ISSN: 2695-1975
AKSUJAEERD 3 (1): 17 – 23, 2020 AKSU Journal of Agricultural Economics, Extension and Rural Development

TECHNICAL EFFICIENCY OF SESAME PRODUCTION AMONG SMALL SCALE FARMERS IN SOUTHERN TARABA STATE, NIGERIA

***[1]Aboki, E., [2]Rukwe, D.T., [3]Dauda, I. and [4]Luka, P.**
[1]Department of Agricultural Economics and Extension, Taraba State University, Jalingo
[2]National Agricultural Extension and Research Liaison Services, Ahmadu Bello University Zaria
[3]Aquatic Bioresource Training Centre, Tunari, Wukari, Taraba State, Nigeria
[4]Taraba State College of Agriculture, Jalingo
***Corresponding Author: abokiedon33@gmail.com, 08163502775**

Abstract
This study determined Technical efficiency of Sesame Production among small scale famers in Southern Taraba. Multi-stage sampling techniques was employed in the study. 160 respondents formed the sample size. The data collected were analyzed using descriptive statistics and stochastic production frontier. The socio-economic characteristics results revealed that majority (77%) of the respondents were males, the farmers were within the age of 20 – 50 years with an average age of 43 years, 84% of the respondents were married, and 94.4 % of the respondents were literate, the average farm size 3.12 hectares. The farmers had mean farming experience of 13.1 years and 88.1% of the respondents had no access to credit. The likelihood estimates (0.736) of the stochastic production frontier revealed that output is significantly influenced by seed, labour farm size and herbicide. The individual technical efficiency indices range between 65% and 94% with mean technical efficiency of 82%. The mean technical efficiency of 82% implies that on the average, the farmers were able to achieve 82% of optimal output of sesame from the set of inputs and technology available to them. *It was recommended that the private sectors and the extension agent collaborate together to train the sesame farmers on the application of new technology that will raise their production to frontier level.*
Keywords*:* Inefficiency, technical efficiency, Sesame, small scale production and stochastic frontier.

Introduction

Nigeria economy experience recession in the third quarter of 2015 due to decline in the price of petroleum globally. Nigeria source of revenue need to be diversified in order to transform the economy from recession to prosperity (Tiamiyu *et al.*, 2017). In order to meet this targeted agriculture goal top priority was given to agriculture sector in recognition of the role play by agriculture in Nigeria economy development. In the 1960s, agricultural commodities such as cocoa, cotton, groundnut, palm oil and rubber accounted for 70% of Nigerian's exports (FAO, 2013). With the advent of petroleum exploration in the 1970s attention was shifted from away from agriculture that was the main stay of the economy to petroleum. The consequence of overdependence on petroleum revenue led to recession, which in turn led to declined Gross Domestic Product (GDP) in 2015. Despite its importance, agricultural sector is still dominated by small scale farmers, who are resource-poor and are characterized by low capital base, low adoption of modern technologies and low production (FAO, 2017)

Sesame seed is one of the oil seed crops that have contributed greatly to Nigeria's agricultural export (Chemonics, 2002). It currently ranks second to cocoa in terms of export volume in Nigeria and is fast becoming prominent among exports crops in Nigeria because it is one of the few cash crops that can earn the country foreign exchange. Due to its high demand, any quantity of the product offered to the market is easily sold (Ebe et al., 2017). It is mainly a small-holder crop, often intercropped with others crops (Abu *et al.* 2011). FAO, (2013), reported that Nigeria exported 140,800 tonnes of sesame seed worth $139 million in 2010 and earned ₦210 billion from the export of sesame seed products in the first half of 2012. This increasing demand for sesame seed provides Nigeria an opportunity to increase its production to meet the international demand for the commodity. Nigeria has the potential and the improved technology it need to produce significant quantity of sesame for domestic consumption and export (NCRI, 2012).

Sesame is one of the important oil seed crop

grown in Taraba state, Nigeria and its demand is on the increase in different ways (Ministry of Budget and National Planning (MBNP), 2017). To bridge this gap, there is need for the sesame farmers to venture into production of improved varieties which will in turn lead to increase production and the volume of export.

The broad objective of the study was to determine the technical efficiency of sesame production in Southern Taraba with a view to examine the efficiency level of sesame farmers. The specific objectives of the study were to

i. describe the socio-economic characteristics of farmers in Southern Taraba State;
ii. determine the technical efficiency of Sesame farmers and
iii. evaluate the sources of inefficiency in sesame production.

Methodology

The Study Area

The study was conducted in Southern part of Taraba State, Nigeria. The southern part is made up of five Local Government areas (Donga, Ibbi Takum, Ussa, and Wukari,) and Yangtu special Development Area. It lies between latitudes 830′N and 930′N of the 0 equator and longitude 830′E and 1030′E of the Greenwich meridian. The study area has a land mass of 14,099km^2. The projected population of the study area as at 2017 is 1,036,183 with an annual growth rate of 3.5% (NPC, 2017). The area shares a common boundary with Gassol, Bali, Kurmi, and Karim-lamido Local Government areas to the North, Nassarawa and Plateau state to the North-west, Benue state to the South-west and Republic of Cameroun to the Southeast (TADP 2004).

The state has a tropical climate marked by dry and rainy seasons. The rainy season starts in April and ends in October. The wettest months are August and September. The dry season starts in November and ends in April. The mean annual rainfall ranges from 800mm in the north to over 2000mm in the south. The mean minimum daily temperature recorded is 14.8^{0}C and the mean maximum daily temperature recorded is 34.4^{0}C (TADP, 2004). Majority of the population are peasant farmers cultivating food and cash crops like sorghum, Yam, Maize, cassava, Sesame, rice and Livestock keeping

Data for this study were collected from primary source using structured questionnaire. Data collected include: (a) the farmers' socio-economic characteristics such as; gender, age, household size, educational level, farming experience, farm size, methods of land acquisition, extension contact, amount of credit obtained, and membership of cooperatives. (b) Production data such as farm size, type and cost of labour, quantities of fertilizers, agro-chemicals, and planting materials and prices, quantity of farm output.

Sampling Technique and sampling size

All the sesame farmers in the study area form the population of the study. Multi-stage sampling technique was used for this study. In the first stage, three Local Government Areas from the zone (Takum, Ussa and Donga), were purposively selected based on their relative importance in Sesame production. In the second stage, four farming communities were randomly selected from each of the Local Government Area.

In the third stage farmer were randomly selected in proportion to the population of sesame farmers in the study area. Finally, a 5%. Proportion of the total population of 267 sesame farmers in the selected farming communities were taken using Yaro Yamen (1964) formula to arrive at a total sample size of 160 respondents.

The sample size was determined at 5% level of significance using Yero Yamen's formula presented by Baridam (2001)

$$n = \frac{N}{1+N\,(e2)} \quad \text{……..(1)}$$

where n = sample size

N = population size

e = level of significance (5%)

$$n = \frac{267}{1+267\ (0.05\ x\ 0.05)} = 160$$

Analytical Technique

Descriptive statistics such as mean, frequency and percentages were employed to address objective i, while the stochastic frontier model was used to address objective ii and iii. The implicit form of the model is specified as follows:

$Y_i = f(X_i, \beta)E_i$ ……(2)

Where,

Y_i= quantity of output of the ith farm

X_i = vector of the inputs used by the ith farm

β = vector of the parameters to be estimated

E_i= Two sided error term

The estimates for all the parameters of the stochastic frontier production function and inefficiency model were obtained using the programme FRONTIER 4.1 (Coelli, 1994). The empirical model is specified as follows:

$lnY_i = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_4 lnX_5 + V_i - U_i$ .....(3)

Where:

ln = Natural Logarithm

y_i = Sesame Output (kg)

β_0 = constant term to be estimated

β_1 - β_5 Partial regression coefficients (Elasticities of production)

x_1 = Quantity of seed (kg)

x_2 = Farm Size (ha)

x_3 = Total Iabour input (man-day/ha)

x_4 = Quantity of Herbicide (L)

x_5 = Quantity of Fertilizer (kg)

v_i = Two-sided idiosyncratic error term

u_i = Measure of inefficiency assumed to be truncated below by zero.

The inefficiency model is stated as follows:

$U_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \alpha_7 Z_7 + \alpha_8 Z_8 + \theta_i$ .....(4)

Where;

U_i = Technical inefficiency

Z_1 =gender

Z_2 = age of farmers (years)

Z_3 = household size (number of persons)

Z_4 = educational level (Number of years of formal education)

Z_5 = membership of cooperative society (Years of participation)

Z_6 = access to credit (access = 1, otherwise =0)

Z_7 = extension visit (number of visit per year)

Z_8 = farming Experience (years)

θ_i = Normally distributed error term with zero mean and constant variance.

Results and Discussion

Socio-economic Characteristics of the Respondents

The results in Table 1 shows that majority (77%) of the respondents were males implying that sesame production in the study area is dominated by men. This could be attributed to the fact that male farmers have more access to family land than their female counterpart because of the exclusive right of male children to inherit family land. Baruwa, (2013) found that men dominated the activities of pineapple production in the research conducted Osun State.

The active sesame farmers were within the age limit of 20 – 50 years which constituted 93.1% of the respondents with an average age of 43 years. The middle aged farmers' involvement in the economic activity shows that majority of the respondents were young and can make positive contribution to agricultural production. This result agrees with the findings of Sharon (2016), who reported in the research conducted in Benue State that Majority of the famers were between the ages brackets of 23-50 years.

Result of the findings shows that 84% of the respondents were married. The result of this work is in line with the findings of Abu *et al*. (2011) who reported that a high proportion of married respondents contributed to the family labour in the research titled Analysis of Cost and Return for Sesame Production in Nasarawa State.

The result in table 1 indicates that 94.4 % of the respondents were literate, implying that the sesame farmers have attended either primary, secondary or tertiary institution. Education help farmers to have access to information on agricultural innovation which enhance their productivity. IITA (2002) reported that the level of education attained by farmers determine the farmers level of adoption of innovation which in turn increase their farm output.

Finding of the study showed that majority (89.4%) of the respondents cultivated an area of land between 1 to 4 hectares, with an average farm size of 3.12 hectares. The result also shows that majority (84.4%) of the respondents had 1-20 years of farming experience in sesame production with a mean farming experience of 13.1 years. This implies that sesame farmers in the study area had adequate experienced in sesame production and this depicts good signal for higher productivity. Farming experience help farmers to make farm management decisions effectively, efficient and run a profitable enterprises (Abu, *et al.*, 2011). Amaza and Olayemi (2002) reported that the longer the farming experience, the better the farmers becomes aware of the new production techniques.

A greater percentage (88.1%) of the respondents had no access to credit, implying

that farmers used their personal saving to purchase farm inputs. The result is in tandem with the findings of Onyibe, *et al.*, (2012) who reported that access to credit is a major constraint to sesame production in Nigeria. Access to credit enables farmers to procure and acquired the needed farm inputs that will give a better output (Oluwatosin, 2011).

Table1: Distribution of respondents according to their Socio-economic characteristic

Variables	Frequency	Percentage	Mean
Gender			
Male	123	77	
Female	37	23	
Age (years)			
11 - 20	1	0.6	
21 – 30	41	25.6	
31 – 40	78	48.8	
41– 50	29	18.1	
51 – 60	11	6.9	43
Marital status			
Single	19	12	
Married	134	84	
Widow/widower	7	4	
Educational level			
No formal education	9	5.6	
Primary education	71	44.4	
Secondary education	44	27.5	
Tertiary education	36	22.5	17
Farm size (ha)			
0.1-2.0	46	28.8	
2.1-4.0	97	60.6	
4.1-60	12	7.5	
6.1-80	5	3.1	3.12
Farming experience (years)			
1-10	33	20.6	
11-20	102	63.8	
21-30	21	13.1	
31-40	4	2.5	13.1
Access to credit			
Yes	19	11.9	
No	141	88.1	
Total	160	100	

Source: field survey, 2018

Estimated Technical Efficiency of sesame farmers and Sources of Technical Inefficiency

The estimated result of sigma square (σ^2) of 0.103 as presented in Table 2 is statistically significant at 0.01 level of significance indicating goodness of fit and correctness of distributional assumption specified. This signifies the appropriateness of the theoretically required distributional assumptions for the decomposed error term (Ebe *et al.* 2017). The gamma (γ) estimate of 0.71 shows that about 71% of total variation in technical efficiency of sesame output was explained by the independent variables while 29% was due to technical inefficiency of the farmers in the study area. This result is consistent with the findings of Omolehin *et al.* (2010) who noted that 85% variation in sesame production in Jigawa State was due to inefficiency. The likelihood estimates (0.736) of the stochastic production frontier revealed that output was significantly influenced by seed, labour, farm size and herbicide.

The result indicates that the coefficients of the variables were in tandem with a priori expectation as four of the variables seed, farm size, labour and herbicide were statistically

significant at 1% except fertilizer. Increases in farm size by 1% will significantly influence technical efficiency by about 0.015 ceteris paribus. This findings is in tandem with the finding of Johansson (2005) who found out that Farm size significantly influence efficiency.

Table 2: Estimates of the Stochastic Production Frontier and the Sources of Technical Inefficiency

Variables	parameters	Coefficients	Stand. Error	t-value
Constant	β_0	0.190330606**	0.080641235	2.36021443
Quantity of seed	X_1	0.250391246***	0.073188124	3.42120054
Farm size	X_2	-0.137831111***	0.045602354	-3.0224561
Total labour input	X_3	0.43964799***	0.098566231	4.46043215
Quantity of herbicide	X_4	12.76004111***	1.162823643	10.9733245
Quantity of fertilizer	X_5	0.00662312	0.008514253	1.29325321
Source of inefficiency				
Constant	α_0	0.25432275	0.2143221	0.8427168
Gender	Z_1	-0.511519182***	0.12715151	-4.0229108
Age	Z_2	-6.243113153***	0.93459793	-6.6799891
Household size	Z_3	-0.62796305	0.77942585	-0.8056739
Educational level	Z_4	-2.28883389**	0.96455815	-2.3729351
Membership of coop. society	Z_5	-3.09670898***	0.85661837	-3.6150392
Access to credit	Z_6	-1.91232446 **	0.91640580	-2.086766
Extension visit	Z_7	-0.7500701075*	0.39688790	-1.889856
Farming experience	Z_8	-0.413190047***	0.13735763	3.0081332
Diagnostic Statistics				
Sigma-square	σ^2	0.10317322	0.49456348	0.20861471
Gamma	Γ	0.71000000	0.67158672	0.28100773
Log likelihood		0.73603464		
LR test		0.88941223		

***, ** and * denote significance at 1%, 5% and 10% levels respectively.

The estimated coefficients of the inefficiency model reveals the contribution of the variables to technical efficiency. In inefficiency model, a positive sign implies that the associated variable has a negative effect on efficiency and a negative sign indicates the reverse. Coefficient of gender was negative and significant at 1%, meaning that gender reduced technical inefficiency. Age was negative and statistically significant at 1% level implying that increase in this factor led to increase in technical efficiency and decrease technical inefficiency of sesame farmers. This result is in consonance with the finding of Abu *et al* (2012) who found that age of farmer (-2.12) to be negative and statistically significant at 1% level of significance. Education coefficient was negative and statistically significant at 5%, meaning that increase in the level of education will decrease technical inefficiency and hence increase technical efficiency.

Technical Efficiency Indices

The result in Table 3 shows high technical efficiency among the farmers. The individual technical efficiency indices range between 65% and 94% with mean technical efficiency of 82%. The mean technical efficiency of 82% implies that on the average, the farmers were able to achieve 82% of optimal output of sesame from the set of inputs and technology available to them. Thus, the sesame output could be increased by 18% with the existing level of resources. This suggests that there are opportunities for the farmers to increase their current resource efficiency in the study area. The result of this work agrees with the findings of Sharon (2016) who reported that the Technical Efficiency (TE) ranged from 0.432 and 0.976 with the mean TE of 0.712 in Benue State, suggesting that an average sesame farmer in the study area still has the capacity to increase TE in sesame production by about 28.8% to achieve the maximum possible level while the most efficient one can increase output by 2.4%. It therefore, shows that there is efficiency gap that need to be covered in sesame production in the study area.

Table 3: Distribution of Technical Efficiency of sesame farmers

Class	Frequency	Percentage
0.61-0.70	2	1
0.71-0.80	55	34
0.81-0.90	94	57
0.91-1.00	12	8
Total	**160**	**100**
Maximum	0.94	
Minimum	0.65	
Mean	0.82	

Source: field survey, 2018

Conclusion and Recommendations

The result showed that the average technical efficiency score was around 82 percent with a minimum score of 65 percent and a maximum of 94 percent. This proved that there was significant possibility to increase Sesame yield in the study area by improving resource use efficiency. The main variables that significantly influence technical efficiency in the study area were quantity of seed, farm size, labour input and herbicide. Based on the result of this finding it was recommended that the private sectors should collaborate with the extension agents in order to train sesame farmers on the application of new technology that will raise their production to frontier level.

References

Abu, G.A., Abah, D and Ater P.I. (2012). Profit Efficiency Among Sesame Farmers in Nasarawa State, Nigeria. *Current Research Journal of Social Science,* 4(4): 261-268

Abu, G.A., Abah, D and Okpachu, S.A. (2011). Analysis of Cost and Return for Sesame Production in Nasarawa State: Implication for Sustainable Development in Nigeria. *Journal of Sustainable Development in Africa* 13(3): 238-249.

Amaza, P.S. and Olayemi, J.K. (2002). Analysis of Technical Inefficiency in Food Crop Production in Gombe State, Nigeria. *Applied Economics letter*. 9(1): 51-54.

Baridam, D. M. (2001). Research methods in administrative science, 2nd ed, Port Harcourt: Paragraphics *International Journal of Business and Management 3(2): pp 135-142*

Baruwa, O.I. (2013). Profitability and Constraints of Pineapple Production in Osun State, Nigeria. *Journal of Horticultural Research,* 21(2): 59–64

Chemonics International Inc. (2002). Overview of Sesame Industry. The United State Agency for International Development (USAID)/Nigeria RAISE IQC contract No PCE-1-00-99-00003-00.

Coelli, T. J. (1994). A Guide to Frontier Version 4.1c:A Computer Programme for Stochastic Frontier Production and Cost Function Estimation. *Working Paper No. 96/07*, Centre for Efficiency and Productivity Analysis, Department of Econometrics, University of New England, Armidale, Australia

Ebe, F. E., Obike, K. C. and Nnamani, N. G. (2017). Analysis of Technical Efficiency of dry season Vegetable Production among Women Farmers in Isi-Uzo Local Government Areas. *FUW Journal of Agriculture and Life Sciences, 2(1), 182-189.*

FAO (2013): FAOSTAS (online) www.faostat.fao.org/site/339 /default.aspx 18/06/14

FAO (2017). FAO Rice market Monitor (RMM). Volume 16, Trade and Market Division. Food and Agriculture Organization of the United Nations, Rome, Italy, 1-36.

Ibrahim, U. W., Umar, A. S. S. and Ahmed, B. (2014).Technical Efficiency and its Determinants in Water Melon

Production in Borno State, Nigeria. *Journal of Economics and Sustainable Development, 5(27): 205-211.*

International Institute of Tropical Agriculture (2002). IITA Annual Report, IITA Ibadan, Nigeria. 19 – 30.

Johansson, H. (2005) "Technical, allocative and economic efficiency in Swedish dairy farms: The Data Development analysis versus the Stochastic Frontier Approach" Paper presented at 11th International Congress of European Association of Agricultural Economists (EAAE,) Copenhagen, Denmark, August, 2005.

Khai, H. V., Yabe, M., Yokogawa, H. and Sato, G. (2008): "Analysis of Productive Efficiency of Soybean Production in the Mekong River Delta of Vietnam. *J. Fac. Agr. Kyushu Univ.*, 53(1): 271-279

Ministry of Budget and National Planning (2017). Economic Recovery and Growth Plan 2017-2020. Abuja: Ministry of Budget and National plan

National Cereals Research Institute [NCRI] (2012). Modern Agronomic Practices in Sesame Production. In: *Training Manual for Sesame Stakeholders in Nigeria*. Shokalu. O. (Eds) Federal Ministry of Agriculture/NCRII, Nigeria.

NPC (2017). Demographic Statistics Bulletin third series, May 2018. State and Federal Ministries, Departments and Agencies (SFMDAs) across the country

Oluwatosin, F. M. (2011), "Measuring Technical Efficiency of Yam Farmers in Nigeria: A Stochastic Parametric Approach." *Agricultural Journals, 6(2);123-129*

Omolehin, R.A.,Usman, S. and Ahmed, B. (2010). Analysis of Technical Efficiency of Sesame Production in Jigawa State. *Savannah Journal of Agriculture,* 5:10-17.

Onyibe, J. E., Abu, S. S. and Tologbonshein, E. B. (2012). The role of extension research and information dissemination in enhancing beniseed production, marketing of resource poor farmers. *Proceeding of the First Workshop on Beniseed,* held at the National cereal research institute, Badegi, Nigeria,March 3rd- 5th 1998. 86-9.

Rahman, S. A., and Umar, H. S. (2009). Measurement of Technical Efficiency and Its Determinants in Crop Production in Lafia Local Government Area of Nassarawa State, Nigeria. *Journal of Tropical Agriculture, Food, Environment and Extension 8(2):90-96.*

Sharon, O. A. (2016). Economic analysis of Sesame Production among Small-Holder farmers in Benue State, Nigeria. M.Sc Agricultural Economics Thesis. Ahmadu Bello University, Zaria, Nigeria.

Taraba Agricultural Development Programme (TADP) (2004*). Crop Production Recommendations for Taraba State. Taraba press Ltd. Nigeria;31-39*

Tiamiyu S.A., Bwala M.A. and Alawode V.O. (2017). Economic Revitalisation through Agriculture: Role of Agricultural Credit Guarantee Scheme Fund in Nigeria. *Regional Journal of Agricultural Sciences, 3(63):3-8.*