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RESEARCH ARTICLE

Socio-economic evaluation and technical efficiency of soybean (*Glycine max*) production in north west, Nigeria: A parametric approach

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Abstract

This study examined the socio-economic evaluation and technical efficiency (TE) of soybean (*Glycine max*) production in North West, Nigeria: a parametric approach. The multistage method of sampling was employed. A sample size totaling 160 soybean farmers was selected. Primary data sources were collected through a well-designed and properly structured questionnaire. The questionnaire was subjected to a validity and reliability test. Data were analyzed using descriptive or summary statistics and the stochastic production efficiency frontier model (SPEFM). The result shows that the mean age of soybean farmers is 46 years. The soybean farmers are literate and attend formal education with an average of 12 years in school. The soybean production is profitable, with an estimated GM (Gross Margin) and NFI (Net Farm Income) of 899,237.80 Naira and 824 468.22 Naira, respectively. The GMR (Gross Margin Ratio) and RORI (Rate of Return on Investment) were calculated at 0.583 and 1.15, respectively. The significant factors influencing TE of soybean production are fertilizer, seed, farm size, labor, and agrochemicals. The significant socio-economic factors increasing the technical efficiency (TE) of soybean production include household size, age, years of experience, level of education, members of cooperatives, and number of extension contacts. The mean TE score of soybean farmers is 53.77%, leaving a gap of 46.23% for improvement. The major constraints soybean farmers face include a lack of improved seeds (1st) and a lack of credit (2nd). The study recommends making credit facilities at single-digit interest rates available for soybean farmers.

Keywords: Technical Efficiency; Soybean Production; Parametric Approach; North West; Nigeria.

1. Introduction

Soybean (*Glycine max*) is the 4th major cereal crop in the world after wheat (1st), maize (2nd), and rice (3rd) (Grassini *et al.*, 2021). Nigeria is the highest producer of soybean in Central and West Africa (Umar, 2020). In 2022, Nigeria produced 1 060 000 metric tons of soybeans with a total land area of 1,200,000 hectares (FAO, 2022). The world soybean production as of 2022 stood at 348,856,427.48 metric tons (FAO, 2022). Soybean is a good source of inexpensive protein of high quality and oil. In terms of protein content, soybean is the highest among all food crops, and in terms of oil content, soybean is second to groundnut among food legumes, with

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an average oil content of 20% and protein content of 40% (Umar, 2020). Soybeans can produce edible oil, milk, and animal feed. Soybean is a versatile crop that can be used to derive products like soybean oil, soy- milk, soy cheese, soy flour, soybean dadawa, soybean fufu, soy sauce, livestock feed, and Baby food such as Babeena, Golden morn, Cerelac, and Nutrend (Omoigui *et al.,* 2020). In the industry, soybeans can be used to manufacture infant food supplements, edible oils, pharmaceuticals, cosmetics, paints, soap making, and animal feed (Biam *et al.,* 2015). In addition, soybean is used in industries for printing ink, wood veneer, adhesive, paper coating and alkyd resins (Mairabo *et al.,* 2023).

The consumption of soybeans is estimated to be 1.275 million tons in Nigeria between 2021 and 2022 (Donley, 2021). Even with increased domestic soybean production, local soybean demand cannot be met. There is a huge supply gap of soybeans in Nigeria. The research gap is more of technical inefficiency (TIE) among smallholder soybean farmers. The viable option is to close the supply gap and for farmers to maximize the use of available production and socio-economic resources. Agricultural growth, which means increasing or enhancing agricultural productivity, plays a key role in reducing food insecurity and rural poverty in Africa (Okello *et al.,* 2019). Sakurai *et al.* (2006) reported that agricultural productivities do` not only depend on yield of crop, but it is also a function of efficiency. It is important to know that ways of increasing agricultural productivity in sub-Saharan Africa, Nigeria inclusive, must be geared towards improving the efficiency of smallholder soybean farming activities and the efficiency in the allocation of resources to different enterprises (AGRA, 2014). The efficiency of smallholder farms and their predisposing factors are key issues for better farm planning and guiding decision-making for policymakers. Tung (2013) reported that smallholder soybean farmers need to have new farm plans or change their existing farm plans, and the output will expand due to the increased or enhanced efficiency in soybean production. According to Amaza and Maurice (2005), efficiency is defined as the possibility of farms (or firms) producing at a given optimal level of output (product) from a certain bundle of inputs or a given level of output at minimum cost. Efficiency is a significant factor in the productivity growth of an economy, especially in Africa, where resources are scarce, and it is a deficiency of opportunities for new technologies. Therefore, studies on soybean efficiency will show that it is possible to raise productivity by improving or enhancing efficiency without increasing the resource base or developing new technology.

According to Miassi *et al.* (2023), efficiency can also be defined or explained as the ability or potential of soybean producers to produce the maximum quantity of output with the minimum producing factors. TE according to Miassi *et al.* (2023) can be defined as measuring the ability or potentials of a soybean producing unit to obtain the maximum possible output or yields from a combination of production inputs. Adeyemi *et al.* (2017) define a technically efficient firm or farm as one that produces the maximum output or yield for a certain amount of inputs, on the condition that the production technology is available. TE (Technical Efficiency) is very important instrument or tool in estimating the technical performance of soybean farms and those producing grains or cereals (Miassi *et al.,* 2023). TE estimates the efficiency of the use of farm resources and factors of production. This implies that it is concerned in the allocation of farm inputs (resources) involved in the production process of a given level of output. In order to improve the efficiency of smallholder soybean farmers, the level of resource allocation must be known. According to Adeyemi *et al.* (2017), soybean production can be improved by increasing the levels of efficiency of the resources allocated to soybean production. This means that soybean production systems should be focused on the estimating of the model combining production

inputs, and then estimating the determinants of TE in soybean production and thereafter acting upon them to enhance the performance of the sector. Bhatt and Bhat (2014) reported that it is important to develop agricultural policies to optimize the efficiency of farmers for an improvement in crop yields as well as the supply of soybean.

Several research studies have reported that given factors or parameters have significant effect on the efficiency level of farms (Miassi *et al.*, 2023). These socio-economic factors can be the age of farmers, the level of education, membership of a farmer group, the size of the farm, and access to credit (Nuama, 2006). The methods for estimating productive efficiency are focused on the non-parametric approach using DEA (Data Envelopment Analysis) and the parametric approach using the stochastic production frontier efficiency model. Several research studies have focused on studying the TE of farms using DEA and little using stochastic production frontier method because DEA allows for the developing of a production frontier without any restriction on the functional form (Hayran and Gul, 2020; Bhatt and Bhat, 2014).

Evidence have suggested that very small is known about the general level of inefficiency of most smallholder farms, also very small is known about the exact level of inefficiency in allocation of resources among smallholder farms in Africa (AGRA, 2014). The goal is to fill the research gap existing in the literature and add to the discussion on efficiency focusing on soybean production.

Objectives of the Study

The major objective is to examined socio-economic evaluation and technical efficiency of soybean (*Glycine max*) production in North West, Nigeria: a parametric approach. The specific objectives include:

(i) identify the socio-economic, institutional and farm-specific characteristics of soybean farmers,

(ii) analyze the profitability of soybean production,

(ii) evaluate the factors influencing TE of soybean production,

(iii) estimate the TE scores of soybean farmers, and

(iv) determine the constraints facing soybean farmers.

2. Methodology

This work was conducted in Kaduna and Kano States, Nigeria. Kaduna State lies between Longitudes 06˚ 15| and 08˚ 50| East and Latitudes 09˚ 02| and 10˚ 36|North of the equator. Kaduna state has total land area of 4.5 million hectares. The mean rainfall is about 1,482mm. The population of Kaduna state is about 8.9 million people as at 2021. Kano State lies between Longitudes 08˚ 30| E and Latitudes 12˚ 02|N. The state has a total land area of 20, 230 Km^2, the population of Kano State is 15,462, 200 people with an annual population change of 3.2% (NPC, 2022). The people of the 2 states engaged in farming activities. A Multistage method of sampling was employed for this study. The total sample size of soybean farmers selected within the 2 states was 160 respondents, comprising 80 soybean farmers from Kaduna State and 80 soybean farmers from Kano State. Primary sources of data were obtained. A structured and correct design questionnaire was administered to the respondent using well-trained agricultural extension officers. The structured questionnaire was subjected to validity and reliability test. This research work used the estimating formula reported by Yamane (1967) in calculating the sample size. The formula is given as:

$$n = \frac{N}{1+N(e^2)}$$

=160……(1)

Where,

n = The Calculated Sample Size (Number)

N = The Sample Frame of Soybean Farmers (Number for the 2 States)

e = Margin of Error (Maximum) Acceptable and as Determined by the Researcher (5%)

Data were estimated using the following descriptive statistics and econometric tools as stated below:

2.1. Descriptive Statistics

This includes the use of mean, percentages, frequency distribution and standard deviation. This will be used to summarize the socio-economic, institutional and farm-specific characteristics of soybean farmers.

2.2. Farm Budgetary Technique

Gross margin model (GM) according to Alabi et al. (2022) is stated thus:

$$GM = TR - TVC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The net farm income(NFI) is defined as:

$$NFI = \sum_{i=1}^{n} P_i Q_i - \left[\sum_{j=1}^{m} P_j X_j + \sum_{k=1}^{k} GK\right] \ldots\ldots\ldots (3)$$

Where

P_i = Price of Soybean ($\frac{N}{Kg}$),

Q_i = Quantity of Soybean (Kg),

P_j = Price of Factor Inputs ($\frac{N}{Unit}$),

X_j = Quantity of Factor Inputs (Units),

TR = Total Revenue (The Sales of Soybean) (N),

TVC = Total Variable Cost (N),

GK = Cost of all Fixed Inputs (Naira)

NFI = Net Farm Income (Naira)

2.3. Financial Analysis

The GMR (Gross Margin Ratio) following to Alabi et al. (2020), is given as:

$$Gross\ Margin\ Ratio = \frac{Gross\ Margin}{Total\ Revenue} \ldots\ldots\ldots\ldots (4)$$

The RORI (Rate of Return per Naira Invested) is calculated as:

$$RORI = \frac{NFI}{TC} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where,

NFI = Net Farm Income from Soybean Production (Naira),

TC = Total Cost (Naira)

2.4. Stochastic Production Efficiency Frontier Model (SPEFM)

The parametric and non-parametric approaches are generally used in measuring TE. If the production model can be represented explicitly by a function and parameters such as the Cobb-Douglas production function, the approach used is called a parametric (Houngue and Nonvide, 2020).

According to Alabi *et al*. (2022), the SPEFM is stated thus:

$$Y_i = f(X_i, \beta_i) e^{v_i - u_i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

$$Ln\ Y_i = Ln\ \beta_0 + \sum_{j=1}^{5} \beta_i\ LnX_i + (v_i - u_i) \ldots\ldots\ldots\ldots (7)$$

Technical efficiency (TE_i) would be estimated as follows:

$$TE_i = \frac{Y_i}{Y_i^*} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

$$TE_{ij} = \frac{F(X_i,\beta)\exp(v_i - u_i)}{F(X_i,\beta)\exp(v_i)} \ldots\ldots\ldots\ldots\ldots (9)$$

$$TE_{ij} = \exp(-u_{ij}) \ldots\ldots\ldots\ldots\ldots (10)$$

Since the actual production is usually < the frontier production ($Y_i \leq Y_i^*$), the values for TE lies between 0 and 1, with a TE of 1 indicating that the actual production = to the frontier production and farm is said to be technically efficient (Ahmed and Melesse, 2018).

where,

Y_i = Output of Soyabean (Kg)

Y_i^* = Unobserved Frontier Output of Soyabean (Kg)

X_i = Vectors of Variable Inputs

β_i = Vectors of Estimated Parameters

V_i = Random Variations in Soyabean Output

U_i = Error Term due to TIE (Technical Inefficiency)

X_1 = Seed (Kg)

X_2 = Fertilizer (Kg)

X_3 = Farm Size (Ha)

X_4 = Labor Input (Mandays)

X_5 = Agrochemicals (Litres)

$U_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$

where,

Z_1 = Age (Years)

Z_2 = Household Size Measured in Number

Z_3 = Level of Education in Years

Z_4 = Years of Farm Experience in Years

Z_5 = Members of Cooperatives (1, Member; 0, Otherwise)

Z_6 = Extension Contact (Number per Month)

α_0 = Constant Term

$\alpha_1 - \alpha_6$ = Estimated Parameters

U_i= Error Term due to TIE

3. Results and Discussion

3.1. Socio-Economic, Institutional and Farm Specific Characteristics of Soybean Farmers

The summary statistics of socio-economic, institutional and farm specific characteristics of soybean farmer is presented in Table 1. The average age of soyabean farmers is 46 years, this means that they are young, strong, energetic in their productive age. The farmers had spent an average of 11 years in soybean production. In terms of gender, about 78% of soybean farmers are male. The household sizes are large with a mean value of 9 persons per household. This result aligns with the outcomes of Saliu *et al.* (2017) who reported an average household size of 9 persons among small-scale soybean farmers in Kaduna State. The soybean farmers have acquired formal education, they have spent an average of 12 years in school. Education plays a significant role in enhancing the adoption of new practices, innovations, and technologies, which in turn increases TE of soybean production. The result is in consonance with Mairabo *et al.* (2023) who observed that 92.7% of soybean farmers had formal education and were literate in Niger state, Nigeria. The soybean producers are smallholder farmers with an average farm size of 1.75 ha. The total revenue obtained from one hectare of soybean farm was 1, 540, 000 Naira with a mean output of 2,200 kg/ha. In terms of institutional variables, about 56% of soyabean farmers are member of cooperatives, this implies that soybean farmers can accessed credit, bulk purchase necessary farm inputs and also disposed their farm products in bulk through cooperatives associations. The mean value of credit accessed was 250, 000 Naira per soybean farmers.

3.2. The Costs and Returns Analysis (Profitability) of Soybean Production per Hectare

The various cost involved and revenue obtained in soybean production was estimated based on the prevailing market price as at the time this field survey was conducted and the result is presented in Table 2. The total cost (TC) is the addition of TVC (Total Variable Cost) and total fixed cost (TFC). The TVC was calculated at 640, 762.20 Naira per hectare and this accounted for 89.56% of TC. The TFC was estimated at 74, 769.58 Naira per hectare, and this accounted for 10.44% of TC. The TVC include seed input (5.26%), agrochemicals (4.56%), fertilizer input (31.96), labour input (41.51%), loading and offloading cost (2.27%), transportation (1.99%), fees and commission (1.12%), and bags/sacks/sewing (0.88%). The fertilizer input and the labour input accounted for the highest percentage of the TVC. The TFC include depreciation on farm implement (3.90%), land rent (3.15%), taxes (2.75%), and interest paid on capital (0.64%). The TC was calculated at 715, 458.78 Naira per hectare. The TR (Total Revenue) and GM (Gross Margin) was estimated at 1, 540, 000 Naira and 899, 237.80 Naira per hectare. This gives a net farm income (NFI) of 824, 468.22 Naira per hectare. This shows that soybean production is profitable in the area. The GMR (Gross Margin Ratio) was calculated at 0.583, this implies that for every one naira invested in soybean production about 58 kobo covered expenses, profits, depreciation, and taxes. The RORI was calculated at 1.15, this means that for every one Naira invested in soybean production, a profit of 15 kobo was made. This finding is in consonant with

Olorunsanya *et al.* (2009) who documented that soybean production was profitable in Kwara State, Nigeria. Wilson *et al.* (2013) also reported that soybean production was profitable in Saboba District in Ghana.

Table 1. Descriptive Statistics of Socio-Economic, Institutional and Production Variables.

Variables	Unit of Measurement	Mean Statistics
Age	Years	46
Gender	Percentage Male	78%
Household Size	Number	9
Farm Experience	Years	11
Level of Education	Years	12
Farm Size	Hectares	1.75
Output	Kg/ha	2,200
Revenue	Naira/ha	1,540,000
Extension Contact	Number of Contact/Month	4
Amount of Credit Accessed	Naira	250,000
Membership of Cooperatives	Percentage	56
Number of Farmers	Number	160

Source: Field Survey (2024)

Table 2. The Costs, Returns and Profitability Analysis of Soybean Production per Hectare.

Variables	Units	Value (N)	% TC
Variable Cost (VC)			
Seed	Kg	37,655.30	05.26
Agrochemicals	Litre	32,657.93	04.56
Fertilizer	Kg	228,678.94	31.96
Labour	Mandays	296,993.65	41.51
Loading and Offloading	Naira	16,231.32	02.27
Transportation	Naira	14,235.87	01.99
Fees and Commission	Naira	7,987.21	01.12
Bags/Sacks/Sewing	Naira	6,321.98	00.88
Total Variable Cost (TVC)	Naira	640,762.20	89.56
Fixed Cost (FC)			
Depreciation on Farm Implement	Naira	27,892.18	03.90
Land Rent	Naira	22,563.87	03.15
Taxes	Naira	19,673.21	02.75
Interest Paid on Capital	Naira	4,567.32	00.64
Total Fixed Cost (TFC)		74,769.58	10.44
Total Cost (TC)		715,458.78	100.00
Quantity Sold	2,200 Kg		
Price	700Naira/Kg		
Total Revenue (TR)	Naira	1,540,000	
Gross Margin (GM)	Naira	899,237.80	
Net Farm Income (NFI)	Naira	824,468.22	
Gross Margin Ratio (GMR)	Number	0.5839	
Rate of Return on Investment(RORI)	Number	1.15	

Source: Field Survey (2024) *Exchange Rate is 950 Naira = 1USD*

3.3. Factors Influencing TE of Soybean Production.

The MLEs (Maximum Likelihood Estimates) using the SPEFM in analyzing factors influencing TE of soybean production is presented in Table 3. The various factors considered in the model include seed, fertilizer, farm size, labor, and agrochemical. The seed and fertilizer were significant in influencing TE of soybean production at ($P < 0.01$). The farm size and

agrochemical were significant at (P <0.05), while labor was significant in influencing TE of soybean production at (P < 0.10). A 1% increase in fertilizer input, making all other variables fixed gives rise to a 53.12% increase in the output of soybean. Also, a 1% increase in labor input, making all other variables fixed will give rise 27.13% increase in soybean output. The RTS (Return to Scale) is the summation of the elasticities of production for all the variables included in the TE component. The calculated RTS was 1.7017, this implies an increasing RTS. The increased RTS signifies that an increase in all the variable inputs included in the TE components of soybean production will lead to more than proportional increase in the output. In the diagnostic statistics component, the coefficient of variance ratio(γ) was 0.8249, this means that 82.49% of variations in the yield of soybean production were due to differences in TE. The coefficient of total variance (σ^2) was 2.8310, which was statistically significant at ($P < 0.01$). This signifies that the data and model are well fitted. The log Likelihood function was -417.23. The result of this study agrees with Mairabo *et al.* (2023), who reported that farm size, seed, and labor were the significant factors influencing TE of soybean production in Niger State, Nigeria.

Table 3. Maximum Likelihood Results of the SPEFM

Variables	Parameters	Coefficient	Standard Error	t-Value
Constant	β_0	2.1245**	0.7153	2.97
Seed	β_1	0.4530***	0.1416	3.20
Fertilizer	β_2	0.5312***	0.1348	3.94
Farm Size	β_3	0.2043**	0.0687	2.97
Labour	β_4	0.2713*	0.1195	2.27
Agrochemical	β_5	0.2419**	0.0837	2.89
RTS		1.7017		
TIE Component				
Constant	α_0	1.8201**	0.7398	2.46
Age	α_1	-0.2338**	0.1003	-2.33
Household Size	α_2	- 0.2718**	0.1037	-2.62
Education Level	α_3	-0.2413**	0.0868	-2.78
Years of Farm Experience	α_4	-0.3564***	0.0968	-3.68
Members of Cooperatives	α_5	-0.3219**	0.1118	-2.88
Number of Extension Contact	α_6	-0.2819**	0.0952	-2.96
Diagnostic Statistics	σ^2			
Total Variance (Sigma Squared)	γ	2.8310***		
Variance Ratio (Gamma)		0.8249		
Log-Likelihood Function		-417.23		

*Source: Data Analysis (2024) *-Significant at (P < 0.10), **-Significant at (P < 0.05), ***-Significant at (P < 0.01)*

3.4. Socio-Economic Factors Influencing TE and TIE of Soybean Production

The maximum likelihood estimates (MLE) using the SPEFM in evaluating the socio-economic factors influencing TE and TIE of soybean production is presented in Table 3. The socio-economic factors under consideration in the TIE component include age, household size, years of experience, level of education membership of cooperatives, and number of extension contacts. The socio-economic factors with negative coefficients increases TE of soybean production, while those with positive coefficients increases TIE of soybean production. All the socio-economic factors included in the TIE component

had negative coefficients. Age, level of education, household size, membership of cooperatives, and number of extension contacts were statistically significant socio-economic factors increasing TE or decreasing TIE of soybean production at ($P < 0.05$). The year of experience was statistically significant socio-economic factors increasing TE or decreasing TIE of soyabean production at ($P < 0.01$). A 1% increase in the level of education of soybean farmers, making all other factors fixed, will give rise to a 24.13% increase in TE or decrease in TIE of soybean production. Also, a 1% increase in number of extension contacts among soybean farmers, making all other factors fixed, will give rise to a 28.19% increase in TE or a decrease in TIE of soybean production. This finding is in conformity with Yusuf *et al.* (2022), who observed that age was a significant socio-economic factor in increasing TE of soybean production in Sabon Gari Local Government Area, Kaduna State, Nigeria.

3.5. TE (Technical Efficiency) Scores of Soybean Producers

Table 4 shows the summary statistics of TE scores of soyabean producers. About 74.66 % of soybean farmers were between 21 to 80 % levels of efficiency. The mean TE was 53.77% leaving an inefficiency gap of 46.23 % for improvement. This means that the soybean farmers are able to obtain 53.77% of potential output from a given mixture of production inputs. Thus, opportunity still exists for increasing soybean productivity and net farm income by increasing the efficiency using available resources and also by adopting new farm technologies and techniques used by the best-performing soybean farmers. In addition, the lowest TE score was 7 %, while the best-performing soybean farms had the highest TE of 97%. If the average soybean producers were to achieve the level of TE like most of its efficient counterparts, then the average soybean producers could make 44.57 % cost savings calculated as open bracket 1 minus 53.77 over 97.00 close brackets calculated as $\left[\left[1-\frac{53.77}{97.00}\right]\times 100\right]$. The calculated value for the most technically inefficient soybean farmers reveal a cost savings of 92.78% calculated as $\left[\left[1-\frac{7.00}{97.00}\right]\times 100\right]$. This is in line with the findings of Mohammed et al. (2016) who obtained an average TE score of 61% among soybean farmers in Northern Region of Ghana. Also, Moses (2017) obtained an average TE score of 90% among soybean farmers in Mubi North Local Governement Area of Adamawa State, Nigeria.

Table 4: Summary Statistics of TE Scores

Efficiency Score	Frequency	Percentage
0.00 to 0.20	19	12.67
0.21 to 0.40	23	15.33
0.41 to 0.60	41	27.33
0.61 to 0.80	48	32.00
0.81 to 1.00	19	12.67
Mean	0.5377	
Standard Deviation	0.2435	
Minimum	0.07	
Maximum	0.97	

Source: Field Survey (2024)

3.6. Constraints Faced by Soybean Producers

The frequency distribution of constraints faced by soybean farmer is presented in Table 5. The soybean farmers were allowed to have multiple responses. Lack of improved seeds had the highest frequency of 154 which accounted for 22.71% of all constraints encountered and was ranked 1st(first). Lack of credit was ranked 2nd

with frequency of 127 and this accounted for 18.73% of all constraints encountered. Inadequate extension officers having frequency of 116 which accounted for 17.11% of all constraints encountered by soybean farmers was ranked 3rd.

Table 5: Constraints Faced by Soybean Farmers

Constraint	*Frequency	Percentage	Rank
Lack of Improved Seeds	154	22.71	1st
Lack of Credit	127	18.73	2nd
Lack of Extension Officers	116	17.11	3rd
High Cost of Fertilizers	109	16.08	4th
Bad Road Infrastructures	87	12.83	5th
High Cost of Labour	85	12.53	6th
Total	678	100.00	

*Source: Field Survey (2024) *Multiple Responses*

4. Conclusion and Recommendations

This research work has established that soybean production is profitable in the study area. The soybean producers were young, strong, agile, energetic, and resourceful. The mean age of soybean producers was 46 years, and they had formal education with an average of 12 years in school. The GM (Gross Margin) and NFI (Net Farm Income) was computed at 899,237.80 Naira and 824, 468.22 Naira respectively. The significant factors influencing TE of soybean production include seed, fertilizer, farm size, labor, and agrochemicals. The socio-economic factors increasing the TE of soybean production include age, household size, level of education, members of cooperatives, years of experience, and number of extension contacts. The RTS was estimated at 1.7017, which means increasing RTS. The average TE score of soybean farmers was estimated at 53.77% leaving a gap of 46.23% for improvement. The major constraints faced by soybean farmers include a lack of improved seeds (1st), a lack of credit (2nd), and inadequate extension officers (3rd). Based on the outcomes, the following were recommendations made:

(i) Credit at low interest rate (single digit) devoid of cumbersome administrative procedures should be made available to soybean farmers by government and private institutions to increase productivity.

(ii) Fertilizer input, improved seed, chemical inputs and other farm inputs should be made available to soybean farmers by government and private institutions to increase TE and productivity.

(iii) Extension officers should be deployed to disseminate innovations, research findings, new farm technologies and techniques to soybean farmers.

(iv)Feeder road infrastructures should be constructed to move soybean produce from producing areas to nearby market centres.

(v) Labour-saving technologies, equipment and machines should be given to soybean farmers to increased efficiency and productivity.

Authors' Contributions

All authors are contributed in this research

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Institutional Review Board Statement

All Institutional Review Board Statements are confirmed and approved.

Data Availability Statement

Data presented in this study are available on fair request from the respective author.

Ethics Approval and Consent to Participate

Not applicable

Consent for Publication

Not applicable.

Conflicts of Interest

The authors disclosed no conflict of interest.

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