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Economic Analysis of Resource Use Efficiency among Small Scale Cassava Farmers in Nasarawa State, Nigeria: Implications for Agricultural Transformation Agenda

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ABSTRACT

The study examined the resource use efficiency in cassava production in Nasarawa State, Nigeria and its implication for the transformation agenda of government at wealth creation. Data used for the study were obtained using structured questionnaire administered to 360 randomly selected small scale cassava farmers in 36 villages in nine of the thirteen local government areas of the state in 2009 and 2010 farming seasons. Data collected were analysed using descriptive statistics, stochastic frontier production function and marginal analysis model. Findings revealed that farmers were inefficient in the use of resources. The technical efficiency of the farmers varied from 0.342 to 0.971 with mean value of 0.873. The quantity of fertilizer applied, labour used and cassava cuttings were over utilized while land and herbicides used were under- utilized. The result showed that appropriate adjustment is required for optimum allocation of resourcesto the cultivation of cassava in the study area.

Keywords: resource use efficiency, technical efficiency, stochastic frontier, cassava production, Nasarawa state.

INTRODUCTION

Agriculture in Nigeria is dominated by small scale farmers who are engaged in the production of the bulk of food requirements of the country (Asogwa*et al*, 2006). In spite of the fact that these small scale farmers occupy a unique and pivotal position, they belong in the poorest group of the population and as such cannot invest much on their farms (Asogwa*et al*, 2006). According to Ajibefun (2002), the vicious circle of poverty among these farmers has led to the unimpressive performance of the agricultural sector. Thus, resources must be used more efficiently, which entails eliminating waste, thereby leading to increase in productivity and incomes (Ajibefun and Daramola, 2003). Cassava *(manihotesculenta*, Crantz) is an important root crop in Nigeria. It plays an important dietary role in many parts of tropical Africa. The importance of cassava as an efficient and economic source of energy in intensive cropping system and its reliability under adverse conditions and adaptability to wide ecological range have made it an attractive crop to farmers (Erhabor*et al*, 2007). In sub-Saharan Africa, the annual per capita consumption of cassava is 103kg which is far higher than maize (40kg), banana/plantain (28kg), sorghum (23kg), yam (28kg) and millet (17kg) in the region (IITA, 2004). Expansion of cassava production has been relatively steady since 1980 with additional push between the year 1988 and 1992 owing to the release of improved IITA varieties (Nweke, 2004).

Nasarawa state is the third largest producer of cassava after Kwara and Kogiwith production figure of 14,586kgper hectare (FMARD, 2010). Prior to the pronouncement of the Presidential initiative on cassava production one of strategies of the past Federal Government National Economic Empowerment and Development Strategy (NEEDS) whose objective was to generate US$5.00billion from cassava export (NPC, 2005). As a result of the use of cassava as an industrial crop, cassava has been categorized as a cash crop to the extent that a Presidential initiative on cassava production and the transformation agenda was inaugurated with the aim of achieving on annual basis foreign exchange from cassava export and the replacement of 20% wheat flour in the production of bread in Nigeria. Cassava could also be processed into ethanol which can be used as a complement to

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petroleum. Thus with these production capacity needs to be increased such that rising demand will be met. One of the ways by which this could achieved is to improve the productivity of small scale cassava farmers in the study area. Farmers will be guided on the inputs to focus on, thereby improving the efficient use of scarce resources in cassava production. This will in turn increase their income and their standard of living. The broad objective is to examine the resource use efficiency of small scale farmers in the study area. The specific objectives are to: determine the socio-economic characteristics of farmers, and determine the input use in the production of cassava in Nasarawa state.

MATERIALS AND METHODS

Area and Scope of the Study

The study was conducted in the nine of the thirteen local government areas in Nasarawa state, Nigeria. The state occupies a landmass of 27,802.01 square kilometers and apopulation of 1,863,275 people (NPC, 2007). It is located between latitudes 7^0 and 11^0 North and longitude 7^0 East. There are estimated 180,433 farm families with average family size ranging from 6-8 persons. The mean rainfall ranges from 1,200mm to over 2,000mm and the rainy season can last up-to 205days in some part of the state. The vegetation consists mainly of short grasses, shrubs and scattered trees (NADP, 1998). The state is agrarian and well suited for production of arable crops such as cassava, yam, maize, sorghum, millet, rice, cowpea, beniseed, cocoyam and sweet potato.

Sampling Technique

The data used were drawn from primary source with structure questionnaire. The questionnaires were administered on 360 farmers in 36 villages in the three ecological zones of Nasarawa state through a multistage sampling procedure. The first stage involved the random selection of three (3) local government areas in the three ecological zones of the state. In the second stage, four (4) villages were randomly selected in each of the local government areas from the list of the villages obtained from Nasarawa State Agricultural Development Project (NADP, 2002). The selected local government areas were; Doma, Lafia, Obi, Nasarawa Eggon, Wamba, Kokona, Nasarawa, Toto and Keffi. In the final stage, ten (10) farmers were drawn from each of the 36 villages randomly based on the sampling obtained from the report of the village listing survey conducted in the state (NADP, 2002). In all 360 smallscale cassava farmers were interviewed using trained enumerators who administered the well structured questionnaire in two seasons of 2009, and 2010 in the 36 villages. Primary data collected focused on socio-economic characteristics of the respondents, input used, cassava outputs and their prices.

ANALYTICAL TECHNIQUES

Descriptive Statistics

The data collected for the two seasons of 2009 and 2010 were subjected to descriptive statistics such as frequency distribution and percentages to determine the socio-economic characteristics of the farmers in the state.

Stochastic Frontier

The stochastic frontier production function was used to analyse the efficiency of inputs used in the production of cassava by farmers in the study area. A production frontier is defined in terms of maximum output that can be achieved from a set of inputs given the technology available to the farm. The production technology of the farmers was specified by the Cob-douglas frontier production function defined by Coelli (1995) as:

$$\text{Log } \Upsilon = b_0 + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + (V_i - U_i) \quad (1)$$

Where

Log = Natural logarithm

Υ = quantity of cassava produced in kg ha^{-1}

X_1 = land areas cultivated with cassava (ha)

X_2 = farm labour (mandays ha^{-1})

X_3 = quantity of fertilizer (kg ha^{-1})

X_4 = quantity of herbicide (litre ha^{-1})

X_5 = quantity of cassava cuttings (bundles ha^{-1})

$B_1 - b_5$ = regression coefficients

V_I = random variables which are assumed to be independent of $U_i$identical and normally distributed

With zero mean and constant variance N(0, δv^2)

U_i= non-negative random variables which are assumed to account for technical inefficiency in

Production and are often assumed to be independent of V_i such that U is the non-negatvie

Truncated (at zero) of half normal distribution with N (0, δ_u^2)

The inefficiency of production, U_i was modeled in terms of the factors that are assumed to affect the efficiency of production of the farmers. Such factors are related to the socio-economic variables of the farmers. The determinants of technical inefficiency is defined by Coelli (1995);

$$U = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5I} + \delta_6 Z_{6I} + \delta_7 Z_{7I} \quad (2)$$

Where

U = technical inefficiency of the i^{th} farmer

Z_1 =age of the i^{th} farmer

Z_2 = household size of the farmer

Z_3 = farming experience of the farmer

Z_4 = extension contact of the farmer

Z_5 = access to credit (1 for access, o otherwise)

Z_6 =membership of cooperative group (1 for membership, o otherwise)

Z_7 = educational attainment of the farmer

$\delta_1 - \delta_7$ = unknown parameters to be estimated.

These variables are assumed to influence technical efficiency of the farmers. The gamma ($\Upsilon = \delta_u^2/\delta^2$) which is the ratio of the variance of U (δ_u^2) to the sigma squared (δ^2) which is a summation of variances of U and V ($\delta_u^2 + \delta_v^2$) were also determined. The maximum likelihood estimate method using the computer frontier version 4.1 was used to estimate the parameters of the stochastic frontier production function. (Coelli,1995).

Marginal Analysis Model

For resource use efficiency, Marginal Factor Cost (MFCs) was compared with the Marginal Value Product (MVPs) and their ratios were calculated to decide on the efficiency of resource use. The marginal physical product (MPP) is given as:

$$MPP_{XI} = \delta_y / \delta_{xi} \quad (3)$$

Where MPP_{xi} = marginal physical product of the inputs $X_1 - X_5$ in equation 1.

When MVP is greater than MFC, then a resource is said to be underutilized and vice versa. Efficiency is upheld when MVP=MFC. The MVP was calculated using the following formula:

$$MVP_{xi} = MPP_{xi} * P_y \quad (4)$$

Where:

X_I = mean value of each of the inputs

P_y= unit price of output.

MVP_{XI} = marginal value product of X_i

Marginal Factor Cost (MFC) is equal to the unit price of the input.

At equation

$MVP_{xi} = MFC = P_{xi}$ (5)

$MVP_{xi} = MPP_{xi} * P_y = P_{xi}$ (6)

$MPP_{xi} * P_y = P_{xi}$ (7)

Therefore'

$MPP_{xi} = P_{XI} / P_Y$ (8)

(Utomakili and Aganmwonyi, 1995)

The relative percentage in MVP of each resource required so as to obtain optimal resource allocation that is r=1 or MVP=MFC was established using the following equation D =(1—MFC/MVP) x 100.

D = absolute value of percentage change in MVP of each resource (Mijindadi, 1980)

RESULTS AND DISCUSSION

The socio-economic information on the respondents in Table 1 showed that 91-94% of small scale cassava farmers are male. This indicates that cassava production is gender exclusive, mostly carried out by the male folk. The age range of the farmers varied, 53.89% of the respondents fall between 26-45years of age, implying that in NasarawaState, cassava production is done by active and energetic people in the middle ages of production. This conform with the findings of Abang*et al*, 2001. Married people constitute 94.17% of the respondents. Farmers who had one form of formal education or the other formed 80.83% of the sample which means the respondents are educated which also conforms to the findings of Njoku (1991) and Ogungbile*et al*, (2002). Those with farming experience of eleven years and above were 94.7%. This implies that cassava farming is not only an occupation but a way of life of the people in the study Area. 68.9% of the farmers have family size of 6-15 persons. This implies that cassava farmers in the state have family hand for most farm operations (Olufe,1998). Majority (86.4%) of the farmers operates on farm holdings of less than or equal to two hectares(2ha), they acquired their land predominantly through family (65.6%) About 24.2% of the respondents had access to credit. The number of farmers with extension visit of between 5-12 times was 52.0%. The benefits for being a cooperative group membership was 30.33% for information sharing, 28.02% for loan and capital ad 25.19% for access to inputs

Table1. *Socio-Economic Characteristics of Small Scale Cassava Farmers in Nasarawa state, Nigeria*

Variables	Frequency	Percentages(%)
45		
46- **Age**	1	0.28
1-25	193	53.61
26-65	164	45.56
66 above	2	0.56
Marital status		
Married	339	94.17
Single	8	2.22
Divorced	4	1.11
Widow/widower	4	1.11
Separated	5	1.39
Gender		
Male	333	91.94
Female	27	8.06
Farming experience		
1-10	19	5.28
11-20	75	20.83
21-30	124	34.44
31 above	142	39.44
Educational attainment		
Primary	107	29.72
Secondary	94	26.11
Tertiary	70	19.44

Adult education	20	5.56
Non-formal	69	19.17
Household size		
1-5	44	12.22
6-10	154	42.78
11-15	94	26.11
16-20	68	18.89
Farm size		
0.1-1.0	199	55.28
0.1-2.0	112	31.11
2.1-3.0	38	10.28
3.1-4.0	11	3.06
Credit access		
Credit received	87	24.17
No credit received	273	75.83
Extension visit		
1-4	148	45.54
5-8	123	37.85
9-12	46	14.15
13 above	8	2.46

Source. *Computed from survey data 2009 and 2010*

Estimates of the Stochastic Frontier Production Function Coefficients

The stochastic frontier production function estimates of small scale cassava farmers in Nasarawa State, Nigeria are presented in Table 2. The result showed that the coefficients of farm size, quantity of fertilizer and quantity of herbicides had the expected signs which indicated that a unit increase in these inputs will lead to increase in gross output of cassava. Farm size, and quantity of fertilizer applied were significant at 1%, and quantity of herbicide applied at 5% level of probability.

Table2. *Stochastic Frontier Estimation of Production Function of Cassava farmers in Nasarawa state, Nigeria*

Variables	Parameters	coefficients	t-ratio
Constant: β_O	2.163		
Farm size	β_1	8.89^{***}	24.56^{***}
Farm labour β_2	-0.0404	0.901	
Quantity of fertilizer	β_3	-1.13^{NS}	3.25^{***}
Quantity of herbicides	β_4	0.0561	2.51^{**}
Quantity of cassava	β_5	0.0504	-0.11^{NS}
cuttings		-0.0054	
Inefficiency Function	α_0		-1.91^{NS}
Constant	α_1	-3.070	2.91^{***}
Age of farmer	α_2	0.0654	-1.82^{*}
Household size	α_3	-0.171	$- 2.77^{***}$
Farming experience	α_4	-0.0345	$- 2.17^{**}$
Contact with extension	α_5	-0.0297	-2.18^{**}
Credit access	α_6	-0.128	-0.94^{**}
Cooperation group	α_7	-0.0076	-0.17^{NS}
membership		-0.0011	
Education experience	δ^2		2.37^{***}
Diagnostic statistics	Υ		37.34^{***}
Sigma squared		0.557	
Gamma		0.943	
Log likelihood function		100.16	
LR Test		40.97	

= significant at 10% level, **= significant at 5% level, *= significant at 1% level and NS= not significant.*

Source. *Field survey data 2009 and 2010*

The coefficients of farm lobour and cassava cuttings were negative. The estimated elasticities of mean output with respect to farm size, fertilizer and herbicide applied were 0.901,0.0561 and 0.0504 respectively. This means that for 1% increase in farm size, the output will increase by 0.901%. Also 1% increase in the amount of fertilizer and herbicide applied will lead to 0.0561% and 0.0504%

increase in the output of cassava respectively. However, a 1% increase in farm labour and quantity of cassava cuttings used will decrease cassava output by 0.0404% and 0.0054% respectively.

Technical Efficiency Estimates of Small Scale Cassava Farmers in Nasarawa State, Nigeria

The technical efficiency indices were derived from the maximum likelihood estimates (MLE) results of the stochastic production function using computer programme frontier 4.1. The indices in Table3, showed that the technical efficiency of the sampled farmers was less than one, implying that all the cassava farmers were producing below the maximum efficiency frontier. Some farmers achieved technical efficiency of 0.971 while the least farmer achieved 0.342. The mean technical efficiency was 0.893, implying that on the average; farmers in the study area were able to obtain a little over 0.893 of the potential cassava output from a given mix of production inputs. Cassava farmers in the study area still have room to increase their efficiency in the use of inputs as a gap of 0.107 was yet to be attained ion the study area.

Table3. *Distribution of Technical Efficiency Indices AmongSmall Scale Farmers in Nasarawa state, Nigeria*

Efficiency class index	Frequency	Percentage(%)
≤0.60	6.00	1.67
0.61-0.70	6.00	1.67
0.70-0.80	20.00	5.55
0.81-0.90	108.00	30.00
0.91-1.00	220.00	61.11
Total	360.00	100.00
Mean	0.893	
Maximum value	0.971	
Minimum value	0.342	

Source. *Computed from field data 2009, and 2010*

Marginal Analysis of Small Scale Cassava Farmers' Input Use in Nasarawa State, Nigeria

The marginal value product for land and herbicide as shown in Table. 4 were higher than their marginal factor cost implying under utilization of inputs, the marginal value product for labour, fertilizer applied and cassava cuttings were lower than their marginal factor cost implying over utilization of the inputs in the production of cassava. The result showed that returns from cassava production were likely to increase if more of inputs such as land and herbicides were used. Fasasi, 2007 and Ekunwe*et al*, 2008, found similar results. The adjustment in the marginal value products for optimal resource use indicated that 95% increase in land was required while 11% increase in herbicide was needed. The labour, fertilizer and cassava cuttings inputs were over utilized, required 94%, 689% and 1881% reduction respectively of these inputs for optimal cassava production to be achieved. (Chapke, *et al*, 2011 Goni*et al*, 2007).

Table4. *Marginal Analysis of Input Used by Small Scale Cassava Farmers in Nasarawa state, Nigeria*

ITEMS	MPP	MVP	MFC	MVP/ MFC	Inferences	Percentage Adjustment Required
Land	7892.22	83,894.28	4,500.00	18.64	underutilized	94.64
Fertilizer	3.44	36.54	70.73	0.517	over utilized	93.60
Herbicide	98.00	1044.90	930.93	1.12	underutilized	10.93
Labour	- 8.94	-95.04	560.00	-1.169	over utilized	689.00
Cassava cuttings	-1.085	- 11.53	205.33	-0.056	over utilized	1881.00

Source. *Computed from field data 2009 and 2010*

CONCLUSION

The empirical study resource use efficiency among small scale cassava farmers in Nasarawa state, Nigeria; implications for the transformation agenda was estimated by maximum likelihood estimation to obtain coefficients and inefficiency determinants. The results revealed that technical efficiency of small scale cassava farmers varied due to the presence of technical inefficiency effects in cassava production. Farm size, fertilizer and herbicide were found to be significant production factors which accounted for changes in the output of cassava in the study area. The distribution of efficiency indices

revealed that most of the farmers were technically efficient with mean index of 0.893. The ratio of the marginal value product to the marginal factor cost was greater than one for land and herbicide but was less for labour, fertilizer and cassava cuttings; This implies that land and herbicide were under-utilized while labour, fertilizer and cassava cutting were over utilized.

Implications for Agricultural Transformation Agenda

The implication of the study is that the level of efficiency among small scale cassava farmers in the state could be increased by 0.107, through better utilization of available resources given the current state of technology. The level of adjustments for the use of various resources to earn optimum returns will serve as a bench mark for cassava growers in Nasarawa State, agricultural agencies and agro-based companies. They can effectively harness the findings for advancement in the transformation agenda at making cassava an export earner and sustainable agricultural development in general in the State.

REFERENCES

Abang, S.O.; Ekpen., and Using, W. W. (1992). Technical and allocative efficiencies of small scalecassava growers in five selected local government areas of Cross River State. *Global Journal of Apllied Sciences,***7** (1):11-13.

Ajibefun, I.A. (2002). Analysis of policy issues in technical efficiency of small scale farmers using stochastic frontier production function with application to Nigeria farmers. Paper presented for presentation at the International Association Congress,Wageningen, Netherland, July 2002 Pp 8.

Ajibefun, I. A. and Daramola, A.G.(2003). Determination of technical and allocative efficiency of micro- enterprises. Farm level evidence from Nigeria, Africa Development Bank 4: 353-395.

Asogwa, B.C., Umeh, J.C. and Ater, P. I. (2006).Technical efficiency analysis of Nigeria cassava farmers. A guide for food security policy. Paper presented for presentation at the International Association of Agricultural Economists conference, Gold Coast , Australia. Pp 14

Chapke, R .R.,Mandal, B. and Mishra, J. S. (2011). Resource use efficiency of sorghum (sorghum bicolor) production in rice (oryza sativa) fallow in Andhra Pradesh, *India Journal of Human Ecology*, **34(**2): 87-90

Coelli, T. J. (1995). Recent development on frontier modeling and efficient measurement, *Australia Journal of Agricultural Economics*.**39**(3):219-245.

Ekunwe, P .A. Orewa, S . I. and Emokaro, C. O. (2008). Resource use efficiency in yam production in Delta and Kogi States of Nigeria. *Asian Journal of Agricultural Research***, 2**(2):61-69

Erhabor, P. and Emokaro, C. O. (2007).Economic importance of cassava the white Gold.Erhabor, P.O, Azaiki, S .S, and Ingawa, S .A. (eds) Initiative Publication Company, Benin city, Nigeria. Pp 251

Fasasi, A. R. (2007). Technical efficiency of food crop production in Oyo,State, Nigeria. *Journal of Human Ecology*.**22**(3):245-249.

FMARD (2010), Report of the 2010 Agricultural Production Survey . Federal Ministry of Agricuture and Rural Development, Abuja, Nigeria.Pp 87.

Goni, M., Mohammad, S. and Baba, B .A. (2007). Analysis of resource use efficiency in rice production in the Lake Chad area of Borno State, Nigeria. *Journal of Sustainable Development in Agriculture and Environment* .**3:**31-37.

IITA(2004). International Institute for Tropical Agriculture.Nigeria cassava industry statistical handbook. IITA Publications.

Mijindadi, N .B. (1980).Production efficiency on farms in Northern Nigeria. An unpublished Ph.D Thesis, Cornell University, U.S.A.

NADP(2002). Nasarawa State Agricultural Development Project Village Listing Survey Publication of NADP.Pp 48.

NADP(1998), The adoption study of technology under the National Technology Support Facility, Publication of Nasarawa State Agricultural Development Project, Lafia. Pp48.

Njoku, J. E.(1991). Factors influencing the adoption of improved oil palm production technologies by small holders in Imo State, Nigeria. Pp.87.

NPC (2007). National Population Commission, Nigeria news, Census 2006 retrieved 24th April, 2009, www.nigeria.com letters/htm.

NPC(2005). National Economic Empowerment and Development strategy (NEEDS)National planning Commission, Abuja.

Nweke, F .I. (2004).New challenges in cassava transformation in Nigeria and Ghana.Pp 102.

Olufe, I. (1998). Resource productivity in food crop production in some selected villages in Oye local government area of Kwara State, unpublished B. Agriculture. Thesis, University of Ilorin, Nigeria, Pp.87

Utomakili, J. B.andAganmwonyi, F. (1995), **Farm Management,** A Basic Text.