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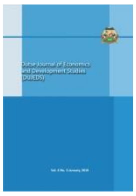

DETERMINANTS OF ACHA PRODUCTIVITY AND ITS CONTRIBUTION TO INCOME GENERATION AND EMPLOYMENT

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Abstract
Empirical studies have revealed the need for much attention on income generation in Kaduna state, which is the basis for this paper. This research will therefore examine the determinants of ACHA productivity and its contribution to household income generation and employment in Kaduna State. The starting point for empirical analysis exhibits a linear production function, so, the ordinary least squares (OLS) method was being employed. Purposive sampling method was used to select three local government areas from Southern Kaduna. The local government areas are Kagarko, Kachia and Jaba. The multi-stage sampling technique was used to select the respondents. Yamane's formula for calculating sample size was used to determine the sample size of 395. The findings of the study show that apart from being an efficient form of agricultural production, the business is a profitable business that contributes significantly to farmers' income. The also provides employment to about 14,545 people currently in the study area, but has the potential to provide additional 1,003,194 jobs in the state.

Keywords: Acha, Employment, Productivity Income Generation
JEL Classifications:

Introduction

The plant originated in West Africa dated back 7000 years ago and it thrives well in the sandy and rocky soils of the Sahel both in drought and flood, and grows so fast that two or three crops can be harvested each year (Morales, 2003). It grows well in Nigeria, mostly cultivated around Plateau, Bauchi, Kaduna and Niger states It is a staple food in these parts of Nigeria and across fifteen West African countries (Jideani, 1999). Hungry rice (acha), is a crop that fits well into the low-input farming systems of the resource-poor farmers as it has a unique ability to tolerate poor and marginal soils and can withstand drought (Aslafy, 2003).

The focus on acha is derived from the fact that agriculture and in particular acha production and export is one of the means that the government of Kaduna State can promote sustainable development and economic/revenue diversification. This is based on the fact that acha consumption is on the increase due to the increasing awareness of its nutritional value, yet its production has been very low ranging from 600-700kg/ha in West Africa and even lower (400-500kg/ha) in Nigeria.

Acha production and export (national and regional) can also play a significant role in raising household income and thereby reducing poverty, and above all providing the much needed jobs for the jobless citizens of the state. Despite its ancient heritage and widespread importance, knowledge about its production remains very scanty even within West Africa itself.

Based on the foregoing, this study provided answer to the research question; what is the contribution of Acha production to employment in Kaduna State? This research will therefore ascertain the determinants of 'ACHA' production and its contribution to employment in Kaduna State and the potential number of jobs 'ACHA' production could provide.

The hypothesis to be tested in this study is; $\mathbf{H_{01}}$: Acha production has not contributed significantly to employment in Kaduna State.

Theoretical Review

Input-Orientated Theory of Measurement

The subject of efficiency measurement started with Farrell (1957). Farrell illustrated his ideas using two inputs X1 and X2 to produce output Y. Frontier technology can be reflected by the unit isoquant, in a two-dimensional plane with the input-output ratios, Farrell proposed that efficiency of a producing unit consists of two components- technical efficiency, which reflects the ability of a firm to obtain maximum output from a given set of inputs and allocative efficiency, which reflects the ability of a firm to use the inputs in optimal proportion, given their respective prices. The two measures then combine to provide a measure of total economic efficiency. If a given farm uses quantities of inputs, defined by the point P, to produce a unit of output, the technical inefficiency of that farm could be represented by the distance QP, which is the amount by which all inputs could be proportionally reduced without a reduction in output. The technical efficiency (TE) of a producing unit can then be measured by the ratio:

$$TEI = OQ/OP \qquad (1)$$

If the input price ratio is also known, allocative efficiency may also be calculated. The allocative efficiency (AE) of the farm operating at P is defined to be the ratio:

$$AEI = OR/OQ \qquad (2)$$

Output – oriented theory of Measurement.

The work of Farrell was subsequently adjusted and extended by a large number of authors. Aigner and Chu (1968) considered the estimation of a parametric frontier production function in input/output space. They specified a Cobb-Douglas production function for a sample of n producing units as:

$$Ln(y_i) = f(\ln (X1), \beta) - u_i, \qquad i = 1, 2, 3, ------n \qquad (3)$$

Where: yi is the output of the ith farm; f (.) is a linear function; and Ui is a non-negative variable representing inefficiency in production. This is an output-oriented measure as opposed to the input-oriented measure. It indicates the magnitude of the output of the ith producing units relative to the output that could be produced by the fully efficient producing units using the same input vector. In the figure, the distance AB represents technical inefficiency. That is the amount by which outputs could be increased without requiring extra inputs. Hence:

$$TE0 = OA/OB \qquad (4)$$

If price information is available, then we can draw the iso-revenue line DD1 and define the allocative efficiency to be:

$$AE0 = OB/OC \qquad (5)$$

Empirical Review

A study by Godoy (2010) on Economic Importance of Agriculture for Poverty Reduction used panel data for 25 years and concluded that while economic growth generally was an important contributor to poverty reduction, the sector mix of growth mattered substantially, with growth in agricultural incomes being especially important.

A study by Maliki (2014) on access to credit facilities by farmers in Kaduna state used multiple regression and 4-point likert scale rating and concluded that commercial interest rate and collateral requirement charged by both formal and informal financial institutions, largely restricted farmers from seeking credit from these sources. Farmers secured credit from informal financial institutions than formal sources.

A study by Michael (2011) on Agricultural Finance and Development used panel data for 10 years and concluded that insufficient institutional credit is a major contributor to the persistent poor performance of the Nigerian agricultural sector.

Ajibuah (2008) used a panel data for 40 years to study Land use changes in Kaduna Metropolis. The result of the analysis indicate that Kaduna metropolitan area witnessed very rapid and dynamic transformation from the 1960s to 2000 as the urban built up area expanded nearly ten folds during the period

A study by Wilson (1998) on technical efficiency in UK potato production used a stochastic frontier production function to explain technical efficiency through managerial and farm characteristics. Mean technical efficiency across regions ranged from 33 to 97 percent. There was high correlation between irrigation of the potato crop and technical efficiency. The number of years of experience in potato production and small-scale farming were negatively correlated with technical efficiency.

A study by Liu and Jizhong (2000) on technical efficiency in post-collective Chinese Agriculture concluded that 76 and 48 percent of technical inefficiency in Sichuan and Jiangsu, respectively, could be explained by inefficiency variables. They used a joint estimation of the stochastic frontier model.

Awudu and Huffman (2000) studied economic efficiency of rice farmers in Northern Ghana. Using a normalized stochastic profit function frontier, they concluded that the average measure of inefficiency was 27 percent, which suggested that about 27 percent of potential maximum profits were lost due to inefficiency. This corresponds to a mean loss of 38,555 cedis per hectare. The discrepancy between observed profit and frontier profit was due to both technical and allocative efficiency. Higher levels of education reduced profit inefficiency while engagement in off-farm income earning activities and lack of access to credit increased profit inefficiency. The study also found significant differences in inefficiencies across regions.

Awudu and Erberlin (2001) used a translog stochastic frontier model to examine technical efficiency in maize and beans in Nicaragua. The average efficiency levels were 69.8 and 74.2 percent for maize and beans, respectively. In addition, the level of schooling representing human capital, access to formal credit and farming experience (represented by age) contributed positively to production efficiency, while farmers. Participation in off-farm employment tended to reduce production efficiency. Large families appeared to be more efficient than small families. Although a larger family size puts extra pressure on farm income for food and clothing, it does ensure availability of enough family labor for farming operations to be performed on time.

Positive correlation between inefficiency and participation in non-farm employment suggests that farmers re-allocate time away from farm-related activities, such as adoption of new technologies and gathering of technical information that is essential for enhancing production efficiency. The result indicated that efficiency increased with age until a maximum efficiency was reached when the household head was 38 years old. The age variable probably picks up the effect of physical strength as well as farming experience for the household head.

A study on gender differentials in technical efficiency among maize farmers in essien udim local government area, Nigeria by Simonyan (2011) estimated farm level technical efficiency for male and female farmers were 93 percent and 98 percent respectively. Results further indicated that the estimated production function revealed that farm size at 1 percent and quantity of fertilizer at 1 percent significantly influenced the maize production function for male farmers while farm size at 1 percent, labour at 5 percent, maize seeds at 10 percent and quantity of fertilizer at 10 percent significantly influenced that of the female farmers.

Methodology

The technical relations between output and inputs of Acha production follow the traditional production function which can be technically expressed as:

$$y_i = f(X_i, \beta).TE_i \qquad (6)$$

If the starting point for empirical analysis is a linear production function, then the ordinary least squares (OLS) method can be employed. If on the other hand, the data and distribution function exhibit constant elasticity of substitution (CES) of factors, or exponential characteristics, then y_i is the log of output and X_i is a vector of logs of inputs, including a 1 to take care of the intercept:

Explicitly, the functions are stated as:

$$\ell nY = \beta_0 + \beta_1 \ell nX_1 + \beta_2 \ell nX_2 + \beta_3 \ell nX_3 + \beta_4 \ell n_4 + \beta_5 \ell nX_5 + \beta_6 \ell nX_6 + \beta_7 \ell nX_7 + U_i \qquad (7)$$

That is outputs depends on inputs such as number of persons employed (L); Farm Assets (k); Fertilizer; Farm Size; Agrochemical; Farm Size, Farm Assets and other inputs.

Where:
Q = Output of Acha Produced (bag)
X_1 = Total labor in man-days (Family and Hired Labor in Man's Days)
X_2 = Fertilizer (Bags)

X_3 = Agrochemical (in Liter)
X_4 = Farm Size (Hectare)
X_5 = Farm Assets
X_5= Seedling (Kilograms)
U_i = Random Error Term/Disturbance Error Term.
Where,
β_0 = constant,
β_1-β_5 = estimated coefficients,
X_1-X_5 are as defined in Equation.

Purposive sampling method was used to select three local government areas from Southern Kaduna. The local government areas are Kagarko, Kachia and Jaba. The reason is that these three local government areas are those with the largest markets for Acha in the state. The multi-stage sampling technique was used to select the respondents.

Yamane's formula for calculating sample size was used to determine the sample size. While there are many formulas to calculate sample sizes, most of them require you to know features about the population, like the mean. The research employed the formulae formulated by Taro Yamane in 1964 as adjusted by Smith (1983) and cited in Aminu and Umar (2013).
First, using the adjusted Taro Yamane formulae for sample selection, four wards were randomly selected from each of the three local government areas making it a total of twelve (12) wards.

Discussion of Research Findings
Based on the afore-mentioned criteria, The Log-linear had the best fit and was selected as the lead equation for the analysis of input-output relationship (table 4.8).

Table 1: Linear, Log-Linear and Generalized Least Squares production Functions

	LINEAR			LOG-LINEAR			GENERALIZED LEAST SQUARES		
Variable	Coefficient		P-	Coefficient		P-	Coefficient		P-
	Unstand'd	Stand'd	Value	Unstand'd	Stand'd	value	Unstand'd	Stand'd	Value
Constant	18.769		.992	5786		.000	5.560		.000
Labour	9.225	.037	.478	.156	.019	.008	.159	.070	.000
Fertilizer	.553	.071	.153	.092	.060	.003	.113	.109	.000
Agrochemicals	-28.901	-.046	.360	-.027	-.025	.632	-.006	-.011	.626
Farm assets	21.320	.063	.172	.144	.107	.113	.153	.220	.000
Farm size	920.41	.391	.000	.495	.445	.002	.502	.511	.000
Seeds in kg	9.641	.257	.000	.131	.195	.010	.127	.124	.000
Other statistics:									
R-squared	.338			0.433			.999		
D-W	1.589			1.529			-		

Source: Computation from Author's survey (2018) using SPSS v19
Note: Unstand'd - unstandardized coefficient Stand'd - standardized coefficient

The econometric equations were estimated and the Log-linear was chosen as the lead equation and used to determine resource-use efficiency. The generalized function which was chosen as the lead equation was based on both econometrics and statistical criteria like R^2, D.W statistics, and F-ratios and the number of variables that were significant and so on. The adjusted R^2 (43%) which measure the goodness of fit, is in conformity with a priori expectations. In respect of the signs of the estimated coefficients, all but one of the explanatory variables in the model met up with the *a priori* expectation and. With the exception of agrochemical in the model was statistically significant indicating their individual contributions as determinants of Acha production. This agrees with the findings of previous studies by Awoniyi (2006), Izekor and Olumese (2010) and Shehu et al. (2010) in Ekiti, Edo and Benue States respectively. Discussions with the farmers revealed that most of them deliberately adopted low usage of herbicides because of the beliefs that its application reduces yield of such crops. The choice of the Log-linear is appropriate as it account for the unequal variability of the depended variable (y, which is output per farmer) of the three local government areas. With Log-linear, observations coming from local government with greater variability are given less weight than those coming from population with smaller variability (that is, closely cluster around their population mean). With GLS the result is so spurious that the R^2 is almost perfect.

The R^2 is .43.3% which goes on to suggest that 43.3% variation in Acha output can be explained by variation in any of the explanatory variables and about 57% are due to error term that is other factors not captured by the model.

The results of the econometric estimation show the production elasticity of labour is significant ($p < 0.05$) and conform to the *a prori* expectation of the positive signs of the coefficient and in line with economic theory. The significance and positive coefficient of the Acha output implies that labour positively and significantly affect output. This means availability of manpower (labour) serves as incentives to farmers, that is, the marginal productivity of labour to output is positive. The positively sign labour coefficient implies that an increase labour by 1% will lead to increase in output of Acha, on the average by 15.6%. Since it is a double log function the coefficient of labour also serve as the labour elasticity of supply. This confirms the analogy that agriculture is still labour-intensive in the state. That explains why farm assets are insignificant.

Estimated Total Revenue Function

Table 2: Estimated Revenue Function

Variable	LINEAR			NON-LINEAR					
	BIVARIATE (LEVEL)			BIVARIATE (LOG)			MULTIVARIATE (LEVEL)		
	Coefficient		P-	Coefficient		P-	Coefficient		P-
	Unstand'd	Stand'd	Value	Unstandard'd	Standard'd	Value	Unstandard'd	Stand'd	Value
Constant	-506.18	-	.091	-1.176		.007	1279.52		.905
Output (y_1)	0.736	0.666	000	1.084	.747	.000	0.872	0.790	.665
Output (y_2)	-	-	-	-	-	-	-2.209E-7	-.003	.097
Output (y_2)	-	-	-	-	-	-	3.949	-.122	.098
Other statistics:									
R-squared	.0.666			0.747			.666		
D-W	2.383			2.379			2.378		

Source: Computation from Author's survey (2018) using SPSS 17
Note: Unstand'd - unstandardized coefficient: Stand'd - standardized coefficient

From table 2 the nonlinear bivariate log function is chosen as the lead equation of the revenue functions. The result shows that revenue function is the most appropriate and is properly sign. The R^2 is .747 which goes on to suggest that 75% variation in revenue can be jointly explained by the explanatory variables and that only about 25% are due to error term that may not be capture by the model.

The output is significant at 0.05 level of significance given that the p-value of the estimate is 0.000 which far less than the significant level ($p < 0.05$) and conform to the *aprori* expectation of the positive signs of the coefficient and in line with economic theory. The significance and positive coefficient of the Acha revenue implies that Acha output significantly and positively affect household income. Therefore, Acha output is a significant component of revenue. The positive sign coefficient implies that an increase in Acha output by one unit will lead to increase in revenue by 108% or more.

Estimated Constraints Function

$$\ell ny = 4.60 + 0.3165\ell nL + 0.243\ell nFERT - 0.106\ell nAGROCHEM + 0.453\ell nEQUIP + 0.702\ell nLAND + 0.327\ell nSEEDLING \quad \text{………….(8)}$$

For the total cost function:

$$\ell nTC = 38.701 + 1.314\ell nL + 0.289\ell nFERT - 0.311\ell nAGROCHEM + 0.692\ell nEQUIP + 0.41\ell nLAND + 0.341\ell nSEEDLING + 0.410\ell nTAX \quad \text{-………………….. (9)}$$

For the total revenue function:

$$\ell nTR \equiv \overline{P} * \ell ny = 56.65 + 1.62\ell nL + 1.15\ell nFERT - 0.061\ell nAGROCHEM + 1.56\ell nEQUIP + 5.12\ell nLAND + 1.294\ell nSEEDLING$$ ------------(10)

For The Profit Function

$$\ell n\pi \equiv \ell nTR - \ell nTC = 43.95 + 0.426\ell nL + 4.141\ell nFERT - 1.411\ell nAGROCHEM + 1.518\ell nEQUIP + 4.35\ell nLAND + 0.382\ell nSEEDLING - 00.62\ell nTAX$$ ……………………(11)

From equation 1, we make ℓnL the subject:

$$\ell nL = -54.97 + 4.3\ell ny - 0.79\ell nFERT - 0.298\ell nAGROCHEM + 0.26\ell nEQUIP - 4.16\ell nLAND - 2.39\ell nSEEDLING$$

$$\frac{\partial \ell nL}{\partial \ell ny} = f'(L_Y) = 4.3 - 8.16\ell nLAND + 2.459\ell nSEEDLING$$ --------------------------- (12)

This determined marginal contribution of Acha production to employment from Acha production.

$$\int_{yopt}^{y\max} f'(L_Y) * dy = 63(\ell n_{\max}) - 63(\ell n_{opt})$$ -----------------------(13)

To make tax the subject:

$$\ell nTAX = 1447.5 + 50\ell n\pi + 10.8\ell nL + 52.05\ell nFERT - 51.1\ell nAGROCHEM + 70.9\ell nEQUIP + 241\ell nLAND + 4.6\ell nSEEDLING$$ ----------- (14)

To get the marginal elasticity, we used the product rule:

$$\frac{\partial \ell nTAX}{\partial Y} = \frac{\partial \ell nTAX}{\partial \pi} * \frac{\partial \pi}{\partial \ell nY} = f'_{TAX} * \int_{\pi}^{'} = 50 * (1.789) = 85.45$$ ----------- (15)

$$\frac{\partial \ell nTAX}{\partial \pi} = 50, \qquad \frac{\partial \pi}{\partial \ell nY} = 1.789$$

The Langragean Functions

To get the Potential Tax Receipt:

--------------- (16)

$$\int_{y_{opt}}^{y_{\max}} f'_{tax} * \int_{\pi}^{'} dy = (50 \times 1.709\ell ny) - (50 \times 1.70\ell ny_{opt})$$

$$H_{MAX} = \ell ny - \lambda M$$ --- (17)

$$\frac{\partial H}{\partial \lambda} = 14.196 + 1.968\ell nL + 0.121\ell nFERT - 0.489\ell nAGROCHEM - 0.11\ell nEQUIP + 0.052\ell nLAND - 0.41\ell nSEED - 0.032\ell nTAX$$

$$\frac{\partial H}{\partial \ell nL} = 0.189 + 1.968\lambda$$ ------------------------ (18)

$$\frac{\partial H}{\partial \ell n_{FERT}} = 0.213 + 1.121\lambda$$ ------------------------- (19)

$$\frac{\partial H}{\partial \ell n_{AGROCHEM}} = -0.006 + 0.489\lambda$$ ----------------- (20)

$$\frac{\partial H}{\partial \ell n_{EQUIP}} = 0.153 + 0.0.11\lambda$$ ----------------- (21)

$$\frac{\partial H}{\partial \ell n_{LAND}} = 0.502 + 0.52\lambda$$ ----------------- (22)

$$\frac{\partial H}{\partial \ell n_{SEED}} = 0.127 + 0.415\lambda$$ ----------------- (23)

$$\frac{\partial H}{\partial \ell n_{TAX}} = 0.032\lambda$$ ----------------- (24)

Table 3: Matrix Form of the Production Function

$$\begin{vmatrix} 1.968 & 0.121 & 0.489 & 0.11 & -0.025 & 0.14 & 0.032 \\ 0.159 & 0 & 0 & 0 & 0 & 0 & 1.968 \\ 0 & 0.113 & 0 & 0 & 0 & 0 & 0.121 \\ 0 & 0 & -0.06 & 0 & 0 & 0 & 0.489 \\ 0 & 0 & 0 & 0.502 & 0 & 0 & 0.11 \\ 0 & 0 & 0 & 0 & 0.127 & 0 & 0.418 \\ 0 & 0 & 0 & 0 & 0 & 0.032 & 0 \end{vmatrix} * \begin{vmatrix} 36.196 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{vmatrix} = \begin{vmatrix} \ell n\lambda \\ \ell nL \\ \ell nFERT \\ \ell nAGROCHEM \\ \ell nLAND \\ \ell nSEED \\ \ell nTAX \end{vmatrix}$$

Using the Inverse of the MINVERSE, MMULT, MD TERM of EXCEL2010, Solve For

$\ell n\lambda, \ell nL, \ell nFERT, \ell nAGROCHEM, \ell nLAND, \ell nSEED, \ell nTAX$

$$\ell n\hat{\lambda} = 5.04221$$

$$\ell n\hat{L} = 8.59113$$

$$\ell nF\hat{E}RT = -3.2955$$

$$\ell nAGROCHEM = 1.65714$$

$$\ell nL\hat{A}ND = 1.6232$$

$$\ell nEQ\hat{U}IP = 6.67305$$

$$\ell nS\hat{E}ED = 0$$

$$\ell nT\hat{A}X = -2.6498$$

Substituting the optimal values into the output function, we obtain the optimal value Thus:

$$\ell\hat{Y} = 3.46 + 4.294 - 3.647 - 2.028 + 2.103 + 0.176 \quad \text{-------------} \quad (25)$$

$$\ell\hat{Y} = 4.273$$

This is the optimal output Optimal output $(\ell\hat{Y}) = 4.2732$; antilog (2.1732) = 186.48

Maximum output = 5.41; antilog (8.91) = 17,047.95

Contribution to Employment:

$$\int_{186.48}^{13047.95} 78(\ell nY) = 78(13047.95) - 78(186.48) \quad \text{-----------------}(26)$$

$$= 1017740.1 - 14545.44 = 1,003,194.66$$

$$\text{So } \hat{\hat{L}} \approx 1,003,194$$

This shows that if Acha farmers were to operate at optimum level additional 1,003,194 of jobs would be available thereby employing additional 1,003194 men in the production. By this, Acha production contributes to employment to that very amount.

Conclusion and Recommendations

The findings of the study show that apart from being an efficient form of agricultural production, the business currently provides employment to about 14,545 people in the study area, but has the potential to provide additional 1,003,194 jobs in the state.

The result from the production efficiency shows that 89 percent of the variation in output was accounted for by the explanatory variables. The results show that farm size, seed, fertilizer and labour were the significant or important inputs in Acha production that explain the variability in Acha output. Farm size was significant at 5%. Seed, fertilizer and labour were significant at 5%. Agro-chemical is not significant at 5% level. The return to scale analysis showed increasing return to scale. The farmers are relatively small-scale farmers, cultivating on the average 2.41ha.

Certain problems are identified as the major problem that limited attainment of higher outputs of Acha production during the year. These include volatile price, unavailability of input like fertilizer and agro-chemicals at the right time, shortage of labour during peak periods of labour demand, transportation problem, lack of credit, diseases processing problem theft and marketing problem.

The study recommends that more involvement in the production of Acha should be encouraged. This will invariably provide more jobs to the teaming unemployed youths in the state. The state agricultural policy should target the entire 97,190 active farming households by providing incentives and promoting the cultivation of Acha in those three local government areas well-known for the production of the produce. The Acha enterprise should be made more attractive to both the old and the young, through the protection of cultivators from incurring loss by stimulating a support price for Acha.

Acha farmers must also access improved technology such modern machines and other farming implements. This will replace the traditional and crude method use by majority of the farmers thereby making more efficient the production, hence the increase in the volume of Acha production.

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