

# Profit Efficiency of Soybean Production in Federal Capital Territory, Nigeria

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## ABSTRACT

This study evaluated profit efficiency of soybeans production in Federal Capital Territory, Nigeria. Multi-stage sampling technique was adopted for this study. Data were collected through the use of well-structured questionnaire. The questionnaire was distributed to 188 sampled soybean farmers in the study area. The data were analyzed using descriptive statistics, gross margin analysis, financial analysis, Cobb-Douglas production functional model, and stochastic frontier profit model. The results of the analysis show that about 25% of the sampled farmers were within the age bracket of 31-40 years, while 56% fell within the age ranges of 41-50 years. The mean age of the sampled soybean farmers was estimated to be 44 years. The results further revealed that majority 82.4% of the sampled respondents were male farmers. About 44.1% of the sampled farmers had no formal education. Majority (78.7%) of the sampled soybeans farmers had a household size range from 1-5 persons, the average farming experience of the farmers in the study area was 7 years. About 80.9% of soybean farmers had farm size between 1-2 ha. The total variable cost on average was ₦ 130,184.51 with an estimated average total revenue of ₦340,250.00. The gross margin obtained was ₦210,063.49. The operating ratio and rate of return on investments were 0.383 and 1.613 respectively, this result implies that soybean production is profitable in the study area. The profit efficiency level attained by soybean farmers was 52% leaving a gap of 48%. The statistically significant factors influencing profit efficiency were price of fertilizer ( $P<0.1$ ), price of chemical ( $P<0.1$ ), price of labour ( $P<0.01$ ), unit price of soybean ( $P<0.01$ ), and total revenue ( $P<0.01$ ). The statistically significant factors influencing profit inefficiency were household size ( $P<0.1$ ), educational level ( $P<0.1$ ), cooperative association ( $P<0.01$ ), farming experience ( $P<0.05$ ), access to credit ( $P<0.05$ ), and price information ( $P<0.05$ ). The soybean farmers encountered the following problems in the cause of production: inconsistent government policy and outbreak of diseases, lack of hired labour, high cost of inputs, inadequate capital, lack of extension services and unavailability of improved seed varieties. Therefore, this study recommends that government should provide farm tractors and other farm implements to ease the drudgery in soybean production and reduce the cost of labour incur by farmers, market information should be made available for farmers, farmers should be encouraged to expand their scale of production by providing them with production inputs like fertilizer, chemical and credit facilities in order to have increased yield, government should also disseminate price information through extension agents, social media, and mass media (Radio, and Television news) to farmers in order to teach farmers how to apply fertilizer and chemical appropriately.

**Keywords:** Frontier Model, Nigeria, Profit Efficiency, Soybean Production, Stochastic Profit.

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## I. INTRODUCTION

The agricultural sector in Nigeria has been suffering many reversals for over past two decades. From the period of where agricultural commodities of export trade were booming, the agricultural sector in Nigeria has transformed to an importation dependent country [1]. In order to attain the level of good health in Nigeria by all its citizens, the importance of protein intake in the daily meal of every citizen cannot be

overlooked. The Food and Agricultural Organization [2] asserted that every person is expected to consume 71gram of protein daily. A cheap means of obtaining protein by an individual is then a good step forward towards promoting good health [3]. Animal source of protein such as fish, beef, mutton, pork, Chevon etc. are very costly and expensive mostly is beyond the reach of an average Nigerian households. The better way of overcoming the protein deficiency is to fall back to plant base protein which is relatively cheaper, and it can be obtain from cowpea, pigeon

pea, Bambara groundnut, soybean and so on, Soybean has the highest percent of protein content among all those listed. Soybean (*Glycine max*) is a legume crop that grows in the tropical, subtropical, and temperate climates regions. According to [4], soybean is classified as a major cash crop which has the potentiality to reduce and eradicate rural poverty level completely because of its importance and multipurpose usage. Soybean seed is rich in oil and protein composition [5], making it a very important food security crop to farmers [6]. It is a versatile crop from which different kinds of products can be processed like soybean oil, soybean milk, soybean “fufu”, soybean “dadawa”, livestock feed, soya sauce and baby foods, such as, Golden morn, Babeena, Nutrend and Cerelac are derived [7]. According to International Institute of Tropical Agriculture [8], soybean seed contains an average protein content of about 40% and oil content of about 20%. It has been discovered that soybean source of plant proteins contains almost all the most important Essential Amino Acid (EAA) required by human body. The oil produced from soybean has a high digestible ability and contain no harmful cholesterol. Nigeria soybean production has attained to about 850,000 metric tons per year which is still not sufficient to reach and satisfy the high domestic demand of the product to attenuate soybean importance in the country [6]. The domestic demand for soybeans is about 1.275 million tonnes, there is a shortfall in production of soybean in Nigeria though Nigeria was ranked the largest producer of soybean in Africa [6]. Most Nigerians are now incorporating soybean into their daily diets intake and the Nigerian Government has declared the production of soybean by farmers and its utilization as a national priority [8]. The International Development Research Center (IDRC) Canada has sponsored projects which have been instrumental to encouraging the development of more than forty Soybean-based foods including soy milk, yogurt, soy flour, biscuits, baby food and breakfast cereals [9]. The thinking of most Nigerians that are concerned today is majorly on how the generality of the poor soybean farmers can be empowered to be self-reliant. The government and some non-governmental organizations have been coming up with some strategies in order to combat poverty so as to reduce it to the barest minimum [10]. The problems of mass poverty arising from the production amid consumption pattern of Nigeria need to be addressed to ensure that soybean farmers maximize profit and increase their income as well as improve their wellbeing.

Profit efficiency is regarded as an economic efficiency concept which enables the measurement of how well the actual profit compares to the optimum profit frontier. A production farm firm unit is said to be operating on profit efficient level if it is able to achieve maximum profit level on the frontier, considering factors such as the prices and levels of fixed variables inputs that it faces, Profit efficiency in soybean production can reflect errors on both the inputs and output sides of the production level [11]. The stochastic profit frontier (SPF) model stipulates that when farm firms produce inefficiently during the production cycle, revenue or profit is lowered as well. The level of profit efficiency can be influenced by factors of production likewise socio-economic and institutional factors. Inputs such as labour, seed varieties, land and capital are majorly used in soybean production. The costs of acquiring these inputs have major implications on

profit efficiency level. In order to achieve optimum profit levels, soybeans farmers must allocate and utilize these resources judiciously. However, whenever these resources are under-utilized or over-utilized, there is an expectation that the level of farm profit and efficiency will decrease [11]. For soybean farmer to maximize profit it requires a farm firm to produce output at the maximum level given the level of input employed in the production process [12]. Profit maximization is a motivating factor for any soybean farmer to be in production, it is one of the important goals of individual farmer or farm firms. Estimation of the profitability level of every farm firm enterprise is always depends on cost-return analysis, this involves listing and itemizing the costs of variable and returns involved in production and utilizing them to arrive at such estimates as the return to one unit of resources used, the gross margin as well as the net farm income. Profit in business enterprise generally is the difference between the total revenue realized and total costs incur [7].

The failure in agricultural sector in Nigeria could be attributed to the problem of inefficiency and use of scare resources such as land, labour and capital in the production chain, high transactional costs and weak performance of enterprises, resulting from high transportation costs, poor storage facilities and equipment and inadequate market infrastructure [13]. Capital is scarce and investment is lean in agricultural production, tradition and the technique in use is obsolete and outdated. Research has shown that the problems of small-scale agriculture in Nigeria also include the lack of high yielding seed varieties and cultivars, inadequate information about new production technology, inadequate basic farm inputs and the use of traditional technology of low productivity. Soybean seed is generally classified and considered as a very highly versatile and multipurpose crop grain which has about 365 applications in the formulation of both human and animal feeds and other industrial uses [3]. [1] described soybean as multipurpose and the importance crop ranges from its use in milk production, vegetable oil processing, livestock feeds production, medicinal drugs, industrial and human consumption and also more recently discovered as a source of bio-fuel and energy despite the importance of soybean, its production doesn't meet demand, there is a gap between demand and supply of the commodity. [7] opined that in order to tackle the challenges facing agriculture production, highly nutritious varieties of crops like soybean are advocated for world-wide involvement in its production. Soybean crop is still regarded as a new crop in Nigeria, but it has made its way successfully to be incorporated into the diet of so many Nigerians particularly the food of children and nursing mothers. Despite the high nutritional content of soybean compare to other legumes, there is lack of knowledge of its uses and it has limited its adoption by farmers, production and processing in non-traditional areas of cultivation and the soybean farmers still not efficient in the use of the available resources [14]. In order to bridge this gap, efforts were being made by research institutions, Non-Governmental Organization (NGOs) and food industries to promote the production level, processing and utilization of soybean in Nigeria [15]. Subsequently, agricultural sector has failed to generate significant foreign exchange for the nation, provide raw materials for feed agro-

allied industries, improve the living standards of farming households and rural dwellers, and provide effective demand for industrial goods and services. Increasing food production however is vital for enhancing future food security in the country as this is no longer debatable but a necessity [16]. New uses for soybean seed and their derivatives, such as biodiesel made from soybean oil, show promises due to recent energy market and public policy development [17]. There is an existing knowledge gap in literature regarding the profit efficiency of soybean production in Nigeria though several authors conducted studies on soybean production but mostly dwelled on technical efficiency, resource use efficiency, economic efficiency and marketing efficiency [7]. The major drawback in these studies is the absence of profit efficiency level of soybean production by soybean farmers especially in the Federal Capital Territory. To achieve and fill this gap in literature, good knowledge of the current profit efficiency levels or inefficiency inherent in the soybean crop production sub-sector by soybean farmers as well as the factors responsible for or influencing the level of profit efficiency and inefficiency must be critically examined. Hence it is on this background that this study profit efficiency of soybean production in Kuje area Council, Federal Capital Territory was carried out to answer the following research questions.

#### A. Research Questions

This study intends to provide answers to the following research questions:

- (i) What are the socio-economic characteristics of soybean farmers?
- (ii) What are the costs and returns analysis of soybean production?
- (iii) What are the factors influencing output of soybean production?
- (iv) What is the profit efficiency scores of soybeans farmers?
- (v) What are factors influencing profit efficiency level of soybeans production?
- (vi) What are the constraints facing soybean farmers in the study area?

#### B. Objectives of the Study

The broad objective of this study is to analyze the profit efficiency of soybean production in Federal Capital Territory, Nigeria. The specific objectives were to:

- (i) determine the socio-economic characteristics of soybean farmers,
- (ii) analyze the costs and returns of soybean production,
- (iii) evaluate factors influencing output of soybean production,
- (iv) estimate the profit efficiency scores of soybean farmers,
- (v) evaluate the factors influencing profit efficiency of soybean production, and
- (vi) identify the constraints militating against soybean production in the study area.

## II. MATERIALS AND METHODS

### A. The Study Area

This study was conducted in Kuje Area Council, Federal Capital Territory, Nigeria. Kuje Area Council has ten (10) wards namely: Chibiri, Gaube, Gudun Karya, Gwargwada, Kabi, Kuje, Kujekwa, Kwaku, Rubochi and Yenché Ward. Chibiri, Gaube, Kujekwa and Kuje Ward was selected for the research. The choice of these wards was essentially on the basis of its high potentials for soybean production [18]. Kuje is located in the Southwest of Federal Capital Territory and Northern part of Nigeria and is located between Latitudes 8°52'56"N and Longitudes 7°13'13"E [18]. It shares common boundaries with Gwagwalada. The hottest months are January-April, with an average daily high temperature above 32 °C, while the coldest months are June-October with an average temperature of 24 °C with an annual rainfall of 1308mm which last from May till October. The vegetation is Northern Guinea Savannah in the North and is a woodland with trees like shear butter and locust bean predominate, the people are engaged in agricultural production activities. The main crops which are grown include: Maize, Sorghum, Soybean, Millet, Rice, Groundnut and Yam. By the 2006 census of the National Population Commission, Kuje Area Council had a population 776,298 people as at the 2006 census [19]. Kuje has a land area of about 1,644 km<sup>2</sup>.

### B. Sampling Techniques and Sample Size

Multi-stage sampling technique was used for the study. In the first stage, Kuje Area Council was purposively selected on the basis of the high level of soybean production in the Area council. Kuje has ten (10) wards. In the second stage, four (4) wards were selected using simple random sampling technique, the ten (10) wards were written on a piece of paper placed in a ballot-box, the papers were well shacked and shuffled, out of the ten (10), four (4) wards were selected. The third stage involved simple random sampling two (2) villages from each ward, making a total of eight (8) villages. One thousand seven hundred (1700) registered soybean farmers were available as a sample frame obtained from Federal Capital Territory (ADP) Register, from which the required sample size of 188 farmers was determined using Yamane [20]. In the fourth stage which is the final stage simple random sampling technique was used in selecting the individual soybean farmers and was accomplished proportionate to the total population of farmers in each of the selected Ward. A total of 188 soybean farmers constitutes the sample size and were selected for interview.

$$n = \frac{N}{1+N(e^2)} = 188 \quad (1)$$

where

N= Population, n= Sample Size,  $e$  = Allowable error = 0.05.

### C. Method of Data Collection

The data for this research work was collected from primary sources. The data were collected through the use of well-structured questionnaires. The questionnaires were distributed to sampled respondents in order to provide information based on the objectives of the study. The data

collected includes socio-economic characteristics of the respondents such as age, sex, household size, educational status, farm size, access to credit, major occupation, farming experience and membership of cooperative and other variables regarding costs of inputs and profitability of soybean production which includes farm production information was also collected such as land size, quantity of fertilizer used, quantity of seeds, quantity of agrochemicals, labour, and quantity of output of soya beans produced by individual farmer as well as prices of inputs and output.

#### D. Method of Data Analysis

The following analytical tools was used in achieving the stated specific objectives of the study:

- (i) Descriptive Statistics;
- (ii) Budgetary Technique (Gross Margin Analysis);
- (iii) Financial Analysis;
- (iv) Stochastic Frontier Profit Analysis;
- (v) Cobb Douglas Production Function;
- (vi) t-Test Analysis.

#### E. Descriptive Statistics

Descriptive Statistics such as measures of central tendency including mean, frequency distribution, percentages and standard deviations were used. Descriptive Statistics was used to determine the summary of socio-economic characteristics of soybean farmers as stated in specific objective (i) and identify the constraints facing soybean farmers as stated in specific objective four (vi).

#### F. Budgetary Technique

Gross Margin Analysis was used as the budgetary technique and is defined as the difference between the gross farm income (GFI) and Total Variable Cost (TVC) this tool is majorly applied by researchers to determine the profitability and the cost incur and revenue obtained from farm business venture by soybean farmers. This tool was applied in order to achieve the stated specific objective three (ii).

Gross margin Model (GM) is stated thus.

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

$$GM = \sum_{i=1}^n P_i Q_i - \sum_{j=1}^n P_j X_j \quad (3)$$

where

GM = Gross Margin (₦/ha);

TR= Total Revenue obtained from the sales of soybean Output (₦);

TVC= Total Variable Cost (₦);

P<sub>i</sub> = Price of soybean Out Sold (₦/Kg);

Q<sub>i</sub> = Quantity of Soybean Output Produced (kg/ha);

P<sub>j</sub> = Price of Inputs (₦/kg);

X<sub>j</sub> = Quantity of Inputs Used (kg/ha).

This was applied to achieve part of specific objective two (ii).

#### G. Financial Analysis

The following type of financial ratios was applied in this study in order to determine the profitability of soybean production by farmers as used by [21] and [22]. This was used to achieve part of specific objective two (ii):

$$\text{Gross Margin Ratio} = \frac{\text{Gross margin}}{\text{Total Revenue}}$$

Operating ratio and rate of return per naira invested in soybean production was calculated according to [23] and [30]. The operating ratio (OR) is stated thus:

$$OR = \frac{TVC}{GI} \quad (4)$$

where

OR= Operating Ratio (Units);

TVC= Total Variable Cost (Naira);

GI= Gross Income (Naira).

An Operating Ratio which appear to be less than one (1) as stated by [24],[25] implies that the total revenue obtained from soybean production by farmers was unable to cover the cost of variable inputs utilized in the production cycle for that particular year. The rate of return on investment invested per naira into soybean enterprise is stated thus:

$$RORI = \frac{NI}{TC} \quad (5)$$

where

RORI= Rate of Return per Naira Invested (Units);

NI= Net income obtained from soybean Production (Naira);

TC= Total Cost (Naira). (Fixed cost is negligible on a short run production cycle).

This was used to achieve part of specific objective three (ii).

#### H. Stochastic Frontier Profit Model

This study was applied stochastic frontier profit functional model developed by [26], [27] and used by [28] which is stated as follows:

$$\pi_i = f(P_i, \beta_i) \cdot \exp(\epsilon_i), i = 1, \dots, N \quad (6)$$

where  $\pi_i$  is the normalized profit obtained by  $i^{\text{th}}$  soybean farmer, which is defined as gross revenue obtained less variable cost, divided by farm-specific output price ( $P_y$ );  $P_i$  is the vector of variable input prices faced by the  $i^{\text{th}}$  farmer divided by output price  $P_i$ , and  $\beta$  is a coefficients or vector of parameters estimated, and  $i = 1, \dots, n$ , is the number of soybean farmers in the sample. Therefore  $\epsilon$  is the stochastic error term, which is decompose into two components as used by [11]:

$$\epsilon = v_i - u_i \quad (7)$$

where,  $v_i$  is the random component of the soybean farmer, and  $u_i$  is the random variable that represent profit inefficiency in the stochastic profit frontier model, which is normally assumed to be independently distributed, and normally distributed with mean  $u_i$  and variance  $N(u_i, \sigma^2)$ .

$\pi'$  = Profit (revenue less total cost) normalized by price of output ( $P_y$ ) – i.e., weighted average sale price of soybean  $P'_j$  = Price of the  $j^{\text{th}}$  input ( $P_y$ ) normalized by the output price ( $P_y$ )

The explicit function is stated thus:

$$\ln \pi_i = \beta_0 + \beta_1 \ln P_1 + \beta_2 \ln P_2 + \beta_3 \ln P_3 + \beta_4 \ln P_4 + \beta_5 \ln P_5 + \beta_6 \ln P_6 + \beta_7 \ln P_7 + V_i - U_i \quad (8)$$



where

$Ln\pi_i$  = Profit Obtained by Soybean Farmers (₦);

$P_1$  = Normalized Price of Seed of Soybean Input (₦);

$P_2$  = Normalized Price of Fertilizer Input (₦);

$P_3$  = Normalized Price of Chemical Input (₦);

$P_4$  = Price of Land Rent Incur (₦);

$P_5$  = Normalized Price of Labour Input (₦);

$P_6$  = Normalized Price of Soybean (₦/50Kg);

$P_7$  = Total Revenue Obtained (₦).

The Profit Inefficiency Component of the Stochastic Profit Frontier Model is stated thus:

$$U_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \alpha_7 Z_7 \quad (9)$$

where

$U_i$  = Profit Inefficiency Component;

$Z_1$  = Age of Farmer (Years),  $Z_2$  = Household Size (Number);

$Z_3$  = Education Level of Farmers (1, Primary; 2, Secondary; 3, Tertiary; 0, Non-Formal);

$Z_4$  = Cooperative Association (1, Yes; 0, Otherwise);

$Z_5$  = Experience in Soybean Production (Years);

$Z_6$  = Extension Contact (Number of Visit);

$Z_7$  = Access to Credit (₦);

$Z_8$  = Price Information (1, Yes; 0, Otherwise);

$Z_9$  = Non-farm Income (₦);

$\alpha_0$  = Constant Term;

$\alpha_1 - \alpha_7$  = Regression Coefficients.

This was used to achieve specific objective four (iv) and five (v)

#### I. Cobb Douglas Production Function Model

Cobb Douglas Production Function Model is stated thus as used by [29]:

$$Y_i = F(X_i, \beta) + \epsilon_i \quad (10)$$

$$Y = f(X_1, X_2, X_3, X_4, X_5 \dots X_9, \epsilon_i) \quad (11)$$

$$LnY_i = \beta_0 + \sum_{i=1}^9 \beta_i LnX_i + \dots \beta_n LnX_n + \epsilon_i \quad (12)$$

The explicit function is stated thus:

$$LnY_i = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + \beta_6 LnX_6 + \beta_7 LnX_7 + \beta_8 LnX_8 + \beta_9 LnX_9 + \epsilon_i + \epsilon_i \quad (13)$$

where

$LnY_i$  = Output of Soybean (kg);

$X_1$  = Seed Input (kg);

$X_2$  = Farm Size (Hectares);

$X_3$  = Quantity of Fertilizer (kg);

$X_4$  = Chemical Input (Litres);

$X_5$  = Labour Input (Man-days);

$X_6$  = Age (Years);

$X_7$  = Household Size (Units);

$X_8$  = Farming Experience (Years);

$X_9$  = Cooperative Association (1, Member; 0, Otherwise);

$\beta_0$  = Constant Term;

$\beta_1 - \beta_9$  = Regression Coefficients;

$\epsilon_i$  = Error Term.

This was used to evaluate factors influencing output of soybean production as stated in specific objective three (iii).

### III. RESULTS AND DISCUSSION

#### A. Socio-Economic Characteristics of the Sampled Soybeans Farmers in the Study Area

Table I show the results of the analysis of the socioeconomic profile of the soybean farmers the results revealed that about 25% of the sampled soybean farmers were within the age bracket of 31-40 years while 56% fall within the age ranges of 41-50 years and majority 64% fall within the age range of 41-50 years, the mean age of the sampled farmers was estimated to be 44 years this shows that majority of the sampled soybeans farmers were young farmers that are still in their age of productive capacity in the study area. Youngers farmers are agile, and they don't fear to take risk and adopt new technology and innovations. This result agrees with the finding of [18] who reported that most farmers are within their active years and can positively contribute to agricultural production. The results further revealed that majority 82.4% of the sampled respondents were male soybean farmers while 17.6% were female farmers this indicates that most of the farmers producing soybeans were male farmers in the study area This is in line with [30] who reported similar results of about (86.6%) of the farmers were males and were predominantly married. Also, the results revealed that 75% of the sampled farmer were married while 5.9% and 6.9% of the sampled soybean farmers were widow and divorced respectively. About 44.1 % of the sampled farmers had no formal education while 30.9% attained primary level of education and 16% and 9% attained secondary and tertiary level of education respectively. This implies that most of the sampled soybean farmers were not educated, the implication of this result is that uneducated farmers will be slow in adopting new innovations and technology and they may find it difficult to know the appropriate quantity of inputs to apply to their farms and may also lack technical know of sourcing information regarding soybean. This is in line with [7] who reported that education is an important factor that can influence small-scale farmers to adopt new innovations and research findings related to their area of production. When a farmer is educated, there is high probability that he will take advantages of innovations and new technologies easily. The results also show that majority 78.7% of the sampled soybeans farmers had a household size ranges from 1-5 persons while 17.6% ranges from 6-10 with an average household size of 4 persons per household, this indicates that the sampled farmers had reasonable number of labour supply for soybeans production in the study area. Also, the results also show that 56.9% of the sampled respondents had 1-5 years farming experience while 33.5% of the farmers had 6-10 years soybeans farming experience, the average farming experience of the farmers in the study area was 7 years. This implies that the farmers producing soybeans in the study area has not been into production for a longer period. Experience aid farmers of knowing the management practices required for a particular crop to produce maximally. The results also revealed that majority 83.5% were members of cooperative association,

about 80.9% had a farm size of 1-2 ha of land while 16.5% had 4-6 ha, this result implies that the soybeans farmers were operating at a small scale level of production with an average farm size of 2 ha in the study area.

TABLE I: SOCIOECONOMIC CHARACTERISTICS OF SOYBEANS FARMERS IN THE STUDY AREA

| Variable                          | Frequency    | Percentage | Mean |
|-----------------------------------|--------------|------------|------|
| <i>Age (Years)</i>                |              |            | 44   |
| 20                                | 20           | 8          |      |
| 21-30                             | 21-30        | 25         |      |
| 31-40                             | 31-40        | 56         |      |
| 41-50                             | 41-50        | 64         |      |
| 51 and above                      | 51 and above | 35         |      |
| <i>Sex</i>                        |              |            |      |
| Male                              | 155          | 82.4       |      |
| Female                            | 33           | 17.6       |      |
| <i>Marital Status</i>             |              |            |      |
| Married                           | 141          | 75.0       |      |
| Single                            | 23           | 12.2       |      |
| Widowed                           | 11           | 5.9        |      |
| Divorced                          | 13           | 6.9        |      |
| <i>Education Level</i>            |              |            |      |
| No Formal Education               | 83           | 44.1       |      |
| Primary School Education          | 58           | 30.9       |      |
| Primary School Education          | 30           | 16.0       |      |
| Tertiary Education                | 17           | 9.0        |      |
| <i>Household Size (Units)</i>     |              |            | 4.03 |
| 1-5                               | 148          | 78.7       |      |
| 6-10                              | 33           | 17.6       |      |
| 11 -15                            | 4            | 2.1        |      |
| 16 and above                      | 3            | 1.6        |      |
| <i>Farming Experience (Years)</i> |              |            | 6.86 |
| 1-5                               | 107          | 56.9       |      |
| 6-10                              | 63           | 33.5       |      |
| 11-15                             | 11           | 5.9        |      |
| 16 and above                      | 7            | 3.7        |      |
| <i>Cooperative</i>                |              |            |      |
| Yes                               | 157          | 83.5       |      |
| No                                | 31           | 16.5       |      |
| <i>Method of Land Acquisition</i> |              |            |      |
| Inheritance                       | 90           | 47.9       |      |
| Lease                             | 11           | 5.9        |      |
| Borrow                            | 36           | 19.1       |      |
| Gift                              | 37           | 19.7       |      |
| Purchased                         | 14           | 7.4        |      |
| <i>Farm Size (Hectares)</i>       |              |            | 2.00 |
| 1-2                               | 152          | 80.9       |      |
| 2-4                               | 31           | 16.5       |      |
| 5-6                               | 2            | 1.1        |      |
| 7 and above                       | 3            | 1.6        |      |

Source: Field Survey (2021) Computed Using STATA Version 14.

### B. Costs and Return in Soybeans Production in the Study Area

Table II presents the results of the estimated cost and returns involved in the soybeans production in the study area the analysis show that the cost of labour has an estimated value of ₦65,818.75 which represent 50.56% of the total variables cost incur in the soybeans production in the study area followed by cost of chemical with an estimated average value of ₦14,605.00 which has a portion of 11.23%. The total variable cost on average was ₦130, 186.51 with an estimated total revenue of ₦340,250.00 on average basis, the gross margin obtained was ₦210,063.49 with a Gross margin ratio, operating ratio, and rate of return on investment of 0.62, 0.38 and 1.6 respectively this result implies that soybean production is profitable in the study are. The rate of return of

1.6 indicates that every 1 naira invested in soybeans production will yield ₦1.6 returns on investment which covers profit, taxes, commissions, and other expenses incur in the process of soybean production in the study area. This is in line with [31], [14] and [22] who reported in their research studies that those positive values of gross margin and farm income indicate that the soybean enterprise is a profitable venture that is worth undertaking for expansion.

TABLE II: AVERAGE COST AND RETURNS ANALYSIS OF SOYBEAN PRODUCTION IN THE STUDY AREA

| Items                        | Average Value (₦/ha) | Percentage (%) |
|------------------------------|----------------------|----------------|
| A. Variable Cost             |                      |                |
| Seed Input                   | 13,074.13            | 10.04          |
| Fertilizer Input             | 11,100.00            | 8.53           |
| Chemical Input               | 14,605.00            | 11.23          |
| Labour Input                 | 65,818.75            | 50.56          |
| Bags/Sacks                   | 8,560.75             | 6.58           |
| Bagging                      | 5,546.50             | 4.26           |
| Loading/Offloading           | 3,350.75             | 2.57           |
| Transportation               | 8,130.63             | 6.25           |
| B. Total Variable Cost       | 130, 186.51          | -              |
| C. Total Revenue             | 340,250.00           | -              |
| D. Gross Margin              | 210,063.49           | -              |
| Gross Margin Ratio           | 0.617                | -              |
| Operating Ratio              | 0.383                | -              |
| Rate of Return on Investment | 1.613                | 100            |

Source: Field Survey (2021).

### C. Factors Influencing the Total Output of Soybeans in the Study Area

The results of the Cobb Douglass production functional model using OLS methods of estimation to determine that factors influencing the total output of soybeans in the study area is presented in Table III. The results show that out of the nine (9) variables that were included in the analysis six (6) variables were the statically significant factors influencing the total output of soybeans in the study area this are farm size, fertilizer, chemical, labour, farming experience and cooperative association. Farm size influence the output of soybeans positively and was statically significant at ( $P < 0.05$ ). The coefficient of farm size is (0.04) this implies that a percentage increase in farm size holding all other independent variables constant results in the increase in the total output of soybeans by 4% in the study area. Farm size is considered as a proxy in production as the size of the farm land expands will lead to increase in the total output of soybeans in the study area. This is in consonance with [21] and [32] who indicated positive effect of farm size on the output of soybean, they reported that an increase in farm size will results in increase in the total output of soybean. The coefficient fertilizer influence soybean output negatively and was statistically significant at ( $P < 0.05$ ) probability level the coefficient of fertilizer (-1.691) implies that a percentage change in the quantity of fertilizer applied to the soybean farm will results in the 1.69% decrease in the total output of soybean in the study area this findings is contrary to the apriori expectation and the economic theory, this could be because farmers wrongly applied the fertilizer or the soybean itself doesn't require fertilizer because it has the ability to fix nitrogen into the soil, this result is not consistent with [12] who reported positive relationship between fertilizer and output of soybean implying that an increase in fertilizer usage will result in increase in total output of soybean. Chemical influence total output of soybean positively and it was significant at ( $P < 0.01$ ) probability level, the magnitude of the coefficient of chemical

(0.267) signifies that a percentage change in the quantity of chemical applied to the soybean farm will result in 26.7% increase or change in the total output of soybean in the study area this an indication of the ability of the chemical to kill the herbs that maybe harmful to the soybean crop and as a result lead to increase in the output of the farmers harvest. Labour also influences output of soybeans positively and statistically significant at ( $P < 0.01$ ). The coefficient of labour (0.602) show that a unit increase in the number of labour input supply to soybeans farm will results in 60.2% increment in the total output of soybeans holding all other variable input constant in the study area. Labour is one of the essential factors used in agricultural production, increase in labour supply leads to proportionate increase in output as it will lead to expansion in farm size which will eventually results in commensurate increase in total output of soybean. This is not in line with [31] who reported negative effect of labour on soybean production in Northern Nigeria, the results are also in agreement with [15] and [14] who equally reported that labour is an important variable in agricultural production. More so the coefficient of farming experience is positive, and it influences the total output positively and was statistically significant at ( $P < 0.01$ ). The magnitude of the coefficient of farming experience (0.349) signifies that a percentage change in the farming experience will result in 34.9% increase in total output of soybeans in the study area. Experience helps farmers to gather more knowledge about farming systems and management practices which could lead to increase in crop yield due to their accumulated technical know-how. Cooperative association influence soybean production positively and was statistically significant at ( $P < 0.01$ ) level with the coefficient magnitude of (0.807), this result implies that a percentage change in the soybean farmer's ability to join cooperative association will result in 80.7% increase or change in the total output of soybean in the study area. Cooperative association enables farmers to come together and pool their resources that makes them have access to production inputs that could lead to increase in their investment in soybean production as well as increased output in the study area. The value of the coefficient of multiple determinations  $R^2$  (0.599) show that 60% of the variation in the total output of soybeans produced by soybean farmers is explain by the explanatory or independent variables included in the Cobb Douglas production model in the study area.

TABLE III: RESULTS OF THE COBB DOUGLAS PRODUCTION FUNCTIONAL MODEL (OLS) FOR FACTORS INFLUENCING TOTAL OUTPUT OF SOYBEANS IN THE STUDY AREA

| Variables               | Parameters | Coefficient | Standard Error | t-Value |
|-------------------------|------------|-------------|----------------|---------|
| Constant                | $\beta_0$  | 0.159       | 0.909          | 0.178   |
| Seed                    | $\beta_1$  | 0.200       | 0.250          | 0.80    |
| Farm Size               | $\beta_2$  | 0.042       | 0.019          | 2.16**  |
| Fertilizer              | $\beta_3$  | -1.691      | 0.850          | -1.99** |
| Chemical                | $\beta_4$  | 0.267       | 0.031          | 8.59*   |
| Labour Input            | $\beta_5$  | 0.602       | 0.224          | 2.69*   |
| Age                     | $\beta_6$  | 0.477       | 0.545          | 0.876   |
| Household Size          | $\beta_7$  | 0.094       | 0.242          | 0.39    |
| Farm Experience         | $\beta_8$  | 0.349       | 0.158          | 2.21**  |
| Cooperative Association | $\beta_9$  | 0.807       | 0.198          | 4.07*   |
| $R^2$                   | -          | 0.599       | -              | -       |
| Adjusted $R^2$          | -          | 0.531       | -              | -       |
| F-Value                 | -          | 8.759       | -              | -       |

Source: Field Survey (2021).

Computed Using STATA Version 14 \*, \*\*, \*\*\*.

Significant at 1%, 5% and 10%, respectively.

The F-value (8.759) which shows the joint contribution of all the independent variables to the total output of soybeans was statistically significant at ( $P < 0.01$ ) probability level. This is in with [1].

#### D. Distribution of Profit Efficiency Scores of Soybean Farmers in the Study Area

Table IV presented the distribution of profit efficiency score level among soybean farmers in the study area, the results shows that 67% of the farmers obtained profit efficiency ranging between 0.21-0.40 the minimum profit efficiency level attained by soybean farmers was 0.011 while the maximum profit efficiency attained by the individuals farmers was 0.998 and the mean value of the profit efficiency was 0.523 this implies that soybean farmers has attained 52% profit efficiency level leaving a gap of 48% which need to be filled to attain maximum profit efficiency level by soybean farmers in the study area if the inefficiency components are properly addressed by adopting and employing modern technology. This result in consonant with findings of [60] and [11] who evaluated mean profit efficiencies of 70% for soybean, 0.58% and 0.53% respectively for certified and conventional groundnut seed producers in northern Ghana.

TABLE IV: DISTRIBUTION OF PROFIT EFFICIENCY SCORES OF SOYBEAN FARMERS IN THE STUDY AREA

| Profit Efficiency Level | Frequency | Percentage |
|-------------------------|-----------|------------|
| 0-0.2                   | 2         | 1.1        |
| 0.21-0.4                | 67        | 35.6       |
| 0.41-0.6                | 61        | 32.4       |
| 0.61-0.8                | 24        | 12.8       |
| 0.81-1                  | 34        | 18.1       |
| Mean                    | 0.523     |            |
| Minimum                 | 0.011     |            |
| Maximum                 | 0.998     |            |

Source: Field Survey, (2021).

#### E. Factors Influencing Profit Efficiency of Soybean Production in the Study Area

Table V presents the results of the analysis of the profit efficiency using maximum Likelihood (MLE) for the estimation of the parameters of the Stochastic profit frontier and the inefficiency components with half-normal distribution assumptions on efficiency error term were also estimated. The value of gamma estimates shows the level of the inefficiency measurement in the various parameters included in the model and the value ranges from 0 to 1. The value of Gamma estimated was 0.452. This indicates the amount of Profit inefficiency of the soybean farmer. The value of the gamma explains 45.2% of the variation in the profit inefficiency in soybean production in the study area. The parameter of sigma square was 0.057. The analysis show that five (5) independent variables were found to be the statistically and significant factors influencing the profit efficiency of soybean production in the study area. The variables are price of fertilizer, cost of chemical, cost of labour, price of soybean and total revenue obtained from the sales of soybean crop. Price of fertilizer had negative effect on the profit efficiency of soybean production in the study area and was statistically significant at ( $P < 0.10$ ) level. The magnitude of the coefficient of fertilizer (-0.17) implies that a unit change in the price of fertilizer will result in the decrease in the level of profit efficiency of soybean

production, the inverse relation could occur due to the fact that soybean doesn't require much fertilizer in its production or as a result of wrong application by the farmer. This is in line with [9] who discovered that the coefficient of fertilizer was positively related to profit inefficiency indicating that adoption of fertilizer in soybean production increases profit inefficiency. Price of chemical influence the profit efficiency negatively and it was statistically significant at ( $P < 0.10$ ) level. The coefficient of chemical was -0.355 implying that a unit change in the quantity of chemical applied the beans farm by the farmer will result in 35.5% decrease in the profit efficiency of soybean production in the study area. Price of labour was found to be positive and statistically significant at ( $P < 0.01$ ) level the magnitude of the coefficient of the price of labour was (0.177) this signifies that a unit change in the price of labour will lead to 17.7% increase in the profit efficiency level of the soybean farmers in the study area. Labour availability to the family will result in the expansion of farmland by the household head thereby improving the profit efficiency due to economies of scale, as farmland expands the cost of production reduces while profit efficiency increases. The price of soybean influence profit efficiency positively and was statistically significant at ( $P < 0.01$ ) level, the coefficient of the soybean price was (0.318) this implies that a unit increase in the price of soybean in the market will result in 31.8% increase in the profit efficiency of the soybean production in the study area this may arise as a result of the higher price of the soybean whenever the price of the soybean increases the profit level of the soybean farmer will also increase provided he has the soybean for sale as the farmers profit increases his income will also increase thereby enabling the farmer to purchase the required inputs that will lead to increase in yield as well as profit level that leads to achieving high level of profit efficiency. Total revenue influence profit efficiency positive and it was statistically significant at ( $P < 0.01$ ) level. The magnitude of the coefficient of the total revenue (0.807) indicates that a unit increase in the total revenue will result in 80.7% increase in the profit efficiency of soybean production by soybean farmers. Total revenue determines the level of profit a farmer makes the higher the revenue the higher the ability of the soybean farmers to make high profit resulting in high profit efficiency.

The inefficiency component of the profit efficiency model of soybean production is also presented in Table V. The negative sign of the estimates parameters in the inefficiency component implies that the variable reduces profit inefficiency (increases profit efficiency). The positive signs of the estimates increase inefficiency (decreases profit efficiency). Household size influences profit inefficiency of soybean production negatively and it was statistically significant at ( $P < 0.1$ ) probability level, the coefficient of the household size was (-0.012) the negative sign implies that household size increases profit efficiency and decreases profit inefficiency of soybean production in the study area the coefficient signifies that a unit increase in the number of household size will result in 1.2% increase in the profit efficiency or decrease in profit inefficiency of soybean production in the study area. Household size plays a significant role in soybean production as high number of households will supply more labour for the production process that would reduce cost of labour which always takes

the largest share in the variable cost of production. This result is contrary with [32] who reported that soybean farmers with larger household sizes tend to have less efficiency than households with small number of people unless they are all productive. Education level of farmers influences profit inefficiency negatively which means it increases profit efficiency and decreases profit inefficiency among soybean farmers in the study area, the coefficient of education level (-0.0367) was statistically significant at ( $P < 0.10$ ) level of probability, this shows that a unit increase in the level of education of the soybean farmers will result in the decrease in the level of profit inefficiency or increase in the profit efficiency of soybean production by 3.67% among the soybean farmers in the study area. Education assists farmers on how to apply the knowledge in sourcing for information, inputs utilization and adoption of new technology in soybean production that will increase their profit efficiency level. This is in line with [23] who reported that educated farmers can read and write and they can source for information about soybean production that will increase their profit efficiency. Cooperative association influences profit efficiency of soybean production in the study area negatively implying that being a member of cooperative will increase profit efficiency and decrease profit inefficiency tremendously. The magnitude of the coefficient of cooperative was (-0.281) and it was statistically significant at ( $P < 0.01$ ). This is in agreement with the results of [1] who found that producers who are members of farmer groups benefit from services provided by the groups such as provision of easy access to information, inputs and services thereby increasing profit efficiency. The results also contradict the finding of [32] and [1] who in their findings reported that the longer a respondent stayed in a cooperative society, the lower is his technical and allocative inefficiencies. Farming experience influence profit inefficiency negatively meaning experience in soybean production decreases inefficiency or increases profit efficiency of soybean production in the study area. The coefficient of the farming experience was (-0.009) and was statistically significant at ( $P < 0.05$ ) probability level. This is in line with [1], [7] who opined that farming experience enhances human capital of farmers by equipping them with the requisite skill and knowledge which usually translates into increased efficiency of production. Access to credit had negative influence on the level of profit inefficiency of soybean production in the study area, and it was statistically significant at ( $P < 0.05$ ) the coefficient of the access to credit was (-0.176) this implies that a unit increase in the access to credit by soybean farmers results in the decrease in the profit inefficiency or increase in the profit efficiency of soybean production by 17.6% in the study area. Access to credit will enable soybean farmers to purchase the required inputs for soybean crop production at a specific time that is needed without delay, and it will lead to increase in yield that might result in the increase in profit efficiency in soybean production by farmers in the study area. This is in line with [17] who opined that access to credit provides a farmer with a means of expanding and improving his farm efficiency but contrary to [7] who found access to credit to be positive in Benue State Nigeria this could happen due to diversion of the credit to other usage other than farming operation.



TABLE V: ESTIMATES OF THE PARAMETERS OF THE MAXIMUM LIKELIHOOD OF THE PROFIT EFFICIENCY STOCHASTIC FRONTIER MODEL OF THE SOYBEAN FARMERS IN THE STUDY AREA

| Variables                                              | Parameter  | Coefficients | Standard Error | Z-score  |
|--------------------------------------------------------|------------|--------------|----------------|----------|
| <i>Profit Efficiency Frontier (<math>\pi_i</math>)</i> |            |              |                |          |
| Constant                                               | $P_0$      | 0.371        | 0.606          | 0.61     |
| Price of Seed                                          | $P_1$      | 0.153        | 0.286          | 0.53     |
| Price of Fertilizer                                    | $P_2$      | -0.170       | -0.100         | -1.70*** |
| Price of Chemical                                      | $P_3$      | -0.355       | 0.201          | -1.76*** |
| Price of Land Rent                                     | $P_4$      | 0.161        | 0.125          | 1.29     |
| Price of Labour                                        | $P_5$      | 0.177        | 0.011          | 16.09*   |
| Price Soybean                                          | $P_6$      | 0.318        | 0.122          | 2.60*    |
| Total Revenue                                          | $P_7$      | 0.807        | 0.198          | 4.07*    |
| <i>Profit Inefficiency Component</i>                   |            |              |                |          |
| Age of Farmer                                          | $Z_1$      | 0.003        | 0.008          | 0.87     |
| Household Size                                         | $Z_2$      | -0.012       | 0.007          | -1.84*** |
| Educational Level                                      | $Z_3$      | -0.037       | 0.021          | -1.74*** |
| Cooperative                                            | $Z_4$      | -0.281       | 0.111          | -2.52*   |
| Experience                                             | $Z_5$      | -0.009       | 0.004          | -2.25**  |
| Extension Contact                                      | $Z_6$      | -0.085       | 0.106          | -0.81    |
| Access to Credit                                       | $Z_7$      | -0.176       | 0.087          | -2.04*   |
| Price Information                                      | $Z_8$      | -0.189       | 0.105          | -1.81*** |
| Non-Farm Income                                        | $Z_9$      | -0.070       | 0.077          | -0.91    |
| <i>Diagnostic Statistics</i>                           |            |              |                |          |
| Sigma <sup>2</sup>                                     | $\sigma^2$ | 0.057        | -              | -        |
| Gamma                                                  | $\gamma$   | 0.452        | -              | -        |
| Log likelihood =                                       | -          | -834.7       | -              | -        |

Source: Field Survey (2021) \*, \*\*, \*\*\*, Significant at 1%, 5% and 10% Probability Levels, respectively.

Price information influences the profit inefficiency of soybean production negatively and it was statistically significant at ( $P < 0.1$ ), the magnitude of the coefficient of the price information was (-0.070) this result implies that a unit increase in the price information will result in 7% increase in the efficiency or decrease in the inefficiency of soybean production in the study area. Access to price information will make a farmer to maximize his profit by locating the best market to sale his crop since he has the price information already, he cannot be cheated.

#### F. Constraints Faced by the Sampled Soybeans Farmers in the Study Area

Table VI show the results of the analysis of the constraints faced by soybeans farmers in the study area, multiple responses were allowed for farmers to choose which of the constraints affects them most. The analysis revealed that about 88.8% of the sampled soybeans farmers were face with the condition of bad roads that linked their farms and the markets and was ranked 6<sup>th</sup>, generally bad roads are very terrible in Nigeria especially when conveying agricultural produce from the farm to the market or to the residence of the farmers. The results also show 93.6% and 93.1 of the sample respondents encountered government policy and the outbreak of diseases as the major constraints respectively and were ranked 3<sup>rd</sup> and 4<sup>th</sup> respectively. Also, 94.1% of the sampled soybeans farmers in the study area were faced with the challenge of lack of land for cultivating soybeans in the area which was ranked 2<sup>nd</sup>, this could be as a result of the encroachment of the residential area or the lands are being used for alternative purposes leaving the farmers stranded without available land for agricultural purpose. This is consistent with [31]. The majority 98.8% of the sampled respondents experienced lack of hired labour as the major constraint in soybeans production in the study area, labour is a key factor in any kind of production most of a time labour carries the largest portion of the cost of production and this constraint was ranked first 1<sup>st</sup> due to its effect on the profit of the farmers. Other constraints identified by the soybeans farmers in the study area include high cost of inputs,

inadequate capital, lack of extension agents and unavailability of improved seed varieties. This result is in line with [32], [1] which revealed similar challenges as most critical constraint to soybean cultivation in the Northern Region of Ghana.

TABLE VI: CONSTRAINTS FACED BY THE SAMPLED SOYBEAN FARMERS IN THE STUDY AREA

| Constraints                               | *Frequency | Percentage | Rank            |
|-------------------------------------------|------------|------------|-----------------|
| Lack of Hired Labour                      | 186        | 98.9       | 1 <sup>st</sup> |
| Lack of Land                              | 177        | 94.1       | 2 <sup>nd</sup> |
| Government Policy                         | 176        | 93.6       | 3 <sup>rd</sup> |
| Outbreak of Disease                       | 175        | 93.1       | 4 <sup>th</sup> |
| High Cost of Inputs                       | 171        | 91.0       | 5 <sup>th</sup> |
| Bad Roads                                 | 167        | 88.8       | 6 <sup>th</sup> |
| Inadequate Capital                        | 150        | 79.8       | 7 <sup>th</sup> |
| Lack of Extension Services                | 137        | 72.9       | 8 <sup>th</sup> |
| Unavailability of Improved Seed Varieties | 131        | 69.7       | 9 <sup>th</sup> |

Source: Field Survey (2021) \*Multiple Responses.

#### IV. CONCLUSION AND RECOMMENDATIONS

Based on the results of the findings emanating from this research work show that soybean is majorly produced by male farmers, mostly youth and in their active productive age and the soybean farmers are mostly not educated because most of the farmers had not attended formal school. The study also revealed that soybean production was a profitable agribusiness in the study area, the soybean production is influenced by farm size, fertilizer, chemicals, labour input, farming experience and cooperative association. The profit efficiency level attained by soybean farmers was 52% with an inefficiency gap of 48% that needed to be close or filled to attain a maximum profit efficiency level by soybean farmers by adopting new technology. The factors influencing profit efficiency were the price of fertilizer, price of chemicals, price of labour unit price of soybean, and total revenue. The statistically significant factors influencing profit inefficiency were household size, educational level, cooperative association, farming experience, access to credit, and price

information. The soybean farmers encountered challenges such as lack of high cost of hired labor as the major constraints in soybeans production in the study area, other constraints identified by the soybean farmers include high cost of inputs, inadequate capital, lack of extension agents, and unavailability of improved seed varieties. Therefore, the study recommends that since soybean production is dominated by male farmers, female farmers should be encouraged to be involved in soybean production in order to make them improve their source of income, Government should also provide farm tractors and other farm implements to ease the drudgery in soybean production and reduce the cost of labour incurred by farmers. Market information should be made available for farmers since soybean production is profitable for profit maximization. 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. Government should make extension agents available to provide services to farmers and to teach farmers about the nutritive value of soybean crop and its profitability for improving their wellbeing and healthy lifestyle in the study area.

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#### CONFLICT OF INTEREST

The Authors declare that they do not have any conflict of interest.

#### REFERENCES

- [1] Moses JD. Technical Efficiency of Soya Beans Production in Mubi North Local Government Area of Adamawa State, Nigeria. *International Journal of Environmental & Agriculture Research*, 2017; 1-3(6):36-42.
- [2] Food and Agricultural Organization, FAO. *Production year book*. Food and Agricultural Organization, United Nations, Rome; 2009.
- [3] United States Department of Agriculture. Soybean Backgrounder. *Electronic Outlook Report from the Economic Research Services*, 2006: 1-43. [Online] [www.ers.usda.gov](http://www.ers.usda.gov).
- [4] Osman A, Donkoh SA, Ayamga M, Ansah IGK. Economic Efficiency of Soybeans production in the Northern Region of Ghana. *Journal of Agricultural Economics and Agribusiness*, 2018; 1(1): 1-30.
- [5] Patil G, Mian R, Vuong T, Pantalone V, Song Q, Chen P. Molecular mapping and genomics of soybean seed protein: a review and perspective for the future. *Theoretical and Applied Genetics*, 2017; 130(10): 1975-1991.
- [6] Amesimeku J, Anang BT. Profit Efficiency of Smallholder Soybean Farmers in Tolon District of Northern Region of Ghana. *Ghana Journal of Science, Technology and Development*, 2021; 7(2): 29-43.
- [7] Biam CK, Okorie A, Nwibo SU. Economic Efficiency of Small Scale Soybean Farmers in Central Agricultural Zone, Nigeria. *A Cobb-Douglas Stochastic Frontier Cost Function Approach*, 2016; 8(3): 52-58.
- [8] International Institute for tropical Agriculture, IITA. Research for Africa, 2007. [Online] [www.iita.org/coms](http://www.iita.org/coms).
- [9] International Development Research Centre, IDRC. *Research gives birth to Nigerian soybean industry*. Publication for IDRC, Dakar, Senegal; 2006.
- [10] International Institute of Tropical Agriculture, IITA. *Soybean for good health*. How to grow and use soybean in Nigeria. Ibadan; 2003.
- [11] Fayama FN. The determinants of economic empowerment and self-reliance. *Knowledge review. Multidisciplinary journal*, 2004;9(1):2-3.
- [12] Ugbabe OO, Abdoulaye T, Karamara AY, Mbavai O. Profit and Technical Efficiency of Soybean Production in Northern Nigeria. *Tropicultura*, 2017; 36(3):203-214.
- [13] Alabi OO, Oladele AO, Maharazu I. Profitability Analysis and Marketing Efficiency of Soybean (Glycine max) Value Chain among Actors in Abuja, Nigeria. *Sarhad Journal of Agriculture*, 2020b; 36(4): 1010-1019.
- [14] Abah EO. Profit Efficiency of Soybean Marketing Chain in North Central States of Nigeria. *International Journal of Innovative Science and Research Technology*, 2020; 5 (3): 1360-1366.
- [15] Upev SK, Haruna L, Giroh Y. Analysis of Resource Use Efficiency Among Soybean (Glycine Max) Farmers in Gboko Local Government Area of Benue State, Nigeria. *Global Journal of Agricultural Sciences*, 2021; 15: 57-63.
- [16] Osho SM. The processing and acceptability of a fortified cassava-based product (garri) with soybean. *Journal of Nutrition and Food Science*, 2003; 33(6):205.
- [17] Otiotoju MA, Adebo GM, Arene CJ. Identification and Stochastic Analysis of Factors Influencing Technical Inefficiency of Nigerian Smallholder Soybean Farmers. *TROPICULTURA*, 2014; 32 (4) 197-204.
- [18] Kuje Abuja Area Guide Villa Afrika Reality <https://www.aafrika.com/kuje-dist>.
- [19] National Bureau of Statistics (2007). Facts and Figures about Nigeria. National Bureau of Statistics.
- [20] Yamane T. *Statistics: An Introductory Analysis*, 2<sup>nd</sup> Ed., New York: Harper and Row; 1967.
- [21] Ebukiba ES, Anthony L, Adam SM. (2020). Economics and Technical Efficiency of Maize Production Among Small Scale Farmers in Abuja, Nigeria: Stochastic Frontier Model Approach EJFOOD, *European Journal of Agriculture and Food Sciences* 2020; 2 (6), November 2020.
- [22] Olukosi JO, Erhabor PO. Introduction to Farm Management Economics: Principles and Applications. Agitab Publishers Limited, Zaria, Nigeria, 2005; 114pp.
- [23] Alabi OO, Oladele AO, Oladele NO. Socio-Economic Factors Influencing Perception and Adaptability of Rural Rice Farmers to Climate Change, Abuja, Nigeria: Applications of Heckman Two-stage Model. *Russ. J. Agric. Soc.-Econ. Sci.*, 2020b; 8(104): 45–56
- [24] Battese GE, Coelli TJ. A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. *Empirical Economics*, 1995; 20(2): 325- 332.
- [25] Aigner DJ, Lovell CAK, Schmidt P. Formulation and Estimation of Stochastic Frontier Production Function Models. *Journal of Econometrics*. 1977; 6: 21-37.
- [26] Abu GA. Comparative Analysis of Resource Use Efficiency between participant and non-participant Farmers in the Special crop Programme in Benue State, Nigeria. Unpublished PhD thesis, Department of Agricultural Economics, Ahmadu Bello University, Zaria, 2007.
- [27] Alabi OO, Oladele AO, Usman MB. Determinants of Agricultural Loan Decision Making Process for Rice (Oryza sativa) Farmers in Abuja, Nigeria. Applications of Heckman Two-Stage Model and Factor Analysis. *J. Agribus. Rural Dev*. 2021; 1(59), 29–38.
- [28] Siagian V, Siregar H, Fariyanti A, N. Analysis of Factors Affecting Soybean Production and Price Efficiency in Banten Province *IOP Conference Series Earth and Environmental Science*. 2022; 950: 012054. doi 10.1088/1755-1315/950/1/02054.
- [29] Konja DK, Mabe FN, Oteng FR. Profitability and Profit Efficiency of Certified Groundnut Seed and Conventional Groundnut Production in Northern Ghana: A Comparative Analysis. *Cogent Economics & Finance*, 2019; 7: 1631525. <https://doi.org/10.1080/23322039.2019.1631525>.
- [30] Mwita AC, Maina M, Nyairo NM, Ramasawmy B. Assessment of Profit Efficiency Among Sweet Yellow Fassion Fruit Farmers in Mbeere South Embu County, Kenya. *Journal of Animal & Sciences*, 2016; 27(3): 4305-4314.
- [31] Otiotoju, MA, Arene CJ. Constraints and Determinants of Technical Efficiency in Medium Scale Soybean Production in Benue State, Nigeria. *African Journal of Agricultural Research* 2010; 5(17): 2276-2280.
- [32] Abubakari SB, Abdulai MHN, Anang BT. Economic Analysis of Groundnut Production in Tolon District, Ghana. *International Journal of Irrigation and Agricultural Development*, 2019;3(1): 192 – 200.