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Production Differential and Resource-Use Efficiency in Cassava Production in Ogun State, Nigeria

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Abstract
This study was focussed to examine production differential and resource use efficiency of traditional and modern farms, small and large scale farms as well as mono and mixed crop cassava farmers in Nigeria, using as a case study farmers in Ogun State, which is one of the highest producers of cassava in the south-west geo-political zone. It considered possible causes of the technical inefficiency The study was necessitated because efforts aimed at increasing cassava output cannot be properly directed unless the current levels of factor productivity and technical efficiency of the farms are known, and likely causes of sub-optimal usage of resources are identified. The study was basically an application of the stochastic frontiers production function to the input-output data collection procedure on selected cassava farmers to estimate the levels of technical efficiency by farm size, technology used, and cropping systems. The finding implied that the current level of output from cassava farms can be increased by about 38% for all farms (aggregate), if all farm inputs are effectively utilized. The cassava output (tonnes/ha) was significantly higher for mono crop and large-scale farmers than in mixed crop and small-scale farmers respectively. Mixed crop farmers who are mainly small holders and who produced other crops in addition to cassava tubers on their farms were however found to be technically more efficient with higher net farm incomes and returns on investment than mono crop and large-scale farmers, respectively ($p \leq 0.05$). It is also recommended that government should intensify efforts to encourage the small-holders to improve upon their production practices. However, in the long run, large scale enterprise cannot be ruled out; so, the impediments to large scale cassava production and the factors which make small scale operation less efficient or productive as compared to the large scale farms should be tackled. Suffice to add that the establishment of large scale farms could ease-off the intensive labour input and thereby making mechanisation more economical.
Keywords: Input, Output, Differential, Production, Resources

Introduction

Cassava (*Manihot spp*) is widely grown in Nigeria and it is one of the most popular food crops cultivated by small scale farmers (Nweke, 1996). In recent years, there is growing realization that given the amount of by-products that can be obtained from industrial processing of cassava tubers, more hectarage would need to be devoted to cultivation of the crop. The popularity of cassava grew further in Nigeria in the last four year with the inauguration of the Presidential Task Force on Cassava Revolution, which promotes cassava cultivation on a commercial scale and process harvested products into various byproducts like cassava flour, cassava chips, ethanol and industrial starch for export. Johnson and Kellog (1989) stated that one of the most important means of accelerating national development in nations with large agricultural sector is the development and adaptation of new agricultural technologies like improved crop cultivars that can be adopted by small scale farmers.

Progress in agricultural development in Nigeria depends to some extent on the willingness and ability of farm families to adopt new farm technologies that are being popularized. Different cassava varieties and several techniques of its production and processing have been developed and disseminated but farmers responses have depended on their perception of benefits derivable from given varieties, socio-cultural suitability and profitability of the production and processing techniques. Despite the release of different cassava varieties in Nigeria, cassava output per hectare of local farmers is still low (Nweke 1996). This can partly be attributed to farmers continued use of local cassava cultivars or landraces based on known characteristics such as colour, texture, taste and adaptability to mixed cropping systems which form bottlenecks to adoption of improved cultivars.

In the 1980's TMS 30395 and TMS 30572 cassava varieties were supplied to farmers, while in the 1990s TMS 4(2) 1425 variety termed high yielding, diseases-resistant with low cyanide acid content and good storability in the field was popularized (IAR&T, 1991). Other improved varieties of cassava are TMS 60506, NR 8082 and NR 8208. Farmers' interpretation of the characteristics of improved cassava varieties in relation to the qualities of what they know about local cassava cultivars may run counter to researcher's information about the improved varieties. Cassava breeders have entrenched traits of high yield, early maturity and disease resistance in the improved varieties but farmers' need borders on the quantity and quality of processed products for marketability purpose. Here, there appears a need gap between the modern technology and farmers' acceptability and efficiency.

Cassava is important, not only as food but even more as a major source of income for rural households.

It is the most widely cultivated crop in the southern part of Nigeria in terms of land area devoted to it and the number of farmers growing it. A survey of cassava – growing areas shows that in more than 90% of the 65 representative villages, the respondents reported an increasing trend in cassava production (Nweke *et al*, 1997). The increase in cassava production activities has been attributed to the increased demand for cassava and cassava products outside the rural communities as well as the realization of the potentials it has for contributing to the attainment of self-sufficiency in food production (Kwatia, 1986).

It has been noted that meeting the demand for cassava and its contribution to food self-sufficiency could be undermined by a number of factors. Amongst them are the low-yield and susceptibility of locally grown varieties to pests and diseases (Olowu *et al*, 1990). In order to avert this situation, research institutions have developed and distributed improved varieties of cassava. Examples of such varieties are the Tropical Manihot Selection (TMS) 30555, 30572, 30211, 50315, 60506 and Umudike (U) 41044. These varieties are known to be high-yielding early maturing and resistant to pest and diseases such as cassava mosaic, cassava bacterial blight, cassava mealy bug and cassava green spider mite (IITA 1997).

The challenge that is currently confronting Nigeria's agriculture is related to the problem of low productivity in production resulting from inefficient use of resources. Nigeria with a population of over 100 million people and about 93 million area of land is predominantly an agrarian country. Although, about 70% of her population is engaged in agriculture, the country is yet not self-sufficient in food production (Obasi and Agu 2000). The reality is that Nigeria has not yet been able to attain self-sufficiency in food production annually. The constraints to the rapid growth of food production seem to be mainly that of low crop yields and resource productivity (Udoh, 2005). This suggests that, there is hope for additional increases in output from cultivated land area, attributed two-third of the increase to world crop production to increase in harvested area. The pressure on available cultivated land and other resources implies that nation may have to rely on improving productivity to attain sustainable agricultural production.

As stated by Eyoh and Igben (2002), that the utilization of land resources is closely guided by the concept of highest and best use, so is labour, capital and management resource necessary to be put to best use for maximum agricultural productivity. Resources are considered to be at its highest and best use when it is put a use with highest comparative advantage to other uses. The present study therefore, is focused on analyzing resource utilization and efficiency in cassava production among cassava farmers under mono-cropping and mixed cropping production systems in Ogun State of Nigeria. The knowledge of the productivity of all farm resources will serve as a guide for adjusting resource allocation within the cassava production industry. Improvement in the level of resource-use by cassava farmers will no doubt have multiple benefits on the economy of Ogun State in particular, and the nation in general.

Objectives of the Study

The broad objective of this study is to examine the production differential and resource-use efficiency in cassava production in Ogun State, Nigeria.

The specific objectives are to:

(i) compare the cropping system and farm size operated in terms of the factor productivity and technical efficiency of farmers in cassava production.

(v) analyse the traditional and modern technology production differential.

Hypotheses of the Study

1(a) There is no difference in the technical efficiency achieved by traditional and modern cassava farmers;

(b) There is no difference in the technical efficiency achieved by smallholder and large holder cassava farmers;

(c) There is no difference in the technical efficiency achieved by mono crop and mixed crop cassava farmers;

2. There is no difference in production function of traditional and modern farms.

METHODOLOGY

The Study Area and Methods of Collection

The empirical setting for the study is Ogun State. Both primary and secondary data were collected for this research. The primary data were gathered from a field survey using structured questionnaire. Specifically, information was sought on the cost-returns structure and input usage for the production of cassava in the study area. In this regard, sets of questionnaire that solicit basic information on cassava production in the study area were administered on respondents. In addition, the secondary data were extracted from published sources such as statistical abstracts, textbooks, journals, research reports, and bulletins obtainable from libraries and government ministries and agencies.

Sampling Techniques

Multi-stage sampling procedure was used in drawing the survey respondents. Ogun State is divided into four Agricultural Divisions namely: Ilaro Zone, Abeokuta Zone, Ikenne Zone and Ijebu Zone. The first stage was to divide the Agricultural Zone into the four existing blocks, while the second stage involved in random selection of two cells from each block and the last stage involved random selection of fifty (50) households making a total of 400 respondents.

Methods of Data Analysis

Descriptive and inferential analytical techniques were used in this study. Descriptive analytical tools used include: frequency tables, percentages and ratio were used to describe the socio-economic characteristics, the cropping system practised by cassava farmers While, Inferential statistics such as the Stochastic Frontier Production Function was used to determined the technical efficiency of the resource used in production and also chow test for examining the production difference of traditional and modern technology farmers in the study area.

Stochastic Frontier Production Function

The Battese and Coelli (1995) model was applied to estimate the efficiency scores and to identify the socio-economic and institutional factors influencing technical efficiencies of cassava producers. In their model the technical inefficiency effect for the i^{th} farmer, U_i, is obtained by truncation (at zero) of the normal distribution with mean, μ, and variance σ^2_u, such that:

$$Ui = Z_i\delta \ldots\ldots \quad \ldots\ldots.. \quad \ldots\ldots. \quad \ldots\ldots \quad \ldots.. \quad (1)$$

Where Z_i is a vector of farm – specific explanatory variables and δ is a vector of unknown coefficients of the farm – specific inefficiency variables. For the investigation of the farm-specific technical efficiencies of cassava producers, the following stochastic frontier production function was estimated.

$$lnY = \beta_0 + \sum_{k=1}^{4} \beta_k \ln(X_{ki}) + \frac{1}{2} \sum_{k=1}^{4} \sum_{j=1}^{4} \beta_{kj} \ln(X_{ji}) + V_i - U_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where Y_i denotes total cassava output of the i^{th} farmer in kg and X_k, k = j = 1, 2, 3, 4 are the four input variables included:

β_1 = Land measures as total area planted to cassava in hectare,

β_2 = Labour, for total family labour, exchange labour and hired labour used in mandays.

β_3= Fertilizer, as the total quantity of fertilizer used in kg; and

β_4 = Capital, the amount of fund available to the households.

The V's are the random variables associated with disturbance in production and the U_i's are non-negative random variables associated with technical inefficiency of the i^{th} farmer and are obtained by truncation (at zero) of the normal distribution with mean, , and variance ^2_u such that:

$$\mu_0 = \delta_0 + \sum_{m=1}^{9} \delta_i X_{mi} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where $_i$ is a vector of the parameters of the inefficiency model to be estimated, and the $X_{m's}$, m = 1, 2, 3 …. 9, are the farm-specific socio-economic variables as well as the institutional factors hypothesized to influence efficiency of resource use by cassava farmers in Ogun State. These are:

δ_o = Intercept (constant)

δ_{1i} = Farm Size measured in hectares

δ_{2i} = Age of the household heads in years

δ_{3i} = No. of Extension visits paid to the farmers

δ_{4i} = Distance to the nearest product/input market from home in minutes.

δ_{5i} = Credit for modern inputs, binary (zero - one) dummy variable.

δ_{6i} = Educational Level of the head of household in years

δ_{7i} = Timely availability of inputs (dummy)

δ_{8i} = Plot ownership (dummy) based on whether the cassava plot was allocated by local administration and thus belonged to the farmer.

δ_{9i} = Plot quality (dummy) based on whether the cassava plot was perceived as fertile by farmers

Chow's Test of Significance

In order to determine if there is any structural shift in production function between the traditional and modern farms in the sample, the following Chow Tests were performed following Johnson(1972), Thamoderan *et al* (1982) and Oyenwaku (1997)

(a) Test for technical change or difference in the production function:

This relates to an overall test of differences in the structural parameters (intercepts and slopes) of the production function of the two categories of farms. The test statistic is $F_{1\alpha/2,v1,v2,}$ while the calculated F, (F_c) is obtained as:

$$F_c = \frac{[\Sigma e_3^2 - \Sigma e_1^2 - \Sigma e_2^2]/[K_3 - K_1 - K_2]}{[\Sigma e_1^2 + \Sigma e_2^2]/[K_1 + K_2]} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .(4)$$

Where:

Σe_1^2 - Error sum of square for traditional farms' production function;
Σe_2^2 - Error sum of square for modern farms' production function;
Σe_3^2 - Error sum of square for the pooled data without a dummy variable;
K_1 - Degree of freedom for the traditional farms' regression;
K_2 - Degree of freedom for the modern farms' regression;
K_3 - Degree of freedom for pooled data;

This statistics is compared against the tabulated F-values, $F_t = F_{0.95,V1V2}$ and we reject the null hypothesis of no structural difference in the production functions of traditional and modern farms if $F_c > F_t$. Otherwise, we fail to reject the null hypothesis.

(b) Test for homogeneity of slopes

This test is central to the use of intercept shifter variables in assessing TFP differences, which is stated earlier requires common slope parameters for all categories of farms. The test statistics is $F_{1-\alpha/2,\ v1,v2}$ which the calculated F, (F_c) is calculated as follows:

$$F_c = \frac{[\Sigma e_4^2 - \Sigma e_1^2 - \Sigma e_2^2]/[K_4 - K_1 - K_2]}{[\Sigma e_1^2 + \Sigma e_2^2]/[K_1 + K_2]} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .(5)$$

Where:

$\Sigma e^2{}_2, \Sigma_e{}^2{}_1$, K_1 and K_2 are as previously defined
Σe_4^2 - Error sum of square for the pooled data with an intercept dummy variable.
K_4 - Degree of freedom for pooled data with an intercept dummy variable

This statistics is also compared against the tabulated F-value,$F_1 = F_{0.95,v1,v2;}$and we reject the null hypothesis of no difference in the slope parameters if F_e>$F_{t..}$ Otherwise, we fail to reject the null hypothesis.

(c) Test for differences in intercepts

This test is of particular relevance to an examination of significant differences of any TFP change reflected in the parameter associated with the intercept shifter variable. The test statistics is $F_{1\alpha/2,v1,v2,}$ while the calculated F, (F_c) is calculated as follows:

$$F_c = \frac{[\Sigma e_3^2 - \Sigma e_4^2]/[K_3 - K_4]}{\Sigma e_4^2/K_4} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .(6)$$

Where:

Σe_3^2, Σe_4^2, K_3 and K_4 as previously defined.

This statistic is also compared against the tabulated F – value, $F_1 = F_{0.95,v1,v2}$; and we reject the null hypothesis of no difference in total factors' productivity of the two categories of farms if $F_c > F_{t.}$ Otherwise, we fail to reject the null hypothesis.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Cassava Farmers

The descriptive statistics and frequency distribution of the farmers according to age and technology used are given in Table 1. For all farm categories, the farmers were aged ranging from 16-76 years old, with overall mean age of about 48 years. It is apparent that most of the farmers are in the active working age bracket of 20-60 years. Result of chi-square test of association between age of the household and technology used was found significant. The results, however, point to the fact that relatively old household heads who are also most likely to have more farming members and experiences, tend to cultivate more cassava farms using modern technology than the younger ones. Sex determines the ability to perform some physical work. The sex distribution of the cassava farmers according to technology used. The table shows that majority of the farmers/head of the families about 82.5% are males while only 17.5% are females. These imply that most of the farms were managed by men as heads of the farm families.

Marital Status of the respondents may determine the level of household size of the respondents which may have implications on the family labour, income composition, consumption and saving pattern. The distribution of respondents according to marital status shows that 72.3% and 66.3% are married among the farmers who used traditional and modern technology respectively. The findings revealed that majority of the respondents were settled family people with expanded households. There is more curiosity to use modern technology because of the increasing need to get more income as the family expands. The findings revealed that the total household sizes ranging from 1 to 15 persons. The respondents with modern technology (51.9%) have 1-5 persons which is the highest modal class. This suggests that as the household increases, the more tendencies for farmers to diversify against risk and make way for increased productivity.

Education is an indispensable tool needed to enhance technical advancement in agricultural production. It enables the farmers to adjust their input combination (especially the improved or modern inputs) towards achieving the economic optimum. However, by implication, only about (14.6%, 13.3% and 13.8%) of traditional and modern farmers and all technology farm holders respectively, are illiterate. The cassava farmers can therefore be regarded to be generally literates. On the average, the farmer had about 21 years of farming experience. The implication is that technology used is not generally determined by the number of the years of farming experiences, rather, is a function of enlightenment, education, awareness, land, labour, and capital.

Table 1: Socio-Economic Characteristics of the Respondents

Variables	Traditional Technology		Modern Technology		All technology	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
<u>Age (years)</u>						
≤ 20	1	0.8	5	1.9	6	1.5
21 - 40	34	26.2	78	28.9	112	28.0
41 – 60	72	55.4	138	51.1	210	52.5
61 – 80	23	17.7	49	18.1	72	18.0
Total	**130**	**100**	**270**	**100**	**400**	**100**
X^2cal = 1.235, df = 3, $p \leq 0.05$ = 0.745 Comment: Significant						
<u>Sex</u>						
Male	105	80.8	225	83.3	330	82.5
Female	25	19.2	45	16.7	70	17.5
Total	**130**	**100**	**270**	**100**	**400**	**100**
X^2cal = 0.400, df = 1, $p \leq 0.05$ = 0.527, Comment: Not Significant						
<u>Marital Status</u>						
Single	14	10.8	30	11.1	44	11.0
Married	94	72.3	179	66.3	273	68.3
Divorced	7	5.4	12	4.4	19	4.8
Separated	11	8.5	30	11.1	41	10.3
Widow/Widower	4	3.1	19	7.0	23	5.8
Total	**130**	**100**	**270**	**100**	**400**	**100**
X^2cal = 3.632, df =4, $p< 0.05$ = 0.458 Comment: Not Significant						
<u>Household Size</u>						
1 – 5	54	41.5	140	51.9	194	48.5
6 – 10	64	49.2	104	38.5	168	42.0
11 – 15	12	9.2	26	9.6	38	9.5
Total	**130**	**100**	**270**	**100**	**400**	**100**
X^2cal =4.337, df = 2, $p< 0.05$ = 0.114 Comment: Not Significant						
<u>Educational Level</u>						
No formal Educ.	19	14.6	36	13.3	55	13.8
Primary School	38	29.2	86	31.9	124	31.0
Secondary School	50	38.5	112	41.5	162	40.5
Tertiary Institution	23	17.7	36	13.3	59	14.8
Total	**130**	**100.0**	**270**	**100.0**	**400**	**100.0**
X^2cal = 9.020, df = 5, $p\leq 0.05$ = 10.8; Comment: Significant						
<u>Farming Exp.</u>						
≤ 10	36	27.7	67	24.8	103	25.8
11 - 20	33	25.4	79	29.3	112	28.0
21 – 30	31	23.8	57	21.1	88	22.0
31 - 40	23	17.7	44	16.3	67	16.8
41 – 50	5	3.8	19	7.0	24	6.0
Above 50	2	1.5	4	1.5	6	1.5
Total	**130**	**100**	**270**	**100**	**400**	**100**
X^2cal = 2.644, df = 3, $p< 0.05$ = 0.755 Comment: Significant						

Source: Field Survey, 2010

MLE Estimates of Cassava Farm on Stochastic Production Frontier

As shown in Table 2, the results confirmed that the estimates of land, labour, capital and fertilizer are critical inputs in cassava production. The output elasticity of labour was turned out to be positive and statistically significant. An examination of the labour data revealed that there was optimal utilization of labour on cassava farms.

The estimate of the coefficients for the inefficiency variables are of particular interest in this study. The estimate of the variance parameter, gamma γ is significantly different from zero, which implies that the inefficiency effects are significant in determining the level and variability of cassava output of farmers in Ogun State. The coefficient for age of the farmers, extension visit, distance to market, credit and plot ownership are negative and significant, suggesting that they significantly and negatively influence inefficiency.

The estimate coefficient of land area and capital both had a positive coefficient, which implies a direct relationship with the cassava output. This confirms *a priori* economic expectations such that as farmers continue to increase their cultivated area, it would lead to increase in the amount cassava output realized. As more production inputs are added, the overall total production would be increased. The estimated coefficient indicates that output from cassava production is relatively elastic to changes in the land area cultivates. A unit change in land, for instance, will result in a less than proportionate increase in the amount of farm output.

The estimates of the overall model variance (σ^2) and gamma (γ) give adequate information on the efficiency of the explanatory variables on the farm output. The overall model variable (σ^2) is 2.140, the gamma (γ) is 0.645 and the mean technical efficiency is 0.455 (45.5%). It implies that the efficiency of the inputs used is low and there is under utilization of production resources which invariably affects farmers' production output.

Table 2: Maximum Likelihood Estimates (MLE) of the Stochastic Production Frontier For Cassava Based Farmers

Variable names & code	OLS	MLE
Production frontier		
Constant (β_0)	11.881(0.095)**	0.013(0.379)**
Land (β_1)	0.441(0.398)	0.074 (0.716)
Labour (β_2)	0.160(1.014)*	0.176(0.115)**
Fertilizer (β_3)	-0.332(1.235)*	-0.422(01.695)*
Capital (β_4)	0.139(0.292)	0.128(0.300)
Production Inefficiency Equation		
Constant (δ_o)	-	0.731(0.760)
Farm size (δ_1)	-	0.230(1.313)*
Age of the household head (δ_2)	-	-0.401(0.284)
Extension visit (δ_3)	-	-0.435(-3.178)*
Distance to the nearest market (δ_4)	-	-0.064(-1.892)*
Credits for modern inputs (δ_5)	-	-0.185(-3.421)*
Educational level (δ_6)	-	0.017(0.132)
Timely availability of inputs (δ_7)	-	0.6361(1.961)*
Plot ownership (δ_8)	-	-0.052(0.738)
Plot quality (δ_9)	-	0.107(0.139)
Variance parameters		
Sigma squared (σ^2)	1.670*	2.140(9.226)*
Gamma (γ)	0.720	0.645(0.013)**
Log likelihood function(LLF)	-667.68	620.480
Return–to–Scale (RTS)	11.407	0.405
LR test	-	94.412
Mean Technical Efficiency	-	0.455

Note: figures in parentheses are t –values of estimates
* significant at p≤0.10, **= significant p≤0.05
Source: Field Survey, 2010

Test of Hypothesis about existence of Technical Inefficiency among the Farmers

To enable the use of these stochastic frontiers production models, two sets of tests were carried out to establish whether inefficiency effect exists, and if so, whether they are not simply random errors. The first set of hypotheses tested relate to the existence of inefficiency as follows: *Ho:* All the farmers are perfectly efficient in the use of resources.

The second set of hypotheses relates to the relevance of the inefficiency variable used in the model and which states that coefficient of each of the inefficiency variables under each category of farm is zero. The results of these tests are presented in Table 3. The first set of test were done on the assumption that the gamma coefficient (γ) and those of the inefficiency of the errors which is attributable to inefficiency of the farms the value of the variance parameter gamma (γ) was invoked. The parameter $\gamma = \sigma^2 u/\sigma^{2,}$ which is the ratio of the variance of the error terms is bounded between zero and one, where if γ=0, inefficiency is not present (implying that any deviation of actual output from the expected is due only to random error) and if γ=1, there is no random error (implying that any deviation of actual output from the expected is due only to the technical inefficiency of the farmers and not in any way related to random error).

Table 3: Hypotheses Tested about the Existence of Inefficiency among the Farmers

Assumption of the test null hypotheses tested	Log likelihood under null hypotheses	Number of restriction	Test statistics	Critical values	Decision
$\gamma = \delta_o = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = \delta_9 = 0$					
Traditional technology	188.99	11	25.036*	20.410*	Reject
Modern technology	449.43	11	22.023*	20.410*	Reject
Small farms	522.58	11	25.362*	20.410*	Reject
Large farms	115.70	11	34682	25.549*	Reject
Mono farms	125.60	11	26.534**	22.140*	Reject
Mixed farms	478.05	11	32.245*	20.410*	Reject
All farms	637.32	11	23.914	20.410*	Reject
$\delta_o = \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = \delta_9 = 0$					
Traditional technology	172.87	9	27.582	18.275	Reject
Modern technology	420.12	9	28.592	18.275	Reject
Small farms	495.03	9	19.876*	16.274*	Reject
Large farms	108.72	9	16.278*	16.274	Reject
Mono farms	116.04	9	25.025*	20.972	Reject
Mixed farms	460.46	9	31.824**	20.972	Reject
All farm	619.15	9	24.442**	20.972	Reject

** the critical values for this was obtained from t- table with degree of freedom equal to the number of restriction plus one. Other critical value were obtained from the normal chi-square table with degree of freedom equal to the number of restriction. * significant ($p \leq 0.05$); ** significant ($p \leq 0.01$). Source: Field Survey, 2010*

Resource Use Efficiency of Variable Inputs

The lead equation is Cobb Douglas production function used to estimate the resource use efficiency of the variable inputs used in cassava production in the study area. The Marginal Physical Product (MVP) = MPPxPy where Py = unit price of output. The mean price for each variable input was used. As shown in Table 4, all the resources were under-utilized. This means that high cost of land and other production inputs will make most of the respondents manage the meager available resources which negatively affect production output. The labour is grossly under-utilized, perhaps the farmers used all the available family labour for production without due consideration to its opportunity cost or labour was used arbitrarily. The total land area for cassava production was used arbitrarily. The total land area is quite expected, since all other resources including working capital meant to be used on the land for production were under-utilized.

Table 4: Resource Use Efficiency of Variable Inputs

Variable	Variable Name	MVP	MFC	$\frac{MVP}{MFC} \neq 1$	Remark
X_1	Land Area Cultivated	15,924.15	25,276.42	0.630	Under Utilization
X_2	Labour Employed	5,766.00	14,088.20	0.409	Under Utilization
X_3	Quantity of Planting Materials	1,344.35	59,304.10	0.022	Under Utilization
X_4	Quantity of Fertilizer	905.55	5,500.00	0.164	Under Utilization
X_5	Working Capital or Expenses	25,123.20	170,326.82	0.147	Under Utilization

Source: Field Survey, 2010

Agricultural Technology and Productivity Level of the Cassava Farmers

The output of any farm is a function of technology used among others by the farmers. However, the productivity level of any farm depends on the handling of management practices as prescribed by modern farming technique. Table 5 presents results of the Ordinary Least Square (OLS) estimates of the various variants of the Cobb-Douglas production function specified with a view of assessing the influence of technology on farm productivity. The associated Chow Test is summarized below.

Table 5: OLS Estimates of Production Functions of Traditional and Modern Farms

Natural Log of Explanatory Variables (InX$_i$)	Traditional Farms	Modern Farms	All Farms without Dummy	All Farms with Dummy
Constant	-73476.00 (-4.902)*	-4877.45 (-0.644)	-10069.50 (-1.156)	-4252.52 (-0.320)
Intercept Shifter Dummy	-	-	-	-0.002 (-0.057)
Capital	0.099 (2.070)**	0.135 (3.142)*	0.114 (2.885)*	0.135 (3.130)*
Labour	0.842 (17.413)*	0.693 (16.071)*	0.595 (14.999)*	0.693 (16.020)*
Intermediate Materials	0.018 (0.360)	0.061 (1.421)	0.085 (2.142)**	0.061 (1.418)
Adjusted R^2	0.709	0.503	0.377	0.502
F-Value	106.018*	91.906*	81.483*	68.672*
Residual Sum of Square (Σe_i^2)	6.20	9.00	2.50	9.00
Sum of Coefficient of X_i (Σb_i)	0.959	0.889	0.794	0.889
Residual Degree of Freedom (K_i)	126	266	396	269

Figures in parentheses are the t-values of the estimates
** = Significant at 1%; ** = Significant at 5%; *** = Significant at 10%.*

The results in Table 5 showed that values of the adjusted R^2 were 0.709 and 0.503 for traditional and modern farm categories. This implies that 70 percent and 50 percent of the variation in output were explained by the variables in both categories respectively. The F-test revealed that the explained variables were significant at 1 percent for traditional and modern farms. For the two categories of farms, all the variables had the expected positive signs and are found to be significant at 1 percent and 5 percent respectively. The coefficient of labour and capital were positive and significantly influence the output, implying that an increase in these inputs would result in increase in farm output. The sums of the coefficient of the production function of both categories were 0.959 and 0.889 percent which indicates an increasing return to scale for traditional and modern farms. This implies that a unit increase in all the explanatory variables would result in about 0.9 unit and 0.5 unit increase in output of an average farmer in traditional and modern farms categories respectively.

Table 6: Chow Test for Differences in Production Function of Trad. and Modern Farms

Hypotheses		F_{cal}	F_{tab}	Comment
H_o	No significant differences between production function of traditional and modern farms.	99.50	26.10	Reject H_o
H_o	Slope parameters (Partial Production Elasticities) are the same production functions of traditional and modern farms.	16.97	6.63	Reject H_o
H_o	No difference between the intercept parameters (Total Factor Productivity) of the traditional and modern farms.	2.53	1.38	Reject H_o

Note: If $F_{cal} > F_{tab}$, significant at 5%, then reject H_o (Null Hypothesis)

Chow Test results presented in Table 6 revealed that there is significant difference in the parameters of the production functions and the slope of the traditional and modern farms. Also, there are significant differences in intercept shifter/dummy, these differences are reflected in terms of significant differences in the Partial Production Elasticities (PPE) of the individual factors employed, and total factor productivity of the two categories of farms.

CONCLUSION AND RECOMMENDATIONS

The study concludes that modern technology cassava-based farmers are relatively more economically and technically efficient than traditional technology farmers. Traditional farmers do not have absolute allocative efficiency in the use of labour and intermediate materials due to inability to adopt improved technology or failure to keep appropriate records of inputs that are required in cassava production. The study also recorded a positive impact of modern input usage on modern technology farms in the study area. There is significant difference in the parameters of the production functions, partial production elasticities and total factor productivity of the traditional and modern farms.

This study has shown that purchase hybrid cultivars reduces technical inefficiency and thus shifts the actual production frontiers closer to the potential frontiers. It is recommended that government should intensify effort to encourage the small holders and traditional farmers to improve upon their production practices, since the food security of the nation depends on them in the short run. The establishment of large scale farms could be ease-off intensive labour input and make mechanisation more economical. It is also recommended that a well-moninted credit policy be put in place to enable the farmers acquire the necessary production input to boost their output

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