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PROFIT EFFICIENCY OF SOYABEAN ENTERPRISE IN TARABA STATE, NIGERIA

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ABSTRACT

This study determined the profit efficiency of soybean enterprise in Taraba State. The specific objectives were to: analyze the performance indices of producers' in soybean enterprise, estimate cost and return from soybean enterprise, identify the determinants of profit function in soybean enterprise, assess the determinants and efficiency levels of soybean enterprise and identify the constraints to soybean enterprise in the study area. Multistage, purposive and stratified random samplings were used. Data were collected with the aid of structured questionnaire. Data were analyzed using descriptive Statistics; Stochastic Frontier Production function and Tobit Regression. About 71.2% of the respondents invested between N1, 000 to N400,000 in the enterprise. The study revealed that soybean enterprise is a profitable venture because farmers gain 62 kobo in every naira invested. The determinants of profit efficiency in the study area were farming experience, savings, sales, investment, cost of modern machines and distance which were positive and statistically significant at 1 and 5% respectively. The R^2 is 0.98 meaning that about 98% variation in the profit efficiency were explain by the explanatory variables. Also, fertilizer, labour and pesticide were positive and significantly influenced technical efficiency. Incidence of pest and inadequate capital were the major constraint faced by farmers. Based on the finding it was recommended that farmers should be encouraged to expand their scale of production by providing them with production inputs like credit facilities, fertilizer, and chemicals in order to have increased yield.

INTRODUCTION

Soybean (*Glycine max*) is an important crop in the world. Soybean production plays a crucial role in the agricultural sector of Nigeria, contributing significantly to food security, economic development, and employment opportunities in the c ountry (Abah 2020, Osman, et al., 2018) . As a versatile crop with various industrial applications, soybean holds great potential for enhancing the livelihoods of farmers and promoting sustainable agricultural practices (Dugje, et al., 2020, and Ichaou and Ismaila, 2016)

Globally, soybean production is on the rise, with a projected output of 395 million tons for the 2023/24 season, a significant increase from the previous season's 367 million tons. Brazil leads the world in production, contributing approximately 161 million tons, followed by the United States with 112.4 million tons, and Argentina with 48.8 million tons. The American continent is the dominant region, accounting for over 93% of global production (FAO, 2023) In Africa, soybean production remains relatively small but is growing faster than the global average.

The continent produces less than 1% of the world's soybeans, with South Africa, Nigeria, and Zambia being the top producers. South Africa alone accounts for 39% of Africa's production, averaging 38.3 million bushels annually. Nigeria and Zambia follow with averages of 23.7 million and 10.4 million bushels, respectively (FAO, 2023). Nigeria is a key player in Africa's soybean market, producing 25% of the continent's output. In recent years, the country has averaged around 23.7 million bushels annually. However, challenges such as limited access to improved seeds, pests, diseases, and market access issues continue to impact production levels (FAO, 2023) Soybean provides a cheaper and high protein rich alternative substitute to animal protein. The inclusion of soybean in the carbohydrate rich staple food in Nigeria will increase their protein content (Dugje *et al*., 2020). Estimates show that about 925 million individuals are undernourished worldwide (FAO 2010b).

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. 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 (Abah, 2020, Siagian, *et al.,* 2022), Rossali, *et al .,* 2019).

Profit efficiency, defined as the ability to maximize profits with given resources and technology, is a critical measure of farm performance. Efficient production practices are crucial for enhancing profitability and ensuring the competitiveness of soybean farmers in the global market.

Despite the significant contribution of soybean production to the agricultural sector in Nigeria, there are few comprehensive studies that specifically analyze the profit efficiency of soybean enterprise. Soybean production in Taraba State is dominated by traditional small scales farmers who use traditional methods of production.

The study sought to provide answers to the following research questions:

i. What are the performance indices of producers' in soybean enterprise in the study area?

ii. What are the cost and return in soybean enterprise?

iii. What are the determinants of profit function in soybean enterprise in the study area?

iv. What are the determinants and efficiency levels of soybean enterprise in the study area?

v. What are the constraints to soybean enterprise in the study area?

Objectives of the Study

The broad objective of this study is to determine the profit efficiency in soybean enterprise in Taraba State. The specific objectives were to:

i. analyze the performance indices of producers' in soybean enterprise in the study area.

ii. estimate cost and return in soybean enterprise.

iii..identify the determinants of profit function in soybean enterprise in the study area.

iv. assess the determinants and efficiency levels of soybean enterprise in the study area and

v. identify the constraints to soybean enterprise in the study area.

MATERIALS AND METHODS

Study area

The study was conducted in Taraba State, Nigeria. The State had a population of about 2,300,736 people as at 2006 (NPC 2006). With a population growth rate of 2.94% year, the current population of Taraba state is 3,066,800. It lies between latitudes 6^{o} 30 N and 8^{0} 30 N of the Equator and between longitudes 9^{0} and 12^{0} E of the Greenwich Meridian with a land mass of 54,426 km^{2} (Oruonye and Bashir 2011). It has a tropical wet and dry seasons, well drained alluvial soils and characterized by both savannah and rainforest vegetations. Its dry season lasts for a minimum of five months (November to March) while the wet season spans early March to late November in the south and early April to November in the north. The mean annual rainfall ranges from 1000mm in the northern part to over 1800mm in the extreme southern part and Mambila area (Oruonye and Bashir 2011).

Sampling Techniques

Multistage, purposive and stratified random sampling techniques were adopted in sampling the study area and the respondents. The first stage involved purposive selection of three Local Government Areas from the states (Ardo-kola, Bali and Donga) for the study. These LGAs were selected because after preliminary investigations by the researcher, they were found to have high level of soybean production activities. In the second stage, five villages were randomly picked from each Local Government Areas, making a total number of 15 villages. In the last stage, soy bean farmers were randomly selected in proportion to the number of farmers in each of the selected village using 10% proportion to make a total number of 250 soybean farmers for the study (Table 1).

Data collection

Data for this study were collected from primary sources using structured questionnaire. Data were collected for 2022/2023 cropping season.

Data Analysis

The following tools were used to analyze the specific objectives of the study:

(i) Descriptive Statistics;

(ii) Budgetary Technique

(iii) Stochastic Frontier production function and

(iv) Tobit Regression

Model Specification

Cost, return and profitability index for Objective three

$NR = TR - TC$ 1

Where

NR = Net return

TR = Total Revenue
TC = Total cost
TC = TVC + TFC ……...…2
TVC = Total variable cost
TFC= Total fixed cost
TR = ΣPxQx ….....……..3
Px = price per bag of soybean (₦)
Qx = quantity of soybean sold (₦/bag)
GP = TR – TVC ……...……4
Where; GP = Gross profit (₦)
Net farm income (NFI) = GM – TFC .....……5
Where; GM = Gross Margin
The profitability of the farmers will be determined by R/N = $\frac{GP}{TC}$
BCR = $\frac{\Sigma B}{\Sigma C}$ ……..……7
Where;
P = price per bag of soybean (₦)
Q = quantity of soybean sold (₦/bag)
TC = Total cost (₦)
ΣB = summation of benefit
ΣC = summation of cost
R/N = Return per naira invested
Gross Ratio (GR) = TC/TR .....……8
Benefit cost ratio (BCR) = TR/TC ….....…9
Soybean production is profitable if its BCR ≥ 1. The higher the BCR, the more profitable the soybean production business is. Depreciation was calculated using the straight line method.
Stochastic frontier production function
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:
Yi = f (Xi, β) exp (Vi – Ui) ……..…10
Yi = Soybean output for ith farmers
Xi = corresponding vector of inputs
Yi = f(X1 …….Xn).....…11
Yi = β0 + β1X1+β2X2+ β3X3…… +βnXn+ ei ……..…12
Where ei = Vi-Ui,
$Y_i = \beta_0 + \beta_1X_1+\beta_2X_2+ \beta_3X_{3.....} +\beta_nX_n+ V_i - U_i$ 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, thestochastic production model is linearized thus:
$\ln Y_i = \beta_0+\beta_1\ln X_1+ \beta_2 \ln X_2 + \beta_3 \ln X_3+\beta_4 \ln X_4 +\beta_5 \ln X_5+\beta_6\ln X_6$……..13
The stochastic frontier cost function for estimating the allocative efficiency adapted from Farrell(1957) is specified as
$C_i = f(Pi, \beta) \exp (Vi - Ui)$ ……...14
C_i = Soybean total cost for i^{th} farmer
P_i = corresponding vector of input prices
$C_i = f(P_1$…….sPn) ……..…15
$C_i = \alpha_0 + \alpha_1P_1+ \alpha_2P_2+ \alpha_3P+ \alpha_4P_4+ e_i$ …...…16
Where ei = Vi-Ui,
$C_i = \alpha_0 + \alpha_1P_1+ \alpha_2P_2+ \alpha_3P_3 + \alpha_4P_4+ \alpha_5P_5+ V_i - U_i$ …….....17
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:
$\ln C_i = \alpha o+ \alpha_1\ln P_1+ \alpha_2\ln P_2 + \alpha_3\ln P_3 + \alpha_4\ln P_4+ \alpha_5\ln P_5+\alpha_6\ln P_6$ …….....18
Economic efficiency (EE) is estimated as:
EE= AE * TE ……..…19
Note that 0 ≤ EE ≤ 1ss
The stochastic frontier cost functions model for estimating soybean production level overall economic efficiency is specified as:

$Ci = (Yi, Pi; \propto) + ei$ 20

where:
i = 1, 2, 3, ... 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 = +
Determinants of production efficiency
The technical inefficiency is outlined by the equation
$Ui = \delta 0 + \delta_1 Q_1 + \delta_2 Q_2 + \delta_3 Q_3 + \delta_4 Q_4 + \ldots. + \delta_n Q_n$ -
Ui ……21
Equation (21) 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)
$\delta_0, \delta_1, \delta_2 \ldots\ldots\ldots \delta_7$ are parameters to be estimated.
The allocative inefficiency is outlined by the equation
$Ui = \phi_0 + \phi_1 Q_1 + \phi_2 Q_2 + \phi_3 Q_3 + \phi_4 Q_4 + \ldots. + \phi_n Q_n$ -
Ui ……,,,,22
Equation (22) 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)
$\phi_0, \phi_1, \phi_2 \ldots\ldots\ldots \phi_7$ are inefficiency parameters to be estimated.
Elasticity of production and return to scale
Elasticity of production and return to scale of the farmer is expressed as follows
$RTS = \sum_{i=1}^{n} \beta i = \sum_{i=1}^{k} EPxi$ ……23
$RTS = \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6$ ……..24
Where;
EP_{xi} = Elasticity of production of the i^{th} input
RST = Return to scale (i.e sum of coefficient of elasticity of production)
K = number of resources
3.5.4 Ordinary Least Square for determinants of profit
Determinants will be expressed implicitly as follows:

$_i = f(W_1, W_2, W_3, W_4, W_5 W_6, W_7, W_8, W_9, W_{10} e)$

……..……..25
Where:

π_i = Business profit (N)

W_1 = Amount of credit (N)
W_2 = Farming experience (years)
W_3 = Amount of Savings (N)
W_4 = Cultivated farmland (Hectares)
W_5 = Sales from Soybean production business (N)
W_6 = Amount of investment for i^{th} farmer (N)
W_7 = Cost of agrochemicals (including herbicide, pesticide and fertilizer (N))
W_8 = Cost of Hiring machinery
W_9 = Cost of hired labour
W_{10} = Distance to farm land (kilometers)

RESULTS AND DISCUSSION

Level of investment in soybean production by the small-holder producers

Distribution of the respondents based on Level of investment is presented in Table 2 The result indicates that majority (75.2%) of the respondents invested between ₦250,001 > N500,000 The overall average investment was N566, 908.33 in the study area. It is the opinion of the authors that prospects for increased soybean production in the study area are high and need government and private sector intervention in terms of loan facilities and access to requisite inputs to boost the economy of the area. This study is in tandem with Ichaou and Ismaïla, (2016) who advocated that efficient utilization of farm inputs - contribute to good

Analysis of Cost and Returns from Soybean Enterprise

The analysis of the estimate shows the gross margin, net farm income, rate of return per naira invested; gross and benefit cost ratios were similarly computed as presented in Table 3. The pooled mean was 1004 kg/ha. The unit selling price is N 453/ kg.

The total variable cost was N186, 327/ha while fixed cost was N94, 893. Costs of renting constituted about 20.03% of the total cost incurred in the soybeans production in the study area. The total revenue earned is N454, 812/ha. The net farm income was N173, 863. The ratio of rate of return per naira invested was 0.62. The results shows that the soybeans enterprise is a profitable venture and thus worth undertaking. These result is in consonance with the findings of Ukaoha *et al.* (2022) who found that soybeans enterprise is a profitable business in their study carried out in the Federal Capital Territory Abuja on "profit efficiency of soybeans production" Based on these findings farmers in the study area could readily be advised to go in to the soybean production venture, having being found to be a profitable venture in the study as well as elsewhere.

The ordinary least square regression (OLS) is presented in Table 4. The results showed that out of the ten (10) variables included in the analysis, six (6) were significant factors influencing profit efficiency of soybeans production. The significant variables include farm experience, savings, sales, investment cost of machinery and distance. The coefficient of farming experience is positive, and found to influences profit of soybeans positively and statistical significant at 1% level. The coefficient of farming experience (0.949) signifies that a percentage change in the farming experience will result in 94.9% increase in total profit of soybeans enterprise. The result is in tandem with findings of Ukaoha *et al., (*2022) which reported that the number of years spends in production can add value to the level of profit efficiency. Savings influence profit of soybean production positively and significant at 5% with the coefficient magnitude of (0.287), implying that a percentage change in the savings of soybean will result in 28.7% increase in the total profit of soybean enterprise. Sales is positive and significant at 1% with the coefficient magnitude of (0.831), meaning that a percentage change in the sales of soybean will lead to 83.1% increase in the total profit of soybean production. Investments positive and significant at 5% with the coefficient magnitude of (0.095), indicating that a percentage change in the investments of soybean will result in 9.5% increase in the total profit of soybean production. This result confirm the findings of zane *et al.* (2018) who reported that soybeans farmers with higher number of investments tend to perform better than those with lesser investment.

Cost of machinery is positive and significant at 1% with the coefficient magnitude of (0.060), this signifies that a percentage change in the Cost of machinery of soybean production will lead to 6% increase in the profit. Distance is positive and significant at 1% with the coefficient magnitude of (0.097), implying that a percentage change in the distance travelled by soybean farmer will lead to 9.7% increase in the total profit of soybean productions.

Analysis of Technical Efficiency and in efficiency of the Soybean Enterprise

The estimated variance (σ^2), gamma (γ) and Log likelihood function that indicates goodness of fit is presented in Table 5 The coefficient of Seed/planting material and cultivated farmland were negative and significant at 1% level respectively. This implies that increase in Seed/planting material and cultivated farmland will lead to decrease in output. This disagrees with the result of Ukaoha *et al.* (2022) who found that cultivated farmland was positive and significantly related to the output in the research conducted at Federal Capital Abuja. The fertilizer, labour and capital were statistically significant and positively related to total output at 1%. This implies that increase in quantity of pesticide,, fertilizer and labor in soybean production will leads to greater output. This result is in consonance with the findings of Ogunjinmi *et al*. (2016) that examined the productivity and technical efficiency of Soybeans production in Oyo State, Nigeria and found that seed/planting material, fertilizer, capital were all positive and significantly related to the output.

Technical inefficiency

Technical inefficiency is presented in Table 5. The result showed a positive and significant (1%) relationship between the inefficiency variables (household size, experience and marital status) included in the model. This shows that increase in these variables will lead to increases in the technical inefficiency. The result is in tandem with the findings of Abah (2020) who reported a positive and significant relationship between the inefficiency variables (household size, and experience). The result further revealed that the inefficiency variables age, formal education, off farm income and sex were negative and significant at 1% level meaning that increase in these variables will decrease technical inefficiency. This implies that the variables with negative signs increases the technical efficiency and decreases inefficiency. This result is in line with the work of Siagian *et al*.(2022) and Zane *et al. (2018)* who found that education and sex decrease technical inefficiency in baten province.

Technical efficiency level of soybean enterprise

The efficiency values obtained lies between 0 and 1. The efficiency value shows the minimum, maximum and mean technical efficiencies as 0.101, 1.00 and 0.897 respectively. This indicates that the respondents in the study area have 10.3% chance for improving production efficiency using the existing technology of the best farmer whose maximum efficiency was 1.This is similar to findings of Regasa *et al.* (2019) who reported that soybeans farmers in Benishangul-Gumuz region recorded the minimum, maximum and mean technical efficiency of 0.80, 0.99 and 0.73 respectively.

The allocative efficiency minimum, maximum and means were 0.111, 1.00 and 0.831 respectively. This showed that the respondents in the study area have 16.9% chance for improving allocative efficiency. This is similar to findings of Ogunjinmi *et al*., (2016) who found that the allocative efficiency of soybeans varies from 0.1094 and 0.9568 with a mean allocative efficiency of 0.86649 of Soya beans production in Oyo State, Nigeria.

Economic efficiency which is the product of technical and allocative efficiencies shows minimum, maximum and mean of 0.127, 1.00 and 0.746. This implies that on the average, the respondents were able to obtain a little over 74.6% of potential output, thus in the short run, there is a hope for increasing soybean production by 25.4%.

Determinants of Allocative Efficiency of Soybean Enterprise

These results revealed that a number of factors influencing allocative efficiency of soybean production. Allocative efficiency has a significant relationship with age ($p < 0.1$), household size ($p < 0.1$), distance to farm ($p < 0.05$), farm size ($p < 0.1$), use of hired labor ($p < 0.01$), use of modern farm machinery ($p < 0.05$), and access to credit ($p < 0.05$).

The result also revealed that age is positive and significant at 10% level. This shows that increase in age of the farmers translate to increase in allocative efficiency. This is consistent with the findings of Ukaoha *et al.* (2022). The coefficient of household size had a negative relationship with allocative efficiency. This shows that an increase in household size is likely to result into a decline in allocative efficiency of soybean production by 10%. The coefficient of farm size was negative and significant at 10%. This implies that increase in farm size decrease allocative efficiency

Use of modern machineries, credit and distance were all positive and significant at 5% respectively, meaning that increase in these variables will increase allocative efficiency. This result is in agreement with the findings of Ameiseku, *et al. (*2021) who found a positive relationship between distance to the nearest farm The coefficient of hired labor was negatively related to allocative efficiency. This implies that hired labour reduced allocaticve efficiency. Ameismeku *et al,* (2021) independently reported inverse relationships between use of hired labor and allocative efficiency.

Constraints Faced by the Sampled Soybeans Farmers

The analysis of the constraints faced by soybeans farmers in the study area is presented in Table 8. Multiple responses were used to allowed farmers to choose which of the constraints affects them most.

The result showed that majority (98%) of the soybean farmers experienced incidence of pest. About 92% of the farmers suffered from inadequate capital to run their business successfully. The results also revealed that 88% of the farmers had problem of inadequate improved seed for better output. This result is in tandem with the work of Abah (2020) who conducted research on Profit Efficiency of Soybean Marketing Chain in North Central States of Nigeria and found similar problem.

CONCLUSION

The study indicated that a good number of soybean farmers invested reasonable amount into the business meaning, soybean enterprise is a popular venture in the study area. The result of the study showed that the business of soybean enterprise is a profitable one. The finding also revealed the mean technical, allocative and economic efficiency of the soybean farmers were 0.897, 0.831 and 0.746 respectively. This means that for a soybean farmer to produce at the frontier level, the farmer needs to cover the gap of 10.3%, 16.9% and 25.4% respectively be technically, alocativelly and economically efficient all things being equal.

RECOMMENDATIONS

Based on the findings the following recommendations were made

i. Farmers should be encouraged to expand their scale of production by providing them with production inputs like credit facilities, fertilizer, and chemicals in order to have increased yield and maximize profit to operate on a high level of profit efficiency.

ii. Nongovernmental organization and private sectors should make fund available to soybean farmers in form of aid in order to invest more on soybean crop for better profit and for their wellbeing and healthy lifestyle in the study area.

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Table 1: Sample frame and sample size of the study area

Local Government Areas	Sampled villages	Population of the area	Sample size
Ardo Kola	Mayo renuwo	170	17
	Iware	130	13
	Mallum	102	10
	Sunkan	201	20
	Namne	151	15
Total	**5**	**754**	**75**
Bali	Bali	220	22
	Maihula	201	20
	Gazabu	140	14
	Suntai	131	13
	Garbacede	161	16
Total	**5**	**854**	**85**
Donga	Akete	200	20
	Suntai dagi	191	19
	Mararraba	18O	18
	Kumbo	161	16
	Nyivu	171	17
Total	**5**	**903**	**90**

Table 2 Level of investment in soybean production in the study area

Investment (₦)	Frequency	Percentages
1 - 50000	4	1.60
50,001 – 100,000	6	2.40
100,001 – 150,000	9	3.60
150,001 – 200,000	11	4.40
200,001 – 250,000	32	12.80
250,001 – 300,000	47	18.80
300,001 – 350,000	31	12.40
350,001 – 400,000	38	15.20
450,001 – 500,000	43	17.20
>500,000	29	11.6
Mean = ₦566,908.33		
Total	**250**	**100**

Source: Field Survey data (2023)

Table 3: Costs and Returns per hectare in Soybeans Production in the Study Area

LGA	Ardo-Kola			Bali			Donga			Pooled mean		
Variables	Qnty	Rate[1]	Value ₦	Qnty	Rate	Value ₦	Qnty	Rate	Value ₦	Qnty	Rate	Value ₦
(A) Revnue												
Mean quantity (Kg)	986	450	443,700	1,020	460	469,200	1005	450	452,250	1004	453	454,812
Total Revenue (₦)			443,700			469,200			452,250			454,812
(B)Variable Cost												
Fertilizer (Kg)	30	1000	30,000 (10.87%)	32	1000	32,000 (11.09%)	31	1000	31,000 (11.19%)	31	1000	31,000
Pesticides (lit)	4	3,500	14,000 (5.08%)	4	3500	14,000 (4.85%)	4	3500	14,000 (5.05%)	4	3500	14,000
Herbicide (lit)	5	3,500	17,500 (6.34%)	5	4500	17,500 (6.06%)	5	3500	17,500 (6.32%)	5	3500	17,500
Seed (Kg)	45	750	33,750 (12.23%)	46	780	35,780 (12.40%)	44	775	34,100 (12.31%)	45	768	34,560
Storage			12,500 (4.53%)			14,700 (5.09%)			13,400 (4.84%)			13,533
Labour (man-days)	34	1,000	34,000 (12.32%)	36	1,000	36,000 (12.47%)	35	1,000	35,000 (12.63%)	35	1000	35,000
Transportation			15,400 (5.58%)			17,200 (5.96%)			15,300 (5.52%)			15,967
Union			5,500 (1.99%)			7,250 (2.51%)			5,800 (2.09%)			6183
Loading and off-loading			17,900 (6.49%)			19,650 (6.81%)			18,250 (6.59%)			18,600
Total Variable Cost			180,550 (65.44%)			194,080 (67.23%)			184,350 (66.53%)			186,327
(C) Fixed Cost												
Depreciation			34,600 (12.54%)			40,780 (14.13%)			40,750 (14.71%)			38,710
Rent on land			60,750 (22.02%)			53,800 (18.64%)			54,000 (19.49%)			56,183(20.03%)
Total Fixed Cost (TVC)			95,350 (34.56%)			94,580 (32.77%)			94,750 (34.19%)			94,893
(D) Total Cost (b + c)			275,900 (100%)			288,660 (100%)			277,100 (100%)			280,553
Gross Margin (GM) = (TR-TVC)			263,150			275,120			268,000			268,485
NFI (GM- TFC)			167,800			180,540			173,250			173,863
RORI= NFI/TC			0.61			0.63			0.63			0.62
G R= TC/TR			0.62			0.62			0.61			0.62
BCR = TR/TC			1.61			1.63			1.63			1.62

Source: Author's computations from Survey data (2023)
Where TC = total cost, TVC = Total Variable Cost, TFC = Total Fixed Cost,,
GM= Gross Margin, NFI= Net Farm Income, RORI= Rate of Return per naira invested,
GR = Gross Ratio, BCR = Benefit Cost Ratio.

Table 4 Determinants of profit in soybean Enterprise

Variables	Linear	Exponential	Semi log	Double log+
Intercept	110083.6	5.599027	-19095.61	-1.925356
	(1.55)	(11.37)***	(-0.11)	(-8.41)**
W_1 = Amount of credit	-0.0898305	3.38e-07	-45090.88	-0.0202486
	(-3.01)***	(1.63)***	(-4.62)***	(-1.52)
W_2 = Experience	90644.12	0.1732413	463944.8	0.9494328
	(72.76)***	(20.01)***	(44.60)***	(66.99)***
W_3 = Savings	6805.75	0.5813647	1.247883	0.2870000
	(1.43)	(17.55)	(1.58)	(2.67)**
W_4 = Farmland	2568.89	0.031459	34058.04	0.0140612
	(0.91)	(1.60)*	(3.49)***	(1.06)
W_5 = Sales	0.097208	3.28e-07	42739.53	0.8308869
	(2.52)**	(1.23)	(1.58)	(22.56)***
W_6 = Investment	0.2402157	5.22e-06	49136.12	0.0954723
	(4.55)***	(14.23)***	(1.92)*	(2.74)**
W_7 = Agrochemicals	0.4003172	3.02e-06	-2373.839	-0.0151381
	(2.65)**	(2.87)**	(-0.30)	(-1.38)
W_8 = Cost of machinery	0.0454642	3.28e-07	31092.77	0.0598499
	(1.10)	(1.14)	(5.20)***	(7.35)***
W_9 = Cost of labour	0.1027072	7.18e-07	9609.037	0.0149972
	(0.74)	(0.75)	(1.07)	(1.23)
W_{10} = Distance	374.1602	0.0013941	19430.15	0.0966383
	(1.48)	(0.79)	(1.46)	(5.33)***
R^2	0.9556	0.7930	0.9170	0.9808
R^{-2}	0.9641	0.7839	0.9134	0.9800
F-ratio	642.92***	87.71***	253.07***	1169.79***

Source: field survey (2023) + lead equation, *** Significant at 1%, ** Significant at 5%, *significant at 10%.

Table 5 Maximum likelihood estimate of stochastic production frontier function

Variables	Coefficient	Standard error	t-ratio
Production factor			
Constant	0.588905	0.566129	10.40***
X_1 = Seed/planting material	-0.493670	0.234254	-21.07***
X_2 = Cultivated farmland	0.528319	0.107547	-49.12***
X_3 = Fertilizer	0.126373	0.816428	15.48***
X_4 = Labor	0.365950	0.124296	29.44***
X_5 = Pesticides/herbicides	0.400065	0.100856	39.67***
Return to scale (RTS)	0.867762		
Inefficiency factors			
Q_1 = Age of respondent	-0.486162	0.168838	-28.79***
Q_2 = Household size	0.116961	0.209181	55.91***
Q_3 = Experience	0.821373	0.183042	44.87***
Q_4 = Formal education (years)	-0.210093	0.432259	-48.60***
Q_5 = Off-farm income (naira)	-0.498052	0.354734	-14.04***
Q_6 = Sex	-0.398761	0.137318	-29.04***
Q_7 = Marital status	0.327771	0.129408	25.33***
Sigma squared(δ)	0.308687	0.108493	-48.53***
Gamma(γ)	0.991154	0.003900	
Log likelihood	0.896689		
Wald $chi^2(6)$	900.38***		

Source: Field Survey data, 2023 * Significant at 1% respectively**

Table 6 Efficiency distribution of respondents

Efficiency Level	Technical efficiency		Allocative efficiency		Economic efficiency	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
0.10-0.19	1	.4	2	0.8	6	2.4
0.20-0.29	3	1.2	3	1.2	4	1.6
0.30-0.39	3	1.2	4	1.6	5	2
0.40-0.49	3	1.2	4	1.6	25	10
0.50-0.59	5	2	6	2.4	20	8
0.60-0.69	4	1.6	3	1.2	15	6
0.70-0.79	2	.8	5	2	30	12
0.80-0.89	43	17.2	40	16	40	16
0.90-1.00	186	74.4	183	73.2	105	42
Min	**0.101**		**0.111**		**0.127**	
Max	**1.000**		**1.00**		**1.00**	
Mean	**0.897**		**0.831**		**0.746**	
Total	***250***	**100.0**	**250**	**100.0**		**100**

Source: Field Survey Data (2023)

Table 7: Determinants of Allocative Efficiency using Tobit Regression Model

Variables	Coefficients	Std. Error	z-value
Age	0.0217	0.0113	1.91*
Household size	-0.0055	0.0032	-1.72*
Education	0.0012	0.0008	1.53
Experience	0.0173	0.0154	1.12
Farm size	-0.0258	0.0130	-1.98*
Use of modern farm machinery	0.0067	0.0026	2.56**
Use of credit	0.0284	0.0130	2.17**
Membership of farmers group	-0.0012	0.0175	-0.07
Distance	0.0000	0.0000	2.43**
Family labor	0.0044	0.0077	0.57
Hired labor	-0.0528	0.0149	-3.54***
Constant	0.0598	0.0388	1.54
LR $chi^2(10)$	28.87		
Prob> chi^2	0.0024		
Pseudo R^2	67.156		
log likelihood	106.55905		
Number of observation	240		

Source: Field Survey data (2023) *, **, *** denotes 10%, 5% and 1% significant respectively

Table 8 Constraints Faced by the Sampled Soybeans Farmers

Constraints	Frequency	Percentage	Ranking
High cost of input	215	86	4th
Incidence of pest	245	98	1st
Inadequate capital	230	92	2nd
Bad road	198	79.2	7th
climatic change	200	80	6th
High cost of labour	195	78	8th
Inadequate improved seed	220	88	3rd
Lack of extension service	210	84	5th

Source: Field survey data (2023)