eventually reduce the high cost of cassava production experienced in Igbo Etche.

(iii) Land, is the major input in cassava farming. Land for cassava production in the area of study is mostly inherited and need expansion. Hence, it is being recommended that agricultural land preparation, clearing and ploughing services, usually rendered by government or its agencies should be revitalized and empowered to operate more efficiently and effectively in rendering these services in the state as before, especially at this period of recession in the economy.

(iv) There is the need for access roads to the heart of farmland of cassava production in the state like Igbo Etche. Hence, it is been recommended that Federal/State governments should construct and maintain feeder roads in order to reduce the high cost of harvesting and transportation of cassava tubers experience in the study area.

(v) In order to reduce the high cost of cassava production in Igbo Etche, the small scale cassava farmers are being encouraged to form cassava farmers' co-operative societies which will enable them reduce cost of production, organize and market their produce, and purchase required farm inputs, This process will lead to higher efficiency in productivity, efficient resource use and increased profitability.

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