Technical Efficiency of Cowpea (Vigna unguiculata (L.)Walp) Production in Nasarawa State, Nigeria

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ABSTRACT

This study evaluated technical efficiency of cowpea production in Nasarawa State, Nigeria. The specific objectives were to determine socio-economic characteristics of the cowpea farmers, estimate costs and returns of cowpea production, evaluate the technical efficiency of cowpea production, evaluate the determinants of technical efficiency of cowpea production, and identify the constraints militating against cowpea production in the study area. Multistage sampling technique was adopted and employed. Data for this study was collected from the primary sources through well-structured questionnaires. The results of the analysis show that majority (79%) of the sampled cowpea farmers were male, the average age of the sampled farmers was 45 years indicating that they are still active and agile operating at a small scale level of 2.14 ha farm size. The study further shows that cowpea production is a profitable agribusiness with 2.8% return on investment. Factors that are statistically significant influencing the total output of cowpea production by the farmers in the study area were seed (P<0.05), organic manure (P<0.01), chemical fertilizer (P<0.01) and agrochemical (P<0.05) while the factors influencing inefficiency of cowpea production were sex (P<0.01) marital status (P<0.01), education level of farmers (P<0.01), occupation (P<0.01) and household size (0.01). The farmers were able to attain 78% level of technical efficiency with inefficiency gap of 22% of inefficiency that needs to be filled. The cowpea farmers were faced with following constraints: pest and insect problem, poor storage facilities, poor marketing, access to credit facilities and poor infrastructure. Therefore, the study recommends that farmers should be encouraged to participate more in cowpea production since its production is profitable in the study area, farmers should also be provided with subsidized production inputs by government or non-governmental organizations like insecticides, herbicides, and credit facilities to increase their level of production capacity that will lead to increase in total output, income as well as improved welfare that will liberate them from poverty and make them food secured in the study area.

Keywords: Cowpea Production, Nigeria, Stochastic Production Frontier Model, Technical Efficiency.

I. INTRODUCTION

Agriculture is contributing significantly to the sector of Nigeria's economy as a whole [1]. The sector is providing employment significant number of labour force, adding much value to Gross Domestic Product (GDP) in the early 1970, Nigeria’s agricultural commodity exports was among the major means of how the country gets her national income from foreign exchange as earnings and non-oil export it supplies about 80% of the food consumed in the country [2]. Account for over 70% of the revenue earning from non-oil exports [3]–[5]. Nigeria agriculture is mainly occupied by small-scale farmers which constitute the serves as a significant part of the Nigerian economy they are operating at subsistence level and they are the major producers of the bulk of food consumed in the country [5]. The amount of money spend on food consumption by Nigerians takes the highest part of total expenditure spent by households in Nigeria the demand for food is growing almost at the rate of about 3.5% per annum while the food production grows at the rate of 2% annually over the few past years, and, the population growth rate is about 2.9%, whereby, creating a demand supply gap in the food industry. The performance of Nigerian agricultural sector in the areas of development is declining therefore creating wide deficit in supply of food [6]. Every country desires to be self-sufficient more especially in providing food for its citizenry. There was an increase in agricultural sector by 2.1% in 2018, this has been the lowest growth rate experience in two decades in the agricultural sector, the total contribution of agriculture in 2018 to GDP accounted for 27.6% [7]. Cowpea (Vigna unguiculata (L.)Walp) is a tropical Africa crop and it is one of the very significant legumes across the globe. The legume crop is mostly grown all over Sub-Saharan Africa [8]. Cowpea is playing very important roles in contributing to the nutritional demand and increase in the economic development in the life style of many
individuals in the underdeveloped world. According to [9], cowpea contains about 23% protein content which is a good source of plant. Cowpea is a well-known leguminous crop in Africa which is called beans ‘in Nigeria it is known as wake in Hausa language, ewa in Yoruba, agwa in Igbo language and niebe ‘in francophone countries. The largest producers are in the moist and dry savannah of Sub-Saharan Africa (SSA), where it is mostly grown in combination with other cereal crops like millet, sorghum and maize as well as rice fallows [10]. Nigeria is the largest producer of cowpea in the World with the capacity of producing about 2.91 million tons of cowpea per annum [9], [4]. Countries in Africa that produces cowpea are Niger (1.57 million tons) Ghana, Burkina Faso, Senegal and Cameroon are also among producers. Outside Africa, the other significant producing countries includes Asia, North and South America.

Cowpea efficiency in Nigeria has not been at optimal level with the technical efficiencies of producers below the frontier in majority of the producing areas in the country [11]. The concept of efficiency is a term that deals with how performance has been achieved by used transforming a given input into output [12]. The important role of efficiency is to increase agricultural output, and it is well considered by researchers and policy formulators alike. On this note, it is important for us to carry out a study research on the level of efficiency of cowpea farmers’ in Nigeria [13]. Furthermore, attaining efficiency level in the utilization of the resources available to the farmers is the most important factor for influencing profitable farm enterprise. Therefore, inefficiency in the application of resources, wrong choices of different enterprises, combination and methods of cropping systems contribute to the problems of food production in Nigeria. [5] postulated that there is high cost of purchasing inputs used by farmers in cowpea production, the high cost of input has negative effects on profit margin and also inefficiency of resource use. The motive of every farmer venturing into agribusiness is to obtain increase output and maximize profit. Purchase inputs at least cost and sale output at higher price level and efficient utilization of resources in production [13]. United State Department of Agriculture [14] observed that the production of cowpea is mostly by the use of direct labour and considered as intensive crop in tropical countries in the world which has enhance low productivity due to high level of illiteracy, farm inputs are costly, use of primitive and local crude tools, like hoes, cutlasses, axes among others. The average land farm size in cultivation by farmers between 1 and 2 hectares. Capital is a major limitation in agriculture, only few farmers have access to rural credit. High costs of insecticides and pesticides [15]. With the fall in the value of Naira the exchange rate of the Nigerian currency against other major currencies that the chemicals are being imported in the world, the costs of the pesticides and herbicides are increasing and going higher every day. However, little is known about the profitability of cowpea production in Nigeria and more especially on how to use it to alleviate poverty among cowpea farmers. This is because despite the great potentials, cowpea has received little attention in terms of agricultural policy thrust and economic research [16]. Most research on the crop focused on characteristics such as yield enhancement through breeding, soil management and agronomical practices. Hence, other information concerning the production efficiency, market dynamics, consumer preference and indeed profitability of cowpea that is limited and it may influence the low level of cowpea production. Several studies have been conducted by researchers on technical efficiencies of farmers in different locations across the globe and all over the country on different crop varieties [17]–[22]. There is an existing gap in literature regarding technical efficiency in cowpea production in the study area. Hence, there are also limited study on how increasing farmers’ efficiency in cowpea production as a means of reducing poverty among farmers in Nasarawa State Nigeria. Nigeria has not been able to reach the level of self-sufficiency in food production for its citizens, despite the increase in land area put to production each year, one means by which farmers can attain the level of sustainable achievement of agricultural development is by raising the efficiency of their farm production through improving productivity level in the limits of the available resources and the existing technologies. Therefore, it is on this basis that this research study was undertaken in order to increase the level of cowpea production by applying the intensive cropping system which plays an important role in farmers’ income earnings in Nigeria as a result of the multiple usage of cowpea seed and also as fodder in human and animal diet [26].

A. Research Questions
This study is designed to provide answers to the following research questions:

(i) what are the socio-economic characteristics of cowpea farmers?
(ii) What are the costs and returns of cowpea production?
(iii) What is the level of technical efficiency in cowpea production?
(iv) what are the factors influencing technical efficiency of cowpea production?
(v) What are the constraints militating against cowpea production in the study area?

B. Objective of the Study
The broad objective of this study was to analyze technical efficiency of cowpea production in Nasarawa State, Nigeria. The specific objectives were to:

(i) determine socio-economic characteristics of the cowpea farmers,
(ii) estimate cost and returns of cowpea production,
(iii) evaluate the technical efficiency of cowpea production,
(iv) evaluate the determinants of technical efficiency of cowpea production, and
(v) identify the constraints militating against cowpea production in the study area.

II. MATERIALS AND METHODS

A. The Study Area
This research work was carried out in Nassarawa State, Nigeria. Nasarawa State is located in North Central Nigeria and it comprises of thirteen local government areas. The State lies in Guinea Savannah region between Latitude 7°N and 9°
N and Longitude 7°E and 10°E, it is located and shares boundary with the Federal Capital Territory to the North-West; Kaduna and Plateau States towards the north-east it has boundary with Benue State to the South [23]. The land area of Nasarawa State is 27,117 square kilometres and population of 1,863,275 people 2006 census report [22]. The State is an agriculturally dominated and its major contributor to its economy. The State also has solid mineral and salt including bauxite. Nasarawa State experiences both dry and rainy season, with an average annual rainfall of about 131.73mm. Cereal crops that can be grown there are rice, sorghum and millet while roots and tubers are yams, cassava, potato and sweet potato; oil seed and legume types of crops include; cowpea, pigeon pea, groundnut, and bean seed. While tree crops include; citrus, oil palm, cashew, mango and sugar cane.

B. Sampling Techniques and Sample Size

Multi-stage sampling technique was employed and adopted for the study, first stage involves purposive sampling procedure to select Nasarawa State due to concentration of the cowpea farmers. In the second stage purposive sampling was also used to select two local Government Areas based on the prevalence and predominance of cowpea production among farmers, the local government areas selected were Keffi and Karu local government areas. The third stage used random sampling technique in selecting three communities from each of the two local government areas selected and finally simple random sampling was adopted in selecting the respondents among the sample frame of (2009) list of registered farmers collected from the two local government areas through ballot box raffle drawn to avoid bias, a sample size of 200 respondents were selected out of the available sample frame of 2009 in the study area.

C. Method of Data Collection

Data for this study were collected from primary sources. The Primary data was collected through the means of using well-structured questionnaires administered to the respondents by the researcher and the trained enumerators who also interpreted the questions in local language where it is applicable, the data collected from the cowpea farmers was based on socio-economic characteristics including variables on profit and the determinant factors that influence cowpea production, types and sources of input and production cost as well as cost and returns in the study area.

D. Method of Data Analysis

The data collected was scrutinized, collated and coded for analysis. The following tools of analysis was employed so as to achieve the specific objectives:

(i) Descriptive Statistics;
(ii) Farm Budgeting Technique;
(iii) Stochastic Frontier Production Model;
(iv) Likert Scale;
(v) Principal Component Analysis;
(vi) t-Test Statistics.

E. Descriptive Statistics

This tool was employed to summarize the data that was collected. It was used to calculate percentages, means, frequency distributions and standard deviations. This was applied to achieve specific objective (i).

F. Budgetary Technique

The Model is expressed as follows:

\[ GM = TR - TVC \]

\[ GM = \sum_{i=1}^{n} P_i Q_i - \sum_{i=1}^{n} P_i X_i \]

where

\( GM \) = Gross Margin (N);
\( TR \) = Total Revenue (N);
\( TVC \) = Total Variable Cost;
\( P_i \) = Cost of cowpea per (kg);
\( Q_i \) = Quantity of cowpea produced in (kg).

\[ \Sigma \] = Summation from the first farmer to the last farmer.

Rate of Return on Investment (RORI) = \( \frac{\Pi}{TC} \)

where

\( \Pi \) = Profit (N);
\( TC \) = Total Cost (N).

Net Farm Income (NFI) = Gross Margin (GM) – Total Fixed Cost (TFC)

This tool was used to achieve specific objective (ii).

G. Stochastic Frontier Production Model

This tool was used to achieve the technical efficiency level attained by cowpea farmers developed by [24], and is stated thus:

\[ Y_i = f(X_i, \beta) \epsilon_i, i = 1, ..., N \]

where \( Y_i \) is the total output from the \( i \)th cowpea farmer, \( X_i \) independent variable i.e inputs used by \( i \)th cowpea farmer, and \( \beta \) is the coefficients estimated, wherefore \( \epsilon \) is the stochastic error term, which is decomposed into:

\[ \epsilon = v_i - u_i \]

Where \( v_i \) is the random errors assumed to be independent and identically distributed (iid) [25]. \( v_i \) is normally distributed \( N(0, \sigma^2) \) and it is independent of \( u_i \), and \( u_i \) is the random component that represent technical inefficiency in the model which is also assumed to be independently distributed, and normally distributed with mean \( u_i \) and variance \( (N(u_i, \sigma^2)/f \)

\[ Y_i = F(X_i, \beta) + \epsilon_i \]

\[ Y = f(X_1, X_2, X_3, X_4, X_5, V - U_i) \]

\[ LnY_i = \beta_0 + \sum_{i=1}^{5} \beta_i LnX_i + \sum_{i=1}^{n} LnX_i + V - U_i \]

The explicit function is stated thus:

\[ LnY_i = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + V_i - U_i \]
where
\[ \ln Y_t = \text{Output of Cowpea (Kg)}; \]
\[ X_1 = \text{Seed Input (Kg)}; \]
\[ X_2 = \text{Farm Size (Hectares)}; \]
\[ X_3 = \text{Quantity of Fertilizer (Kg)}; \]
\[ X_4 = \text{Chemical Input (Litres)}; \]
\[ X_5 = \text{Labour Input (Man-days)}. \]

The Technical Inefficiency Component of the Stochastic Frontier Model is stated thus:
\[ U_t = \alpha_0 + \alpha_1 \delta_1 + \alpha_2 \delta_2 + \alpha_3 \delta_3 + \alpha_4 \delta_4 + \alpha_5 \delta_5 + \alpha_6 \delta_6 + \alpha_7 \delta_7 + \alpha_8 \delta_8 \] (9)

where
\[ U_t = \text{Technical Inefficiency Component}; \]
\[ \delta_1 = \text{Age of Farmers (Years)}; \]
\[ \delta_2 = \text{Sex (1, Male; 0, Otherwise)}; \]
\[ \delta_3 = \text{Household Size (Number)}; \]
\[ \delta_4 = \text{Education Level of Farmers (Years Spent Schooling)}; \]
\[ \delta_5 = \text{Extension Contact (Number of Contact per Month)}; \]
\[ \delta_6 = \text{Farming Experience (Years)}; \]
\[ \delta_7 = \text{Access to Credit (1, Access; 0, Otherwise)}; \]
\[ \delta_8 = \text{Cooperative Association}; \]
\[ \alpha_0 = \text{Constant Term}; \]
\[ \alpha_1 - \alpha_6 = \text{Regression Coefficients}; \]
\[ \text{This was used to achieve specific objective (ii)}. \]

H. Five-Point Likert Scale

The constraints that were faced by small-scale cowpea farmers were analyzed using 5-point Likert scale rating: 1=strongly disagree, 5=agree, 4=undecided, 3=disagree and 2=strongly disagree.

The mean score was calculated using the formula:
\[ MS = \frac{\sum (RP \times O)}{\sum O} \] (10)

where
\[ MS = \text{Mean Score (Units)}; \]
\[ RP = \text{Rating Point (Units)}; \]
\[ O = \text{Number of Observations (Units)}; \]
\[ \sum O = \text{Total Number of Sampled Respondents (Units)}.

This was used to achieve part of specific objective four (iv).

I. Principal Component Analysis

Constraints faced by cowpea farmers was subjected to Principal Component Analysis or Factor Analysis.

III. RESULTS AND DISCUSSION

A. Socio-Economic Characteristics and the Profile of the Cowpea Farmers in the Study Area

Table I shows the results of the analysis of the socio-economic characteristics of the sampled cowpea farmers in the study area. The results show that majority (79%) of the sampled cowpea farmers were male, while only 21% of the sampled respondents were female. This shows that cowpea production is dominated by male farmers in the study area. This result is contrary with [21] who reported that cowpea production was dominated by female farmers in Adamawa State. Also, 75% of the sampled cowpea farmers were married, while 10.5% were single. The results further show that 80% of the sampled cowpea farmers had less than 5 members per household. This is consistent with [5] who reported that families that has large members may have the ability to supply more labour for farm operations. More so 29.2% had 1–6 years in school while 20.8% had 7–12 years of schooling and 44.9% had no formal education. The level

| TABLE I: RESULTS OF THE SOCIO-ECONOMIC CHARACTERISTICS OF COWPEA FARMERS |
|-----------------------------------------------|
| Variables                   | Frequency | Percentage | Mean Value |
| Gender                       |           |            |            |
| Male                         | 158       | 79         |            |
| Female                       | 42        | 21         |            |
| Age (Years)                  |           |            | 45          |
| >20                          | 4         | 2          |            |
| 21–30                        | 27        | 13.5       |            |
| 31–40                        | 71        | 35.5       |            |
| 41–50                        | 68        | 34         |            |
| 51 and above                 | 30        | 15         |            |
| Marital Status               |           |            | 6.3         |
| Married                      | 150       | 75         |            |
| Single                       | 21        | 10.5       |            |
| Widowed                      | 14        | 7          |            |
| Divorced                     | 15        | 7.5        |            |
| Years Schooling              |           |            |            |
| 1–6                          | 63        | 29.2       |            |
| 7–12                         | 45        | 20.8       |            |
| 13 and above                 | 11        | 5.1        |            |
| No Years in School           | 97        | 44.9       |            |
| Household Size (Units)       |           |            | 6           |
| 1–5                          | 160       | 80         |            |
| 6–10                         | 30        | 15         |            |
| 11–15                        | 4         | 2          |            |
| 16 and above                 | 6         | 3          |            |
| Farming Experience (Years)   |           |            | 10          |
| 1–5                          | 90        | 45         |            |
| 6–10                         | 94        | 45         |            |
| 11–15                        | 7         | 3.5        |            |
| 16 and above                 | 9         | 4.5        |            |
| Cooperative                  |           |            |            |
| No                           | 170       | 85         |            |
| Yes                          | 30        | 15         |            |
| Source of Capital            |           |            |            |
| Personal Savings             | 145       | 72.5       |            |
| Credits                      | 7         | 3.5        |            |
| Friends and Family           | 30        | 15         |            |
| Money Lenders                | 10        | 5          |            |
| Borrow                       | 1         | 0.5        |            |
| Others                       | 7         | 3.5        |            |
| Non-Farm Income (Naira)      |           | 57.390     |            |
| None                         | 115       | 57.5       |            |
| 50000                        | 18        | 9          |            |
| 51-100000                    | 36        | 18         |            |
| 101-150000                   | 12        | 6          |            |
| 1510000 and above            | 19        | 9.5        |            |
| Extension Visit              |           |            |            |
| No                           | 30        | 15         |            |
| Yes                          | 170       | 55         |            |
| Farm Size (Hectares)         |           | 2.14       |            |
| 1–2                          | 150       | 75         |            |
| 3–4                          | 41        | 20.5       |            |
| 5–6                          | 5         | 2.5        |            |
| 7 and above                  | 4         | 2          |            |
| Method of Land Acquisition   |           |            |            |
| Inheritance                  | 101       | 50.5       |            |
| Lease                        | 6         | 3          |            |
| Borrow                       | 41        | 20.5       |            |
| Gift                         | 30        | 15         |            |
| Purchased                    | 22        | 11         |            |
| Total                        | 200       | 100        |            |

Source: Field Source (2021).
of education of a farmer can lead to increase in his farm efficiency and increase in output likewise improves his ability to discern and distinguish between old and new production technologies. This agrees with [26] who postulates high level of education may lead to positive improvement about the farm operation as a result of having the ability to interpret research and extension advices and considered as a clue of having better managerial skills access and understanding of information handling. About 13.5% were between the age ranges of 21–30 years of age while 35.5% were within the age range of 31–40 with an average age of 45 years. This result revealed that most of the sampled respondents were still strong and energetic, this will make them allocate more time to farm activities. This result is also consistent with [27] who observed that the youths within the age level has the ability of increasing productivity and also the tendency of reducing poverty level. The results further revealed that 45% had 1–5 years farming experience while and also 45% had 6–10 years farming experience. This result is in agreement with the findings of [26] who opined that farmers have more consideration for their experience than formal educational qualifications in areas of productivity. However, the more educated an individual is, the less likely would he be available for agricultural labour. More so 18% of the farmers had non-farm income of ₦101–150000 with an average non-farm income of about ₦57,390. About 85% of the sampled cowpea farmers were not members of cooperative association. Majority (72.5%) sampled cowpea farmers acquire their capital through personal savings. Table I also depict that about 75% of the sampled respondents had farm size ranging between 1–2 ha with a mean farm size of 2.14 ha, this indicated that the cowpea producers were majorly smallholder farmers.

B. Costs and Returns Analysis of Cowpea Production in the Study Area

Table II presents the results of the estimated cost and returns involved in the cowpea production in the study area, the analysis show that the cost of labour on average has an estimated value of ₦35,818.75 which represent 57.22% of the total variables cost incur in the cowpea production in the study area followed by cost of chemical with an estimated average value of ₦14,605.00. The total variable cost on average was ₦62,597.88 with an estimated total revenue of ₦240,250.00 on average basis, the gross margin obtained was ₦177,652.12 with a rate of return on investment of 2.84 respectively this result implies that cowpea production is profitable in the study area. The rate of return of 2.84 indicates that every 1 naira invested in soybeans production will yield ₦2.84 returns on investment which covers profit, taxes, commissions, and other expenses incurred in the process of cowpea production in the study area. This is in line with [28] and [29] who reported in their research that those positive values of gross margin and farm income indicate that the enterprise is profitable, this result is also consistent with findings of [30] who asserted that farm business production was profitable based on the fact that an average farmer in the area investigated recorded over 100 percent returns on investment.

C. Factors Influencing Technical Efficiency of Cowpea Production in the Study Area

Table III presents the outcome of the analysis of maximum Likelihood (MLE) for an estimated parameters included in the Stochastic frontier model that also comprises of the inefficiency model which was estimated using econometric and statistical software called STATA version 14. The MLEs model were estimated with half-normal assumptions about the error term of the efficiency estimated. The estimated value of the gamma accounts for the measure of the level of the existing inefficiency that were present in various parameters included in the model and the value is between 0 and 1. Gamma value was 0.083. This signifies the level of technical inefficiency for individual farmers. This finding implies that about 8% of the random variation in the total output of cowpea produced by farmers was because of the differences in technical efficiency. The value of the sigma square was estimated at 0.092. The average value of technical efficiencies obtained by individual cowpea farmers was 0.78 this indicates that, on average basis an individual cowpea farmer was able to reach 78% level of the potential total output of cowpea using the available mixture of the inputs applied in the production process, this implies that in a short run, there exist a gap of (22%) in technical efficiency that needs to filled by increasing the efficiency of cowpea production among farmers, by adopting the technology and techniques used by cowpea farmers. This result shows that farmers are efficient but not at optimum level in the cowpea production in the study area. The estimated coefficient of seed was 0.282 and was statistically significant at (P<0.01). The coefficient of seed 0.282 implies that a unit increase in the quantity of seed results in 28.2% increase in the total output of cowpea in the study area. The estimated coefficients for organic fertilizer was 0.19 and it was statistically significant at (P<0.05). The positive signs of the coefficients of organic fertilizer indicates that a unit increase in the quantity of organic fertilizer as a result of more usage by farmers will result in increase in output of cowpea by 19.3%. While the coefficient of the chemical fertilizer was negative and statistically significant which implies that a unit increase in the use of chemical fertilizer will lead to decrease in the output of cowpea. This result is in line with the report of Sani [31]. The estimated coefficient of labour was 0.126 and it was not significant. This agreed with the findings of Sani [31]; [32] who observed that the magnitude of the coefficient of labour would induce an increase in the output of crop, and vice versa. The estimated coefficient of chemical was (0.487). The magnitude of the coefficient of chemical 0.487 was

| TABLE II: AVERAGE COST AND RETURNS ANALYSIS OF COWPEA PRODUCTION IN THE STUDY AREA |
|-----------------------------------------------|
| Items                           | Average (₦) | Percentage (%) |
|-----------------------------------------------|
| A. Variable Cost                  |             |                |
| Seed Input                        | 2,074.13    | 3.31           |
| Fertilizer Input                  | 10,100.00   | 16.13          |
| Chemical Input                    | 14,605.00   | 23.33          |
| Labour Input                      | 35,818.75   | 57.22          |
| Transportation                    | 1,830.63    | 2.9            |
| B. Total Variable Cost            | 62,597.88   |                |
| C. Total Revenue                  | 240,250.00  |                |
| D. Gross Margin                   | 177,652.12  |                |
| Net Farm Income                   | 177,652.12  |                |
| Rate of Return on Investment      | 2.84        |                |

Source: Field Survey (2021).
D. Distributions of Technical Efficiency Score Among Cowpea Farmers in the Study Area

The estimates of the technical efficiency score distribution revealed that 7% of the sampled respondents fall within the range of 0–0.2 and 19.5% were within the ranges of 0.21–0.4 level of technical efficiency respectively while 28% of the late cowpea farmers attained 0.41–0.6 level of technical efficiency, 36.5% and 9% attained 0.61–0.8 and 0.81–1.0 level of technical efficiency respectively. The minimum technical efficiency value attained by individual cowpea farmers was 0.01 which represent the worst technically efficient cowpea farmer while the maximum technical efficiency attained was 0.923 representing the highest technically efficient individual farmer with mean technical efficiency of 78%. This result revealed that, the cowpea farmers were highly technically efficient in cowpea production to some extent but had a shortfall of 22% below perfection technically. This result is consistent with [4] who reported 79% level of technical efficiency among cowpea farmers in Nigeria.

Table III: Maximum Likelihood Estimates of the Stochastic Frontier Production Function for Cowpea Farmers in the Study Area

| Variables          | Parameter | Coefficient | Standard Error | Z-value |
|--------------------|-----------|-------------|----------------|---------|
| Constant           | $\beta_0$ | 2.1322512   | 1.086764       | 1.96    |
| Fertilizer         | $\beta_1$ | 0.2821517   | 0.1338265      | 2.11    |
| Organic            | $\beta_2$ | 0.1930479   | 0.1150942      | 1.72    |
| Chemical           | $\beta_3$ | -0.7258278  | 0.4050025      | -1.79   |
| Labour Input       | $\beta_4$ | 0.1262792   | 0.2300131      | 0.5     |
| Chemical Input     | $\beta_5$ | 0.4871905   | 0.1947846      | 2.50    |
| Farm Size          | $\beta_6$ | -0.1545417  | 0.2705031      | -0.57   |

Source: Field Survey Data, (2021).

E. Constraints Faced by Cowpea Farmers in the Study Area

Table V shows the results of the Principal component analysis to identify the constraints faced by cowpea farmers in the study area, Principal component analysis (PCA) is one of the statistical technique which is almost the same with factor analysis which transform the interrelated survey data with many variables into nearest minimum or few number of variables that are uncorrelated. The output result of the number of principal components retained using the Kaiser Meyer criterion were five (5) based on the Eigen values that are greater than 1. The components that were retained explained about (0.7008) 70% of the variation in the component included in the model. The Kaiser-Meyer-Olkin measures of sampling adequacy (KMO) for cowpea farmers were 0.5265 and the Bartlett test of Sphericity of 214.719 and was statistically significant at 1% probability level this justified the subjection of the data set for principal component analysis. Insects had an Eigen-value of 2.07691 and it was ranked 1st in the order of importance based on perception of the cowpea farmers while, Poor Storage, Poor Marketing had an Eigen values of 1.29969 and 1.17791 respectively was ranked 2nd, 3rd respectively while Access to credit and Poor Infrastructure with Eigen values of 1.15259 and 1.05198 respectively were also in the order of its occurrence measured based on the understanding of the cowpea farmers and classified it as the problem truncating cowpea production in the study area, which were chosen in order of their
appearance on the list from the component analysis and its severity according to the cowpea farmers and was tagged as a challenge faced in the cowpea production by the sampled farmers. This result is in conformity with the following authors [33]; [4] and [5] who use similar approach to identify the constraints encountered by farmers in crop production.

| TABLE V: RESULTS OF THE PRINCIPAL COMPONENT ANALYSIS OF CONSTRAINTS FACED BY COWPEA FARMS IN THE STUDY AREA |
|---------------------------------------------------------------|
| Constraints                  | Eigenvalue | Difference | Proportion | Cumulative |
|---------------------------------------------------------------|
| Insects                     | 2.07691    | 0.77721    | 0.2596     | 0.2596     |
| Poor Storage                | 1.29969    | 0.121778   | 0.1625     | 0.4221     |
| Poor Marketing              | 1.17791    | 0.12593    | 0.1472     | 0.5693     |
| Access to credit            | 1.15259    | 0.310406   | 0.310406   | 0.7167     |
| Poor Infrastructure         | 1.05198    | 0.122952   | 0.1315     | 0.7008     |
| Bartlett Test of Sphericity | 214.719    |             |            |            |
| Kaiser-Meyer-Olkin (KMO)    | 0.5265     |             |            |            |
| Chi-Square Value             | 344.56     |             |            |            |
| Rho                          | 1.0000     |             |            |            |

Source: Field Survey Data (2021).

IV. CONCLUSION AND RECOMMENDATIONS

The outcome emanating from the findings of this study indicates that majority of the sampled farmers were male which shows that cowpea production was dominated by male farmers and were operating on a small scale basis in the study area, the study further revealed that cowpea production was profitable with the rate of return on investment of 2.8 implying that everyone naira invested about 2.8 naira was obtained as a return on investment which covers cost of production, interest charges, fees, commission and profit, the factors influencing cowpea production were seed, organic manure, chemical fertilizer and agrochemical while the factors influencing inefficiency of cowpea production were sex marital status, education level of farmers, occupation and household size. The farmers were able to attain 78% level of technical efficiency with gap of 22% of inefficiency that needs to be filled through the use of available resources and the existing technology, the cowpea farmers were faced with following constraints pest and insect problem, poor storage facilities, poor marketing, access to credit facilities and poor infrastructure. Therefore, the study concludes that Farmers should be encouraged to participate more in cowpea production since its production is profitable in the study area farmers should be provided with subsidize production inputs like insecticides, herbicides, and credit facilities in order to improve the production capacity of the cowpea farmers that will lead to increase in total output and their income as well as improved welfare that will liberate them from poverty and make them food secured.

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CONFLICT OF INTEREST

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

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