academicJournals

Vol. 8(3), pp. 52-58, March, 2016
DOI: 10.5897/JDAE2015.0688
Article Number: 9A2DCB457096
ISSN 2006-9774

http://www.academicjournals.org/JDAE

Journal of Development and Agricultural Economics

Full Length Research Paper

Economic efficiency of small scale soyabean farmers in Central Agricultural Zone, Nigeria: A Cobb-Douglas stochastic frontier cost function approach

C. K. Biam[1]*, A. Okorie[2] and S. U. Nwibo[2]

[1]Department of Agricultural Economics, University of Agriculture, Makurdi, Benue State, Nigeria.
[2]Department of Agricultural Economics, Management and Extension, Ebonyi State University, Abakaliki, Nigeria.

Received 11 August, 2015; Accepted 9 December, 2015

This study employed the Cobb-Douglas stochastic frontier cost function to measure the level of economic efficiency and its determinants in small scale soyabean production in Central Agricultural Zone of Nigeria. A multistage sampling procedure was used to select 485 soyabean farmers in the Zone, in 2010, from whom input-output data and their prices were obtained using the cost-route approach. The parameters of the stochastic frontier function were obtained using the maximum likelihood method. The result of the analysis showed that average economic efficiency was 52%. The study found age, farm size and household size to be negatively and significantly related to economic efficiency at 5 and 1%. Education, farming experience, access to credit and fertilizer use were significantly and positively related to economic efficiency. No significant relationship was found between economic efficiency and extension contact and membership of farmers' association. It was recommended that policies that will increase farmers' economic efficiency level be targeted at improving their educational levels and easy access to credit and fertilizer, while experienced farmers should be encouraged to remain in soyabean farming.

Key words: Cobb-Douglas stochastic frontier cost function, economic efficiency, small scale soyabean farmers

INTRODUCTION

Soyabean (*Glycine max* (L) Merr), "the miracle seed", is the world most important oilseed legume with respect to total production and international trade (Salunke et al., 1992). It is a versatile crop from which products like soyabean oil, soyabean milk, soyabean "fufu'', soyabean "dadawa", livestock feed, soya sauce and baby foods, such as, Golden morn, Babeena, Nutrend and Cerelac are derived. The production figures for soyabean in Nigeria have been on steady increase since 1985 when over 114,000 metric tons were produced mainly due to the realization of the potential of the crop as a source of protein to blend with carbohydrate sources, as a good substitute raw material for vegetable oil and as concentrate supplement for poultry and other livestock

*Corresponding author. E-mail: ckbiam@gmail.com Tel: +2347050315612, +2348069311665.

feeds. Researchers have developed wide range of recipes which blend with traditional food habits or various cultural settings in Nigeria. This has increased soyabean consumption among low income groups that naturally cannot afford the expensive sources of protein such as meat, fish and eggs. The whole soyabean is already used in soy yoghurt, soy-burger, soy-cheese, soy-loaf, salad dressing, etc., and is also used in the manufacture of other food and non-food products such as paints, printing ink, cleaners capable of lifting grease, lipstick, mascara and drugs (OSAN, 2003).

Nigeria is the largest producer of soyabean in West and Central Africa; other producer countries include Zaire, Cameroon and Ghana (Singh et al., 1987). The crop was first introduced into the country in 1908 (Fennel, 1966), however, the first successful cultivation was in 1937 with the Malayan variety, which was found suitable for commercial production in Benue State (Nyiakura, 1982). Since then, many small-scale farmers have incorporated it in their cropping system as well as in their diets. Soyabean is produced in almost all the States of Nigeria with its concentration in the Northern States, particularly in the Central Agricultural Zone. Shaib et al. (1997) recorded that the Zone is the largest soyabean producer in the country, producing well over 64% of national production.

Recently there has been increased awareness campaign to farmers on inherent benefits of cultivation of soyabean. A strategy of accelerating production of soyabean in the Central Agricultural Zone of Nigeria should explore the potentials of the crop by increasing the production efficiency of the farmers which will culminate not only into incremental soyabean output and profitability but also sustainable food security for the country. Production efficiency mean attainment of a production goal without waste (Ajibefun and Daramola, 1999), while efficiency is concerned with the relative performance of the processes used in transforming given inputs into output (Onyenweaku et al.,1995).

Efficiency is at the heart of agricultural production because the scope of agricultural production can be expanded and sustained by farmers through efficient use of resources (Udoh, 2000). For these reasons, efficiency has remained an important subject of empirical investigation particularly in developing economies where majority of farmers are resource poor. There are four major approaches to measuring efficiency (Coelli et al., 1998).These are: the non-parametric programming approach (Charnes et al., 1978), the parametric programming approach (Aigner and Chu, 1968; Ali and Chaudhry, 1990), the deterministic statistical approach (Afriat, 1972; Schipper, 2000; Fleming et al., 2004), and the stochastic frontier approach (Aigner et al., 1977; Kirley et al., 1995). Among these, the stochastic frontier and non-parametric programming, known as Data Envelopment Analysis (DEA), are the most popular approaches. The stochastic frontier approach is preferred for assessing efficiency in agriculture because of the inherent stochasticity involved (Ezeh, 2004; Coelli, 1994).

This study estimates the level of economic efficiency and its determinants in soyabean production in Central Agricultural Zone of Nigeria using the Cobb-Douglas stochastic frontier cost function approach. The cost function approach combines the concepts of technical and allocative efficiency in the cost relationship. Technical and allocative efficiencies are necessary and when they occur together, are sufficient conditions for achieving economic efficiency (Yotopulous and Lau, 1973). Economic efficiency is the ability of farmers to maximize profit and is also described as the product of technical and allocative efficiency (Adeniji, 1988). It indicates the costs per unit of output for a firm which perfectly attains both technical and price efficiencies.

MATERIALS AND METHODS

Study area, sampling and data collection

The Central Agricultural Zone of Nigeria covers Benue, Kogi, Kwara, Niger, Nasarawa, Taraba and Plateau States, as well as the Federal Capital Territory, Abuja. Situated between latitudes 6° 30$^{/}$- 11° 2$^{/}$N and longitudes 3°E and 14°E, the Zone has 22,664,756 million people with the rural population constituting 77% (NPC, 2006). The Zone has a land area of 296, 898 km^2 representing nearly 32% of the country's land area with the total available land estimated at 24.7 million hectares, but only 6.6 million hectares are under cultivation (Shaib et al., 1997). This indicates that the zone has substantial scope for expansion of the agricultural area as only about 25% of the available land is cultivated. Agriculture is the mainstay of the Zone's economy, with large proportion (43%) of rural adults involved in agriculture (CBN, 1993) The major crops of the Zone are maize, rice, millet, sorghum, cowpea, groundnut, yam, cassava, melon, soyabean, mango and citrus with most of the crops grown in mixtures. The Zone is the largest rice, groundnut and soyabean producer in the country, producing well over 40% of rice and groundnut, 64% soyabean with three other important crops, maize, sorghum and cowpea, contributing 25% each in addition to 34% yam and 98% Irish potato (Shaib et al., 1997).

A multistage and simple random sampling techniques were adopted to select respondents for the study. First, three States, namely: Benue, Niger and Plateau were purposively selected based on their lead in soyabean production in the Zone. Second, based on the classification of States into Zones by their respective Agricultural Development Projects (ADPs), Zones were purposively selected from the three States based on intensity of soyabean production. Third, respondents were randomly selected at a proportion of 0.2% from a list of farmers obtained from the selected States' ADPs which served as the sampling frame. Consequently 240, 125 and 120 were selected from Benue, Niger and Plateau States, respectively, giving a total sample size of 485 respondents. Primary data were collected through the use of well structured questionnaires/ interview schedules administered to the 485 sampled farmers on their socio-economic characteristics and production resources, such as land, labour, seed, fertilizer and agro chemicals and their prices using the cost – route – approach.

Analysis of data

The data collected were analyzed using the stochastic frontier cost function model defined by:

$C = F (W_i, Y_i, a) \exp Є_i$ (i = 1,2,3………n) (1)

Where
C = minimum cost of soyabean production
W = vector of input prices
Y = soyabean output
a = vector of parameters
$Є_i$ =composite error term ($v_i – u_i$)
Using shepphard's Lemma we obtain

$ӘP_i = ӘC / X_i (w, y, a)$ (2)

This is a system of minimum cost input demand equations (Bravo-Ureta and Pinheiro, 1997). Substituting a farm's input prices and quantity as output in Equation 2 yields the economically efficient input vector $X_{c,}$. With observed levels of output given, the corresponding technically and economically efficient cost of production will be equal to $X_{ii}P$ and X_{ie}, respectively, while the actual operating input combination of the farm is X_ip. The cost measures can then be used to compute the economic efficiency indices as follows:

$TE= (X_{ii}P)/(X_iP)$ (3)

$EE= (X_{ie}.P)/(X_i.P)$ (4)

The combination of Equations (3) and (4) is used to obtain the allocative efficiency (AE) index following Farrel (1957).

$AE=EE/TE = (X_{ie}.P)/(X_i.P)$ (5)

The efficient production is represented by an index value of 1.0, while the lower values indicate a greater degree of inefficiency. Using the method by Bravo-Ureta and Pinheiro (1997) which was based on the work of Jondrow et al., (1982), efficiency can then be measured using the adjusted output as shown in Equation (6)

$Y^*= f(X_i,β)-u$ (4)

Where U can be estimated as:

$E (u_i/ε_i) = σλ/1+λ^2/ [f^* (ε_i λ/σ)/1- f^* (ε_i.λ)- ε_i.λ]$ (5)

Where
$f^*(ε_iλ/σ)$ and $f^*(ε_iλ)$ are normal density and cumulative distribution functions, respectively.
$λ =, σ_u/ σ_v; ε_i = v_i-u_i$ and
f* = observed output adjusted for statistical noise.

When $ε_{i,}σ$ and λ estimates are replaced in Equation 7, it will provide estimates for v_i and u_i The term V is a symmetric error, which accounts for random variations in output due to factors beyond the control of the farmer (e.g. weather, disease ,outbreaks, measurements errors, etc). The term U is a non-negative random variables representing inefficiency in production relative to the stochastic frontier. The random error V_i is assumed to be independently and identically distributed as $N(σ^2)$ random variables independent of the u_is which are assumed to be non-negative truncation of the $N(σ,u^2)$ distribution (that is, half normal distribution) or have exponential distribution. Micro economic theory holds that for profit maximation, firms should produce at the point where the marginal value product (MVP) equals its price.

Empirically, economic efficiency was measured using Cobb-Douglas stochastic frontier cost function for soyabean production, using the maximum likelihood method. The model is specified as follows:

$LnC = bo + b_lLnP_l + b_2LnP_2 + b_3LnP_3 + b_4LnP_4 + b_5LnP_5 + V_i-U_i$ (8)

Where:
C = the cost of production in Naira,
P_1 = price of seeds in Naira per kilogramme,
P_2 = price of fertilizer in Naira per kilogramme,
P_3 = price of agro chemicals in Naira per litre,
P_4 – average wage rate in naira per manday
Y = output of soyabean in kilogrammes per hectare
$b_0 – b_5$ = parameters to be estimated
V_i and U_i = as earlier defined

The determinants of economic efficiency were modeled in terms of socio-economic variables and other factors. Economic efficiency was simultaneously estimated with their determinants by:

$Exp(-U_i) = δ_0 + δ_1Z_1 + δ_2 Z_2 + δ_3 Z_3 + δ_4 Z_4 + δ_5 Z_5 + δ_6 Z_6 + δ_7 Z_7 + \mathbf{δ_8 Z_8} + δ_9 Z_9$ (9)

Where:
Exp (-Ui) = economic efficiency of the i-th farmer
Z_1 =age of farmers in years
Z_2 =educational level of farmers in years
Z_3=farming experience of farmers in years
Z_4=farm size in hectares
Z_5=number of extension contacts in a year
Z_6=fertilizer use (dummy variable, 1 = used fertilizer, 0 otherwise)
Z=access to credit (dummy variable, 1 = access, 0 otherwise)
Z_8=membership of farmers cooperatives (dummy variable, 1 = member, 0 otherwise)
Z_9=household size in numbers
$δ_1$ - $δ_9$ =parameters to be estimated

A priori expectation is that educational level, farming experience, extension contact, farm size, fertilizer use, credit access and membership of farmers' cooperatives will be positive while age of farmers and household size will be negative.

RESULTS AND DISCUSSION

Average statistics of soya bean farmers

The average statistics of the sampled soyabean farmers are presented in Table 1. The average age of the soyabean farmers was found to be 46 years. This result agrees with the findings of Ezedinma and Ohi (2001), and Ogunwale (2000) that the average age of farmers in Nigeria is between 45 and 48 years and that this age group forms the productive work force. On the average, soyabean farmers had 12 years of schooling with 21 years of farming experience. This finding contradicts the often reported illiterate status of farmers from many previous studies, such as Shaib et al. (1997), who reported low literacy level of farmers as a constraint to agricultural development in Central Nigeria, but agrees with Ochepo (2010), who found that 92.8% of the rural people, who are mostly farmers, were educated at various levels.

The farmers were found to own a mean farm size of 1.57 ha. This result shows that soyabean farmers in Central Nigeria are predominantly small-scale, based on the classification of farm holdings in Nigeria by Olayide

Table 1. Average statistics of soyabean farmers in Central Agricultural Zone of Nigeria.

Variables	Percentage mean	Minimum	Maximum
Sex			
Male	86.6		
Female	13.4		
Marital status			
Single	05.5		
Married	86.8		
Widowed	5.2		
Divorced	02.5		
Access to Credit			
No access	71.8		
Access	28.2		
Age (years)	46.0	17	78
Household size (no.)	9.19	1	22
Edu status(years)	12	4	18
Farming exp (years)	21	2	0.3
Farm size(ha)	1.57	0.1	55
Farm income (₦)	280,185.58	45,000.00	558,000.00
Off-farm income (₦)	**114,683.52**	170.00	216,000.00

Source: Field Survey, 2010.

(1980), that small, medium and large scale farmers hold 0.1-5.99, 6.0-9.99 upward of 10 ha, respectively. The average household size of farmers was found to be 9 members. This result agrees with the findings of Ochepo (2010) that the mean household size of farmers was 9 members. Majority (86.6%) of the farmers were males predominantly married (86.8%). The result of gender is in contrast with the findings of Sigot (1995), that women in Africa are responsible for an estimated 70% of total food production throughout the continent. Marriage, according to Igben (1980), is one of the most important factors influencing production and productivity.

The result showed that the sampled farmers had a mean annual farm income of ₦ 280,185.58, with a mean off-farm income of ₦114,683.52. Huffman (1980), argued that though increased non-farm work increases income of farmers and reduces financial constraint, particularly resource poor farmers, by enabling them to purchase productivity enhancing inputs, the situation is likely to decrease farmer's efficiency by limiting their time available for supervision of farm activities. The result of accessibility to credit shows that majority (71.8%) of the soyabean farmers had no access to credit. The lack of access to credit by farmers could reduce their efficiency by limiting procurement of farm inputs and information needed for improved productivity, since according to Tijani et al. (2006), access to credit provides a farmer with a means of expanding and improving his farm.

Estimated cost function

The maximum likelihood estimates of the parameters in the Cobb-Douglas frontier cost function for soyabean in Central Agricultural Zone of Nigeria is shown in Table 2. The sigma squared (σ^2=0.78) is high and significant at 1% level of probability, which indicates goodness of fit and correctness of the specified assumption of the composite error term distribution (Idiong, 2005). The gamma (γ=0.32) is significant at 5% level and shows that only 32% of variability in the output of the soyabean farmers unexplained by the function is due to economic inefficiency.

The estimated coefficients of the variables show that wage rate (0.64), price of seed (0.78) and price of agrochemicals (-0.04) were significant at 1% while price of fertilizer (0.15) and output (0.11) were significant at 5%. All the independent variables included in the cost function were found to be significant. This indicates the importance of these variables in the cost structure of the farmers. Wage rate (0.64) and price of seed (0.78) were highly significant at 1% level. This shows that the cost of soyabean production in the study area increases by 6.4 and 7.8% as the prices of wages and seed, respectively, are increased by 1%. The significant influence of wage rate and seed is in line with the findings of Okoh (2009). The inverse relationship of agrochemicals with cost of soyabean production implies that using agrochemicals

Table 2. Maximum likelihood estimates of the parameters in the Cobb-Douglas frontier cost function model for soyabean farmers in Central Agricultural Zone of Nigeria.

Variables	Parameter	Coefficient	t- value
Constant	β_0	6.58	6.64***
Ln wage rate	β_1	0.64	4.46***
Ln price of fert	β_2	0.15	2.44**
Ln price of seed	β_3	0.78	5.13***
Ln price of agroch	β_4	-0.04	-4.73***
Ln output	β_5	0.11	2.12**
Variance parameters			
Sigma squared	σ^2	0.78	11.88***
Gamma	Y	0.32	2.64**
Log likelihood function	-	-602.86	-602.86
LR test	-	44.10	44.10

Source: Field Survey, 2010. ***and ** t-test significant at 1 and 5%, respectively.

Table 3. Maximum likelihood estimates of the determinants of economic efficiency in soyabean production.

Constant	Parameters	Coefficient	t-value
Age	σ_1	-0.19	-2.55**
Education	σ_2	2.31	2.28**
Farm size	σ_3	-3.11	-4.96***
Farm experience	σ_4	0.26	2.96***
Extension contact	σ_5	0.02	0.03
Membership of ass	σ_6	0.13	0.07
Access to credit	σ_7	0.55	2.88**
Household size	σ_8	-0.17	-3.42***
Fertilizer use	σ_9	0.27	2.80**

Source: Field Survey, 2010. ***and ** t-value significant at 1 and 5% respectively.

even at higher prices is more cost effective in soyabean production than manual control of weeds.

Determinants of economic efficiency

The factors that influence economic efficiency are shown in Table 3. The results reveal that the coefficients of farm size (-3.11), farming experience (0.26), and household size (-0.17) were significant determinants of economic efficiency at 1% while those of age (-0.19), education (2.31) access to credit (0.55) and fertilizer use (0.27) were significant at 5%. The negative influence of age on economic efficiency agrees with the assertion of Idiong (2005) that the older a farmer becomes the more he or she is unable to combine resources in an optimal manner given the available technology. Also, Tsaku (2009) found that young farmers were more efficient in minimizing cost in yam production in Nasarawa State. The negative relationship of farm size with economic efficiency implies that small farm holdings are economically efficient. This result is in agreement with Yotopoulos and Lau (1971) that smaller farms were more efficient in cost allocation, and corroborates the findings of Van-Zyl et al. (1995) that commercial farms could become significantly more efficient if they become smaller.

The positive relationship of education with economic efficiency agrees with the findings of Amaza and Olayemi (2000) that increasing years of formal education increases farmers' level of allocative and technical efficiency which implies improved economic efficiency. Also, Laha and Kuri (2011) opined that schooling and farming experience positively influence the level of economic efficiency in agriculture. The positive and

Table 4. Distribution of economic efficiency estimates of soyabean production in Central Agricultural Zone of Nigeria, 2009.

Efficiency range	Frequency	%
≤0.30	41	8.5
0.31-0.60	292	60.2
61-0.90	151	31.1
0.91-1.00	1	0.2
Total	485	100
Mean	0.52	-
Minimum	0.10	-
Maximum	0.99	-

Source: Field Survey, 2010.

significant coefficients of access to credit and fertilizer use by soyabean farmers enhances their economic efficiency. Extension contacts and membership of farmers' cooperatives were positively signed but not significant.

Estimation of economic efficiency

The results of frequency distribution of economic efficiency estimates presented in Table 4 reveal that economic efficiency ranged from 0.10 to 0.99 with a mean of 0.52. This result indicates that for the average farmer in the study area to attain the level of the most cost efficient farmer, he/she would save costs by 47% (1-0.52/0.99) while the most cost inefficient farmer would save 90% (1-0.10/0.99) cost. Thus, in the short run, there is scope for increasing the farmers cost (economic) efficiency in the study area by 48%, by adopting the technology and techniques used by best-practiced soyabean farmers. The results further show that majority (60.2%) of the soyabean farmers operated within the cost efficiency range of 0.31 to 0.60 indicating moderate economic efficiency among the farmers across the Zone.

CONCLUSION AND RECOMMENDATIONS

The study found that majority of soyabean farmers in the Zone were male with moderate education and highly experienced in soyabean farming with small farm holdings and were not fully economically efficient. Economic efficiency ranged between 0.10 and 0.99 (10 and 99%) with a mean of 0.52 (52%), which indicates substantial economic inefficiency, hence considerable potential for enhanced profitability by reducing costs through improved efficiency. There is scope for improving economic efficiency in the Zone by 48%. The average soyabean farmer would be able to reduce cost by 47% by employing best practices.

Important factors directly related to economic efficiency were found to be education, farming experience and fertilizer use, while age, farm size and household size were indirectly related. Policies aimed at improving soyabean farmers socio-economic and farm specific factors that significantly determined economic efficiency will be useful in increasing farmers efficiency levels in production of soyabean in the Zone. These policies should be targeted at encouraging young farmers to produce soyabean, experienced farmers to remain in farming soyabean cultivation and the farmers encouraged to attain higher levels of education. Also, credit and fertilizer should be made easily accessible to the soyabean farmers.

Conflict of interests

The authors have not declared any conflict of interests.

REFERENCES

Adeniji JP (1988). Farm size and resource use efficiency in small-scale agricultural production: a case study of rice farms in Kwara State of Nigeria. Nig. Agric. J. 23(2):51-62.

Afriat SN (1972). Efficiency Estimation of the Production Function. Int. Econ. Rev. 13:568-598.

Aigner DJ, Chu SF (1968). Estimating the Industry Production Function. Am. Econ. Rev. 58:826-839.

Aigner DJ, Lovell CAK, Schmidt P (1977). Formulation and estimation of stochastic frontier production model. J. Econ. 6:22-37.

Ajibefun IA, Daramola AG (2003). Efficiency and Micro-Enterprises in Nigerian Economy, Nairobi: African Economic Research Consortium (AERC), Research paper. P 134.

Ali M, Chaudhry MA (1990). International farm efficiency in Pakistan Punjab: a frontier production function study. J. Agric. Econ. 41(3):42-74.

Amaze PS amd Olayemi JK (2002). Analysis of technical in efficiency in food crop production in Gombe State, Nigeria. J. Appl. Econ. Lett. 9(1):51-54.

Bravo-Ureto BB, Pinheiro E (1997). Technical, allocative and economic efficiency in peasant farming: evidence from the Dominican Republic. J. Dev. Econ. 35(1):48-67.

CBN (1993). Central Bank of Nigeria. Econ. Fin. Rev. 31(2).

Charnes A, Cooper W, Rhodes E (1978). Measuring the efficiency of decision making units. Eur. J. Oper. Res. 2:429-444.

Coelli TJ (1994). A Guide to Frontier Version 4.1: A Computer Programme for Stochastic Frontier Production and Cost Function Estimation. Armidale: Department of Econometrics, University of New England.

Coelli TJ, Prasada RDS, Battese GE (1998). An Introduction to Efficiency and Productivity Analysis. Boston: Kluwer Academic Publishers.

Ezedinma CI, Ohi NN (2001). Socio-economic issues in development of cassava processing in Nigeria. J. Sustain. Agric. Environ. 3(1):120-126.

Ezeh CI (2004). A comparative study of Fadama and non Fadama crop farmers in Osisionma Ngwa L.G.A. Abia State, Nigeria. J. Sustain. Trop. Agric. Res. 11:75-80.

Fennel MA (1966). Present state of research on edible legumes in Western Nigeria. First Nigerian Legumes Conference. Ibadan: International Institute for Tropical Agriculture (IITA).

Fleming P, Fleming E, Griffith G, Johnston D (2004). Animal Efficiency in an Intensive Beef Production Genetic Breeding Unit, Armidale: University of New England, NSW, Australia.

Huffman WE (1980). Farm and off farm decisions: the role of human capital. Rev. Econ. Stat. 62:108 -115.
Idiong IC (2005) Evaluation of Technical, Allocative and Economic Efficiencies in Rice Production Systems in Cross River State, Nigeria. Ph.D Thesis, Ibadan: University of Ibadan.
Igben MS (1980(90?). Socio-economic Activity of Communities: Implications for Rural Development in Nigeria, Benin: Paper Presented at the Centre Conference, University of Benin, 22nd – 25th September.
Jondrow JC, Lovelle AK, Materov V,Schmidt P (1982). On the estimation of technical inefficiency in the stochastic frontier production function model. J. Econ. 19:233-238.
Kirkley JE, Squires D, Strand IE (1995). Assessing technical efficiency in commercial fisheries: the Mid-Atlantic Sea Scallop fishery. Am. J. Agric. Econ. 20:31-34.
Laha A, Kuri PK (2011). Measurement of Allocative Efficiency in Agriculture and its: Evidence from Rural West Bengal, Ladies. Int. J. Agric. Res. 6: 377-388.
National Population Commission (2006). Abuja: Census Facts Sheet Issued April 2006.
Nyiakura O (1982). Soyabean in Nigeria: problems and prospects. Zaria: Proceedings of the 2nd National Meeting of Nigerian Soyabean Scientists held at Institute of Agriculture Research.
Ochepo CO (2010). Evaluation of the Local Empowerment and Environmental Management Project in Benue State. MSc Thesis, Makurdi, Department of Agricultural Extension and Communication, University of Agriculture.
Ogunwale (2007). Communication Channels for information Dissemination on Poverty Alleviation among small-scale farmers in Oyo State, Ibadan: Annual conference of the Agricultural Extension Society of Nigeria held at University of Ibadan.
Okoh CO (2009). Resource Use Efficiency in Tomato Production in the Fadama: Implications for Poverty Reduction in Benue State. M.Sc Thesis, Makurdi: Department of Agricultural Economics, University of Agriculture.
Olayide SO (1980). Food and Nutritional Crisis in Nigeria, Ibadan; Ibadan University Press.
Onyenweaku CE**,** Obasi O, Anyanwu S (1995). Relative efficiency of compound and non-compound farms in Imo State. Uyo: Paper Presented at the Annual conference of farm management Association of Nigeria held at Cross River University of Technology.
OSAN (2003). Update of White paper study on the Oil Seed Situation in Nigeria, Abuja: Oil Seed Association of Nigeria in Collaboration with Raw Materials Research and Development Council pp. 35-36.
Salunkhe, DK, Chavan JC, Adule RM, Kadam SS (1997). World Oil Seeds: Chemistry, Technology and Utilization. New York: an AVI Book Published by Van Reinnhold 200p.
Shaib B, Adamu A, Bakshi J (1997). Nigerian National Agricultural Research Strategy Plan: 1996 – 2010. Abuja: Federal Ministry of Agriculture and Natural Resources.atural Management in Africa. Nairabi: ACTS Press. pp 1-13.
Sigot AJ (1995). Discourse on gender and natural resource management. In: Sigot AJ, Athrup L and Green J (eds). Towards Common Ground and N
Singh SR, Rachie KO, Dashiell KE (1987). Soyabean for the Tropics: Research Production and Utilization. IITA Research, Chiester: a Wiley Interscience Published, John Willey and Sons Ltd 81-87.
Tijani AA, Alimi T, Adesiyan AT (2006). Profit efficiency among Nigerian Poultry egg farmers: a case study of Aiyetero farm settlement, Nigeria. J. Agric. Biol. Sci. 2(6):256- 261.
Tsaku SA (2009). Efficiency of small holder Yam Producers in Nasarawa State, M.Sc, Thesis Makurdi: Department of Agricultural Economics, University of Agriculture.
Udoh EJ (2000). Land Management Resource use Efficiency among Farmers in South Eastern Nigeria. PhD Thesis, Ibadan: Department of Agricultural Economics, University of Ibadan.
Van-Zyl J, Binswanger H, Thirtle C (1995). The Relationship Between Farms Size and Efficiency in South African Agriculture, Washington D.C: Policy Research Working Paper No1548, The World Bank.
Yotopoulous PA, Lau LJ (1973). Test of relative economic efficiency: some further results. Am. J. Econ. Rev. 214- 225.