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**RESEARCH ARTICLE**

# RESOURCE USE EFFICIENCY IN CASSAVA PRODUCTION IN KEBBI STATE

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**ABSTRACT**

This study was conducted to analyze the resource use efficiency of cassava production in Kebbi State, Nigeria. One Local Government was selected from the Four Agricultural Development Zones of Kebbi State. Simple random sampling technique was used in selecting the five (5) villages and the five (5) farmers. Inputs-output data was collected from fifty farmers each from one Local Government, making a total sample size of 200 farmers. Data was analyzed using production function model and marginal analysis model. The double-log regression functional form of the production function analysis was selected as the equation that best fit the data. Results shows that fertilizer and labor are significant at 5% ($p<0.005$) level while cuttings and agro chemical inputs are significant at 1% ($p<0.001$) level of significance. The efficiency ratio for fertilizer, cuttings, labor and agro chemicals are 3.8, 7.2 1.8 2.8 respectively, which shows that the resources were under-utilized to the economics optimum level. While the efficiency ratio for farm tools were 0.032 which show over utilization of these resources to the economics optimum level. The elasticity of production was 1.5 indicating increasing returns to scale.



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## INTRODUCTION

The national concern for cassava production is because in Nigeria, cassava production is well-developed as an organized agricultural crop. It has well-established multiplication and processing techniques for food products and animal feed (USAID, 2013) According to Food and Agriculture Organization of the United Nations database (FAOSTAT, 2009), Nigeria is the largest producer of the cassava with 45,721,000, 43,410,000 and 44,582,000 million tons in 2006, 2007 and 2008 respectively, (Awoyinka, 2009). Cassava is 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. Therefore, its production and utilization must be given prime attention in food policy formulation (Tsegia and Kormawa, 2002). 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, 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 cassava (Tsegia and Kormawa, 2002). Nigeria produces more than 40 million metric tons of cassava, thus emerging as the world's largest producer (USAID, 2013).

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In spite of this volume the full yield potential has not been realized since smallholder production rarely exceeds 2 metric tons per hectare as against 25-40 metric tons per hectare recommended by experts. This yield per hectare is indicative of the yield experienced in the North- west region of Nigeria Kebbi State inclusive. Despite high yield experience in North West, Kebbi state is the lowest producer in the region. Cassava production is low in the state due to number of factors including small scale farming (on plots that are usually less than 1hectare), manual operation, little or no use of fertilizers and limited knowledge in the use of high yield root to name a few. Farming at this level makes it difficult to achieve efficiency and economies of scale. Base on the above scenarios, the objectives was to conduct an economics analysis of cassava production in Kebbi state. The study also describe the socio economic characteristics of the farmer, examine the resource use efficiency in cassava production and identify the constraints encounters in cassava production in the study area

In 2002, cassava suddenly gained national prominence following the pronouncement of a presidential initiative. The intent of the initiative was to use Cassava as the engine of growth in Nigeria. To put Nigeria in the global context for competition, the country needs to upgrade the use of Cassava by the primary industries such as starch, ethanol, chips and flour in order to provide an industrial base diversification of its national economy. Cassava can be used to improve farmers and retailer's income and development in Nigeria if investment in the downstream sector or the industry is made more effective Presidential Initiative on Cassava (PIC, 2003).

## MATERIALS AND METHODS

Kebbi State was located between latitudes 10°8'N and 13°15'N and longitudes 3°30'E and 6°02'E, the State is boundary with Sokoto State to the north and east, Niger State to the south, and Benin Republic to the west. It has a total of population of 3.8 million people (PIC, 2003). Kebbi State has twenty one Local Government Areas, four emirate councils (Gwandu, Argungu, Yauri and Zuru), and thirty five districts. Kebbi State has a total land area of approximately ' 36,985sq km. Out of this, only an estimated 13, 209 sq. km is currently being used for cultivation; leaving a large proportion of land still underutilized. About 200,000 ha of fertile land is fadama land, situated along the flood plains of the Rima and Niger valleys. The rest is upland, where seasonal cultivation were carry out. The wet season lasts from April to October in the south and May to September in the north; while the dry season lasts for the remaining period of the year. Mean annual rainfall is about 800mm in the north and 1000mm in the south. Temperature is generally high with mean annual temperature of about 26°C in all locations. However, during the harmattan season (December to February) the temperature can go down to about 21 °C and up to 40°C during the months of April to June, (PIC, 2003). Relative humidity is generally low (40 per cent) for most of the year except during the wet season when it reaches an average of eighty percent. This explains the hot dry environment which is in sharp contrast to a hot humid environment in the southern parts of Nigeria (PIC, 2003). For sampling procedure one (1) Local Government was purposively selected from Agricultural development programme (ADP) zones of the state. The Local Government areas are; Augie, Maiyama, Shanga and Zuru. Simple random sampling was used in selecting both the villages and the farmers within each Local Government area. Five villages were selected from each Local Government. The lists of the farmers were collected through the use of district heads. The sampling process was done by writing each individual farmer's name in a sheet of paper, fold it and put it in a calabash. Each name was selected without replacement to give equal chance of selecting each farmer. Fifty (50) questionnaires were administered in each local government making a sample size of two hundred (200) cassava farmers interviewed. The data were collected with the help of trained enumerators. The data were collected during 2012 and 2013 rainy seasons. Data collected include information on quantity of fertilizer applied (kg), labor (man-days) used, and cuttings used (kg), agro-chemicals (insecticides and herbicides) (litres) and farm tool (no.).

The information collected was analyzed using the following tools:

Descriptive statistics was used to analyze socio economics characteristics and constraint encounter by cassava farmers, production function analysis was used to analyze resource use efficiency in cassava production. Production function can defined as the technical relationship between the output and the inputs used in the production of the product (Lange, 2009). It can be described mathematically as:

$Y = ʃ(X_1…………………Xn)$ …………….. (1)

$Y = (a+b_1X_1+b_2X_2 …………………..bnXn)$ …….. (2)

Where

Y = aggregate cassava output (kg)
$X_1$ = in organic fertilizer (NPK) (kg)
$X_2$ = cassava cuttings (kg)
$X_3$ = family and hired labor (man-day)
$X_4$ = agro chemical (Round up and primextra) (litre)
$X_5$ = farm tool (number)
a = constant
b = coefficient of X

The Double-log Function is the best fitted model for this research and it is expressed as:

$\log Y = \log a + b_1\log X_1 + b_2\log X_2 ……………..bn\log Xn$ ….. (3)

Where Y and X is as stated as above.

The ratio of the marginal value product (MVP) with the marginal factor cost gives a measure of resource use efficiency. A ratio less than one indicate that an input is over utilized and under-utilized if the ratio is greater than one. A resource is said to be efficiently utilized if its MVP is equal to the unit acquisition cost or where the ratio of MVP to MFC (marginal fixed cost) equals to one.

r = MVP/MFC

Where;

r = Efficiency ratio
MVP = marginal value product of a variable input. (MPP x Px)
MFC = Marginal factor cost (Price per unit input) (Px)

The value of MVP was estimated using the regression coefficient of each input and the price of the cassava output as expressed in equation below:

MVPxi = MPPxi x Px
Where,
Px = Price of unit input
MVPxi = Marginal value product of resource Xi
(i = 1,2……n)
MPPxi = Marginal Physical Product of input xi
but,
MPP for double-log = $\log Y = a + b_1\log X_1$
$MPPx_1 = dy/dx = b_1Y/X_1$
$MPP = b_1Y/X_1$
Where;
MPPxi is as defined above,
bi = The estimated regression coefficient of input xi
X = Arithmetic mean value of the input being considered
$\bar{Y}$ = Arithmetic mean value of output.

## RESULTS AND DISCUSSION

### Production Function Analysis

Production function analysis was carried out to examine the resource use efficiency of cassava production in the study area. Linear, semi-log and double –log regression models were used for the estimation. However, only equations whose parameter estimates were better in statistical significance and provided the best fit in terms of a priori economic criteria were selected as equation for the cassava production which is semi-log regression model. The results in Table 1 below present the double-log function for the cassava production. Double-log production function selected in this study was due to the fact that it provided the best regression fit in terms of priori economics criteria based on statistical significance of regression coefficient, the F – statistics, t – statistics as well as magnitude of the co-efficient of determination ($R^2$).

**Table 1. Result of Double-log Regression Model for Cassava Production**

| Variables | Regression coefficient | Standard error | T-value |
|---|---|---|---|
| Constant | 3.857 | 0.380 | 10.161** |
| Fertilizer $X_1$ | 0.262 | 0.027 | 9.782** |
| Cuttings $X_2$ | 0.105 | 0.027 | 3.933* |
| Labor $X_3$ | 0.32 | 0.027 | 11.767** |
| Agro chemical $X_4$ | 0.74 | 0.024 | 3.03* |
| Farm tools $X_5$ | 0.04 | 0.025 | $1.658^{ns}$ |
| $R^2$ = 0.869 | | | |
| Adjusted $R^2$ = 0.862 | | | |
| F-value = 124.57** | | | |

Sources: Field Survey, 2013.
** Significant at 5%; *Significant at 1%; ns= not significant

The result in Table 1 indicates that fertilizer (X1) and labor (X3) are significant at 5% level of significance, cuttings (X2) and agro chemicals (X4) are significance at 1% level. The results showed that the four variables were able to explain 86% of the variation in the output of cassava. Also the F-statistics, which shows the overall of the model fit, is statistically significant at the 5% level. This means that a unit increase in these inputs when other explanatory variables are held constant will increase cassava output by 9.782kg, 11.767kg, 3.933kg and 3.03kg respectively.

### Resources use efficiency and marginal value of productivities of cassava production

(Lange, 2009), defines efficiency as the quantity of output per unit input used in the production process. Marginal analysis is one of the tools use in finding the resource use efficiency by which each production resource is used. For the double –log function, the marginal product is given by the formula biY/Xi
The marginal value productivities and marginal factor cost of the variable are presented in the Table (2) below. Evaluation of resource use efficiency enables the firm to know their operation status in order to adjust the production rationally. From the Table (2), each MVP was compared to its corresponding MFC and recourse use efficiency status was determined by dividing MVP/MFC. A ratio less than one shows over utilization of that resources and profit would be increase by decreasing the quantity of that input. A ratio greater than one indicate underutilization of input and increasing the rate of that input will increase the level of output.

**Table 2. Estimated Resource-use Efficiency Ratio of Cassava Production**

| Variable | MVP | MFC | Efficiency ratio | Remark |
|---|---|---|---|---|
| Fertilizer | 380.2 | 100 | 3.8 | Under-utilized |
| Cuttings | 118 | 16.4 | 7.2 | Under-utilized |
| Labor | 910 | 500 | 1.8 | Under-utilized |
| Agro chemicals | 2801 | 1000 | 2.8 | Under-utilized |
| Farm tools | 16 | 500 | 0.032 | Over-utilized |

Sources: Field Survey, 2013.

The Table 2 shows the marginal value productivities as well as the marginal factor cost per unit of the variable input. Table 2 shows that, fertilizer has the marginal value product of 380.2 Naira, which is greater than the marginal factor cost (MFC) of 100 Naira. This implies that increasing fertilizer input by one unit would lead to additional expense of 100 Naira and revenue of 380.2 Naira. For the fact that expense incurred by one unit increase is less than the revenue, farmers are advised to increase the use of fertilizer efficiently to produce more of output. This will achieve economic optimum (PIC, 2003). The marginal value product (MVP) for cassava cuttings input was found to be 118 Naira, while the MFC was found to be 16.4 Naira. This implies that for every unit increase in input cassava cuttings, while other variables remains constant, an additional cost of 16.4 naira is incurred and revenue of 118 Naira will be realized. Since expense is less than revenue on the unit increase, farmers will be urged to increase the usage of the input resource. Labor input had a marginal value product (MVP) of 910 Naira, while the marginal factor cost was found to be 500.00 Naira. This implied that for every unit of labor increase, while other variable inputs remained constant an addition revenue will be recorded, hence, there is the need to increase the use of labor, because by implication it is been used below economic optimum level and this will affect profit [19]. Likewise the MVP of agro chemical was found to be 2801 naira while its MFC is 1000 naira. Since the MVP is greater than the MFC, the farmers are advised to use more of this input to reach the economics optimum level. But the farm tools MVP is less than its MFC which implies that for every unit increase in this variable input when other variable input are held constant there is additional cost of 500 naira and the revenue realized is 16 naira. The implication is that increasing this input will increase the cost of production and the profit will not be realized. Therefore farmers are advised to reduce the use of this input in order to make the profit.

### Elasticity of Production Inputs and Return to Scale

(Sani *et al.,* 2007), noted that one of the attractive features of Cobb-Douglas production function is its ability to determine the overall performance of the entire production input (return to scale). The returns to scale measure the proportionate change in output, assuming all the inputs are changed simultaneously by 1%. From the results in Table 3, it showed that cassava production in the study area had an increasing return to scale (34.89). The economics explanation of this could be that the farmers are still in a rational stage of production where marginal physical product is still positive.

**Table 3. Elasticity of Inputs used in the Study Area**

| Input | Quantity/ha | Elasticity |
|---|---|---|
| Fertilizer | 100 (kg) | 0.262 |
| Cuttings | 244 (kg) | 0.105 |
| Labor | 34 (man-days) | 0.32 |
| Agro chemical | 2.6 (litres) | 0.74 |
| Farm tool | 25 (number) | 0.04 |
| Return to scale | | 1.5 |

Sources: Field Survey, 2013.

### Conclusion

The result of double-log regression model shows that fertilizer and labor inputs are significant at 5% level of significant, cassava cuttings and agro chemicals are significant at 1% level. $R^2$ value was very high 86% which shows that 14% of the variables was not captured. All the resources are not utilized to the economics optimum level. Returns to scale value of 1.5 was obtained, which is increasing returns to scale region, meaning the farmers are operating in stage one of the production process, result indicates that the farmers are inefficient in the use of their resources in Cassava production in the area. Therefore, variable resources should be used wisely in order to achieve maximum output from Cassava production which will lead to the increase their profit margins.

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