

EFFICIENCY OF SOYBEAN PRODUCTION IN TARABA STATE, NIGERIA

¹Samuel, P., ²Nwachukwu, C. N. and ¹Ahmadu, S.

¹Department of Agricultural Economics and Extension, Taraba State University Jalingo.

²Department of Agribusiness and Management, Micheal Okpara University of Agriculture Umudike Abia State, Nigeria.

Corresponding Author's Email Address: mbwidi2013@gmail.com

Received 13th February, 2023 Accepted 18th November, 2023

ABSTRACT

This study analyzed the efficiency of soybean production in Taraba State, Nigeria. The specific objectives were to: determine the socio-economic characteristics of soybean producers in the study area; examine the determinants of efficiency and efficiency levels of soybean producers in the study area. Multistage, purposive and simple random sampling techniques were used to select 240 respondents for the study. Data for this study was collected using structured interview schedule (questionnaire). The objectives of the study were achieved using and descriptive statistics (percentages and mean) and stochastic production frontier. The result obtained revealed that soybean enterprise in the study area have 43.6% chance for improving production efficiency using the existing technology of the best farmer, 49.1% shortfall in allocative efficiency of an average farmer, 56.25 soybean enterprise had an efficiency index less than 50% while 54 enterprises had between 50% -79.9% which indicates a moderate economic level efficiency of enterprise in the study area. It was recommended that farmers should be encouraged by the Government and Non-Governmental organization to participate in soybean production in order to increase the level of output.

Key word: soybean, production, efficiency, enterprise, output.

INTRODUCTION

Soybean (*Glycine max*) is an annual crop of great importance, it was domesticated from America. It is used as a source of carbohydrate to both human (in the developing countries) and animal feed worldwide due to its high feeding value (Sahel capital, 2017). It is recently used in production of bio fuel. It is equally well accepted for feed ingredient and can contribute up to 30% protein, 60% energy, and 90% starch in animal diet. Soybean is one of the important crops occupying third position next to wheat and rice in cereal production in the world (Khojely, *et al.*, 2018). Soybean has been recognized as a common component in most intercropping system. It seems to lead as the cereal constituent of intercrop and is regularly combined with dissimilar legumes (Mahendra *et al.*, 2018). Soybean yield is generally higher in high solar intensities, lower night temperatures and lower incidence of pest and diseases (Daramola, *et al.*, 2019). One of the major food problems in Nigeria

is the gross deficiency in protein intake, both in quantity and quality. Although, protein in human diet is derived from both plant and animal sources, the declining consumption of animal protein due to its high prices requires alternative sources. Soybean provides a cheaper and high protein rich alternative substitute to animal protein. It is an important crop in the world and has been the dominant oilseed since the 1960s. It is a multipurpose crop and its importance ranges from its use in milk production, oil processing, livestock feeds, medical, industrial and human consumption and more recently, as a source of bio-energy (Omoigui *et al.*, 2020)

Efficiency is often used synonymously with that of productivity which relates output to input. In agriculture, the analysis of efficiency is generally associated with the possibility of farm production to attain optimal level of output from a given bundle of input at least cost. Analysis of efficiency is very important because our resources are limited. In order to achieve

optimum production level, resources must be available and whatever quantities of available resources must be used efficiently. Successful result oriented farm planning and policies require the knowledge of productivities of farm resources to know the resources whose quantity or rate of use should be increased or decreased (Sani *et al.*, 2010). Efficiency is an effort to achieve the desired production and productivity by using minimum input. Technically efficient farmers are highly productive because they are able to use a minimum level of inputs to produce a given level of output or produce maximum output from a given level of inputs. Similarly, allocative efficient farmers tend to run more profitable farming enterprises as they are able to produce a given level of output from minimum costs. Efforts to increase productivity can be done through technological changes by using a more advanced technology, increasing technical, allocative and economics efficiency (Omoigui *et al.*, 2020). The low national soybean production is caused by several factors, such as: unavailability of land allocation that is definitely and specifically intended for the soybean production system; high-risk soybean farming, low productivity and low soybean farming income; perpetrators of soybean farming of traditional farmers with a small business scale; slow adoption of production technology; and program to increase soybean production which is not focused because the harvest area data is not accurate (Daramola, *et al.*, 2019; Omoigui, *et al.*, 2020). Increasing soybean production in Taraba State not only in terms of productivity but also on price stability has become a challenging factor to soya bean farmers. Efforts to increase productivity through government policies in increasing the competitiveness of domestic soybeans and efficiency of resource use are not feasible. Studies on agricultural efficiency related to soybeans production have been carried out by numerous scholars across developing countries especially in Africa (Omoigui, *et al.*, 2020; Daramola *et al.*, 2019; Regasa *et al.*, 2019; Ichaou and Ismaila, 2016; Upev, *et al.*, 2015). Much of the existing literature on efficiency in Soybean has exclusively focused on technical efficiency. However, how farmers allocate their resources in response to price incentive is also an important determinant of profitability of the farming

enterprise. In addition, Technical, allocative and economic efficiency are important in improving the productivity gains from existing technologies. To achieve optimum production level, resources available must be used efficiently. Successful planning and result-oriented policies require the technical knowledge of productivities of farm resources to know the needed necessary adjustments to achieve a correct input mix. Despite its importance, Soybean production in Taraba State is dominated by traditional small scales farmers who use traditional methods of production. Resources are underutilized in addition to use of low yielding varieties, poor extension services, inadequate incentives and amenities, which give rise to low output and hence low farm income (Omoigui *et al.*, 2020; Shehu *et al.*, 2017). In addition, farmers might use resources rationally but not at economic optimal level, all these contribute to low output. The small-scale production of soybean in Taraba State could be attributed mainly to the relatively small initial capital investment, lack of readily available high yielding varieties and many unresolved and poorly understood issues associated with land ownership. In view of the foregoing, it is proper to examine the economic analysis of small-scale soybean production in Taraba State, Nigeria. The specific objectives of the study were to determine the socio-economic characteristics of soybean producers in the study area; examine the determinants of efficiency and efficiency levels of soybean producers in the study area

METHODOLOGY

The study was conducted in Taraba State, Nigeria. Data was collected using structured interview schedules with the aid of questionnaires. Multistage, purposive and simple random sampling techniques were adopted in sampling 240 respondents for the study. Objective one and two were achieved descriptive statistics. The stochastic production frontier was used to determine the production level and production efficiency (objective three) of the soybean farmers in the study area.

Model Specification

Stochastic Efficiency Frontier Production Function for Objective Three

The stochastic production frontier was used to determine the production level and

production efficiency of the soybean farmers in the study area.

The stochastic efficiency frontier production function is defined by:

$$Y_i = f(X_i, \beta) \exp(V_i - U_i) \text{ --- (3.10)}$$

Y_i = Soybean output for i th farmer

X_i = corresponding vector of inputs

$$Y_i = f(X_1, \dots, X_n) \text{ --- (3.11)}$$

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + e_i \text{ --- (3.12)}$$

Where $e_i = V_i - U_i$,

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + V_i - U_i \text{ --- (3.13)}$$

V_i = is independently and identically distributed random errors, having $N(0, \sigma^2)$ distribution.

U_i = technical inefficiency

e_i = error term

Where:

Y_i = Soybean output for i th farmer

X_1 = Seed/planting material (in kilogramme)

X_2 = Cultivated farmland (hectares)

X_3 = Fertilizer (in kilogramme)

X_4 = Labour in manday

X_5 = Pesticides/herbicides (litres)

X_6 = Capital (Depreciation, insurance, tax, interest and rent on land)

In the frontier model specified, to estimate β , which is the vector of the regression parameter, the stochastic

production model is linearized thus:

$$\ln Y_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 \text{ --- (3.14)}$$

The stochastic frontier cost function for estimating the allocative efficiency adapted from Farrell (1957) is specified as

$$C_i = f(P_i, \beta) \exp(V_i - U_i) \text{ --- (3.15)}$$

C_i = Soybean total cost for i th farmer

P_i = corresponding vector of input prices

$$C_i = f(P_1, \dots, P_n) \text{ --- (3.16)}$$

$$C_i = \alpha_0 + \alpha_1 P_1 + \alpha_2 P_2 + \alpha_3 P_3 + \alpha_4 P_4 + e_i \text{ --- (3.17)}$$

Where $e_i = V_i - U_i$,

$$C_i = \alpha_0 + \alpha_1 P_1 + \alpha_2 P_2 + \alpha_3 P_3 + \alpha_4 P_4 + \alpha_5 P_5 + V_i - U_i \text{ --- (3.18)}$$

Where:

V_i = is independently and identically distributed random errors, having $N(0, \sigma^2)$ distribution.

U_i = allocative inefficiency

e_i = error term

C_i = Soybean total production cost for the i th farmer (in naira)

P_1 = price of seed/planting material (in naira)

P_2 = price of labour (in naira)

P_3 = price of fertilizer (in naira)

P_4 = price of cultivated land (in naira)

P_5 = price of pesticides/ herbicides (in naira)

P_6 = price of capital (Value of depreciation, insurance premium, tax, interest and rent on land)

In the frontier model specified, to estimate α , which is the vector of the regression parameter, the stochastic production cost frontier model is linearized thus:

$$\ln C_i = \alpha_0 + \alpha_1 \ln P_1 + \alpha_2 \ln P_2 + \alpha_3 \ln P_3 + \alpha_4 \ln P_4 + \alpha_5 \ln P_5 + \alpha_6 \ln P_6 \text{ --- (3.19)}$$

Economic efficiency (EE) is estimated as:

$$EE = AE * TE \text{ --- (3.20)}$$

Note that $0 \leq EE \leq 1$ ss

The stochastic frontier cost functions model for estimating soybean production level overall economic efficiency is specified as:

$$C_i = (Y_i, P_i; \alpha) + e_i \text{ --- (3.21)}$$

where:

$i = 1, 2, 3, \dots, n$

Where

C_i = represents the total production cost

Y_i = represents the output produced

P_i = represents the prices of inputs

α = represents the parameters of the cost function

e_i = represents the error term that is composed of two elements, that is:

$$e = V_i + U_i$$

Determinants of production efficiency

The technical inefficiency is outlined by the equation

$$U_i = \delta_0 + \delta_1 Q_1 + \delta_2 Q_2 + \delta_3 Q_3 + \delta_4 Q_4 + \dots + \delta_n Q_n - U_i \text{ --- (3.22)}$$

Equation (3.22) outlines the technical inefficiency effect and it also indicates that these effects in a stochastic frontier are expressed in terms of various explanatory variables, which include the following:

Q_1 = age of respondent (years)

Q_2 = household size (head count)

Q_3 = years of experience (years)

Q_4 = years of formal education (years)

Q_5 = value of off-farm income (naira)

Q_6 = sex of respondent (1=male, 0=female)

Q_7 = marital status of respondent (1=married, 0= single)

$\delta_0, \delta_1, \delta_2, \dots, \delta_7$ are parameters to be estimated.

The allocative inefficiency is outlined by the equation

$$U_i = \phi_0 + \phi_1 Q_1 + \phi_2 Q_2 + \phi_3 Q_3 + \phi_4 Q_4 + \dots + \phi_n Q_n - U_i \quad (3.23)$$

Equation (3.23) outlines the allocative inefficiency effect and it also indicates that these effects in a stochastic cost frontier are expressed in terms of various explanatory variables, which include the following:

Q_1 = age of the respondent (years)

Q_2 = household size (head count)

Q_3 = years of experience (years)

Q_4 = years of formal education (years)

Q_5 = value of off-farm income (naira)

Q_6 = sex of respondent (1= male, 0= female)

Q_7 = marital status of respondent (1= married, 0= single)

$\phi_0, \phi_1, \phi_2, \dots, \phi_7$ are inefficiency parameters to be estimated.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Soybean Farmers.

The results on socio-economic characteristics of the soybean farmers in the area are presented in on Table 1. The result in the Table 1 showed that soybean farmers within age range of 40 – 49 represented 41.7 percent, 50-59 years represented 33.3 percent, 30 – 39 years were 13.3 percent of the sample, whereas farmers between the ages of 60 and 69 represented 11.7 percent. The mean age of the respondent was 48.8 years. This means that the farmers are ageing. This result is in support of the findings of Obasi (2015) who recorded a mean age of 50.4 years. The high percentage of farmers within 40–49 and 50 – 59 years might be due to the fact that, within the age bracket, people are still in their active ages and are capable of undergoing different difficult task and are more financially capable to involved in soya beans production. Although the implication is that farmers are aging. Mgbada, (2010) noted that Nigerian farmers are mostly old people. Sex of soybean farmer showed that majority of the respondents (59.17%) were females while 40.83% were males. The crowding of the female in the soya beans production activities may be due to the fact that soybeans is a crop that is more associated

with women both at its raw stage and its value chain stages. This is in-line with the findings of Dolaree *et al.*, (2017) where they noted that soybean farming is female dominated because it involves less fatigue and stress, and the low percentage of male participating in the soya beans farming may also be explained by socio-cultural factors affecting men, stress involved and the fatigue involved and not as a result of technical and managerial inefficiency. Furthermore, female is more patient in the harvesting and processing process that are involved in the cultivation of soya beans. This shows that females dominated soybean farming activities in the area. This result proves positive since women in African countries form big portion of the population undertaken farming activities. However, they face socially conditioned inequalities in the access, use and control of productive resource. The study showed that majority (91.3%) of the respondents were married, 2.1% were single while 5.4% and 1.3% were divorced and widows respectively. This is typical of Nigeria rural setting because family members often serve as a source of additional labor together with cultural value attached to marriage. This result is in consonant with the findings of Ademola and Olujide (2014) where more than three-quarter of the farmers were married, implying that household labour might complement farm activities. Marital status can influence the role and responsibilities as well as occupational lives of members and their family (Kuhn *et al.*, 2000; Akinbode, 2013). Also, Zalkuwi *et al* (2014) who found that about 55.67 percent of farmers in Numan Local Government Area of Adamawa State were married. The result also revealed that a greater proportion (35 %) of the respondents have between 2.1-3.0 hectares of farm land, 30 percent have between 1.1-2.0 hectares of farm land, 17.92% of the respondents have between 0.1 -1.0 hectares of farm land, 11.67 percent have between 3.1-4.0 hectares of farm land while 4.58 percent have between 4.1 - 5.0 hectares respectively. The mean farm size is 2.09 hectares. The above situation reveals that there is skewedness in the distribution of land in the study area. Greater number (35 percent) have small area usually fragmented holding which supported subsistence agriculture. The result reveal that majority of the farmers are small-scale farmers. This may be attributed to high level of

poverty where poor farmers can only afford small parcel of land for subsistence farming coupled with inadequate credit facilities necessary to expand their farm lands. According to FOS/FBS (1999) and Awoke and Okoji (2004), small scale farmers are farmers who cultivate between 0.1 – 4.99 hectare and produce on subsistence level. The result supports the assertion made by Nnadi and Amaechi, (2004), that under inheritance, the whole heirs of every family have their shares of land no matter how fragmented and small their sizes area. This lays credence to the subsistence farming characteristic in the area. The survey showed that the respondents (20.0%) had spent 1 – 10 years, 38.3% had spent 11- 20 years while 28.3% and 13.3 had spent 21 – 30 and 41 – 50 years in farming respectively. The mean farming experience was approximately 19 years. This showed that soybean farmers in the study area had considerable experience in farming. This result agrees with Zalkuwi *et al* (2014) who found out that about 64.95 percent had farming experience above 5 years. This result shows that majority of the respondents had much farming experience to improve their production techniques. Because this could positively influence their management capabilities on the crops, farmers with more years of farming experience may likely to adopt new innovation and are likely to be technically efficient in their farm practices.

Nwaru (2004) noted that, the number of years a farmer spends in farming business may give an indication of the practical knowledge he has acquired. The implication of this is that they are equipped to overcome their farming challenges to a considerable extent (Ademola and Olujide 2014). It also shows that majority (98.8%) of the respondents acquired one form of formal education or the other. The result implies that the farmers are literate having acquired one level of education or the other. This means that they manage and utilized credit properly given their level of education in innovations and better farming practices. Their high literacy level is an asset as the farmers would be exposed to many information sources, embrace innovations and analyze farm situations objectively. Undoubtedly, the high level of literacy predisposes some level of managerial ability in

the farm business (Acquah and Addo, 2011; Abula *et al.*, 2013).

Furthermore, this study agreed with findings of Nzeakor and Aigbokie (2021) that education provides a favourable atmosphere for awareness and adoption of innovation.

The formal educational profile and farm training experience of the farmers could adequately expose them to the importance of credit farming operation. Zalkuwi *et al* (2015), also who found out that majority of the respondent have one form of formal education. This has implications on their involvement in agricultural development activities such as credit scheme since they can access information through print, electronic and professional associations meeting and workshop. In addition, respondents' level of education can have positive effect on enhancing their ability to pay back credit within stipulated payback period. Pasha and Negese (2014) noted that level of education positively and significantly influenced credit repayment. A dominant number of the farmers indicated membership of association. Specifically, majority (62.9 percent) indicated that they belong to one association or the other. On the contrary, 37.1 percent indicated that they do not belong to any association. Membership of association satisfies the social needs of farmers in additions to serving as an avenue for access to information on agricultural technology. Farmers by virtue of their membership discern the obvious advantages of agricultural technology as well as clarify their misconception of technology and the adoption. Farmers that do not belong to association may be ignorant of the obvious gains through membership. This calls for concerted extension campaigns for farmers' membership of co-operative society (Nnadi *et al*, 2013). Majority (81.7%) of the soybean farmers had contact with extension agent while 18.3% of the sampled population never had extension contact through farming season. This suggests that greater number of the sampled population had extension visits. Ukoha *et al* (2013) reported that better education through improve extension service would lead to improve access to credit, knowledge and improves farm technologies, farm tools etc. which has strong influence on increased productivity.

Table 1: Socio-Economic Characteristics of the Soybean Farmers

Variables	Frequency	Percentage (%)
Age (years)		
30 – 39	31	12.9
40 – 49	81	33.8
50 – 59	76	31.7
60 – 69	28	11.7
69 – 79	19	7.9
79 – 80	5	2.1
Mean	48.8	
Sex		
Female	142	59.17
Male	98	40.83
Total	240	100.0
Marital status		
Single	219	91.3
Married	5	2.1
Divorced	13	5.4
Widow	3	1.3
Farm size		
0.1-1.0	43	17.92
1.1-2.0	74	30.83
2.1-3.0	84	35.00
3.1-4.0	28	11.67
Mean	2.09	
Experience		
1 – 10	48	20.0
11 – 20	88	36.7
21 – 30	68	28.3
31 – 40	32	13.3
41 – 50	2	0.8
51- 60	2	0.8
Education		
Never attended	3	1.25
Nursery	11	4.58
Primary	115	48.33
Secondary	60	25.00
Tertiary	46	19.17
Others (e.g Technical)	4	1.67
Association		
No	89	37.1
Yes	151	62.9
Extension		
No	44	18.3
Yes	196	81.7
Total	240	100.0

Source: Field Survey (2021)

Efficiency Levels of Soybean Production in the Study Area

The maximum likelihood estimates using stochastic frontier parameters for soybean farming is presented in Table 2. The estimated variance (σ^2), gamma (γ) and Log likelihood function indicate goodness of fit with the stochastic frontier model. For production factors the coefficient of land and labour were statistically significant at 1% and positively related to total output. This implies that increase in any of these variables will lead to increase in

output and vice versa. This is expected and in accordance with a priori expectations. This result is in agreement with the findings of Atabohet *al* ., (2014) on determinants of technical efficiency where farmland and labour had a direct relationship with production output. Also Quantity of fertilizer used was significant at 1% and positively related to output of the soybean farmers, this implies that the higher the use of fertilizer, the more productive the soybean farmers become. This suggests that when the soybean farmers adopt and utilize the fertilizer

appropriately, it would lead to improved output. This supports the findings of Ogundele and Okoruwa (2006) which observed that the use of fertilizer increased output of farming in Nigeria.

Furthermore, the result shows that there is a positive relationship between the inefficiency variables (household size, education and marital status) included in the model. This shows that increase in these variables increases the output of the enterprise. Meaning that, the more the number of person per household, the greater the output level. Also, education implied that an increase in

level of education by one year increases the output. While a negative relationship exist between age of farmers, off-farm income and sex. This implies that as soybean farmers advance in age and have increased number of activities in off-farm sector, the output level decreases. The implication is that the older the farms becomes the more his output declines. This concur with the findings of (Olwande and Mathenge, 2012). Also the coefficient of sex was negative and significant at 1%. This implies that output increase in favour of female farmers.

Table 2: Maximum likelihood estimate of stochastic production frontier function

Variables	Coefficient	Standard error	t-ratio
Production factor			
Constant	9.6694	1.9790	4.89***
X ₁ = Seed/planting material	0.0000	0.0479	0.00
X ₂ = Cultivated farmland	0.0021	0.0005	4.01***
X ₃ = Fertilizer	0.9223	0.072	12.81***
X ₄ = Labour in manday	0.0005	0.0001	3.70***
X ₅ = Pesticides/herbicides	0.0000	0.0000	0.000
X ₆ = Capital	-0.0035	0.0045	0.78
Inefficiency factors			
Q ₁ = Age of respondent	-0.8541	0.0913	-9.35***
Q ₂ = Household size	0.0006	0.0001	7.05***
Q ₃ = Experience	0.0657	0.1106	0.59
Q ₄ = Formal education (years)	0.9465	0.0407	23.26***
Q ₅ = Off-farm income (naira)	-0.4425	0.0880	-5.03***
Q ₆ = Sex	-0.9345	0.0988	-9.46***
Q ₇ = Marital status	0.6999	0.0781	8.96***
Sigma squared(δ)	1.0591	0.0619	17.10***
Gamma(γ)	1.4138	0.0119	
Log likelihood function	-83.84		
LR test	104***		

Source: Field Survey data, 2021 ***, *, Significant at 1% and 10%, respectively

The estimated parameters for the stochastic frontier cost function for soybean enterprise presented in Table 3 revealed the estimated gamma (γ) parameter of 0.7565 implies that about 76 percent of the variations in the total cost of production of soybean under was due to differences in their cost efficiencies. This means that cost inefficiency effects do make significant contributions to the cost of producing soybean in the study area. Therefore, the hypothesis that the parameter estimate of $\gamma = 0$ is rejected. The test was confirmed by the test of hypothesis using the Log likelihood-ratio test presented in Table 3 which shows the estimated value of -94.14 exceeding the chi-square critical value at 1 percent level of probability. Therefore,

the null hypothesis, which specifies that the inefficiency effects are absent from the model, is strongly rejected.

Specifically price of planting material, labour, fertilizer, land and price of pesticide were the significant variables influencing the production cost of the soybean enterprise. The coefficient of price of planting material, labour, fertilizer, land and price of pesticide were significant at 1% and positively related to production cost for the soybean enterprise. This implies that a rise in the price of any of variables would result in increase in the total cost of production. A similar result of direct effect of output on cost of production was obtained by Mausoybean *et al.* (2015)

Table 3: Allocative Efficiency of Soybean Enterprises

Variables	Coefficient	Standard error	t-ratio
Allocative efficiency			
Constant	10.68781	3.16331	3.38***
P ₁ = Price of seed	0.15743	0.00329	47.90***
P ₂ = price of labour	0.15204	0.00566	26.84***
P ₃ = Price of fertilizer	0.24069	0.00145	165.59***
P ₄ = Price of cultivated land	0.12737	0.00857	14.86***
P ₅ = Price of pesticides	0.15331	0.00046	334.54***
P ₆ = price of capital	0.03586	0.07114	0.504
Allocative inefficiency			
Q ₁ = Age of respondent	-0.04612	0.01891	-2.44**
Q ₂ = Household size	-0.11008	0.03672	-3.00***
Q ₃ = Experience	-0.11942	0.06135	-1.95**
Q ₄ = Formal education (years)	-0.02952	0.32283	-0.09
Q ₅ = Off-farm income (naira)	0.08012	0.05231	-1.53
Q ₆ = Sex	-0.43938	0.48298	-0.91
Q ₇ = Marital status	-0.02598	0.02980	0.87
Sigma squared(δ)	0.80232	0.48056	
Gamma(γ)	0.7565	0.06701	11.29***
Log likelihood function	-94.14		
LR test	128.211***		

Source: Field Survey data, 2021 ***, *, Significant at 1% and 10%, respectively

Allocative Inefficiency

Estimated coefficient for Age (-0.04612), Household size (-0.11008) and experience (-0.11942) were negative. The negative relationship of soybean farmers indicates a negative effect on cost allocation of respondents. Implying that older and more experience farmers tend to be cost efficient than younger respondents in soybean enterprise. This means if younger and energetic soybean farmers indulge into the enterprise, allocative efficiency would rise thereby reducing total cost of production and vis-a-vis increasing profit. Also increase in household size reduced the lease to decrease in allocative efficiency.

Table 4 indicates that the values of efficiency obtained lies between 0 and 1. This implies that the soybean enterprise were operating below the frontier. The general distribution of respondents' efficiency presented in Table 4 shows the obtained minimum, maximum and mean technical efficiency 0.07, 0.94 and 0.564 respectively of the respondents indicates that soybean enterprise in the study area have 43.6% chance for improving production efficiency using the existing technology of the best farmer. Therefore, there is need to increase production by utilizing available resources to attain the frontier level. About 17.5% of the respondents fall between technical efficiency of 1

- 29%. Respondents operating at technical efficiency of between 30 and 59% were 35% while respondents with technical efficiency above 59% were 48%. This showed that there is room for improvement since most farmers had technical efficiency less than 50 percent.

The allocative efficiency minimum, maximum and mean were 0.04, 0.93 and 0.509 respectively. This shows a wide distribution of allocative efficiency among the respondents, though, none of the respondents had attained the cost frontier level of 100%. This implies that there is 49.1% shortfall in allocative efficiency of an average farmer. Respondents allocating the cost resources between 1 – 29% were 25% of the sample whereas, 38.8% of the respondents allocate cost resources between 30 to 59% while respondents with allocative efficiency above 59% were 27.5%.

Economic efficiency which is the product of technical and allocative efficiencies shows minimum, maximum and mean were 0.02, 0.91 and 0.469 were obtained, this implies that on the average, the respondents were able to obtain a little over 46.9% of potential output, thus in the short run, there is a hope for increasing soybean production by 50.4% by adopting the technology and techniques used by most efficient enterprise as to reduce inefficiency and increase economic

efficiency in soybean production in the study area. The result also reveals that 56.25 soybean enterprise had an efficiency index less than 50% while 54 enterprises had between 50% and 79.9%. Only 30 soybean enterprise representing 12.5% recorded economic efficiency of 80-100%. Soybean enterprise who scored 70% and above are said to be efficient; hence, only 51 enterprises could be said to be economically efficient in soybean production in the study area. This clearly indicates a moderate level efficiency

of enterprise in the study area. This finding corroborates with findings of Adewuyi and Joseph, (2013) who reported that enterprise that scored 70% and above are said to be efficient and they indicate a low-level efficiency of enterprise in the study area. Furthermore, the Technical efficiency of the sampled enterprise is less than one (i.e. 100%) which according to Abba, (2019) indicate that all the enterprises are producing below the maximum efficiency frontier.

Table 4: Efficiency Distribution of Respondents

Efficiency	Technical Efficiency		Allocative Efficiency		Economic Efficiency	
	Frequency	%	Frequency	%	Frequency	%
0.10-0.19	24	10.00	33	13.75	27	11.25
0.20-0.29	18	7.50	27	11.25	21	8.75
0.30-0.39	21	8.75	18	7.50	36	15.00
0.40-0.49	36	15.00	42	17.50	51	21.25
0.50-0.59	27	11.25	33	13.75	21	8.75
0.60-0.69	30	12.50	27	11.25	33	13.75
0.70-0.79	33	13.75	21	8.75	21	8.75
0.80-0.89	27	11.25	21	8.75	18	7.50
0.90-1.00	24	10.00	18	7.50	12	5.00
Min	0.07		0.04		0.02	
Max	0.94		0.93		0.91	
Mean	0.564		0.509		0.496	
Total	240	100.0	240	100.0	240	100.0

Source: Field Survey Data, 2021

SUMMARY AND CONCLUSION

Based on result on the maximum likelihood estimates, the coefficient of planting material, land, quantity of fertilizer and labour were statistically and positively related to output of the soybean farmers while there is a positive relationship between the inefficiency variables (household size, education and marital status) included in the model. Also the coefficient of sex was negative and significant at 1%.

The estimated parameters for the stochastic frontier cost function for soybean enterprise shows that price of planting material, labour, fertilizer, land and price of pesticide were the significant variables influencing the production cost of the soybean enterprise, while estimated coefficient for Age (-0.04612),

Household size (-0.11008) and experience (-0.11942) were negative.

The minimum, maximum and mean technical efficiency were 0.07, 0.94 and 0.564 respectively of the respondents, the allocative efficiency minimum, maximum and mean were 0.04, 0.93 and 0.509 respectively while economic efficiencies shows minimum, maximum and mean as 0.02, 0.91 and 0.469 respectively.

RECOMMENDATIONS

The following recommendations are made in-line with major findings:

- Soybean enterprises should no longer practice subsistence enterprises but should mechanize their enterprise in order to increase their profit and farm income,

- government on the other hand should subsidize agricultural inputs, and enterprise equipment which will help the enterprises achieve their goals.
- ii. Concerted efforts should be geared towards increased production of soybean in order to meet the demands for food security in both the study area and the country (Nigeria) in general.
 - iii. Nigeria government and international development agencies ensure that any intervention has a capacity-building component which should center around environmental and ethnographic research, education about the training on how to interact with soybean and maintain a successful farm, and the development of infrastructure.

REFERENCE

- Abba, P. (2019). Technical efficiency analysis of cassava farmers in Ogun state, Nigeria. *International Journal of Applied Agricultural Sciences*. Vol 1 (3): 66–73
- Abula, M., Otitolaiye, J. O., Ibitoye, S. J., & Orebiyi, J. S. (2013). Repayment Performance of Rural Farmers Loan Beneficiaries of Microfinance Banks in Kogi State, Nigeria. *International Journal of Farming and Allied Sciences*, 2(5), 104-110.
- Acquah, H. D., & Addo, J. (2011). Determinants of Loan Repayment Performance of Fishermen: Empirical Evidence from Ghana. *Cercetări Agronomice în Moldova*, 44(4), 148
- Ademola, A. O. and Olujide, M. G. (2014). Soil conservation practices of arable crop farmers in Atisbo Local Government Area of Oyo State, Nigeria. *Advances in Research*, 2(12):879-888
- Adewuyi S.A and Joseph T.T. (2013). Economic Efficiency and Labour Utilisation among Cassava Farmers in Osun State, Nigeria. *American-Eurasian J. Agric. & Environ. Sci.*, 13 (9): 1232-1238.
- Aigbokie, S. O., Ibe, G. I. C., Inyang, N. N., Eze, A. A., Bassey, I., Uchendu, C. O. and Umeadi, S. C. (2021). Gender Differentials in Labour Source and Utilization Among Rural Rice Farmers In Enugu State, Nigeria. *Nigeria Agricultural Journal*. Volume 52 Number. Pg. 181-187
- Akinbode, S.O (2013). Access to Credit: Implication for Sustainable rice Production in Nigeria. *Journal of Sustainable Development in Africa*. Vol.15, No.1, pp. 13 – 30
- Ataboh G.R., Ayanwale A.B. and O. Oluwasola (2009) “Socio-economic Factors Determining Upland Rice Production in Small Holder Agriculture in Osun State, Nigeria”. *Ife Journal of Agriculture*, 24:79-96.
- Awoke, M.U. and C. Okorji (2004). The Determination and Analysis of Constraints in Resource Use Efficiency in Multiple Cropping Systems by Small Holders in Ebonyi State, Nigeria. *African Developments* 29(3):22-23
- Daramola, S.O., Adeyemi, O.R., Adigun, J.A., Adejuyigbe, C.O. (2019). Row spacing and weed management methods
- Dolaree. A D.; Joyce. D. M. & Jimjel. Z. (2017). Profitability of soya beans production in Mubi north local government area of Adamawa state, Nigeria. *International Journal of Advances in Agricultural Science and Technology*, Vol.4 Issue.6, pg. 1-18
- Federal Office of Statistics/ Federal Bureau of Statistics (1999). Poverty and Agricultural Sector in Nigeria, Poverty Incidence of Farmers by Region pp 22-23,
- Ichaou M and Ismaïla B (2016) Estimation of stochastic frontier of the technical efficiency of the soybeans production's determinants in Benin: the case of the commune of Savé. *Global Journal of Agricultural Economics, Extension. Rural Development*, 4(4), 410-420.
- Khojely, D.M., Ibrahim, S.E., Sapey, E., & Han, T. (2018). History, current status and prospects of Soybean production and research in Sub-saharan Africa. *The Crop Journal*, 1(1), 226-235.

- Kuhn, M. E., M. A. G. Darroch and G. F. Ortman (2000). Assessing the Efficacy of a South African Microlender's Loan Screening Mechanism *Agrekon*, Vol 39, No 4.
- Mahendra K, Sanjay K., and Aman S., (2018). An economic analysis of production and marketing of soybean in Rajnandgaon district of Chhattisgarh. *International Journal of Chemical Studies*. Vol. 6(4): 675-679
- Mausoybean S.A, Agbonlahor M.U and Oke A.T. (2013). Technical efficiency analysis of cassava farmers in Ogun state, Nigeria. *International Journal of Agriculture and Food Security (IJAFS)*, 4: 515- 522
- Mgbada,, T. 2010.Productivity, Technical Efficiency, and Farm Size in Paraguayan Agriculture". The Levy Economics Institute of Bard College. Working Paper No. 490, Feb
- Nnadi, F.N. and Amaechi E.C.C.I., 2007. Rural Sociology for Development Studies. 1st Edn., Custodabs Investment, Owerri
- Nwaru, J. C (2004) "Rural Credit Market and Arable Crop Production in Imo State of Nigeria" Ph.D Dissertation Michael Okpara University of Agriculture Umudike, Nigeria.
- Nzeakor F.C.,and Aigbokie S.O (2021). Adoption of Yam Storage Techniques and Food Security Status of Rural Farmers in Enugu State, *Nigeria Journal of Community & Communication Research*, Vol. 6 No.1 June 2021
- Obasi, I.O. 2015. Effect of land degradation on productivity of small scale farmers in Abia State of Nigeria. *Advanced Journal of Agricultural Research*, 3(3): 36-41.
- Obike, K.C., Amusa, T.A. and Olowolafe H.B (2017). Risk management and determinant of farm output among small scale Poultry farmers in Ekiti State, Nigeria. *Agro - Science Journal of Tropical Agriculture, Food, Environment and Extension* 16(2): 9 – 12
- Ogundele, O.O. and Okoruwa, V.O. (2006)"Technical Efficiency Differentials in Rice Production Technologies in Nigeria".AERC Research Paper 154. African Research Consortium, Nairobi, pp 1 - 37.
- Olwande, J. & Mathenge, M. (2012). Market Participation among Poor Rural Households in Kenya. In Paper Presented at the International Association of Agricultural Economists Triennial Conference, Brazil. (18-24 August).
- Omoigui, L.O., Adeyemo, R. and Akinola A.A (2020). Guide to Soybean production in Northern Nigeria (revised edition). Feed the future, Nigerian Integrated Agriculture Activity. International Institute of Tropical Agriculture, Ibadan; Nigeria.
- Pasha, S.M.A. and Negese, T. (2014) Performance of Loan Repayment Determinants in Ethiopian Micro Finance: An Analysis. *Eurasian Journal of Business and Economics*, 7, 29-49
- Regasa D W., Mesay Y and Adam B (2019). Analysis of production efficiency,s productivity variances and resource
- Sani, A., Yakubu, A. A and Bello, H. M., 2010 Resource-use Efficiency in Rice production under small scale irrigation in bunkure local Government area of Kano State. *Nigerian Journal of Basic Applied Science*. Vol. 18, (2): 292 – 296.
- Shehu U. A, Ibrahim A. I.,Hassan T., & Bello M (2017).Analysis of resource use efficiency in small-scale maize production in Tafawa-Balewa local government of Bauchi state Nigeria. *IOSR Journal of Agriculture and Veterinary Science*, 10(1), 59-65.
- Ukoha, B.A., Edet, J.U. and Ebirigor, A.A. (2013). Analysis of Savings determinants among Agro-based firm workers in Nigeria: a simultaneous equation approach. *Journal of Research on humanities and social sciences*. 1(3): 1-11
- Upev S. K., Haruna L. and Giroh D. Y (2015) . Analysis of Resource Use Efficiency

among Agro-based Firm Workers in Gboko Local Government Area of Benue State, Nigeria. *Global Journal of Agricultural Sciences*. 15(6):57-63.

Zalkuwi. J, Udhav P.S, Amita M and Asabe 2015. Cost and Return Analysis of Local Chicken Marketing in Mubi North Local Government Area of Adamawa State, Nigeria

Zalkuwi.J., Daniel.J.D. and Kwakanapwa.E.(2014) Resource productivity of Maize in Numan Local Government Area of Adamawa State, Nigeria. *International Journal of Scientific and Research Publication*