

# Comparative Economic Analysis of Cassava Mosaic Disease-Resistant Varieties and Non-Resistant Varieties Production in Akwa Ibom State of Nigeria

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**Abstract**— *Comparative Economic Analysis of Cassava Mosaic Disease (CMD)-resistant Varieties and Non-Resistant Varieties (NRV) Production in Akwa Ibom State of Nigeria is the research. The CMD, which causes reduction in yield to about 20-30%, or 90-100% is a problem to farmers. Multi-stage sampling procedure was used to select 80 CMD-resistant varieties and 80 NRV farmers, while descriptive statistics, net farm income and production function analysis were used in analyzing the data. The study was to provide useful information to students, policy makers, investors and researchers to aid them in their various fields. The study revealed the socio-economic characteristics, such as farming experience, educational level, number of extension contact and farm size to positively influence the CMD-resistant varieties farmers' income. The  $R^2$  of 0.83454 variability in the income of the CMD-resistant farmers was explained by the socio-economic variables in the model. The  $R^2$  of 0.6696 variability for the non-CMD-resistant farmers' income was also explained by the socio-economic variables in the model. The CMD varieties production at ₦91,270 Net Farm Income against ₦41,170 of NRV productions, indicated both productions' profitability. Average rate of return indicated every Naira invested by CMD-resistant farmers, earned ₦2.49 profit, while NRV farmers earned ₦1.67 profit. CMD-resistant farming was thus, more profitable than the NRV farming. The Z-test of the mean income (3.5271) at 1% level of significance against tabulated Z-value (1.96) causes the hypothesis' rejection. Production of CMD-resistant varieties was more profitable and farmers are, advised to produce it and form cooperatives for wider dissemination of research information.*

**Keywords**— *Comparative economic analysis: Cassava Mosaic Disease-resistant, non-resistant-varieties production.*

## I. INTRODUCTION

Cassava is one of the major food crops of Nigeria. It has high starch content with useful extracts for food, both for humans and animals, or industrial use as starch, gum and dye. Cassava was first introduced into Africa during the slave trade era of 1558, and cultivated as a source of food for the slave ships [10]. The crop was not popular until late 1890s when famine forced the people that live around the coastal regions to accept and cultivate the crop [13]. Cassava production has been on the increase in Nigeria since 1960s, and today, the country ranks as the world's largest producer of cassava [6]. It plays a particularly important role in developing countries, especially in sub-Saharan Africa as it does well on poor soils with low rainfall, and is a perennial crop that can be harvested as required [22]. Like most other root-crops, it has long growth cycles, high perish-ability, and slow multiplication rates of propagation and is subject to several stresses like insects, mites, nematodes, weeds and diseases, including Cassava Mosaic Disease (CMD) [15]. Cassava production has been on increase in Nigeria since the mid-1960s when estimated to rise to about 8 million tonnes produced from 0.83 million hectares. Food and Agriculture Organization (FAO) in 2001 pronounced Nigeria as the world's largest producer, estimated to be about 34 million tonnes per year from about 3.1 million hectares [14]. [16] estimated that about 42% of harvested cassava roots in West and East Africa are processed into dried chips and flour for easier storage. In Nigeria, however, cassava production has helped in increasing food availability, reducing rural

poverty and unemployment and enhancing agro-industrial and socio-economic growth.

Cassava and its products are used for food, feed, and industrial use [14]. Industrially, its product is used in the production of ethanol [18]. Cassava tubers can be peeled, dried and blended into flour and used by confectionery industries. It has an average yield of about 11 tonnes per hectare, mainly from the numerous small-scale, subsistence farmers from the southern and central regions of Nigeria, [8]. It is a very important crop for food security and income in the tropics and Africa, which translate into 300 calories per day for more than 200 million Nigerian people. It is a prolific crop and can survive on wide range of soils which are acidic with low fertility. In recent times, despite its versatility, its production has been on the decline due to the presence of CMD virus in the country [18]. [17] in a diagnostic survey in Nigeria revealed that CMD symptoms were mild in most farms in Akwa-Ibom, Lagos, Delta and Edo States (South-South) geopolitical zone; Anambra and Enugu State (South-East zone); Kwara, Nassarawa and Niger (middle belt); Jigawa (North-East) and Kaduna (North-West). CMD symptoms were either moderately severe or severe in most farms in Cross River and Bayelsa (South-South); Abia, Ebonyi and Imo (South-East); Ekiti and Ondo (South-West); Plateau, Federal Capital Territory, Benue and Kogi (Middle belt); Bauchi, Gombe, Adamawa, Borno and Yobe (North-East); while Kano, Katsina and Sokoto (North-West) showed CMD symptoms of either mild, moderately severe or severe in various proportions. In the entire country, the farms, although randomly distributed, showed that 48% of the farms had cassava with moderately severe or severe symptoms [11]. These were about the same proportion of farms with mild symptoms which were about 52% [5]. [11] diagnostic survey in Nigeria also revealed that about 74% of the 1397 cassava leaves samples tested positive for African Cassava Mosaic Virus (ACMV). Whiteflies (the disease vectors) were not found in a lot of the farms in Northeast and Northwest [21]; [17]. This is because the geographical climatic condition of Northern Nigeria (Semi-arid/arid) does not favour the spread of CMD as whitefly population is very low unlike in the South humid region. The potentials of the crop has made the government of Nigeria in 2004 to suggest it to be treated as one of the major source of foreign exchange and a food security crop.

However, Akwa Ibom States was chosen for this study due to the intensity of cassava production and, possibly, exchange of the cassava stems among farmers across neighbouring country, such as Cameroun. The cultivation

of CMD-resistant genotype by farmers have led to increase in cassava production in the State (Dixon *et al.*, 2005). Improved cassava varieties planted provided about 590 farmers with the planting stem, which were replanted in 2004 to form another source of planting materials for 2005. The improved cassava varieties were planted by the Cassava Development Committee (CDC) in 2005 for stem multiplication at Ube/Obufi and Ebighi in Okobo Local Government Areas of the State. Nine hundred and twenty five hectares have been cultivated through farmer to farmer transfer within the State and the overall hectares of improved cassava varieties cultivated within the State are about 785 hectares [1]. Presidential initiative of Cassava Enterprise Development Project (CEDP) was being made to enhance its processing, encourage its trade, market its products, as well as encourage the adoption of the CMD-resistant varieties. Since these varieties were introduced in 2002, and adopted by farmers in Akwa Ibom State, few studies have evaluated the cassava farmers' performances economically, in terms of cassava varieties produced. Thus, this study of comparative economic analysis of CMD-resistant varieties and NRV production in Akwa Ibom State becomes very necessary.

### Problem Statement

Introduction of CMD-resistant varieties in 2002 has boosted the crop yield substantially, although still inadequate in supply relative to demand [2]. Some farmers have adopted the new varieties, while many have not due to lack of information on the economic advantage and profitability of the new varieties. The presence of CMD is a problem to the farmers and manifests in chlorosis of the cassava leaf blade, reduction, twisted and yellowish leaves with bright areas separated by normally green areas [11]. The disease causes reduction in yield to about 20 to 30% and the cultivation of the susceptible cassava genotypes can lead to greater losses of about 90 to 100% [9]. Perfect control of CMD is said to be rare, but its economic control may be possible if the increase in yield is greater than the cost of production through planting of healthy cassava stock, using disease-resistant varieties, adopting protective measures, immunizing, eradicating diseased plants, and avoiding infested stock. However, most farmers in Akwa Ibom State are yet to become fully aware of the potentials of the CMD-resistant varieties and adoption benefits. Although, certain improved production techniques and CMD-resistant varieties have been adopted by farmers, the desired level of the crop's productivity is yet to be achieved. This may be due to high cost of production,

insufficient planting materials, or none evaluation of the outcome of the production. This study is to provide the needed statistical information on cassava production, processing and distribution, based on such research questions as; What are the socio-economic characteristics of farmers growing CMD-resistant varieties and NRV in the study area?; What is the relationship these characteristics and their income?; What are the costs and returns of CMD-resistant varieties and NRV production?; What is the input-output relationship for the crops, the resource use efficiency and constraints faced by both farmers in their production?

### Objectives and Justification of the Study

The aim of this study was to carry out a comparative economic analysis of CMD-resistant varieties and NRV production in Akwa Ibom State of Nigeria. The objectives were to: describe the socio-economic characteristics of farmers growing CMD-resistant varieties and NRV in the study area, determine the relationship between farmers' socio-economic characteristics and their income, estimate the costs and returns of production of CMD-resistant varieties and non-resistant varieties, determine the input-output relationship for the CMD-resistant varieties and NRV, evaluate the resource use efficiency in CMD-resistant varieties and non-resistant varieties production, and identify constraints faced by both farmers in their production. Cassava is the most important singular staple food crop in every home in Akwa Ibom State of Nigeria, supplying about 70% of the daily calorie intake, and recently, the second most important cash crop after palm oil [3]. It provides most of the dietary intake of carbohydrate of the average population of southern Nigerians. It is one of the major staple food crops produced at a range of 0.5 to 1.0 tonnes per hectare from the local varieties [2]. This quantity is yet to meet the high demand for the crop within the State and is thus substituted with other food crops like yam, cocoyam, and plantain.

The nature and harvesting duration of cassava enables it to act as famine reserve crop and is invaluable in managing labour schedules. It is flexible for resource-poor farmers as it serves as both subsistence and cash crop as well as gives the highest yield of food energy per cultivated farmland area per day among crop plants. Research studies have not shown clearly, the comparative economic analysis of CMD-resistant varieties and NRV production in the State. However, it is expected that the findings of this study will be found useful to agricultural students in providing useful academic information for their studies. Researchers will

find the information to be a relevant feedback for further studies. Policy-makers will be guided in agricultural policy formulation that will contribute to the sector's development, while investors will be able to backup their decisions on cassava production with reliable data provided by this study. The information from this study will also help stimulate more production of either CMD-resistant varieties or NRV by the resource-poor, small-scale farmers in the agricultural sector.

**Hypotheses:-** There is no significant relationship between farmers' socio-economic characteristics and the incomes of CMD-resistant and NRV farmers. Also, there is no significant difference between the mean incomes of CMD-resistant varieties' farmers and NRV farmers.

## II. MATERIALS AND METHODS

### 2.1. Study Area

The study was carried out in Akwa Ibom State of Nigeria in the South-South geo-political zone as it is involved in massive production of cassava. The State is about 7,245,935 square metres in land area [7], and is divided into 31 Local Government Areas (LGAs) and 3 Senatorial Zones, with a population of about 5,304,318 people as at 2009, based on the 2006 population estimate of 4.8 million people at 2.5% growth rate. It has a temperature that varies between 28°C and 30°C, and a relative humidity that varies between 63% in December to February and 79% from June to September [7]. It is located between longitudes 7°35' and 8°25' East and latitudes 4°33' and 5°33' North of the Equator. The State lies within the humid rainfall zones of Nigeria, has a relief of gently undulating plains with sandy, loamy, deep and well drained soil derived from alluvium and coastal deposits. It has rain forest mangrove vegetation, and shares boundaries with 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 make up the major ethnic groups of the State. These people are mostly Christians of various denominations. Eighty percent of the rural people are farmers and cassava is the major agricultural crop of the people in all the 31 LGAs of the State. The remaining twenty percent are made up of white and blue-collar workers, fishermen, traders, artisans and transporters. There are about 0.8 million registered cassava farmers in Akwa Ibom State, according to [3]. Some of these farmers also cultivate other crops such as maize, plantain, yam, cocoyam, vegetables, and swamp-rice, but in a smaller quantity. Mixed cropping, both in compound and farmland environments are practised in the State. Every

household processes the cassava for consumption or for sale as *garri*, chips, pellets and *fufu*. The people also keep some domestic animals such as goat, sheep, pig, chicken and turkey. Head carriage, and use of bicycles, motorcycles, pick-up vans, cars, truck and wheel-barrow are the major means of transportation for the people and their produce.

## 2.2. Method of Data Collection

Only Primary data was used for the study. Primary data was collected with the help of interview method using structured questionnaire with the assistance of the extension staff of Akwa Ibom State Agricultural Development Project, on the socio-economic characteristics of the cassava farmers and their production variables. These socio-economic variables included age, educational status, years of cassava farming experience, household size, farm-size, number of contact with extension agents and membership of cooperative societies. The production variables included quantity and cost of planting materials, quantity and cost of fertilizers, cost of labour, quantity and value of the cassava output, and problems that both CMD-resistant and non-CMD-resistant varieties' farmers face in the course of their production.

## 2.3. Analytical Techniques

### 2.3.1. Descriptive statistics

These include means, ratios, percentages and frequency distributions and were used to achieve objectives i, ii, and v.

### 2.3.2. Gross margin analysis

This was used to partially achieve objectives iii. It is the evaluation of the efficiency and profitability of an individual farm enterprise or farm plan that enables one to compare different farm enterprises or farm plans. [19] refer to Gross Margin (GM) as a very useful tool in a situation where fixed capital is a negligible portion of the farm enterprise. The formula is:

$$GM = GI - TVC \quad (1)$$

Where: GM refers to the gross margin (₦/ha); GI refers to gross farm income (₦/ha) and TVC refers to total variable cost (₦/ha).

### 2.3.3. Net farm income analysis

This was used to also achieve objective (iii) of the study. According to [19]. It is expressed as :

$$NFI = GFI - TVC - TFC \quad (2)$$

Where: NFI refers to net farm income (₦/ha); GFI refers to gross farm income (₦/ha); TVC refers to total variable cost (₦/ha) and TFC refers to the cost of fixed input (₦/ha for cutlasses, hoes, axes and rakes). Straight-lie depreciation

method was used to estimate depreciation value for the fixed assets used for the farming activities and the assets are hoe, cutlass, axe and rake.

### 2.3.4. Regression analysis

Ordinary Least Square technique (OLS) was used to treat objective (ii), the model in the simplified form is thus expressed as;

$$Y = f(X_1, X_2, X_3, X_4, U) \quad (3)$$

Where:  $Y_1 = a + \beta X_1$

$Y_1$  refers to Income (Naira);  $X_i$  refers to the socio-economic characteristics of  $i^{\text{th}}$  individual;  $\beta$  refers to the regression coefficient; and  $a$  refers to the constant term. For this study  $Y_1$  is explicitly expressed as:

$$Y_1 = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + U \quad (4)$$

Where: -

$Y_1$  refers to the income (Naira),  $X_1$  is the age of the farmer (expressed in the number of years);  $X_2$  refers to farming experience of farmers (expressed in years);  $X_3$  refers to the educational level (number of years spent in a formal school);  $X_4$  refers to household size (number of persons in the household);  $X_5$  refers to membership status in an association. (Years) ;  $X_6$  refers to extension contact (number of visits to, and received from an extension officer);  $X_7$  refers to the farm size (hectares cultivated per season);  $X_8$  refers to the amount of credit obtained (Naira) and  $U$  is the disturbance term. The socio-economic data collected were fitted into the linear functional form expressed thus;

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + U$$

Linear

### 2.3.5. Production function analysis

This was used to achieve objective (iv) of the study. The production function establishes the physical or technical relationship between inputs and output in any production process [19]. Researchers have estimated production function with such equations as linear, quadratic, Cobb-Douglas, Spillman, semi-log, square-root and exponential. Production Function for this study is expressed in implicit form as:

$$Y = f(X_1, X_2, X_3, X_4, U) \quad (5)$$

Where;  $Y$  refers to the output (Kg/ha);  $X_1$  refers to the farm size (ha);  $X_2$  refers to the quantity of cassava stem(Kg/ha) ;  $X_3$  refers to the quantity of fertilizer used (Kg/ha);  $X_4$  refers to units of labour used (manday/ha); and  $U$  is the error term. Data collected were fitted into these three functional forms and the best fitted equation selected for further analysis, based on the magnitude of co-efficient

of multiple determination ( $R^2$ ), signs of regression co-efficient, significance of *t-values* and *F-values*. The three functional forms are expression as;

$$Y = a + b_1 X_1 + b_2 X_2 + b_n X_n + e$$

Linear

$$Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_n \ln X_n + e$$

Semi-log

$$\ln Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_n \ln X_n + e \quad \text{Double Log}$$

Log

Where;  $b_1 - b_n$  refers to the regression co-efficient of inputs  $X_1 - X_n$ ;  $a$  refers to the constant;  $\ln$  refers to the log, and  $e$  is the error term

### 2.3.6. Estimation of resource use efficiency

This was used to achieve objective (v) of the study, and is computed thus;

$$r = \frac{\text{Marginal Value Product}}{\text{Marginal Factor Cost}} = \frac{MVP}{MFC} \quad \text{--} \quad (6)$$

Where:  $r$  refers to the efficiency ratio; MVP refers to the marginal value product; and MFC refers to the marginal factor cost. However, when:  $r = 1$ , it implies efficiency in resource use; and when  $r > 1$ , it implies under-utilization in resource use;  $r < 1$ , it implies Over-utilization in resource use, Where:  $=$ ,  $>$ ,  $<$ , refer to: equal to, greater than, and less than, respectively

### 2.3.7 Specification of hypothesis testing, using mean incomes and z-test

This was also used to achieve objective (iii) of the study. It involved carrying out a Z-test of the mean incomes of the CMD-resistant varieties' producers and non-CMD-resistant varieties' producers. The mean incomes were tested for significance at 1%. 5% and 10% levels of probability. If the

calculated Z-value was greater than tabulated Z-value, it means that there is a significant difference between the mean output, income and profit of CMD-resistant varieties' farmers and non-CMD-resistant varieties' farmers. The formula is:-

$$Z - test = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad (7)$$

Where:  $Z$  refers to the Z-test value;  $\bar{X}_1$  refers to the mean incomes of those who produced CMD-resistant varieties;  $\bar{X}_2$  refers to the mean incomes of those who did not produce CMD-resistant varieties;  $S_1^2$  and  $S_2^2$  refer to standard deviations for the two groups (CMD-resistant varieties and non-producers); and  $n_1$  and  $n_2$  refer to the sample sizes for the two different groups

## III. RESULTS

### 3.1. Socio-economic Characteristics of Respondents

The socio-economic characteristics of the sampled cassava farmers analyzed included among others, gender, age, marital status, educational level, household size, cassava farming experience, number of extension contact, sources of farm labour, farm size, method of farm-land acquisition, reason for preference of particular cassava varieties, sources of non-farm income and other crops grown by the sampled farmers. Majority (63%) of the CMD-resistant and non-resistant varieties (60%) farmers were found to be male, while 38% of the CMD-resistant and 40% non-resistant varieties farmers were found to be female as shown in Table 1.

Table.1: Gender and age distribution of respondents

Variable	MD-resistant varieties Farmers		Non-CMD-resistant varieties farmers	
	Frequency	Percentage	Frequency	Percentage
Male	50	62.5	48	60
Female	30	37.5	32	40
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>
Age	16	20.00	0	0
Less than30	33	41.25	8	10.0
31 – 40	18	22.50	34	42.5
41 – 50	13	16.25	38	47.5
51 and above				
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>

The Table also revealed that the highest number (41%) of the CMD-resistant varieties farmers was found to be within the active age bracket of 31-40 years old. This indicates

that most of the farmers were young and were likely to be more receptive to innovation and energetic for increased production, [20]. However, the highest population of the

non-CMD-resistant varieties farmers (48%) was found to fall within the age bracket of 51 years old and above, which indicates that they were much older, less active and are likely to be less receptive to innovation, and more conservative.

However, according to Table 2, over 80% of the CMD-resistant varieties and 78% non-resistant varieties farmers respectively were found to be married. Eleven percent, 1% and 8% of the CMD-resistant varieties farmers were single, divorced and widowed, respectively. However, none of the non-resistant varieties farmers were single, but 6% and 16% were divorced and widowed respectively. These

indicate that both farmers were able to rely on family support in their farm work, since family is known to play critical role in provision of labour for farm work in the State, . [20].

The results also showed the CMD-resistant varieties farmers, which is 3%, to have formal education, while on the other hand, among the non-resistant varieties' farmers, the highest percentage (48%) of them also had no formal education.. This is in line with the findings of [23]. who agreed that education significantly enhance farmer's ability to make accurate and meaningful management decision as he is able to read and interpret the recommended practices.

Table.2: Distribution of Farmers According to Marital Status and Educational Level

Variable	CMD-resistant varieties Farmers		Non-resistant varieties Farmers	
	Frequency	Percentage	Frequency	Percentage
<b>Marital Status:</b>				
Married	64	80	62	77.5
Single	9	11.25	0	0
Divorced	1	1.25	5	6.25
Widowed	6	7.5	13	16.25
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>
<b>Educational Level:</b>				
No Formal Education	2	2.5	38	47.5
Primary Education	33	41.25	32	40
Secondary Education	39	48.75	10	12.5
Diploma and above	6	7.5	0	0
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>

Household Size of the farmers, was measured by adding up the number of wives, children, relatives and dependents actually living with the respondents as at the time of the survey. This information is important since agriculture in the study area is traditional and the primary source of cheap labour for farm work is the farmer's household. Table 3 indicates majority (51%) of the CMD-resistant varieties farmers to have household sizes of less than 5 members.

Non-resistant varieties farmers, rather, had most of their members (41%) having between 6 and 10 household members,. Large households adopt fewer innovations, due to insufficient financial resources to acquire modern inputs after the other commitments of the family have been taken care of. Thus, innovative farmers tend to have smaller families.

Table.3: Distribution of Respondents According to Household Size and Years of Cassava Farming Experience

Variable	CMD-resistant varieties Farmers		Non-resistant varieties Farmers	
	Frequency	Percentage	Frequency	Percentage
<b>Household Size:</b>				
Less than 5	41	51.25	24	30.00
6-10	25	31.25	33	41.25
11 and above	14	17.5	23	28.75
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>
<b>Farming Experience</b>				

Less than 10	25	31.25	12	15.00
11-20	37	46.25	15	18.75
21-30	15	18.75	23	28.75
More than 31 years	3	3.75	30	37.5
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>

The Table also indicates majority (46%) of the CMD-resistant varieties farmers to have between 11 and 20 years of cassava farming experience, while non-resistant varieties farmers, on the other hand, had the largest percentage (38%) that had more than 31 years of cassava farming experiences. Most (38%) of the CMD-resistant varieties farmers had up to 3 times visits from extension officers or contacts during their cassava production period, while the highest population (50%) of the non-resistant varieties farmers reported to have had only a single contact with the extension officers, and the least population (15%) indicated

to have had up to 3 times contacts, as shown in Table 4. This may have contributed to their non-production of the improved cassava varieties due to insufficient information from less extension contact. The highest proportion of the farmers, 64% and 58% of CMD-resistant varieties and non-resistant varieties farmers according to Table 4 employed both family and hired labour respectively. It has been argued that availability of family labour influences the adoption of new practices positively as it reduces the labour constraints faced by the farmers. However, farm size determines the scale of production in agriculture.

*Table.4: Distribution of respondents according to number of extension contact and sources of farm- labour*

Variable	CMD-resistant varieties Farmers		Non-CMD-resistant varieties Farmers	
	Frequency	Percentage	Frequency	Percentage
<b>Extension Contact:</b>				
1	0	0	40	50.00
2	23	28.75	28	35.00
3	30	37.50	12	15.00
4	27	33.75	0	00.00
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>
<b>Source of Labour</b>				
Family	17	21.0	30	37.5
Hired Labour	12	15.0	4	5.0
Both family and hired labour	51	64.0	46	57.5
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>

The study also showed that 43% of the CMD-resistant varieties farmers cultivated cassava on less than 1 hectare of land, as shown in the Table 5. Similarly, 53% of the non-resistant varieties producers cultivated less than 1.0 hectare of cassava farm lands, while, 31%, 11% and 5% of

them cultivated their non-improved cassava varieties on 1.1 – 2.0, 2.1 – 3.0 and 3.1 hectares and above, respectively. This implies small-scale farming on less than 2.0 hectares of farm land.

*Table.5: Distribution of the farmers according to farm sizes and method of land acquisition*

Farm size (ha)	CMD-resistant varieties Farmers		Non-resistant varieties Farmers	
	Frequency	Percentage	Frequency	Percentage
Less than 1.0	34	42.5	42	52.5
1.1 – 2.0	31	38.75	25	31.25
2.1 – 3.0	11	13.75	9	11.25
3.1 and above	4	5.0	4	5.0

TOTAL	80	100	80	100
<b>Method of Land Acquisition:</b>				
Inheritance	60	75.0	62	77.5
Purchase	14	17.5	16	20.0
Rent	6	7.5	2	2.5
<b>TOTAL</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>

Method of land acquisition revealed in Table 5, that about 75% and 78% of the CMD-resistant and non-CMD-resistant varieties farmers respectively, acquired their lands through inheritance. The least form of land acquisition was by rent, by 8% CMD-resistant and 3% non-CMD-resistant varieties farmers. This implied that farmers were restricted in terms of farm size due to land fragmentation, and those who have large farms were in bits and scattered in different locations. These impede easy access to more farm land for expansion and mechanization. Most of the CMD-resistant varieties farmers (71%) gave high yield of the improved varieties as the main reason for their adoption of the

varieties. However, twenty percent of CMD-resistant and 31% of non-resistant varieties farmers gave high starch content, as their reasons for cultivating the improved varieties (Table 6). Forty-five percent of the non-resistant varieties farmers indicated that they preferred the local varieties because these tend to last longer on the farm. None of the non-resistant indicated high yield as a reason for their choice of their varieties. Experienced farmers have learnt over the years not to rely solely on any one agricultural activity for economic survival. Thus, they tend to generate additional incomes from other sources.

Table.6: Distribution of the respondents according to reasons for their choices of cassava varieties and sources of non-farm income

Reasons for Preference	CMD-resistant varieties Farmers		Non-resistant Varieties Farmers	
	Frequency	Percentage	Frequency	Percentage
High Yield	57	71.25	0	0
High Starch Content	16	20.0	25	31.25
Better Taste	3	3.75	19	23.75
Matures Early	4	5.0	0	0
Last Longer in farm	0	0	36	45.0
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>
<b>Sources of Non-Farm Income</b>				
Artisan	13	16.25	26	32.5
Manual-Labour	10	12.5	8	10.0
Transportation	10	12.5	5	6.25
Salaried work	18	22.5	6	7.5
Tailoring	16	20.0	11	13.75
Petty trade	13	16.25	16	20.0
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>

The results in Table .6 also shows that the highest percentage (23%) of the CMD-resistant varieties farmers earned non-farm income through salaried works, while, the greatest population (33%) of the non-resistant varieties farmers earned their non-farm incomes through artisan

work. Meanwhile, Table 7 indicated majority (40%) of the CMD-resistant varieties farmers to have earned between ₦21,000 and ₦40,000 average annual income from their non-farm activities. The highest percentage (43%) of the non-CMD-resistant varieties farmers, too, earned average



annual non-farm income of less than ₦20,000. These non-farm incomes are important since they act as financial security against risk.

Table.7: Distribution of the respondents according to average amount of non-farm income per annum

Average Amount of Non-Farm Income (Naira)	CMD-resistant varieties Farmers		Non-CMD-resistant varieties Farmers	
	Frequency	Percentage	Frequency	Percentage
Less than 20,000	21	26.25	34	42.5
21,000 – 40,000	32	40.00	23	28.75
41,000 – 60,000	15	18.75	12	15.00
61,000 and above	12	15.0	11	13.75
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>

Farmers in the study area practiced mixed cropping. A proportion (33%) of both CMD-resistant and non-resistant varieties farmers (33%) were sole cassava producers. Twenty-five percent, 9%, 5%, 11% and 18% of the improved varieties farmers produced maize, yam, plantain, vegetables and palm fruit respectively alongside the cassava as shown in Table 8. Similarly, 13%, 23%, 8%,

15% and 10% of the non-CMD-resistant varieties farmers combined their local cassava varieties production with maize, yam, plantain, vegetables and palm fruit, respectively. The farmers practiced mixed cropping as a way of diversification so as to increase their revenue, food supply and insurance bases, in case of poor yield from cassava production.

Table.8: Distribution of farmers according to cropping system

Cassava/Other Crop Produced	CMD-resistant varieties Farmers		Non-CMD-resistant varieties Farmers	
	Frequency	Percentage	Frequency	Percentage
Sole Cassava	26	32.5	26	32.5
Cassava / Maize	20	25.0	10	12.5
Cassava/ Yam	7	8.75	18	22.5
Cassava/ Plantain	4	5.0	6	7.5
Cassava/ Vegetables	9	11.25	12	15.0
Cassava/ Palm Fruit	14	17.5	8	10.0
<b>Total</b>	<b>80</b>	<b>100</b>	<b>80</b>	<b>100</b>

Table 9 contains the result of the relationship between CMD and non-CMD-resistant varieties farmers' socio-economic characteristics and their income. The linear form of the regression analysis was found to be the best in explaining the relationship for both groups of farmers. The  $R^2$  was about 0.8354 for CMD and 0.6696 for non-CMD-resistant varieties farmers, which indicate that 84% and 67% of the variability in the incomes of CMD and non-resistant varieties farmers respectively was explained by the socio-economic characteristics. The F-values of 45.03 and 17.73 were significant at one percent level of

probability, and indicated the overall statistical significances of the regression equations of both varieties as all the variables jointly determined the incomes of both farmers. Five, out of the eight socio-economic variables in the regression equation were found to be statistically significant at 10%, 5% and 1% levels of probability for the CMD-resistant varieties farmers, while four of the socio-economic variables were found to be statistically significant at 5% and 1% levels of probability for the non-resistant varieties farmers.

Table.9: Socio-economic Determinants of Income of CMD-resistant and Non-resistant Varieties Farmers in the Study Area.

Variables		CMD-resistant Varieties Farmers		Non-resistant varieties Farmers	
		Linear	t-value	Linear	t-value
Age	(X <sub>1</sub> )	-0.0388663 (0.0679821)	-0.57	0.0439739 <sup>NS</sup> (0.0871843)	0.50
Farming Experience	(X <sub>2</sub> )	0.1428501* (0.0661088)	2.16	0.0023414 <sup>NS</sup> (0.0631227)	0.04
Educational Level	(X <sub>3</sub> )	0.1833944** (0.110422)	1.66	-0.3611233*** (0.1001117)	3.61
Household Size	(X <sub>4</sub> )	0.0906855** (0.055296)	1.64	0.4219649*** (0.1443919)	2.93
Yrs of membership Of Association	(X <sub>5</sub> )	-0.0925512 (0.1635484)	-0.57	0.9842953** (0.3937395)	2.50
No. Extension Contact	(X <sub>6</sub> )	0.2733607*** (0.0628415)	4.35	-0.3065236 <sup>NS</sup> (0.5649307)	-0.54
Farm Size	(X <sub>7</sub> )	6.563861*** (0.4999238)	13.13	2.701899*** (0.5004699)	5.40
Amount of Credit	(X <sub>8</sub> )	-0.000031 <sup>NS</sup> (0.0000239)	1.30	0.0000147 <sup>NS</sup> (0.0000233)	0.63
Constant	(a)	7.0255*** (2.467453)	2.85	-4.976575 <sup>NS</sup> (4.262384)	-1.17
R <sup>2</sup>		0.8354		0.6696	
R <sup>2</sup> - adjusted		0.8168		0.6318	
F value		45.03***		17.73***	

\*\*\*, \*\*, \* = Significant at 1%, 5%, 1% levels of probability ; <sup>NS</sup> = Not Significance.

Values of Standard Error are in parenthesis

Farming experience had positive co-efficient and was significant at 10% level of probability for the CMD farmers but was not significant for the non-CMD farmers. This implied that farming experience had a direct effect on the income of CMD-resistant varieties farmers, as the positive sign suggests that increase in farming experience led to increase in the production and thus, income of CMD-resistant varieties farmers. This is consistent with the findings of [20], who found farming experience to be the main determinants of production efficiency and better income.

Educational level had positive coefficient that is significant at 5% level of probability for CMD but negative coefficient that is significant at 1% level of probability for non-CMD farmers. These indicate a positive relationship with the incomes of CMD-resistant varieties farmers and negative relationship with the incomes of non-CMD farmers. The implication is that the more educated the CMD farmer is, the more his income, since he is more knowledgeable in better production techniques. On the other hand, the more

educated the non-CMD farmer is, the less he is likely going to continue to produce the non-resistant varieties thus, the less his income. This is consistent with the findings of [23], who confirmed from their various studies that education was a predetermining factor in information assimilation and technological adoption among farmers of diverse socio-economic environment. The coefficient of household size was found to be positive as expected and significant at 5% and 1% levels of probability for CMD and non-CMD farmers respectively. This positive sign indicates that the higher the size, the higher the incomes of both farmers, since the assumption is that the more the number of members of the household in a subsistence set-up, the more the availability of cheap and ready family labour and thus, the more the output and income [20]. Family labour availability stimulates increase in production activities as labour constraint is reduced

Farm size also had positive coefficients and was significant at 1% level of probability for both groups of farmers. These indicate positive relationships with the incomes of the

farmers and the implication is that the larger the farm size, the more the farm area cultivated and thus, the more the incomes of both farmers. However, the coefficient of number of extension contact was also found to be positive and significant at 1% level of probability for only CMD farmers. This implied that more contact with extension agencies enhanced information acquisition which encouraged investment in the CMD-resistant varieties production for a more rewarding income. However, based on this, therefore, the hypothesis that there is no significant relationship between farmers' socio-economic characteristics and their income from the production of CMD-resistant varieties and non-resistant varieties was rejected since all the variables' coefficients were statistically different from zero.

### 3.3. Costs and Returns of Cassava Production

The average costs and returns of cassava production for both the CMD-resistant and non-resistant varieties are as presented in Table 10. The CMD-resistant varieties farmers utilized about 21,000Kg of cassava stem cuttings, 225Kg of fertilizer and 205 man-days per 1hectare of farmland, and thus incurred about ₦66,750 Total Variable Cost (TVC). The non-resistant varieties farmers, on the other hand, utilized about 21,000Kg of cassava stem cuttings, 123Kg of fertilizer and 230 man-days per 1hectare of farmland, and thus incurred a Total Variable Cost of about ₦74,450. The farm land of CMD farmers was valued at ₦8,000 per

hectare according to the prevailing rent value, while that of the non-CMD farmers was valued at ₦8,500 per hectare. Farm tools/implements were depreciated using the straight line method, and valued at market price of ₦10,400 for CMD farmers and ₦8,500 for non-CMD farmers. The CMD farmers were able to produce about 12,440Kg of cassava tubers valued at ₦99,520 at the rate of ₦8/Kg and 665 bundles of cassava stem valued at ₦66,500, at the rate of ₦100/bundle and thus, generated about ₦166,020 Total Revenue, a Gross Margin of ₦99,270, and Net Farm Income of ₦91,270. The non-CMD farmers on the other hand were able to produce about 8,165Kg of cassava tubers valued at ₦65,320 (at the rate of ₦8.00/Kg) and 588 bundles of cassava stem valued at ₦58,800 (at the rate of ₦100/bundle), to generate a Total Revenue of about ₦124,120, a Gross Margin of ₦49,670, and a Net Farm Income of ₦41,170. The CMD farmers were able to get an Average Rate of Return of 2.49 against 1.67 ARR of the non-CMD farmers. This 2.49 ARR meant that to every ₦1 spent by the CMD farmers a return of ₦2.49 was made, whereas, to every ₦1 spent by the non-CMD farmers a return of ₦1.67 which is less was made. In comparison therefore, the production of CMD-resistant varieties is more profitable than that of the non-resistant varieties since there was a better response of output to input in CMD-resistant varieties production than that of the non-resistant varieties.

Table.10: Costs and Returns of Cassava Production of CMD-resistant and Non-resistant Varieties.

Categories	CMD-resistant Varieties Production			Non-resistant Varieties Production		
	Quantity	Cost/ Value	%	Quantity	Cost/ Value	%
<b>A Inputs/Costs:</b>						
I Variable Inputs:		(₦)			(₦)	
Cassava-stem cuttings(Kg)	21,000	7,000	8.00	2,100	4,800	4.80
Fertilizer (Kg)	225	6,750	7.71	123	7,500	7.51
Labour (man-day):	(205)			(230)		
Family labour	100	30,000	34.29	121	36,300	45.65
Hired labour	105	36,750	50.00	109	38,150	42.04
Farm Size (ha)	1	0	0	1	0	0
<b>a Total Variable Cost (TVC)</b>		<b>66,750</b>	<b>100</b>		<b>74,450</b>	<b>100</b>
2 Fixed Inputs:						
Farm land (Rent)	1ha	8,000		1ha	8,500	
<b>b Total Fixed Cost (TFC)</b>		<b>8,000</b>			<b>8,500</b>	
<b>Total Cost (TC=a+b)</b>		<b>74,750</b>			<b>82,950</b>	
<b>B Outputs/Revenue:</b>						

Tubers (Kg)	12,440	99,520	8,165	65,320
Stem (Bundles)	665	66,500	588	58,800
<b>C Total Revenue (Naira)</b>		<b>166,020</b>		<b>124,120</b>
<b>Gross Margin (C - a)</b>		<b>99,270</b>		<b>49,670</b>
<b>Net Farm Income(C-b)</b>		<b>91,270</b>		<b>41,170</b>
<b>Average Rate of Return</b>	<b>(TR/TVC</b>	<b>2.49</b>		<b>1.67</b>
	<b>)</b>			

### 3.3.1. Statistical difference between the mean incomes of both cassava farmers

The mean incomes of the CMD-resistant varieties farmers and that of non-resistant varieties' farmers were tested using the Z-test as shown in Table 11. This was necessary to achieve the second hypothesis, which states that 'there is no significant difference between the mean incomes of CMD-resistant varieties' farmers and non-resistant varieties farmers'. The CMD-resistant varieties farmers mean income was estimated to be ₦166,020 and that of the non-CMD-resistant varieties farmers was ₦124,120. The Z

- calculated was found to be 3.5271 at 1% level of significance. This is greater than the tabulated (1.96), meaning that, there is a significant difference between the mean incomes of the CMD-resistant varieties and non-CMD-resistant varieties' production. The coefficient of variation of the mean incomes of the two groups of farmers was found to be 34%. The hypothesis that there is no significant difference between the mean incomes of CMD-resistant varieties' producers and non-CMD producers is thus rejected.

Table.11: Test of Statistical Difference in Income of the Cassava Farmers Using the Z-Test.

Group	Mean Income	Standard Deviation	Standard Error	Z-Calculated	Z-table	Sign.
CMD-resistant varieties Farmers	166,020	65134.60	7,636.2	3.5271	1.96	0.006***
Non-CMD-resistant varieties Farmers	124,120	32067.30				
Difference	41,900					
<b>Co-efficient of Variation (%)</b>	<b>33.76</b>					

\*\*\* = Significant at 1% level of probability

### 3.4. Input-output Relationships for the Production of CMD-resistant and Non-resistant Varieties

According to Table 12, the input-output relationships for the production of both the CMD-resistant and non-resistant varieties were best explained by the double-log forms of the production model. The R<sup>2</sup> for the CMD and non-CMD farmers were 0.831 and 0.634 respectively, which meant that about 83% and 63% of the variability in the incomes of CMD and non-resistant varieties respectively was explained by the input variables. The F-value of 92.02 and 32.43 for CMD and non-CMD respectively were significant at 1% level of probability, which indicate that the independent input variables included in the models

were important in explaining the variations in the incomes of the farmers. All the variables, such as stem-cutting, fertilizer, labour, and farm size had positive coefficients but only fertilizer and farm size were statistically significant at 1% and 5% levels of probability respectively for the CMD farmers, whereas, for the non-CMD farmers fertilizer, labour and farm size had positive coefficients and were significant at 1% level of probability. The quantity of cassava stem cuttings indicated a positive relationship for CMD farmers and negative for non-CMD farmers but was not significant. The possible explanation here is that increases in the quantity of fertilizer, labour and farm size increase the farmers' incomes.

Table.12: Production Function Result for Cassava Production.

Variables	CMD-resistant Varieties	Non-resistant Varieties
	Double-log	Double-log
Constant	2.270*** (0.423)	3.926*** (0.644)
Stem X <sub>1</sub>	0.008 (0.067)	-0.100 (0.114)
Fert. X <sub>2</sub>	0.689*** (0.057)	0.537*** (0.058)
Labour X <sub>3</sub>	0.172 (0.144)	0.248*** (0.217)
Farm S. X <sub>4</sub>	0.095** (0.129)	0.726*** (0.219)
R <sup>2</sup>	0.831	0.634
R <sup>2</sup> -Adjusted	0.822	0.614
F – Value	92.02***	32.43***

F – Value = Significant at 1% level of probability

### 3.5. Resource Use Efficiency

The results of the calculations of resource use efficiency (Table 13) revealed that the CMD-resistant varieties farmers were efficient in the use of cassava stem cuttings, since the efficiency ratio is equal to 1.00. They, however,

over-utilized fertilizer (0.69) and farm size (0.50), and under-utilized labour (1.15). The non-CMD-resistant varieties farmers, on the other hand, under-utilized cassava stem cuttings (2.5) and farm size (1.60), and over-utilized fertilizer (0.14) and labour (0.84).

Table.13: Estimated Marginal Value Product and Marginal Factor Cost

Production Resources	CMD-resistant Varieties Efficiency			Non-CMD-resistant Varieties Efficiency		
	MVP	MFC	$r = \frac{MVP}{MFC}$	MVP	MFC	$r = \frac{MVP}{MFC}$
Stem (Kg)	29,830	29,830	1.00	29,547	92,400	2.5
Fertilizer (Kg)	52,450	75,900	0.69	4,050	67,500	0.14
Labour (manday)	74,130	64,320	1.15	72,640	86,750	0.84
Farm Size(ha)	500	1,000	0.50	800	500	1.60

### 3.6. Constraints Faced by Farmers in the Production of CMD-resistant and Non-resistant Varieties in the Study Area

Majority (15%) of the CMD-resistant varieties and non-resistant varieties (16%) farmers reported high cost of production as the most important and ranked it as the first constraint in their cassava production (Table 14). This may be due to the low-income, poor and rural background of the cassava farmers. Eleven percent CMD and 15% non-CMD farmers ranked scarcity of the cassava stem cuttings at the peak of planting season as their second constraint.

Ten percent of the CMD farmers ranked difficulties in maintaining the cassava farm in terms of weeding and fertilizer application, and low farm gate price for the cassava outputs as third constraints, while 10% of the non-CMD farmers on the other hand ranked short storage duration and also low farm gate price as their third complaints in their cassava production.. However, nine percent of the CMD farmers ranked the need for the cassava stem to be planted on time for high yield and short storage duration as their fourth constraint, while 9% of the non-CMD farmers too ranked difficulty in maintaining the cassava farm in terms of weeding and insufficient fertilizer

supply as at when needed as their fourth constraints. Eight percent of the CMD farmers ranked difficulty in getting enough CMD cassava stem during planting season and insufficient fertilizer supply as at when needed as the fifth

constraints, while 8% of the non-CMD farmers on the other hand only ranked need for the cassava stem to be planted on time for maximum yield as their fifth constraint.

Table.14: Distribution of CMD-resistant varieties farmers according to the constraints of production of CMD-resistant varieties

S/N.	Constraints	CMD-resistant Varieties			Non-resistant Varieties		
		Freq	%	Rank	Freq.	%	Rank
1	High cost of production	12	15.00	1 <sup>st</sup>	13	16.25	1 <sup>st</sup>
2	The Cassava stem is scarce at the peak of planting season when needed most	9	11.25	2 <sup>nd</sup>	12	15.00	2 <sup>nd</sup>
3	Seen other farmers who plant CMD-resistant varieties fail	3	3.75	8 <sup>th</sup>	5	6.25	6 <sup>th</sup>
4	Needs to be planted on time for maximum yield.	7	8.75	4 <sup>th</sup>	6	7.50	5 <sup>th</sup>
5	It does not stay long in the farm but decays fast after maturity.	7	8.75	4 <sup>th</sup>	8	10.00	3 <sup>rd</sup>
6	Difficult to maintain in terms of weeding and fertilizer application.	8	10.00	3 <sup>rd</sup>	7	8.75	4 <sup>th</sup>
7	Difficult to get enough CMD cassava stem during planting season.	6	7.50	5 <sup>th</sup>	5	6.25	6 <sup>th</sup>
8	Low farm-gate price for output.	8	10.00	3 <sup>rd</sup>	8	10.00	3 <sup>rd</sup>
9	Poor means of transportation of output to the nearest market.	5	6.25	6 <sup>th</sup>	3	3.75	8 <sup>th</sup>
10	Insufficient fertilizer supply as at when needed.	6	7.50	5 <sup>th</sup>	7	8.75	4 <sup>th</sup>
11	Difficult to store/preserve produce after a certain period	5	6.25	6 <sup>th</sup>	4	5.00	7 <sup>th</sup>
12	Lack of financial assistant from the Government.	4	5.00	7 <sup>th</sup>	2	2.50	9 <sup>th</sup>
<b>Total</b>		<b>80</b>	<b>100</b>		<b>80</b>	<b>100</b>	

Six percent of the CMD farmers ranked poor means of transportation of output to the nearest market and difficulty in storing or preserving produce after a certain period as the sixth constraints, whereas their counterpart ranked seeing other farmers who plant CMD-resistant varieties fail, and difficulty in getting enough CMD cassava stem during planting season as their sixth constraints. Five percent of the CMD farmers ranked lack of financial assistant from the Government as the seventh while 5% of the non-CMD farmers ranked difficulty in storing or preserving produce after a certain period as their seventh constraints too. The eight constraints ranked by the farmers were that about 4% of the CMD and non-CMD farmers complained to have seen other farmers who plant CMD-resistant varieties fail,

and poor means of transportation of output to the nearest market, respectively. Only 3% of the CMD farmers rated lack of financial assistant from the Government as their ninth constraints

#### IV. CONCLUSION

Comparative Economic Analysis of Cassava Mosaic Disease-resistant varieties (CMD) and Non-Cassava Mosaic Disease-resistant varieties production in Akwa Ibom State is the main purpose of this study. Respondents were selected with the use of multi-stage sampling procedure and data collected with interview method and well structured questionnaires from 160 respondents.. Descriptive statistical analysis described the socio-

economic characteristics of respondents, while, the Gross Margin Analysis enabled the evaluation of returns to investment of the CMD-resistant and non-CMD-resistant varieties farmers to enable their performances to be compared. Linear form of the regression analysis was found to be the best in explaining the socio-economic determinants of both farmers. Mean incomes and Z-test established the effects of production of the varieties on their incomes.

Majority (63% and 60%), of the respondents were male among the CMD and non-CMD-resistant varieties farmers respectively. But the CMD-resistant varieties farmers were found to be younger (35 years old) than the non-CMD-resistant varieties farmers (45 years old) on the average. Fifty-one percent of the CMD-resistant varieties farmers had house hold size of less than 5, against the majority (70%) of the non-CMD-resistant varieties farmers, who had more than 5 members in their house hold. Both groups of farmers were fully aware of the CMD-resistant varieties. The highest populations (43% CMD and 53% non-CMD) of both farmers produced their cassava on less than 1 hectare of farm land and the mean difference in farm size between the CMD-resistant and non-CMD-resistant varieties were found to be 0.913 and significant at 5% level of probability. Also, majority (75% and 78%) of the CMD-resistant and non-CMD-resistant varieties farmers respectively acquired their farm lands through inheritance. They both earned non-farm incomes within the range of slightly less than N20,000 and N61,000. Majority (76%) of the CMD-resistant varieties farmers had been in cassava production for less than 20 years, while 66% of the non-resistant varieties farmers had been in the cassava production for more than 20 years. The socio-economic determinants of the income of the CMD-resistant-varieties farmers were determined by a regression analysis. The linear form was found to be the best in explaining the relationship, since the magnitude of co-efficient of multiple determinations ( $R^2$ ) was 0.8354 and the F-value was 45.03. These indicate that 84% of the variability in the income of CMD-resistant varieties was determined by the socio-economic characteristics and the statistical significance of the regression of the variables were important in explaining the variations in the income. The coefficients of farming experience, educational level, household size, and farm size were positive and statistically significant at various levels. However, for the non-CMD-resistant varieties the  $R^2$  was about 0.6696, thus indicating that 67% of the variability in the income of the non-CMD-resistant varieties farmers was also determined by their socio-economic characteristics.

The coefficients of household size, years of membership of association and farm size except educational level, positive and statistically significant at various levels too.

Cost and return analysis of the cassava production activities revealed that the CMD-resistant varieties farmers used ₦66,750 Total Variable Cost to generate an Average Revenue of about ₦166,020, a Gross Margin of ₦99,270 and a Net Farm Income of ₦91,270 and Average Rate of Returns of 2.49. The non-CMD-resistant varieties on the other hand, used a Total Variable Cost of about ₦74,450 to generate an estimated income of about ₦124,120, a Gross Margin of ₦49,670, and a Net Farm Income of ₦41,170 at an Average Rate of Returns of 1.67. The Farm Income of the improved varieties farmers increased by ₦50,100 or 121% over that of the non-improved varieties and was significant at 1% level of probability. Also, to every ₦1 spent by the CMD-resistant varieties farmers, a return of ₦2.49 was made, while for their counter-part, only ₦1.67 return was made. The input-output relationship for the CMD and non-CMD-resistant varieties, determined with the production function analyses revealed that the double log forms of the production function were found to give the best fit as the  $R^2$  were 0.831 and 0.634 for CMD and non-CMD-resistant varieties respectively. These meant that 83% and 63% of the farmers' variations in the income of the improved or non-improved cassava varieties were explained by the input and cost variables. Positive signs and significant coefficients of the variables indicated that the production of the CMD-resistant varieties relate with the producers' incomes, while the reverse was the case if the sign or coefficient was negative as is seen in labour for the non-CMD-resistant varieties farmers in the study area. The resource use efficiency analysis revealed that the CMD-resistant varieties farmers were more efficient (1.00) in their cassava stem cutting usage and less efficient in the use of other inputs than the non-CMD-resistant varieties farmers who were inefficient in all their inputs allocation, since the efficiency scores were either less or more than 1.00. The Mean Incomes and Z-test revealed that the value of the Z-calculated (3.6128) was greater than the table Z (1.96) at 1% level of significance. Thus, the null hypotheses which state that 'there is no significant relationship between farmers' socio-economic characteristics and the income of CMD-resistant varieties and non-CMD-resistant varieties farmers and their mean incomes' were all rejected. However, both the CMD-resistant varieties farmers (16%) and non-CMD-resistant varieties farmers (19%) reported high cost of production, scarcity of planting material and low farm gate price for

output as the three major constraints in their cassava production. This may be due to the low-income, poor and rural background of the cassava farmers.

Socio-economic variables such as farming experience, education level, household size and farm size were the major determinants of CMD-resistant varieties' income. The non-CMD-resistant varieties farmers on the other hand, were influenced by their house hold size, membership of an association and farm size. The CMD-resistant varieties farmers earned more net farm income (₦91,270) than the non-CMD-resistant varieties farmers (₦41,170). The mean incomes of both farmers varied at 34%, Z-test indicated the Z-calculated (3.5271) was greater than the Z-tabulated (1.96) and the hypothesis which stated that there is no significant difference between the mean incomes of CMD-resistant and non-resistant varieties farmers was rejected. Fertilizer and farm size were the major inputs that determined the incomes of both farmers positively, while 83% and 63% of the variability in incomes of CMD-resistant and non-resistant varieties farmers respectively were explained by the input variables. The F-values of 92.02 and 32.43 for CMD-resistant and non-resistant varieties farmers respectively indicate that the independent input variables contained in the model were important in explaining the variation in the farmers' incomes. Only the CMD-resistant farmers were efficient in their stem cutting allocation and inefficient in the allocations of other resources, while the non-resistant varieties farmers were inefficient in all their inputs allocations. The most common constraints faced by both farmers in their cassava production were high cost of production, scarcity of planting materials during planting season, short storage duration and low farm-gate price for the cassava output. Based on the findings of the study these recommendations were made:

- Farmers were recommended to produce the CMD-resistant varieties since it is more profitable.
- They should be encouraged to form cooperatives through which extension workers can easily pass down research information to the practicing farmers, distribute the planting materials on time and help them market their produce.
- Cassava farmers should be encouraged to device means of earning more non-farm incomes, and to increase their farm holdings to enable them generate more income.
- Improved cassava stem should be made readily available as at when needed through farmers' co-operatives and associations.

- Occasional trainings should be organized for the farmers on the benefits of innovations, and they should be taught and encouraged to add value to their produce before sale by processing them first.

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