Comparative Analysis of Technical Efficiency of Small Holder Fadama II and Fadama III Cassava Farmers in Imo State

Osondu, C. K. Ezeh, C. I. Emerole C. O. and Anyiro C. O.
Department of Agricultural Economics and Extension Abia State University, Umuahia Campus, PMB 7010, Umuahia, Abia State, Nigeria
Corresponding author E-mail: Osonducharles87@gmail.com

Abstract

This study was conducted in Imo state, Nigeria. Multi stage random sampling technique was used to select 240 respondents (120 Fadama II and 120 Fadama III cassava farmers). Instrument of data collection was well structured set of questionnaire. The study employed percentages, frequencies and Cobb-Douglas stochastic production model as analytical tools. Results show that the mean technical efficiency of Fadama II and Fadama small holder cassava farmers was $\overline{x}$ *=0.76 and* $\overline{x}$ *= 0.81 respectively. For Fadama II small holder cassava farmers, Peculiar determinants of technical efficiency were membership to cooperative society, household size and farm income while, access to credit and household size were peculiar significant determinants of Fadama III small holder cassava farmers technical efficiency. Constraints to cassava production includes: inadequate access to formal sources of capital (25% and 40.0% for Fadama II and III farmers respectively), lack of mechanized equipment (36.67 and 28.3% for Fadama II and III farmers respectively) and agro-chemicals (43.34% and 33.33 for Fadama II and III farmers respectively). It is recommended that the Fadama project should assist resource poor farmers to procure credit facilities. Government should establish adult education centres to improve literacy level as it influenced technical efficiency of both small holder cassava farmer groups.*

Keywords: Technical efficiency, Fadama II, Fadama III, Small holder farmers

INTRODUCTION

Over half of the world's cassava (*Manihotesculenta*) is cultivated in the humid and sub-humid tropics of sub-Saharan Africa where it is the most important food crop grown mainly by small-holder farmers. Nigeria is currently the largest producer of cassava in the world, with an annual output of about 45 million tones of tuberous roots (FAO, 2008).Cassava is a root and tuber crop which performs well across a wide ecological spectrum. It therefore benefits farmers across broader swath of ecological zones. Cassava is likewise, less expensive to produce. It tolerates poor soil, adverse weather, pests and diseases more than other major staples. The cash income from cassava proves more egalitarian than the other major staple because of cassava's low cash input cost compared with other major staples (Nweke, 2004).

These outstanding features of cassava have prompted the federal government to initiate and execute policies and programmes aimed at increasing production technologies. The aim of these programmes and increment in cassava input is to tap the potentials of the cassava crop, which has remained largely unappreciated and un-harnessed. The second National Fadama Development Project (NFDP II) started in 1998 with the main objective of increasing the income of the Fadama users through the expansion of farm and non-farm activities with high value added output. The second National Fadama Development Project adopted a demand driven approach where by users of Fadama resources are encouraged to develop participatory and socially inclusive local plans.

The third National Fadama Development Project (NFDP III) which is a follow-up on the National Fadama II Project aims at also increasing the income of Fadama user groups by directly delivering resources to the beneficiary rural communities. It seeks to empower them through

collective decision-making on how to effectively and efficiently allocate and manage resource for their livelihood. The central objective of NDFP III was to raise rural productivity and income in Fadama areas. The strategy includes investing in public infrastructure, asset acquisition through matching grants and advisory services and improving mechanisms to avoid and resolve conflict among Fadama resource users (FMARD, 2003).

Despite the disproportionate agricultural roles played by the national Fadama Development project, it is not clear if the technical efficiency of each participant in general and Fadama cassava user groups in particular was fully realized. According to (Asumugha and Aniedu (1999), numerous problems such as inadequate capital base, land fragmentation, poor resource availability continues to hinder the production of cassava within the country. Cassava is produced mostly by small holders of marginal or sub-marginal lands of the humid and sub-humid tropics, such small holder systems as well as other aspects of production and use often create problems, including unreliability of supply, uneven quality of products, low producer prices and an often costly marketing structure (Plucknett *etal*,2002).

Imo State was one of the states that implemented both the second and the third phase of the national Fadama development project. It then becomes imperative to comparatively analyze the technical efficiency of the cassava farmers who participated in the second and third phase of the Fadama project in the state. The specific objectives were to describe the socio-economic characteristics of Fadama II and Fadama III cassava farmers in relation to their technical efficiencies, estimate the technical efficiency of Fadama II and Fadama III cassava farmers in the study area; estimate the determinants of technical efficiency among Fadama II and Fadama III cassava farmers in the study area; estimate and analyze efficiency differences between Fadama II and Fadama III cassava farmers in the study area and identify farmers perceived constraints to effective cassava production among Fadama II and Fadama III cassava farmers in the study area.

MATERIALS AND METHODS

Study area

The study was carried out in Imo state Nigeria. The state lies between longitudes 6^0 54^1 and 7^0 7^0 East of the Greenwich meridian and Latitude 5^0 44^1 and $5^0 54^1$ North of the equator. The state has a land area of 5,100 sq.km with a population of over 3,927,563 people of which over 1,951,092 are females and 1,976,471 males (NPC, 2006).

Sampling procedure and sample size

Multistage sampling procedure was used in the selection of respondents who either participated in Fadama II or Fadama III project phase but not in both. In stage one, two agricultural zones Owerri and Orlu were randomly selected. The sampling frame which contained 134 and 181 names of fadama II and Fadama III cassava farmers was obtained from the Fadama offices located within the headquarters of Agricultural Development programme (ADP) in each selected zone. From the sampling frame 120 Fadama II and 120 Fadama III cassava farmers were randomly selected. This gave a total of 240 respondents.

Data used for this study was from primary source through a field survey using semi structured questionnaire. The same set of questionnaire was used to elicit information from both groups. The data generated was mostly demographic and those related to input/output coefficients and their prices.Data were analysed using descriptive (frequency, percentages and means) and inferential statistics (maximum likelihood estimation of the cobb-Douglas stochastic production function).

Model specification

The stochastic frontier model adopted in this study is the variety of Yao and Liu (1998) and Ogundele (2003). The model specified output (y) as a function of inputs (x) and error term (E_i).

The empirical model of the stochastic production frontier is shown as:

$$\ln Y_i = \alpha_0 + \alpha_1 \ln X_{1ij} + \alpha_2 \ln X_{2ij} + \alpha_3 \ln X_{3ij} + \alpha_4 \ln X_{4ij} + \alpha_5 \ln X_{5ij} + \alpha_6 \ln X_{6ij} + V_{ij} - U_{ij} \quad \text{..... (1)}$$

Subscripts I and j refers to the ith farmers and jth observation respectively

Y = total farm output (kg)

X_1 = farm size (ha)

X_2 = quantity of cassava stem (kg)

X_3 = labour (mandays)

X_4 = quantity of fertilizer (kg)

X_5 = quantity of herbicide (litre)

X_6 = depreciation (₦)

V_{ij} = a random error term with normal distribution N (0,δ2)
U_{ij} = a non- negative random variable associated with technical efficiency of the enterprises involved. It accounts for inefficiency and under control of the farmer.
In = natural logarithm
α_0 - α_1 = parameters estimated
α_0 = intercept

From the above model (equation 1), the determinants of technical efficiency were estimated as follows:
μ_1 = F (Z_1 Z_2 Z_3, Z_4, Z_5, Z_6, Z_7, Z_8,)
μ_1 = technical efficiency
Z_1 = age of the farmers (years)
Z_2 = education level of the farmers (years)
Z_3 = farming experience (years)
Z_4 = farm size (ha)
Z_5 = access to credit (₦)
Z_6 = membership of cooperative society (Yes =1, No =0)
Z_7 =householdsize (number)
Z_8 = improved technology (yes=1, no=0)

Estimation of the above was accomplished through estimation of the technical efficiency as specified in Coelli (1996).

RESULT AND DISCUSSION

Socio-economic characteristics of the respondents

Table 1 reveals that more than half of the respondents (55.0% of NFDP II and 58.3% of NFDP III small holder cassava farmers) were females. This implies that the Fadama project was non gender discriminatory and targets the less disadvantaged in the society. A further implication of the result is that females in the area were more involved in cassava production than the males who concentrate effort more on yam production. Table 1 also shows the distribution of respondents' age. It shows that 42.5% and 35.0% of the NFDP II and NFDP III small holder cassava farmers were within the age range of 31 and 40 years respectively, while 45.00% of the Fadama II and Fadama III respectively were within the range of 41 and 50 years. This implies that majority of the respondents fell within the age range of 31 and 50 years, which is an active age. This is a productive age group which can absorb the shocks involved in farming (Chukwu, 2007). The marital status distribution of respondents as shown in table 1 indicates that majority (78.3% of NFDP II and 71.7% of Fadama III small holder cassava farmers) were married. Nwaru (2006) posits that family stability creates conducive environment for good citizenship training, development of self and entrepreneurship which are very important for efficient use of resources.

Data on household size in Table 1 shows that 30.0% and 35.0% of the Fadama II and Fadama III small holder cassava farmers respectively had a household size of 1-5 persons while majority (70.00%) and a high percentage (65.00%) of the Fadama II and Fadama III small holder cassava farmers respectively had household size of 6 – 10 persons. The result indicates that the household size is large; this will help the farmers not to spend much money hiring labourers. This result is in agreement with Ezeh *etal (*2012) who state that large households tend to use family members as sources of labour.

Table 1 further reveals that 45.0% of Fadama II small holder cassava farmers had farm income that ranged from ₦4,000 - ₦7,999 while, 46.67% of the Fadama III small holder cassava farmers had income that also ranged from ₦4,000 - ₦7,999 monthly. This shows that production is at a subsistent level and little of the output is sold. Hence, the farmers are utilizing a low capital base. As further shown in table 1 50.0% of Fadama II small holder cassava farmers had farm size that ranged from 0.1 – 1.0 hectare and 41.6% range from 1.1 – 2.0 hectares. For the Fadama III small holder cassava farmers, 63.3% have farm size that ranged from 0.1 to 1.0 hectare and 30.0% had farm size that ranged from 1.1 – 2.0 hectares. This shows that Fadama II cassava farmers have more land holding than Fadama III cassava farmers. The implication is that Fadama II cassava farmers will have relatively more output since land is a major economic input in agriculture.

Estimated production functions of Fadama II smallholder cassava farmers

Maximum likelihood estimates of the specified Cobb-Douglas stochastic production function for Fadama II small holder cassava farmers in Imo state is presented in (Table 2). The result shows that the coefficients of the variables have the expected positive signs. However, the coefficients of farm size was significant at 1.0% probability level, while the coefficient of cassava stem cuttings and fertilizer were significant at 5% alpha level.

Specifically, The estimated coefficient of cassava cutting is positive (0.4943) and implies that for every one percent increase in the quantity of cassava stem cuttings, would lead to 0.4934

percent increase in the output of Fadama II small holder cassava farmers. This is in consonance with Akanni and Dada (2012) that the larger the quantity of input, the higher the output and the less inefficient a farmer becomes.

The estimated coefficient for farm sizewas positive (0.3506) and implies that every one percent increase in farm size, would lead to 0.3506 percent increase in output of cassava. This is in consonance with Effiong and Nwachukwu (2005) and Nwachukwu and Onyenweaku, (2007) that the larger the farm size, the less inefficient a farmer becomes.

In consistent with classical production theory, quantity of fertilizer used had a positive coefficient and statistically significant at 90% confidence level. With an elasticity of 2.158, the enterprise operates in stage one of the classical production function and by implication, increase in quantity of fertilizer used should be encouraged. This indicates that an increase in fertilizer usage, increased significantly cassava output of Fadama II small holder farmers. This result highlights the importance of fertilizer in increasing crop yield as low fertilizer usage tends to decrease agricultural growth. This result is consistent with the findings of Belbase and Grabowski (1985) whose study established that production and quantity of feed are directly related.

Table 1: Socio-economic characteristics of the Fadama II and Fadama III smallholder cassava farmers in Imo state

	Fadama II Cassava Farmers		Fadama III Cassava farmers	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage**
Gender				
Male	54	45.00	50	41.66
Female	66	55.00	70	58.33
Age				
21 – 30	10	8.33	12	10.00
31 – 40	51	42.50	42	35.00
41 – 50	54	45.00	54	45.00
51 – 60	5	4.17	12	10.00
Marital status				
Single	8	6.67	6	5.00
Married	94	78.33	86	71.67
Widowed	18	15.00	28	32.33
Household size				
1 – 5	36	30.00	42	35.00
6 – 10	84	70.00	78	65.00
Farm income (₦)				
1000 – 3999	10	8.33	12	10.00
4000 – 7999	54	45.00	56	46.67
8000 – 11999	36	30.00	28	23.33
12000 – 15999	20	16.67	24	20.00
Total	120	100	120	100

Table 2: Maximum likelihood estimation of the Cobb-Douglas Stochastic frontier production function for Fadama 11 smallholdercassava farmers.

Variable	Parameter	Coefficient	Standard Error	T - Value
Constant	α_0	6.702	0.442	15.157***
Farm size	α_1	0.351	0.091	6.114***
Cuttings	α_2	0.494	0.248	1.993*
Labour	α_3	0.122	0.154	0.728
Fertilizer	α_4	0.088	0.021	4.206***
Agro chemicals	α_5	0.028	0.0143	0.198

*** Significant at 1.0%; * Significant at 10.0%

Estimated production functions of Fadama III small holder cassava farmers

The Maximum Likelihood Estimates (MLE) of the Stochastic frontier production parameters of Fadama III cassava farmers are presented in Table 4.8. The table shows that of the five production factors, farm size and labour input were highly significant at 1.0% risk while quantity of fertilizer used level was significant at 10.0% and this, have high influence on the value of cassava output among Fadama III small holder farmers.

The estimated coefficient for farm size was negative (-0.6551) and implies that every one percent increase in enterprise size, would lead to 0.6551 percent decrease in the value of cassava output. This is at variance with Effiong and Nwachukwu (2005) and Nwachukwu and Onyenweaku (2007) that the larger the larger size, the less inefficient a farmer becomes. However, this suggests efficiency in the use of land rather than expansion of cultivated areas as a necessary requisite that could increase the level of efficiency in production (Anyiro and Oriaku, 2011).

Consistent with classical production theory, the quantity of fertilizer used had a positive coefficient (2.58) and statistically significant at 90% confidence level. With an elasticity of 2.58, the enterprise operates in stage one of the classical production function and by implication, increase in quantity of fertilizer used should be encouraged. This result is consistent with the findings of Belbase and Grabowski (1985) whose study established that production and quantity of feed are directly related.

Labour input had a coefficient of -0.7192 and high t-value (17.051). Its implication is such that increase in labour input reduces technical efficiency. Given the production elasticity of -0.7192, the Fadama III cassava farmers in the study area are either misallocating or over utilizing labours. This finding contradicts Iwueke (1987) and Ezeh (2006) that farm operations especially in Nigeria are labour intensive.

Table 3: Maximum likelihood estimation of the Cobb-Douglas Stochastic frontier Production Function for Fadama 1I1 Small Holder Cassava farmers in Imo state.

Variable	Parameter	Coefficient	Standard Error	T - Value
Constant	α_0	6.702	0.442	15.157***
Farm size	α_1	-0.655	0.047	-14.052***
Cuttings	α_2	0.112	0.154	0.728*
Labour	α_3	-0.719	0.042	-17.051
Fertilizer	α_4	2.158	1.143	1.889*
Agro chemicals	α_5	0.135	0.1016	1.327

*** Significant at 1.0%; * Significant at 10.0%

Determinants of technical efficiency of Fadama II small holder cassava farmers

The determinants of technical efficiency of Fadama II small holder cassava farmers in Imo state is as shown in Table 4. The result of the analysis shows that the coefficients of age (-3.116), education (0.1267), farm size (0.0105) and household size (-6.701) were statistically significant at varied risk levels. While, the coefficient of education and farm size was positively signed, the coefficient of age and household size was negative.

Specifically, Farmer's age showed a negative relationship (-3.116) with technical efficiency. This result agrees with that of Ajibefun and Daramola (2003), Kasim and dada (2012) andOluyole *et al (2011)* which suggest that increasing age would lead to decrease in efficiency since aging farmers would be less energetic to work in the farm. But this result disagrees with those of Belbase and Grabowski (1985), Kalirajan and Shand (1985), Bravo-Ureta and Pinheiro (1997) whose results showed age to be positively related to technical efficiency.

The coefficient (0.1267) of Education shows a positive and significant relationship with technical efficiency. This indicates that the technical efficiency of Fadama II small holder cassava farmers increased with increase in level of education. Education enhances the acquisition and utilization of information on improved technology by farmers (Idiong, 2006; Onyeaweaku *etal*., 2004) and this significantly increases efficiency (Rahman and Hasan, 2008).

The positive significant coefficient (0.0105) of the extent of cultivation (farm size) among Fadama II small holder cassava farmers could be attributed to the fact that size of farm determines its output. That is, the larger the farm the more the number of farm inputs that would be employed on

such farm and vice versa. The hectarage of a farm dictates the scale of farm productions. It determines the magnitude of efficiency and productivity (Akpan *et al*, 2012). As farm size increases, the level of output increases.

On the other hand, the coefficient of household size (-6.701) had a negative significant impact on technical efficiency of Fadama II cassava farmers. An increase in the farmer's household size could exert considerable pressure on the relatively finite Fadama land area meant for cassava cultivation, as part or whole might be converted to alternative land uses (Ogunniyi, 2008). This would reduce available land for cassava cultivation. Hence technical efficiency of the farmer will be reduced as good proportion of potential revenue will be lost. Also, increased family size could increase the quantity of farm produce consumed by the family in addition to increased family consumption expenditure. All these factors tend to reduce farmer's income, farm investment and eventually technical efficiency in farm resource utilization.

From the analysis of technical efficiency model, it could be inferred that increase in household size and age increases technical inefficiency among Fadama II small holder cassava farmers in the study area; while increase in other significant variables in the model reduce technical inefficiency. The diagnostic statistics have coefficients that are all statistically significant. The coefficient of total variance (6^2) was 1.950 while the variance ratio (Y) is 0.992. Variance ratio measures the ratio of the variance of farm specific amount of labour-used (mandays) to the total variance. This means that 99.2% of the variation in the output of cassava among the Fadama II farmers was attributed to technical inefficiency. The total variance of 1.950 is statistically significant and as such, indicates a good fit and the correctness of the specified distributional assumption of the composite error term. This confirms the presence of one sided error term in the specified model (Yao and Liu, 1998 Udoh and Akintola, 2001). Thus this further validates the appropriateness of the specified stochastic model and the choice of maximum likelihood estimation.

Table 4: Determinants of Technical Efficiency of Fadama 11 Small holder Cassava farmers

Variable	Parameter	Coefficient	Standard error	T - value
Age	Z_1	-3.116	1.138	2.734**
Level of education	Z_2	0.127	0.615	2.061*
Farm experience	Z_3	0.655	0.347	0.188
Farm size	Z_4	0.011	0.003	3.289***
Access to credit	Z_5	-0.063	0.187	-0.332
Cooperative society	Z_6	0.655	0.442	14.051***
Household size	Z_7	-6.701	0.442	-5.157***
Improved technology	Z_8	0.490	0.340	1.440
Farm income	Z_9	2.790	1.069	2.608**
Diagnostic statistics				
Total variance	δ^2	1.950	0.068	2.227*
Variance Ratio	Y	0.992	0.170	5.879***
L R Test		0.167		
Log Likelihood Function		-5.980		

*** Significant at 1.0%; ** Significant at 5.0%; * Significant at 10.0%.

Determinants of technical efficiency of Fadama III small holder cassava farmers:

The determinants of technical efficiency of Fadama III small holder cassava farmers are presented in Table 5. The result of the analysis shows that age, education, access to credit and household size were statistically significant at varied risk levels.The coefficient of age (-0.2036) was negatively signed and significant at 5.0% risk level. This supports the argument that farmers become less efficient as they get older. This could result not only from efficiency loss as farmers get old but also because younger farmers tend to be more open and likely to be exposed to methods and techniques that were not captured by variables included in the analysis. This result agrees with that of Ajibefun and Daramola (2003), Ezeh et al (2012), Onyenweaku *et al* (2004) and Onyenweaku and Nwaru (2005) which implied that increasing age would lead to decrease

in technical efficiency since aging farmers would be less energetic to work in the farm. But this result disagrees with those of Belbase and Grabowski (1985), Kalirajan and Shand (1985), Bravo-Ureta and Pinheiro (1997) whose results showed age to be positively related to technical efficiency.

Education shows a positive coefficient (1.2671) which was significant at 5.0% risk level. This implies that increase in educational attainment had positive bearing on Technical Efficiency. Generally, it is believed that education increases human capital and contributes positively to change farmers' attitudes towards use of modern technology. The result shows that Fadama III small holder cassava farmers that are literate are more efficient. This result agrees with Onyenweaku and Nwaru (2005), Onyenweaku *et al,* (2004), Onu *et al,* (2000), Amaza and Olayemi (2000), whose results showed education and technical efficiency to be positively related.

Farmer's credit access gave a coefficient of 2.159 indicating a positive relationship with technical efficiency. The implication of this result is that for each naira increase in farm credit accessed by Fadama III small holder cassava farmers an increased yield is obtained. This figure was significant at 5.0% risk level. This result agrees with Fantu et al (2011) whose result showed farm credit to be positively related to technical efficiency.

Household size was found to be positive (6.112) and highly significant at 1.0% level of significance. This suggests that larger households may utilize family labour which helps in reducing labour cost and creates formidable basis for improved technical efficiency (Mubmik and Flinn, 1998). However, this result agrees with Ezeh et al (2012) and disagrees with the findings of Nwachukwu and Onyenweaku (2007), Onyenweaku and Nwaru (2004) and Bravo-Ureta and Pinheiro (1997), which showed household size and technical efficiency to be negative and significantly related.

The coefficient of farm size (-0.063) had a negative significant impact on technical efficiency of Fadama III small holder cassava farmers. This implies that as farm size increases technical efficiency of Fadama III small holder cassava farmers decreases. This result implies that smallholder cassava farmers could be more efficient in resource allocation and management of small farms which are less complex than management of large farms that require advanced farm management knowledge, which could be lacking among small holder farmers. Furthermore, the significant influence of farm size relates to capturing variation in efficiency that arises from differences in scale (Okoruwa *etal*, 2006; Edeh and Awoke, 2009).

The diagnostic statistics have coefficients that are all statistically significant at 99% confidence level. The coefficient of total variance (6^2) is 0.907 while the variance ratio (Y) is 0.927. Variance ratio measures the ratio of the variance of farm specific technical efficiency to the total variance. This means that 92.7% of the variation in output among the poultry feed producers were due to the disparities in technical efficiency. The total variance of 0.907 is statistically significant and as such, indicates a good fit and the correctness of the specified distributional assumption of the composite error term.

Table 5: Determinants of technical efficiency of Fadama III small holder cassava farmers' production

Variable	Parameter	Coefficient	Standard error	T – value
Age	Z_1	-0.204	0.091	2.249**
Level of education	Z_2	1.267	0.615	2.062*
Farm experience	Z_3	0.254	0.086	-0.295
Farm size	Z_4	-0.063	0.024	-2.585***
Access to credit	Z_5	2.159	1.143	1.889*
Gender	Z_6	0.053	0.039	0.135
Cooperative society	Z_7	0.021	0.104	0.206
Household size	Z_8	6.112	0.403	15.155***
Improved technology	Z_9	-0.026	0.116	-0.229
Diagnostic statistics				
Total variance	δ^2	0.907	0.053	1.722*
Variance Ratio	Y	0.927	0.049	18.867***
L R Test		16.669		
Log Likelihood Function		35.518		

*** Significant at 1.0%; ** Significant at 5.0%; * Significant at 10.0%.

Technical efficiency estimates of Fadama II small holder cassava farmers in Imo state

Table 6 presents the distribution of technical efficiency estimates of Fadama II small holder cassava farmers in Imo state. The Cobb-Douglas stochastic frontier estimates shows that the mean technical efficiency value was 0.76 for the sampled Fadama II small holder cassava farmers in the state. This shows that there is about 0.24 inefficiency gaps. Hence, farmers employing resources above the production frontier are technically efficient in cassava production while those operating below the frontier are considered technically inefficient. Additional output of cassava is still technically necessary so as to be on the frontier. The result shows that 47.50% of the Fadama II small holder cassava farmers operate between 0.61-0.80, a further 39.17% of the cassava farmers in the study areas operate within technical efficiency range of between 0.81 - 1.00. The estimates are skewed to the right, implying high level of efficiency. The minimum efficiency is 0.13 which indicates gross underutilization of resources while the maximum technical efficiency in cassava output is 0.97. In other words, the best technically efficient Fadama II small holder cassava farmers operated almost on the frontier.

Table 6: Distribution of technical efficiency Estimates of Fadama II small holder cassava farmers in Imo state, Nigeria

Technical Efficiency Range	Frequency	Percentage (%)
0.01-0.20	16	3.33
0.21-0.40	0	0.00
0.41-0.60	0	0.00
0.61-0.80	57	47.50
0.81-1.00	47	39.17
Total	120	100.00
Maximum Technical Efficiency		0.97
Minimum Technical Efficiency		0.13
Mean Technical Efficiency		0.76

Technical Efficiency Estimates of Fadama III small holder cassava farmers in Imo state

Table 7 shows the distribution of technical efficiency estimates of Fadama III small holder cassava farmers in Imo state. The mean efficiency estimate among Fadama III cassava producers in the state was 80.7% (0.807). The range is: Minimum, 0.38 (which indicates gross underutilization of resources) – Maximum, 0.96. Only 1.7% had a low technical efficiency estimate in the study area while 6.7% had a moderately high estimate of >0.40 to 0.60. Fadama III cassava farmers with very high efficiency estimate of 0.81-1.0 constituted the majority (66.7%) in the study area. The estimates are skewed to the right, implying high level of efficiency. In other words, the best technically efficient cassava farmers operate almost on the frontier.

Given that about 99.17% of the Fadama III small holder cassava farmers have efficiency indices above average (0.50), the frontier cassava farmers therefore are more or less output maximizers while the non frontier cassava farmers represent only 1.67%. To bridge the wide gap between the technical efficiency levels of the best and the worst cassava farmers, the average Fadama III farmer needs a cost saving of 19.3% to become the best efficient poultry feed producer. This is in agreement with earlier literature (Ogunyika & Ajibefun, 2004) who observed that the mean technical efficiency of Fadama III farmers in Nigeria have been 1.00.

Therefore, it can be conclude that Fadama III cassava farmers in Imo state are technically more efficient in cassava production than Fadama II cassava farmers based on the fact that the mean technical efficiency for Fadama III small holder cassava farmers (0.807) is greater than that of Fadama II small holder cassava farmers (0.760).

The minimum technical efficiency value of 0.20 obtained for Fadama II cassava farmers shows that some of the farmers (Fadama II) are quite far from the frontier region, while the mean value of 0.760 shows that there is about 0.24 (24%) inefficiency gap among Fadama II cassava farmers compared to 19.0% inefficiency gap among Fadama III cassava farmers.

Table 7: Distribution of Technical Efficiency of Fadama III small holder cassava farmers in Imo state, Nigeria

Technical Efficiency Range	Frequency	Percentage (%)
0.01-0.20	0	0.00
0.21-0.40	2	1.67
0.41-0.60	8	6.67
0.61-0.80	30	25.00
0.81-1.00	80	66.67
Total	120	100.00
Maximum Technical Efficiency		0.96
Minimum Technical Efficiency		0.3
Mean Technical Efficiency		0.81

Elasticity of production and return to scale of Fadama II and Fadama III small holder cassava farmers in Imo state

Table 8 reveals the elasticities of production of Fadama II and III small holder cassava farmers in Imo state. The table shows that the elasticities of Fadama II and III cassava farmers were greater than 1 (1.07 and 2.34 respectively). This is the case in which each additional unit of input results to a more total product than the preceding unit (Onyebinama, 2000). In this case, the cassava farmers of both Fadama II and III were operating in stage one of the classical production function. This was obtained from the coefficient of production factors.

Table 8: Distribution of production elasticities for both Fadama II and III small holder cassava farmers in Imo state

Variables	Fadama II farmers	Fadama III farmers
Farm size	0.35	0.66
Cutting	0.49	0.11
Labour	0.12	-0.72
Fertilizer	0.09	2.16
Agro chemicals	0.03	0.13
Sum of elasticities	1.07	2.34

Perceived production constraints of Fadama II and III small holder cassava farmers in Imo state

Table 9 shows the distribution of Fadama II and III farmers according to perceived problems encountered in cassava production in Imo state. As regards farmers' access to and control over productive resources, the results show that 26.7% of Fadama II and 11..67% of Fadama III farmer had problems of limited land, formal sources of capital (25% and 40.0% for Fadama II and III farmers respectively), lack of mechanized equipment (36.67 and 28.3% for Fadama II and III farmers respectively) and agro-chemicals (43.34% and 33.33 for Fadama II and III farmers respectively) such as fertilizers, herbicides and pesticides while none of them had absolute control over these resources. With respect to the respondents' access to infrastructural facilities, most of them (28.33% and 16.67% for Fadama II and III farmers respectively) did not have access to reliable public transportation and storage facilities. Nearly all the infrastructural facilities were not available. Where they were available, the respondents did not have access to them. Meanwhile, inadequate and irregular supervisory extension workers (21.67 and 18.33% for Fadama II and III farmers respectively) also pose serious constraints to Fadama II and III cassava production in the area. The result implies that although Fadama farmers contribute significantly to agricultural production in Nigeria, they are least likely to benefit from agricultural extension services, agricultural credit schemes and technologies that would improve their productivity. This has been as a result of barriers exerted by cultural, social, biological and religious factors (Nwaru, 2003; Ajibufun, 2002). In fact, there is a strong case for arguing that without credit and complementing public infrastructure (roads, bridges, electricity, schools), it is difficult to see how small holder cassava farmers could generate incomes that can sustain an adequate livelihood and improve on productivity (Durno and Stuart 2005; Hoddinott, 1998; Anyiro and Oriaku, 2011; Ezeh *et al*, 2012).

Table 9. Production constraints of Fadama II and III cassava farmers in Imo state

Variables	Fadama II farmers		Fadama III farmers	
	Frequency *	%	Frequency*	%
Limited land	13	21.67	7	11.67
Lack of fertilizer	10	16.67	8	13.33
Lack of credit facilities	15	25.00	27	40.00
Distance from farm to market and marketing channel	18	30.00	16	26.67
Irregular supervisory visit	13	21.66	11	18.33
inadequate labour	24	40.00	13	21.66
Unavailability of improved cassava stems	19	31.66	15	25.00
Lack of Agro chemical	16	26.67	12	20.00
Lack of mechanized equipment	22	36.67	17	28.33
Inadequate reliable public transportation	17	28.33	10	16.67

*Multiple responses recorded

CONCLUSION

The mean technical efficiency of Fadama II cassava farmers in the study area is (0.76) and the mean technical efficiency of Fadama III cassava farmers is (0.81) implying that Fadama III cassava farmers were technically more efficient. Although Fadama III cassava farmers were technically more efficient than Fadama II cassava farmers, optimum efficiency status have not been fully realized. Age, level of education, farm size, membership to cooperative society, Household size, Farm income were significant determinants of Fadama II cassava farmers technical efficiency. On the other hand, Age, level of education, farm size, access to credit and household size were significant determinants of Fadama III cassava farmers technical efficiency.

RECOMMENDATION

Based on the findings of this study, the following recommendations suffice:

1) The study shows that level of education was a significant determinant of both fadama farmer groups. Hence, there is need to establish adult education centers in the state that will teach farmers to adopt technical efficiency enhancing innovations.

2) The Fadama project should assist the resource poor cassava farmers to procure credit facilities to facilitate the expansion of their production base as this will help increase farmers revenue.

REFERENCES

Ajibefun, I. A (2002). Analysis of policy issues in technical Efficiency of Small Scale farmers using stochastic frontier production function. With application to Nigerian farmers. Paper prepared for presentation at the international farm management Associate congress, Wagenning in Netherland, July.

Ajibefun, I.A. and Daramola, A. G. (2003) "Efficiency of Micro-enterprises in the Nigeria Economy" AERC Research Paper 134, African Economic Research Consortium Nairobi, Kenya.

Akanni A. K. &Dada, A. O. (2012). Analysis of Labour-Use Patterns among Small- Holder Cocoa Farmers in South Western Nigeria. *Journal of Agricultural Science and Technology,* 2, 107-113

Akpan, S.B. Inimfon, V.P and Udoka, S.J (2012). Stochastic profit Efficiency of Homestead based Cassava Farmers in Southern Nigeria. *Asian economic and Social Society*. Vol 2 (2).

Amaza, P. S. and Olayemi, J. K. (2000) "The influence of Education and Extension Contact on food crop production in Gombe State, Nigeria". *Journal of Agribusiness and Rural Development* 1(1): 80-92.

Anyiro, C.O.and Oriaku B.N (2011). Access to and Investment of Formal Micro Credit by small Holder Farmers in Abia State, Nigeria. A case study of ABSU Micro Finance Bank, Uturu. *The Journal of Agricultural Sciences*.6(2): 69-76.

Asumugha, G.N and Aniedu, O.C (1999) Determinants of labour Productivity on small holder Cocoyam farmers in Anambra State, Nigeria. *Academic Journals Scientific research and Essay* Vol. 3 (11): 559-561.

Belbase, K and Grabowski, R. (1985) "Technical Efficiency in Nepalese Agriculture". *Journal of Development Areas,* 19(4): 515-525.

Bravo-Ureta, B. E. and Pinheiro ,A. E. (1997). "Technical, Economic and Allocative Efficiency in Peasant farming: Evidence from the Dominican Republic". *The Development Economics*: 35(1): 48-87.

Coelli, V. J. (1996). Guide to Frontier Version 4.1. A Computer programme for stochastic frontier production and cost function estimation. Dept. of Economics, University of New England, Arm dale, Australia.

Durno, J and Stuart, R (2005). Gender issues in sustainable agriculture. P. 24-37. In Overholt, C. (ed.). Gender roles in development projects. New Delhi Fox publisher, New Delhi, India.

Edeh, H. O and Awoke, M.U (2009). Technical efficiency Analysis of Improved Cassava farmers in Abakaliki LGA of Ebonyi State; A stochastic Frontier Approach. *Agricultural Journal.* 4(4): pp 171-179

Effiong, E. O. (2005) "Efficiency of production in selected livestock Enterprises in Akwa-Ibom State, Nigeria". PhD. Thesis, Dept. of Agricultural Economics, Michael Okpara University of Agriculture, Umudike.

Ezeh, C. I. (2006)"Socio-economic Determinants of Output and Profit levels of smallholder Rice production Systems in Abia State,

Nigeria". *Journal of Research in Agriculture* 3(3): 44-50

Fantu, N. Guush, B. Sinafikeh, A. Gerawork, G. Alemayehu, S. T. and John, H. (2011). Development Strategy and Governance Division, International Food Policy Research Institute – Ethiopia Strategy Support Program II, Ethiopia ESSP II Working Paper 019.

Federal ministry of Agriculture and rural development (FMARD) (2003) Second national Fadama development project. Protection Implementation manual. VOL. 1, pp3-7.

Food and Agricultural organization (FAO) (2008). Food and Agriculture Organization of the United Nations, Cassava for food and energy: Investing in cassava research and development could boost yields and industrial uses. http://www.fao.org/newsroom/en/news/2008/1000899/index.html(accessed 10/09/13).

Hoddinot, S. A. (1998). Implementation of the Poverty Alleviation Programme: Lilongwe, Malawi MIT press p.12.

Idiong, I.C (2006). Estimation of farm level technical efficiency in small Scale Swamp Rice production in Cross River State of Nigeria.

Iwueke, C. C. (1987) "Farmer related factors influencing the Adoption of Innovations in Imo State: Ph.D. Thesis. Dept. of Agricultural Extension, UNN.

Kalirajan, K. and Shand, R. T. (1985) "Types of Education and Agricultural Productivity; A Quantitative Analysis of Tamil Nadu Rice Farming. *Journal of Development studies.* 21(2): 232-243.

Mubmik, A. and Flinn, J. C. (1998) "Profit Efficiency among Basmatic Rice producers in Pakistan Punjab". *American Journal of Agricultural Economics* 71: 303-310.

National population Commission (NPC) (2006). Population Figure report in Imo State.

Nwachukwu, I. N. and Onyenweaku, C. E. (2007) "Economic Efficiency of Fadama Telfairia Production in Imo State, Nigeria: A Translog Profit function Approach". *Journal of Agricultural Research and Policies* 2(4): 87-93.

Nweke F.I. (2004). "Cassava. A cash crop in Africa. A Collaborative Study of Cassava in Africa", working paper. No. 14

Nwaru, J.C. (2003). Gender and relative Production efficiency in Food Crop farming in Abia state, Nigeria. *NigerianagriculturalJournal*. 34; 1-10.

Nweke, F. (2004). New Challenges in the Cassava transformation in Nigeria and Ghana. Environment and population Technology Division (EPTD) Discussion Paper No 118, international Food policy research Institute. Washington D.C, USA.

Ogundele, O. O. (2003). Technology Differentials and Resource Use Efficiency in Rice Production in Kaduna State. PH.D Thesis, University of Ibadan, Ibadan, Nigeria.

Ogunniyi, L.T. (2008). Profit Efficiency among Cocoyam producers in Osun State, Nigeria. *International Journal of Agricultural Economics and Rural Development*. Vol. 1, pp. 38 – 48.

Ogunyika, A. G and Ajibufun I. A. (2004). Efficiency of micro Enterprises in the Nigeria economy. AERCC Research paper 134. Africa Economy Research Consortium Nairobi.

Okeke, I. (2000). Crop Livestock Interactions and Economic Efficiency of farmers in the Savannah zones ofNigeria. Ph.D. Thesis Department of Agricultural Economics, University of Ibadan.

Okoruwa, V. O. Ogundele, O. O and Oyewusi, B. O. (2006). Efficiency and productivity of farmers in Nigeria. A poster paper prepared for presentation at the International Association of Agricultural economist Conference, Gold Coast, Australia.

Oluyole K.A., Egbetokun, O.A., Oni O.A and Aigbekaen, E.O. (2011). Technological Changes and Labour Demand among Cocoa Farmers in Nigeria. *World Journal of Agricultural Sciences* 7 (5): 638-641.

Onu, J. K. Amaza, P. S. and Okunmadewa, F. Y. (2000) "Determinants of Cotton Production and Economic Efficiency". *African Journal of Business and Economics Research* 1: 234-240.

Onyebinama, A. U (2000): Economics and Production Management for Agriculture

Alphabet. Nigeria Publishers, Owerri. Pg 86.

Onyenweaku, C. E. and Nwaru, J. C. (2005) "Application of the Stochastic Frontier Production Function to the Measurement of Technical Efficiency in food production in Imo State, Nigeria" *Nigeria Agricultural Journal.*

Onyenweaku, C. E. Igwe, K. C. and Mbanasor, J. A. (2004). "Application of the Stochastic Frontier Production Function to the Measurement of Technical Efficiency in Yam Production in Nasarawa State, Nigeria". *Journal of Sustainable Tropical agricultural Research, Nigeria* 13: 20-25.

Plucknet, D.L and Philips, T.P and Kagbo R.B. (2002). A Global Development Strategy for cassava, transforming traditional Root Crop. Proc of Validation forum on the global Cassava Development Strategy. Rome, 26-28 April 2000p. 5-37.

Rahman, S., Hasan, M.K. 2008. Impact of environmental production conditions on productivity and efficiency: A case study of wheat farmers in Bangladesh. *Journal of Environmental Management* 88, 1495-1504.

Udoh, E. J. and Akintola, J. O. (2001). Measurement of technical Efficiency of Crop farms in Southeastern region of Nigeria. *Nigerian journal of Economics and Social Studies*. Vol. 43: pp. 93-104.

Yao, S and Liu, O. (1998). Determinant of Grain production and technical efficiency in China, *Journal of Agricultural Economics,* Vol. 49 (2). Pp 171-184.