

Investigation of Factors Affecting Technical Infancy of Akpu Processing in Delta State, Nigeria

A. I. N. Kaine

*Department of Economics, Novana University, Ogume, Delta State, Nigeria.
Telephone: 08038822372, 08057395579; E-mail: kainatonne@yahoo.com,
kainatonne@gmail.com*

KEYWORDS Akpu. Processing. Technical Inefficiency. Stochastic Frontier

ABSTRACT The study examined the factors affecting technical inefficiency of akpu processing in Delta State. Data were obtained from 285 farmers involved in akpu processing in the State using a structured questionnaire. The information generated was coded and analyzed using stochastic frontier production function methodology. The estimated results show that age ($b = 0.250$) and household size (-0.270) were positively related to inefficiency of akpu processors while education ($b = -1.020$) and processing experience (-0.260) were negatively related to inefficiency of akpu processors. Education was 10 percent (critical $t = 1.533$) level of significance.

INTRODUCTION

Cassava roots are perishable and contain potentially toxic glycosides, therefore, they need to be processed (Sanni et al. 2008). In line with this, Nweke (2003) reported that cassava cyanogens can be eliminated during processing by using well-known traditional processing method. He further noted that, today cases of cyanide poisoning from cassava consumption are now rare and the fear of it therefore, should not discourage public or private investors in the cassava food investment.

Processing of cassava roots prior to consumption is essential because of its cyanide content and generally, they do not store for a very long time after harvest. IITA (2005), CCDN (2008), and Ndalima (2008) noted that there is need to process cassava roots within 24 to 48 hours after harvesting due to its toxicity and perishability. Hahn and Onobolu (1988) on the other hand, remarked that it is only sweet cassava with low HCN content that can be consumed without processing. Chukwuji et al. (2007) added that proper processing and preservation of harvested produce minimize post-harvest losses and thus help to offset shortage in food supply and increase the shelf life.

Oke (2005) reported that approximately 16 percent of cassava roots produced in Nigeria in 2001 was used as chips in animal feed, 51 percent was processed into syrup concentrate for soft drinks, and less than 1 percent was processed into high quality cassava flour used in biscuits and confectionary, dextrin pre-galled starch for

adhesives, starch and hydrolysis's for pharmaceuticals, and seainings (Kormawa and Akoroda 2003). These estimates left about 84 percent or 23.9 million tones of production for food consumption.

Processing involves the conversion of agricultural produce (otherwise known as inputs) to a transformed product (output). It also involves size, weight reduction. Cassava processing leading to size reduction comprise combination of activities such as peeling, soaking, grating, fermenting (which removes the toxic substance through the use of hydrolyzing enzymes), frying, slicing, sieving, dewatering, drying, boiling, steaming (which eliminates HCN) etc. (IITA 1992; Abolaji et al. 2007; CCDN 2008; Ndalima 2008). The end products desired determine the number of processing activities.

Cassava processing activities are usually carried out by children, women and men depending on the stage of operation (IITA 1992 and Kaine 2009). Abolaji et al. (2007) and Sanni et al. (2008), however, observed that cassava processing in Nigeria is carried out mainly by traditional method, which has a number of undesirable attributes such as time and energy consuming and provides low yields. Processed products include: garri, akpu, fufu, cassava flour, abacha, starch, tapioca and kpo kpo garri.

Akpu is a pasty product of cassava, the processing of which involves fermentation. The roots are soaked in water for three to five days, during which time the roots soften and ferment. The soaked roots are manually crushed and sieved in water using basket or perforated metal

bowl in a sack submerged in water. The fermented cassava is boiled or cooked and pounded. Pounding changes the texture of the previously prepared crop to a more palatable, pasty consistency. The cooked and pounded pasty product is molded, wrapped in cellophane, sold in rural and urban markets. Prepared akpu can be eaten with egusi (melon) soup, stew or served with vegetables. Fermented cassava tubers (akpu) are represented in Figure 1 while Figure 2 shows cooked and pounded pasty product.

Efficiency is an important aspect in agricultural production. Technical efficiency and pro-

ductivity are measures of performance. While productivity is easy to derive, given that it is the ratio of output to any given input, "technical efficiency" is a more elaborate concept. It is a component of the broader notion of "economic efficiency". It is often assumed that factors affecting technical efficiency are due to household specific demographic characteristics (Unai 2004).

Studies in efficiency are important. Ogunfowora et al. (1978) observed that gains in efficiency are particularly important in period of financial stress. Efficient farms (Alabi 2003 and Osuji 1978) are more likely to generate higher income and thus stand a better chance of surviving and prospering. Efficiency could be helpful in determining the cost of several poverty focused programmes being established by the government (Dittoh 1994). Furthermore, efficiency analysis will enable comparison of the attributes of the farms operating near the frontier with those operating far from the frontier (Alabi 2003), and importantly in this era of deregulation, efficiency will be the key determinants of small-holder farm survival.

Results on technical efficiency are used to estimate the effects of various factors on efficiency. This is because, technical inefficiency scores obtained from the production frontier approach have a very limited use for policy and management purposes if empirical studies don't investigate the sources of inefficiency (Dimeke 1998).

Not much study has been made to establish the degree of technical inefficiency of akpu processors particularly in Delta State. It is against this background that this study was undertaken to examine the level of and factors affecting technical inefficiency of akpu processing in Delta State.

METHODOLOGY

The study area is Delta State. Delta State is comprised of 25 Local Government areas with a total population of about 4,098,391, by the 2006 census figure (N P C 2006). The land area of the State is about 17,440 square kilometers. About one-third of this is swampy and waterlogged. The State is sub-divided into three agricultural zones, which include: Delta North, South, and Central corresponding to the three senatorial districts in the State. Each of these zones is engaged in one form of agriculture or the other.

The State lies roughly between longitude 5000" and 6045" East and latitude 5000" and 6030"



Fig. 1. By-product of fermented cassava tubers (Akpu)



Fig. 2. Pasty product (akpu)

North of equator. It is bounded on the north by Edo State, east by Anambra State and Rivers State, on the south by Bayelsa State. The Atlantic Ocean forms the western boundary while the north-west boundary is Ondo State (Delta State Diary 1993 and 2007).

The State is richly endowed with fertile agricultural land suitable for the growth of various tropical crops and good fodder for domestic animal. Major crops grown include oil palm, citrus, rubber, yam, cassava, and pepper. Others are mango, cocoa, maize, egusi (melon), groundnuts and various vegetables. Pigs, goats, sheep, poultry constitute the important livestock enterprises. People living in the riverine area in addition to crop farming, practice fish farming. With 160 kilometer coastline, numerous rivers and waterways, Delta State has vast and rich fisheries resources. Forestry products include swan, timber, bamboo, paper and board.

Data collected include, sources of labour/processing materials, methods, stages, cost of labour, task performed and revenue generated. Data on social characteristics of akpu processors such as age, household size, composition, educational level, years of experience were also collected.

In order to estimate and analyze the factors affecting technical inefficiency of akpu processors, the Stochastic Frontier Analysis (SFA) was used. It is an econometric analytical technique, which allows for variation in output of individual producer from the frontier of maximum achievable level to be accounted for by factors, which cannot be controlled by the firm. A stochastic production frontier comprises a production function of usual regression type with a composite disturbance term equal to the sum of the two error components (Aigner et al. 1977). The first error component accounts for factors such as measurement error in output variable, weather, topography, distribution of supplies, combined effects of unobserved inputs on production and so on. The other component captures the existence of technical inefficiency. Technical inefficiency arises when actual or observed output from a given resource mix is less than the maximum possible. Inefficiency in developing country agriculture, is as a result of subsistence needs, socio-economic and demographic characteristics of the farmers. Other factors that may affect efficiency of the farm are experiences, information, supervision contact and credit availability (Alabi and Osifo 2005).

Stochastic Frontier Production Function and Inefficiency Model

The empirical model of stochastic frontier production function (Aigner et al. 1977) is specified as:

$$\ln Q = \alpha_0 + \beta_1 \ln X_{1ji} + \beta_2 \ln X_{2ji} + \beta_3 \ln X_{3ji} + \beta_4 \ln X_{4ji} + \beta_5 \ln X_{5ji} + \beta_6 \ln X_{6ji} + \beta_7 \ln X_{7ji} + \beta_8 \ln X_{8ji} + \beta_9 \ln X_{9ji} + (V_i - U_i) \dots \dots \dots (1)$$

The subscripts i refers to the i - th cassava farmer processor.

Where

- Q = Total value of processed output (N)
- X₁ = Quantity of cassava tubers (kg)
- X₂ = Depreciated or fixed cost (N)
- X₃ = Family (Household) labour (Mandays)
- X₄ = Hired labour (Mandays)
- X₅ = Expenses on fire wood (kg)
- V₁ = A random error term independently and identically distributed with mean zero and δv^2 , intended to capture events beyond the control of the cassava farmers processors.
- U_i = Non-negative random variable called technical inefficiency effects associated with technical inefficiency of cassava farmers processors involved. It is assumed to arise from a normal distribution with a mean variance δv^2 , which is truncated at zero. If U_i = 0 no allocative inefficiency occurs, the production/processing lies on the stochastic frontier. If U_i > 0, production/processing lies below the frontier and is efficient.

Inefficiency Model

The average level of technical efficiency measured by the mode of truncated normal distribution (ie U_i) is a function of socio-economic factors as shown in equation below.

$$U_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5$$

Where U_i = Inefficiency function

- Z₁ = Age of cassava farmer processor (years)
- Z₂ = Educational level attained (years)
- Z₃ = Years of processing experience
- Z₄ = Household size

α 's, β 's and γ 's coefficients are unknown parameters which are expressed in term of $\delta^2 = \delta v^2 + \delta u^2$ $\gamma = \delta u^2 / \delta s^2$

Where the γ - parameter has value between zero and one. The parameters of stochastic

frontier production function model were obtained by Maximum Likelihood estimation model using the Computer Program, FRONTIER VERSION 3.1.

RESULTS AND DISCUSSION

A summary statistics of the socio-economic characteristics of akpu processors shows that age of akpu processors studied ranged between 30 and 51 years with a mean age of 47 years. The results implies that akpu processors in the study area were relatively old, a condition that may make processors to be conservative and resistant to innovation adoption, which may affect their productivity.

The average year of formal education, household size and processing experience were 9, 7 and 15 respectively. This indicates that literacy level of processors was relatively high as majority (85.3 percent) acquired formal education. Family size is large and processors were well experienced.

As indicated in Table 1, 59.91 percent of akpu processed were sold, in order to meet other financial commitments. This implies that akpu is of great economic importance. The result also shows that an average of 32.33 percent of akpu processed was consumed while about 8 percent were given out.

The maximum likelihood estimate of akpu processing is as shown in Table 2. The estimated coefficients for, quantity of cassava tubers ($b = 0.277$), fixed cost (0.874) and hired labour (0.255) were statistically significant and positively related to the value of processed akpu. The variable quantity of cassava tubers and fixed cost were significant at 5 percent. The result indicates that an increase in supply of the quantity of cassava tubers will increase output of akpu processed. The result also shows that increase in investment in processing equipment will increase akpu output. The parameter, hired labour was positively significant at 10 percent level. This suggests that akpu processing is labour intensive. It also implies that increase use of hired labour will lead to increased akpu processed. The variable

Table 1: Uses of akpu by respondents (%)

Uses	Mean (%)
Consumed	32.33
Sold	59.91
Given out	7.76
Total	100.0

firewood ($b = 0.574$) was negative and statistically significant at 5 percent level. This implies that the variable had a negative effect on akpu output and by increasing the variable in production process can bring a less than proportional addition to the output. Similar result was obtained among agro forest farmers.

Technical Inefficiency Analysis

The determinants of inefficiency of akpu processing were examined by using the estimated δ coefficients associated with inefficiency effects as in equation 2. The inefficiency effects are specified as those relating to age of akpu processors, education, processing experience and household size. The inefficiency model estimates is presented in Table 3.

The estimated coefficient of age ($b = 0.593$) of akpu processors is positive and statistically significant at 10 percent level. This implies that older akpu processors are more technical inefficient than the younger processors. The coefficients, education (-0.618) and processing experience (-0.653) are negatively related to technical inefficiency. The negative estimated

Table 2: Maximum likelihood estimates

Variables	Parameter	Coefficient (b)	t - ratio
Constant	B_0	0.168	0.080
Cassava tubers	B_1	0.277*	2.450
Depreciated cost	B_2	0.874*	3.650
Family labour	B_3	0.195	1.370
Hired labour	B_4	0.255*	1.900
Firewood	B_5	-0.536	-2.57
Sigma-squared	52.490	19.090	1.800
Gamma	0.993	0.843	7.130

Log likelihood = 98.458

*Estimate is significant at 5 percent (critical $t = 2.132$) and 10 percent (critical $t = 1.476$)

Source: Computed from survey data 2008

Table 3: Technical inefficiency model estimation

Variables	Parameters	Coefficient	t-ratio
Constant	δ_0	-27.405	-1.340
Age	δ_1	0.539*	1.830
Education	δ_2	-0.618*	-2.180
Processing experience	δ_3	-0.653	-1.580
Household size.	δ_4	1.044	1.310

*Estimate is significant at 5% (critical $t = 2.132$) and 10% (critical $t = 1.533$)

Source: Computed from survey data 2008

coefficient of education and processing experience variables implies that an increase in any of these variables would lead to a decline in the level of technical inefficiency of akpu processors. This shows that educational attainment and processing experience of akpu processors decreased technical inefficiency and increased technical efficiency. Similar result was obtained among small scale farmers.

The estimated coefficient of household size (1.044) is positively related to technical inefficiency. This implies that large household size reduces the efficiency of the processors. This is so because, large household size constitutes a drain on the resources of the processors. Similarly, large household size increases household consumption and expenditure thereby making little money available for purchase of necessary inputs.

CONCLUSION

This empirical study revealed the technical inefficiency that exists in akpu processing. Among the factors, which were found to significantly influence the level of inefficiency among the processors were, level of educational attainment, processing experience, age and household size. The implication of the study therefore, is that the level of efficiency among akpu processors in Nigeria could be increased by increased investment in processing equipment and in cassava production.

REFERENCES

- Abolaji DD, Sinyanbola WO, Afolabi OO, Oduola IA 2007. Capacity innovations in cassava production, harvesting and processing in Nigeria. <http://209.85.165.104/search?q=cache:4aywky/folsJ:globelics2007.sstu.ry/globelics> (Retrieved September 2, 2008).
- Aigner DJ, Lovell CAK, Schmidt P 1977. Formulation and estimation of stochastic frontier production function models. *Journal of Econometric*, 6(1): 21-28.
- Alabi RA 2003. Human capital as determinant of technical inefficiency of Cocoa based Agro-forestry Farmers in Oyo State. *Journal for Food, Agriculture and Environment*, 3 and 4: 277-281. www.worldfoodnet.org. (Retrieved September 2, 2008)
- Alabi RA, Osifo AA 2005. Population density and technical efficiency of cocoa-based agro forestry. *Bowen Journal of Agriculture*, 2(2): 216-224
- Cassava Cyanide Diseases Network (CCDN) 2008. Cassava processing for storage and to remove cyanide compounds. Towards the elimination of *Konzo*. TAN other cassava diseases. <http://www.anuredu.edu/AU/BOZO/CCDN/SIX.html> (Retrieved September 2, 2008).
- Chukwuji CO, Inoni OE, Ike PC 2007. Determinants of technical efficiency of garri processing in Delta state, Nigeria. *Journal of Central European Agriculture*, 8(3): 327-336.
- Delta State Diary 1993, 2007. *Delta State Diary*. A Publication of Delta State Government Federal Republic of Nigeria.
- Dimeke BE 1998. *Economics of Soil Conservation: Review of Literature and Dynamic Non-Linear Optimization Model with Risk and Uncertainty. A Case Study for Aude't Tid Area, Ethiopia*. Thesis. Duraisamy: Wageningen Agricultural University.
- Dittoh JS 1994. Critical Issues in Planning for sustainable Agriculture Development in Nigeria. *A Paper Presented at the Center for Econometrics and Allied Research*. University of Ibadan, Ibadan.
- Hahn ND, Onabolu A 1988. *Potential of Sweet (Low cyanide) Cassava as a Household Food Security Crop, Cassava Based Cropping Systems Research II*. Ibadan: IITA.
- International Institute of Tropical Agriculture 1992. *Traditional Processing and Utilization of Cassava in Africa. IITA Research Guide 41*, Ibadan, Nigeria. IITA Publication. Ibadan: IITA.
- International Institute of Tropical Agriculture 2005. *Cassava Home "Research for Development" Root and Tuber Systems*. Ibadan: IITA Publication.
- Kaine AIN 2009. Economic analysis of alternative cassava processing technologies. A case study of delta North agricultural zone, Delta State, Nigeria. *Journal of Science and Technology*, 8(1): 73- 78.
- Kormawa P, Akoroda MO 2003. *Supply Chain Arrangement for Industrialization in Nigeria*. Ibadan: IITA.
- Ndaliman MB 2008. Development of Cassava Grating Machine. A -Dual-Operational Mode. *Leonardo Journal*. http://jsacademicdirect.org/A09/103_110 (Retrieved September 16, 2009).
- Nweke FI 2003. New challenges in the cassava transformation in Nigeria and Ghana. *Paper presented at the In WENT, IFPRI, NEPAD and CTA Conference on Success in African Agriculture*. Pretoria. December 1-3, 2003.
- Ogunfowora D, Essang SM, Olayid SO 1978. Resource productivity in traditional agriculture. A case study of four agricultural divisions in Kwara State of Nigeria. *Journal of Rural Economics and Development*, 9(2): 117-132.
- Oke OL 2005. Cassava yesterday and tomorrow. *Ife lectures series, No 7*. The Post-Graduate College, Obafemi Awolowo University, Ile-Ife, Nigeria.
- Osuji LO 1978. *Resource Productivity In Traditional Agricultural. A Study of Some Selected Villages in Imo State of Nigeria*. Ph.D Thesis. Ibadan: University of Ibadan.
- Sanni MO, Sobminwa AO, Modupe-Eyinla C, Rosling H 2008. Safety aspects of processing cassava to garri in Nigeria. *ISHS Acta Horticulture 375*. International Workshop on Cassava Safty. (http://www.actahort.org/books/375/375_22.htm. Retrieved September 16, 2009).
- Unai P 2001. *Soil Degradation and Technical Efficiency in Shifting Cultivation: The Case of Yucatan (Mexico). Poverty and Land Degradation in Traditional Agroecosystems*. Environment Department, University of York and Centre for Food Agriculture and Resource Economics, University of Manchester.