

**PROFITABILITY AND EFFICIENCY OF COWPEA PRODUCTION IN GIWA
AND SOBA LOCAL GOVERNMENT AREAS OF
KADUNA STATE, NIGERIA**

BY

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DECLARATION

I hereby declare that this dissertation titled “**Profitability and Efficiency of Cowpea Production in Giwa and Soba Local Government Areas of Kaduna State, Nigeria**”, has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another degree or diploma in this or any other institution. All borrowed information has been duly acknowledged in the text and list of reference provided.

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CERTIFICATION

This dissertation titled “**Profitability and Efficiency of Cowpea Production in Giwa and Soba Local Government Areas of Kaduna State, Nigeria**” by Winnifred Godiya AFUWAI meets the regulations governing the award of the Degree of Master of Science in Agricultural Economics of the Ahmadu Bello University, Zaria and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This dissertation is dedicated to God Almighty who made this work possible.

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Abstract

The study examined the profitability and efficiency of cowpea production in Giwa and Soba Local Government Areas of Kaduna state, Nigeria. A multi-stage sampling technique was adopted in selecting two Local Governments, and two districts from each Local Government. Primary data were collected from the total of 158 respondents through the use of a structured questionnaire. Descriptive statistics, Stochastic Frontier production function and Net farm Income was used. The study showed the mean age of the respondents to be 43years, the majority of the farmers (85%) had some form of education. The average household size was 11 persons while majority of the farmers were members of a cooperative society. The parameters of the stochastic frontier production function were estimated simultaneously with those of the model of inefficiency effects. Results indicated that all the variables (seed, fertilizer, agrochemical, labour, capital and cooperative association) were significant ($P < 0.01$). The mean technical efficiency is 73%. Findings further revealed that none of the sampled cowpea farmers reached the frontier threshold. However, the average economic efficiency of the cowpea farmers was 48%. This indicates that cowpea farms were economically inefficient. Also, age, household size, farming experience, cooperative association, extension contact, and amount of credit received were the socio-economic variables responsible for the variation in economic efficiency of the cowpea producers indicated that the total revenue was ₦82352.91 while the total cost is ₦65852.55. The net farm income is therefore ₦16500.36. The average rate of returns on investment was 1.25, indicating that for every ₦1 invested in cowpea production in the study area; a profit of 25 kobo was made. It was therefore recommended that timely and adequate supply of fertilizer, agrochemical and seed should be made available to farmers at affordable price in order to enhance the production of cowpea by the cooperative society and government.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Cowpea is the most important pulse crop in the savannah regions of West and Central Africa, where it is also an important vegetable and a valuable source of fodder (Brink and Belay, 2006). It is the predominant food grain in African regions of moderate to abundant rainfall and is most important in the semi-arid tropics where they are grown mainly for their mature seed (Onwueme and Sinha, 1991). Nigeria, Niger, Cameroon, Burkina Faso, Mali and Senegal are considered to be the major cowpea-producing countries (Onwueme and Sinha, 1991).

Cowpea, *Vigna unguiculata*, is one of the most important grain legume consumed in most parts of Nigeria. It contributes about 57% of the total proteins from legumes but only about 3% of the total intake (Anon, 1987). The dry grains are for direct human consumption while the stems, leaves and the empty dry pods after shelling are very nutritive and additional sources of animal feed. Cowpea is an extreme valuable crop both as a source of revenue and as an important item in the diet of Nigerians. Its production in Nigeria is estimated at 800,000 tons annually with over 80% of this grown in the savanna zones of northern Nigeria. Here the crop is grown as a component of mixed cropping system with very little grown as a sole crop because of production problems, the most important of which are insect pests (Ohiagu, 1986)

Pulses, in general are the second most important type of food after cereals in many parts of the world, especially Southeast Asia. Where animal protein is scarce they provide a large proportion of the protein requirement. Although, they are deficient in some essential proteins (cystine, methionine, tryptophan and cysteine), these are all found in cereals and the two foods are usually eaten together (Onwueme and Sinha, 1991).

Apart from their nutritious seeds, legumes are able to survive on poor soils and because of their ability to fix atmospheric nitrogen, are useful in crop rotations or mixed cropping systems and for improving poor soils (Onwueme and Sinha, 1991). When intercropped with cereals, it compensates for the loss of nitrogen removed by cereal (Onwueme and Sinha, 1991).

A very high percentage of the crop is intercropped with millet, sorghum and more recently with maize by small-scale farmers. Another recent development is the cultivation of sole cowpea in large hectareage following the demonstration that chemical insect control in sole cropped cowpea effective and profitable. Since most of the production is still in the hands of small-scale farmers, reliable production statistics are to obtain. It is however estimated that more than 1.5 million hectares of land are under cowpea production yielding about 900,000 tonnes of grains (Anon, 1987). Recently, researchers have realized that to improve the overall productivity level, a closer study of indigenous cropping systems is essential.

1.2 Problem Statement

A large proportion of the 1700 million tonnes of cereals (wheat, maize, rice, sorghum, millet) and the 600 million tonnes of tubers (potato, cassava, yam, etcetera) produced in the

world constitute a very significant part, particularly in the developing countries, of the essentials of human food. But the legumes, of which the world production is hard to evaluate, are used as food crops to a much smaller and very variable extent, in spite of the fact that the relative composition of carbohydrates and lipids in legumes and their richness in protein make them important components of the food ration, particularly when there is an insufficiency of proteins of animal origin, a typical situation in many tropical developing countries (Onwueme and Sinha, 1991).

It is a disquieting fact that, where malnutrition is prevalent, the levels of protein production and consumption are hardly improving. For example the production of cowpea declined from 147,600 tonnes in 2000 to 103,212 tonnes in 2004 in Nigeria (Ojanuga, 2006). Precise investigations have also given a lower protein consumption figure of less than 20g/day/head as against a recommended figure of 40 grammes/day/head in Africa (Ojanuga, 2006)

The progress in production of the crop is still very inadequate and the areas cultivated are falling by approximately 7 percent per year. For example, the average yield of dry cowpea seeds under subsistence agriculture in tropical Africa is 100-500 kg/ha. In Nigeria, the average seed yield is 600 kilogramme/hectare as against a potential yield of 3- 4 tonnes per hectare, indicating a yield gap of between 400-567% (Brink and Belay, 2006, Manyong *et al.*, 2005). Apart from the effects of diseases and pests, the low yields are partly explained by the fact that: (i) The crop is mostly grown at low densities in intercropping systems, shaded by taller cereals, (ii) cowpea is often sown later in the rainy season, which results in a shorter crop duration due to photoperiod-sensitivity and (iii) Inefficiency in the

use of resources in the production of both food and cash crops in the country. (Brink and Belay, 2006).

Based on these, this research provided answers to the following questions;

- (i) What are the socio-economic characteristics of the cowpea farmers in the study area?
- (ii) What is the technical, allocative and economic efficiencies of cowpea production?
- (iii) What are the socio-economic factors influencing the economic efficiency in cowpea production?
- (iv) Is cowpea production profitable? and
- (v) What are the constraints faced by cowpea farmers?

1.3 Objectives of the study.

The broad objective of the study was to evaluate the profitability and efficiency of cowpea production in Giwa and Soba LGAs of Kaduna State of Nigeria. The specific objectives were to:

- (i) describe the socio-economic characteristics of farmers in the study area,
- (ii) estimate the technical, allocative and economic efficiencies of cowpea production,
- (iii) determine the socio-economic factors influencing the economic efficiency of cowpea production,
- (iv) estimate the costs and returns in cowpea production in the study area,
- (v) describe the constraints faced by cowpea farmers in the study area.

1.4 Justification of the study.

The provision of an adequate protein supply in human nutrition in quantity as well as in quality is one of the major aspects of the fight against hunger. In regions where animal

protein is scarce due to the absence of livestock rearing capabilities due to drought or the incidence of trypanosomiasis in the forest zones or other reasons, the grain legumes are an alternative source of vegetable protein which is capable of at least partially compensating for the deficiency in animal protein supply (Ojanuga, 2006). The seeds of most legume species have average protein contents of 20 to 35 percent (i.e. percent of dry matter), whereas in the most frequently cultivated tropical cereals such as maize, sorghum, millet and rice, these contents vary between 7 and 12 percent. The essential amino-acid contents of these legumes are also all higher than they are in these cereals (Ojanuga, 2006)

The importance of the study is basically to contribute to the existing knowledge on the efficiency and profitability of cowpea production in Kaduna State in particular and Nigeria in general. Profit maximization is one of the major objectives of business enterprises and is dependent on how production resources are harnessed (Afolabi *et al.*, 2013).

Information provided on the efficiency of resource use in cowpea production in the study area will guide the adjustment of resources, provide a framework for evaluating policy and show how maximum possible output can be attained from the minimum possible set of inputs. This will help producers in making decisions with regards to the optimal use of scarce resources in improving cowpea production to meet domestic and foreign demand. This study will also provide information on those factors that influence production efficiency in cowpea production in the study area.

Similarly, the study will provide basis for rational policy formulation for the improvement farmers' performance in cowpea production in the state, based on the measurement and identification of the sources of inefficiency in cowpea production.

1.5 Hypotheses of the Study

The following hypotheses were tested in the study:

- i. There is no significant relationship between inputs and output in cowpea production.
- ii. There is no significant relationship between the socio-economic characteristics of cowpea producers and their economic efficiency.
- iii. There is no significant difference between costs and returns in cowpea production.

CHAPTER TWO

LITERATURE REVIEW

2.1 World Production and International Trade in Cowpea.

According to FAO statistics the total annual world production of dry cowpea seeds in 1999-2003 was about 3.6 million tonnes from 9.5 million hectares. Other estimates indicate a higher production: over 4.5 million tonnes from 14 million hectares (Brink and Belay, 2006). According to FAO, 3.3 million tonnes was produced annually in sub-Saharan Africa, from 9.3 million hectares, mainly from West Africa which accounts for the bulk of the output (3 million tonnes/year from 8.8 million hectares). The main producers are Nigeria (2.2 million tonnes/year from 5.1 million hectares) and Niger (400,000 tonnes/year from 3.3 million hectares).

Cowpea seeds are produced for local consumption and surpluses are sold in local markets. International trade is mainly within West Africa, with the exporting countries in the drier Sahelian zone, and the importing countries in the more densely populated humid region along the coast. It has been estimated that at least 285,000 tonnes was traded between West African countries in 1998, mainly from Niger to Nigeria, but the total trade is probably larger (Brink and Belay, 2006).

There are no statistical data on the quantity of leaves and pods harvested, but it is likely to be considerable. Fresh and dried leaves are much sold in urban markets and some are traded to neighbouring countries. Dried leaves in the form of black balls are exported from Zimbabwe to Botswana and South Africa (Brink and Belay, 2006).

2.2 Cropping Systems for Cowpea in Nigeria

The term *cropping system* refers to the crops and crop sequences and the management techniques used on a particular field over a period of years. It is the sequence of crops in one field, and the ways in which they are managed (Davies and Woolley, 1993). It is also the cropping patterns used on a farm and their interactions with farm resources, other farm enterprises, and available technology that determine their makeup (Davies and Woolley, 1993).

In West Africa, cowpea is grown mostly in subsistence farming systems and on a small scale in the lowland dry savanna and Sahelian regions. Traditionally, cowpea is grown in association or in relay cropping with cereals such as sorghum, millet, and maize mainly in the Sahelian regions (Davies and Woolley, 1993). However, cowpea cropping systems are moving towards mono cropping as the crop's economic importance increases. For example, cowpea mono-crop has taken off in central Mali, as a result of an integrated rural development project which supplied improved seed, fertilizer, and pesticides on credit (Davies and Woolley, 1993).

Cowpea mono-crop is frequent in cotton-producing zones and in inland valleys and the Lake Chad basin in Cameroon (Davies and Woolley, 1993). The increase in cowpea production is linked to the use of improved technologies including high-yielding varieties and improved crop protection and production practices. A key issue behind the wide use of the improved cowpea technologies is their profitability (Davies and Woolley, 1993)

A very high percentage of the crop is intercropped with millet, sorghum and more recently with maize by small-scale farmers. In the traditional cereal farming system in West Africa, cowpeas are interplanted with sorghum or millet about 6 weeks after the cereals are sown, and after they have been weeded and earthed up. The spreading growth of the cowpeas soon smothers weeds, protecting the soil from the impact of heavy rainfall, and it is likely that the cereals derive some nitrogen from the roots nodules of the cowpeas, especially towards the end of the growing season. Their roots also excrete a substance that provokes the germination of the parasitic witchweed (*striga lutea*). Cowpeas are therefore useful as a trap crop for this root parasite. They are a good preceding crop for cotton and cereals. Another recent development is the cultivation of sole cowpea in large hectareage following the demonstration that chemical insect control in sole cropped cowpea is effective and profitable (Davies,1993).

2.3 Uses of Cowpea

Cowpea is the preferred food legume in large parts of Africa. The seeds are cooked together with vegetables, spices and often palm oil, to produce a thick bean soup, which accompanies the staple food (cassava, yam, plantain). In West Africa the seed is decorticated and ground into flour and mixed with chopped onions and spices and made into cakes which are either deep fried ('akara balls'), or steamed ('moin moin). The flour can also be used as a basic ingredient in the preparation of many foods including baby foods. The dry seed has been used as coffee substitute. In the United States considerable amounts of immature cowpea seeds are eaten fresh.

Cowpea leaves are served boiled or fried and are usually eaten with a porridge. The leaf may be preserved by sun-drying or boiling and then sun-drying to be used during the dry season. In Botswana and Zimbabwe boiled cowpea leaves are kneaded to a pulp and squeezed into small balls, which are dried and stored. Immature green and still soft seed is cooked to a thick soup and used as relish. The tender seedless cowpea pod is sometimes used as a cooked vegetable, as are young pods of yard-long bean. In Asia this is the most important use of cowpea, in Africa it is uncommon. In Benue State, Nigeria, the stringless coiled pods with little parchment of a landrace called 'Eje-O'Ha' are parboiled for few minutes, opened and split in half. The seeds are eaten directly while the pod walls are dried and preserved for later use. Pods are also eaten locally in Benin.

Cowpea is used as fodder in West Africa, Asia (especially India) and Australia; it is used for grazing or cut and mixed with dry cereals for animal feed. In the United States and elsewhere cowpea is grown as a green manure crop. In Nigeria special cultivars are grown for the fibre extracted from the peduncle; the fibre is especially suited for fishing gear, and produces a good-quality paper.

A few medicinal uses of cowpea have been reported: leaves and seeds are applied as a poultice to treat swellings and skin infections, the root is used as an antidote for snakebites and dysmenorrhea, and unspecified plant parts are used as a sedative in tachycardia and against various pains (Brinks and Belay, 2006).

Cowpea also has industrial uses; which include cowpea been served as meal in restaurants, serve as fast food (moi-moi) , processed as canned beans and sold in stores for consumption, it can also be processed into flour, packaged and sold in stores, etc.

2.4 Profitability of Cowpea Production

Farm profit analysis

2.4.1 Budgeting techniques

Budgeting techniques can be used to select the most profitable plan from among a number of alternatives and to test the profitability of any proposed change in plan. It involves testing a new plan before implementing it, to be sure that it will improve profit. Farm budgeting is a method of estimating expected income, expenses and profit for a farm business. Olukosi and Erhabor (2008) described a farm budget as the detailed physical and financial plan for the operation of a farm for a certain period.

An enterprise budget should contain several components. A detailed description should include a production goal, the production techniques to be employed, the land resource required, and even something about the capital and labour requirements. An enterprise budget should include all costs and all returns associated with the defined enterprise. All variable and fixed costs, both cash and non-cash item should be included. The returns from products produced for sale plus those that are produced for use in another enterprise should be included in an enterprise budget.

Variable costs are the costs of such input items as seed, feed, fertilizer, normal repairs, custom operations, and machinery and equipment operating expenses. These costs also

include labour whether associated with machinery or equipment or as hand labour operations. They are items that will be used during one year's operation or during one production period and would not be purchased if the enterprise was not produced. Variable costs are always included in an enterprise budget. Fixed costs are the costs associated with buildings, machinery, and equipment which are prorated over a period of years. Included in this category are depreciation, interest, insurance, and taxes on individual buildings and pieces of machinery and equipment that can be allocated to an individual enterprise. Fixed costs are always included in an enterprise budget.

Budgeting techniques in conjunction with profit efficiency could be used in the determination of the viability of farm enterprise. Profit efficiency is defined as the ability of the farm to achieve the highest profit, given the farm's prices and the levels of fixed factors (Ali and Flinn, 2000). Farm specific profit frontier is obtained with interaction between farm specific prices levels of fixed factors. Profit inefficiency is defined by the proportion by which farms' operation deviate from the profit frontier given the farms' prices and resource endowments.

Profit efficiency is a broader concept than cost efficiency since it takes into account the effects of the choice of a certain vector of production both on costs and on revenues. Two profit functions can be distinguished, depending on whether or not there is market power: the standard profit function and the alternative profit function. The standard profit function assumes that markets for outputs and inputs are perfectly competitive.

Method of estimating expected income, expenses and profit for the farm business include the following:

(i) Gross margin analysis

Gross margin is a very useful planning tool in a situation where fixed cost is negligible portion of farming enterprise as in the case of subsistence agriculture. It is easily computed and represents the most relevant economic tool to draw the attention of the farmer to the problem of his farm. Gross margin analysis, according to Olukosi and Erhabor (2008), involves evaluating the profitability and efficiency of an agricultural enterprise or farm. It is usually expressed as Gross income minus Total variable cost.

$$GM = GI - TVC \text{-----}(7)$$

Where:

GM = Gross Margin

GI = Gross Income

TVC = Total Variable Cost

Gross margin is a basis for profitability analysis and form the basis of the whole decision making process under resource constraints, which are put into alternative uses. The viability and position of farm business could be determined by estimating the gross margin. It implies the extent to which returns is more than the cost component. Invariably, a positive gross margin can be translated to mean efficiency in the ordinary context.

(ii) Net farm income

This is one of the simplest and oldest tools of analysis in farm management and production economics studies. It involves the determination of gross or total revenue and gross or total costs. The difference between the two constitutes the net farm income. The total revenue is derived from unit price of output multiplied by the quantity of output. While the total costs

is made up of total variable cost and total fixed cost. The total variable costs are those costs that varied with level of production such as cost of labour, pesticides, fertilizers and seeds. While fixed costs are those costs that do not vary with the level of output such as irrigation machines, bicycle and farm implements.

$$\text{NFI} = \text{GM} - \text{TFC} \text{-----}(8)$$

Where;

NFI = Net Farm Income

GM= Gross Margin

TFC = Total Fixed Cost

This tool would assist in determining the profitability of the two onion production systems (irrigation and Rain-fed). It will tell us the profitability level in each of the system and assist in the choice or selection of the most profitable enterprise. In order word, it helps in decision making process as well as planning tool.

(iii) Profitability index (PI)

This is the Net Farm Income (NFI) per unit of Gross Revenue (GR) i.e

$$\text{PI} = \frac{\text{NFI}}{\text{GR}}$$

The following profitability measures were calculated:

i. Rate of Returns on Investment (%)

$$\text{RRI} = \frac{\text{NFI}}{\text{TC}} \times 100\%$$

Where,

TC = total cost, hence (TVC + TFC)

ii Capital Turnover (CTO): = TR/TC

An estimate of the profitability of every farm enterprise is always based on critical cost-return analysis. This involves itemising the costs and returns of production variables and using them to arrive at estimates such as:

- (i) The net return to one unit of resources used.
- (ii) The gross margin and (iii) Gross and net returns(Iheanacho, 2000)

In some instances these values are subjected to test of statistical significance in order to verify differences between them. According to Olayide and Heady (1982), monetary units should be used as basis for measuring all inputs and outputs in costs and returns for millet based cropping system. These include (i) budgetary analysis which indicates the average cost of production for the crop (ii) gross margin based on total output revenues of different crop mixtures and the associated total variable costs. The gross margin per man-day could be used as a measure of return to labour especially in peasant agriculture where fixed costs are negligible.

In a similar study using cost-return analysis on onion production, Hameed (2007) observed that the cost of land preparation, fertilizer, labour and irrigation were the most important cost items. He further stressed that the breakeven point, pointed out that onion production was profitable as reflected by the considerable difference between average yield per hectare and the break-even point.

Bolatova and Jemmett (2009) concluded that, operating costs represents 70-75% of the total onion production while ownership costs represent 25-30%. The major operating costs are

associated with seeds, fertilizer, pesticides, irrigation, fuel, labour and storage ownership costs include depreciation, insurance, land, overhead and management fees. Tanko (2010) posited that profits are higher in irrigated onion production than in rain-fed production. This was based on the premise that, yields are higher under irrigation than in rain-fed.

Olukosi and Erhabor (2008) stated that, major problems associated with cost-return analysis as basis for profitability assessment are: (i) it does not indicate the relative importance of each of the resources in production and (ii) it is location bound and specific in applicability due to use of money as the common unit of measurement and the prevailing price of the estimates. In spite of the limitations, cost-return analysis is a useful tool in enterprise comparison and in indicating profitability pattern of aggregate input used (Olukosi and Erhabor, 2008).

2.5 Resource Productivity in Agriculture

Olayide and Heady (1982) defines agricultural productivity as the index of the ratio of the value of total farm output to the value of the total inputs used in farm production. Since one of the chief objectives of any society is the attainment of an optimally high level of living with a given amount of effort, any increase in the productivity of resources employed in farm production amounts to progress. Increases in agricultural productivity will contribute to the well-being of the economy as a whole. Aggregate measures of productivity in production economics analysis will add to the sum of our knowledge by (i) serving as barometer of economic progress, (ii) serving as guides to adjustment of resources, (iii) providing a framework for formulating and evaluating policy and (iv) indicating problem areas that need further research (Olayide and Heady, 1982).

The final objective in productivity should be to find ways of increasing output per unit of input, and of attaining desirable inter-firm, intra-firm and inter-sector transfer of production resources, thereby providing the means for raising economic level of living.

The input-output process of farm production is important in at least four major problem areas. These are the distribution of income, the allocation of resources, the relation between stocks and flows and the measurement of efficiency or productivity. In the productivity concept, a meaningful assessment will depend upon a clear and precise definition of input and output in such a way that their movements over time are not equal. We should also seek to determine which inputs and outputs are consistent with the particular productivity concept in question. In other words, resource productivity is definable in terms of individual resource inputs or in terms of a combination of them. Thus labour productivity can be defined as the ratio of total labour inputs relative to output realized in production.. Similarly, “land”, “capital” productivities can each be defined as the ratio of the total output to inputs of land and capital, respectively (Olayide and Heady, 1982).

Thus, both single-factor and multifactor indexes are used to measure productivity. Single-factor productivity indexes measure the output per unit of one input at the same time other inputs may be changing. Multifactor productivity indexes consider all productive resources as a whole, netting out the effects of substitution among inputs. Crop yield per acre, output per workhour, and livestock production per breeding animal are all single-factor productivity indicators. The Total Farm Output per Unit of Input Index is a multifactor measure (Olayide and Heady, 1982)

Using this definition as a bench-mark, change in productivity over time will depend upon changes in both the “included” and “excluded” components and maximum resource productivity will imply obtaining the maximum possible output from the minimum possible set of inputs. Thus, optimal productivity of resources implies an efficient utilization of resources in the production process.

An increase in farm output will result from one of the three forces (i) first, it will result from an increased quantity of inputs, with no change in output per unit of input, (ii) second, it will result from increased productivity of inputs with no change or a decrease in quantity of inputs and (iii) thirdly, it will result from combination of changes in inputs and productivity.

2.6 Production Efficiency in Agriculture

Efficiency relates to the use of all inputs in producing any given output, including personal time and energy (www.investopedia.com, 2015). Several attempts have been made to define economic efficiency and to measure it in an empirical sense. Farrell (1957) defined economic efficiency in three related terms. First, he defined “technical’ efficiency as the measure of a firm’s success in producing maximum output from a given set of inputs. Second, he defines “price” (allocative) efficiency as the measure of a firm’s success in choosing an optimal set of inputs. This is an indication of the gains that can be obtained by varying the input ratio on certain assumptions about the future price structure. Third, he defines “overall” (economic) efficiency as the simple product of the technical and price efficiencies.

Heady (1952) specified eight technical conditions for the attainment of economic efficiency. These are:

- i. The marginal rate at which factor is transformed into product must be the same for any pair of farms using the same factors and producing the same product.
- ii. The marginal rate of substitution between any pair of factors must be the same for any two farms using both factors to produce the same product.
- iii. The marginal rate of substitution between two factors must be the same for every product in which they are used.
- iv. The marginal rate of substitution between two products must be the same for any two farms producing both products.
- v. The marginal rate at which two crops substitute as products on one farm must be equal to the marginal rate of substitution as factors on another or the same farm.
- vi. Marginal rate of substitution must be equal between (a) the income and direct utility (leisure) of a resource, in production, and (b) the income and direct utility of a resource in consumption for any single resource owner and between resource owners.
- vii. Marginal rate of substitution of products in time or resource in time must be equal for all farms which produce or use both.
- viii. Price ratios must equal substitution and transformation rates in all cases such that
 - a) The factor-product prices ratios equal the marginal rate at which factor is transformed into product.
 - b) The product-product price ratio is equal to the marginal rate of substitution of any two commodities.
 - c) The factor-factor price ratio is equal to the marginal rate of substitution between any pair of factors.
 - d) The discounted price ratio is equal to the substitution ratio for one product produced at two points in time.

- e) The compounded price ratio is equal to the substitution ratio for two resources extending into time.

These conditions are necessary but not sufficient conditions for efficiency in resource use to be attained. This is due to the fact that these conditions do not guarantee that a maximum product is forthcoming from a given stock of resources or, otherwise, that a given output is being produced with the minimum of factor services. Maximum efficiency will be guaranteed if single products are produced under conditions of decreasing returns (or increasing costs) and if commodities produced in combination are never produced within ranges of complementary and supplementary relationships. Unless these eight necessary conditions and sufficient conditions are all attained simultaneously, resources are not efficiently used, and this implies they can always be arranged to allow (with given and limited resources) a greater total output of the product desired by the consuming society.

If the goals of efficiency are specifically the re-organization of resources and the maximization of farm income, then it is necessary to isolate the main causes of inefficiency in farm production process. Inefficiency may be due to endogenous and/or exogenous factors. These factors fall into three main categories (Olayide and Heady, 1982):

- (i) there are factors explaining why the resources of an individual farm are not organized to maximize the value of the product,
- (ii) there are those which explain why the return on resource differs between agricultural areas, and
- (iii) there are those which seek to explain why the value of the product of agricultural resources is low relative to that of certain other occupations, and/or less than the maximum for the resources employed in the industry.

The specific causes of inefficiencies in production are as follows: (Olayide and Heady, 1982):

- (i) Lack of knowledge of alternative techniques and resource organization.
- (ii) Uncertainty and capital limitations coupled with net product of labour in relation to capital.
- (iii) The hypothesis that resource returns in primary or extractive industries such as agriculture are continually pressing below those of secondary industries, such as manufacturing.
- (iv) Institutions serving as adjustment base may precipitate inefficiency, for example, creation of homesteads and pre-emption units in southern Nigeria and the feudal structure of northern Nigeria.
- (v) The low income structure of family farms and the complexities of rural life and farm-household complex.
- (vi) The labour supply function in agriculture in relation to non-agriculture and the level of investment in the human agent, coupled with restraints as well as problems of migration.
- (vii) The degree of competitiveness or otherwise of markets for goods, services and products.
- (viii) The structure of costs and returns to society, due to regional differences in resource productivity, as well as the allusive structure of an efficient agriculture.

Each of these specific causes constitutes broad areas of research and discussion topics on modernizing peasant agriculture to enhance increased productivity. It is, however, necessary to outline some possible steps in reducing inefficiency in resource utilization in the production process. These steps will, among others, include the following (Olayide and Heady, 1982):

- (i) The minimization of risk and uncertainty in farming enterprise.
- (ii) Useful education directed at increasing productivity and adoption of new techniques on small-income farms.

- (iii) Provision of credit for acquisition of capital and expansion of farm size.
- (iv) Provision of employment outlook services, coupled with job training and transfer assistance.
- (v) Introduce steps that will try to successfully eliminate differences in costs and returns for the individual and the community.
- (vi) Integration of agriculture and industry in agribusiness framework and introduction of corporate and part-time farming.

2.7 Methods for Measurement of Production Efficiency

DEA (Data Envelop Analysis) and stochastic frontier are the two alternative methods for estimating frontier functions and thereby measuring efficiency of production. DEA involves the use of linear programming whereas stochastic involves the use of econometric methods.

Data envelop analysis (DEA) involves the use of linear programming methods to construct a non-parametric piece-wise surface (or frontier) over the data. Efficiency measures are then calculated relative to this surface. Comprehensive reviews of the methodology are presented by Seiford and Thrall (1990), Lovell (1993), Ali and Seiford (1993), Lovell (1994), Charnes *et al* (1995) and Seiford (1996).

The piece-wise-linear convex hull approach to frontier estimation, proposed by Farell (1957), was considered by only a few authors in the two decades following Farell's paper. Boles (1966) and Afriat (1972) suggested mathematical programming methods which could achieve the task, but the method did not receive wide attention until the paper by Charnes, Cooper and Rhodes (1978), in which the term data envelop analysis (DEA) was first used.

Since then there has been a large number of papers which have extended and applied the DEA methodology.

Charnes and Rhodes (1978) proposed a model which had an input orientation and assumed constant returns to scale (CRS). Subsequent papers have considered alternative sets of assumptions, such as Banker, Charnes and Cooper (1984), in which a variable return to scale (VRS) model is proposed.

Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977) independently proposed the stochastic frontier, in which an additional random error, v_i , is added to the non-negative random variable, u_i , to provide

$$\ln(y_i) = x_i\beta + v_i - u_i \quad , i = 1, 2, \dots, N \dots \dots \dots (i)$$

The random error, v_i , accounts for measurement error and other random factors, such as the effects of weather, strikes, luck, etc., on the value of the output variable, together with the combined effects of unspecified input variables in the production function. Aigner, Lovell and Schmidt (1977) assumed that the v_i , s were independent and identically distributed (i.i.d.) normal random variables which mean zero and constant variance, σ^2 , independent of the u_i s, which were assumed to be the i.i.d. exponential or half-normal random variables. The model, defined by equation above, is called the *stochastic* frontier production function because the output values are bounded above by the stochastic (random) variable, $\exp(x_i\beta + v_i)$. The random error, v_i , can be positive or negative and so the stochastic frontier outputs vary about the deterministic part of the frontier model, $\exp(x_i\beta)$.

The parameters of the stochastic frontier production, defined by the equation above, can be estimated using either the maximum-likelihood (ML) method or using a variant of the COLS (Corrected Least Squares) method, suggested by Richmond (1974). The COLS approach is not as computationally demanding as ML method, which requires numerical maximization of the likelihood function. The distinction, however, has lessened in recent years with the availability of computer software, such as the LIMDEP econometric package (Greene 1992) and the FRONTIER program (Coelli 1992, 1996), both of which automate the M\ML method for estimation of the parameters of stochastic frontier models.

The ML estimator is asymptotically more efficient than the COLS estimator, but the properties of the two estimators in finite samples cannot be analytically determined. The finite-sample properties of the half-normal frontier model were investigated in a Monte Carlo experiment in Coelli (1995), in which the ML estimator was found to be significantly better than the COLS (corrected least squares) estimators when the contribution of the technical inefficiency effects to the total variance term is large. Given this result and the availability of automated ML estimator should be used in preference to the COLS estimator whenever possible. We now discuss the basic elements of obtaining ML estimator for the parameters of the stochastic frontier model.

The Cobb-Douglas functional form has been commonly used in the empirical estimation of frontier models. Its simplicity is a very attractive feature. A logarithmic transformation provides a model which is linear in the logarithms of the inputs and, hence, the Cobb-Douglas form is easy to estimate.

A number of alternative forms have also been used in the frontier literature the two most popular alternative forms are the translog (e.g., Greene, 1980) and the Zellner-Revankar generalized production (e.g., Forsund and Hjalmarsson, 1979; and Kumbhakar, Ghosh and McGuckin, 1991). The Zellner-Revankar form removes the returns-to-scale restrictions, while the translog form imposes no restrictions upon returns to scale or substitution possibilities, but has the drawback of being susceptible to multicollinearity and degrees of freedom problems.

2.8 Review of Empirical Applications of Stochastic Frontier Production Function

The stochastic frontier production function has been applied in a considerable numbers of empirical studies in the field of Agriculture.

Yassin (2004) used the stochastic frontier production function in estimating the production function of the irrigated cotton production in Sudan's Gezira Scheme. The result from the general model showed that pest infestation and difference were significantly related at 10%, irrigation, weeding and delayed number of irrigations were significantly related at 1% and labour was significantly related at 5% with general cotton output. The tenant model result showed that irrigation and harvesting were significantly related at 10% and labour, weeding and income were significantly related at 5% with tenant cotton output. The scheme management model result showed that pest infestation and difference were significantly related at 1% and delayed number of irrigations was significantly related at 5% with scheme management output. The mean technical efficiency of the general, the tenants' and scheme management model were 0.52, 0.72 and 0.74 respectively. The significant determinants of technical inefficiency in the general model were extension contact, difference and visit were

statistically significant at 1% level of significance and negatively related with technical inefficiency. Credit and area were statistically significant at 5% levels respectively.

Rahman *et al.* (2005) used the stochastic frontier production function in estimating the technical efficiency in sorghum-based cropping systems in Soba area of Kaduna state of Nigeria. For sole sorghum production, land, fertilizer and labour were significantly related with output at 5% level of probability, with an average technical efficiency of 0.62. For sorghum-cowpea production, land and labour were reported to be statistically significant at 5% level with an average technical efficiency of 0.74. For sorghum-groundnut production, land and labour were statistically significant at 5% level with an average technical efficiency of 0.64. For sorghum-soya bean production, land and labour were statistically significant at 5% with an average technical efficiency of 0.71 (71%). For sorghum- millet production, land and labour were statistically significant at 5% level with an average technical efficiency of 0.58 (58%). The overall technical efficiencies achieved in the sorghum-based cropping system ranged between 58 to 74 percent.

Idiong *et al.* (2006) used Cobb-Douglas stochastic frontier model to estimate technical efficiency of swamp and upland production system in Cross River state, Nigeria. The estimated individual technical efficiency ranged 48% to 99% and 55% to 99% in swamp and upland rice production systems, respectively. The mean technical efficiency was 77% and 87% for swamp and upland rice respectively. The mean technical efficiency values of both swamp and upland rice production are an indication that if the efficiency of inputs used is increased by 23% and 13%, the farmers would increase output and income generation. The significant determinants of

technical efficiency for both swamp and upland rice were education, membership of cooperatives and access to credit.

Amos (2007) used the stochastic frontier production function model in his analysis of productivity and technical efficiency of small-holder cocoa farmers in Nigeria. From the result, cost of fungicide and cost of processing were significant related with cocoa output at 10% level of probability. The technical efficiencies ranged between 0.11 and 0.91 with mean technical efficiency of the cocoa farmers of 0.72. The results of the determinants of technical efficiency in cocoa production showed that age of farmer, level of education and family size were significantly related with technical efficiency at 10% level of significance. The elasticity of production showed that farmers were experiencing increasing returns to scale in cocoa production in the study area with a value of 1.26.

Udoh and Etim (2007) used the stochastic frontier production function in estimating farm level technical efficiency of fluted pumpkin production in Uyo, Nigeria. The result showed that land, labour, inorganic fertilizer and planting material were significantly related with output of fluted pumpkin at 1%, 5% and 10% levels of probability, respectively. The technical efficiencies ranged between 0.01 and 0.96 with a mean technical efficiency of 0.86. The determinants of technical inefficiency in fluted pumpkin production result showed that extension contact and farming experience were the significant determinants of technical inefficiency at 5% and 1% levels of probability respectively.

Kadurumba *et al.* (2009) used translog stochastic frontier production function to measure the level of technical efficiency and its determinants in traditional palm oil processing in Imo State

of Nigeria. From the result, oil palm fruit (kg), water used, amount of loan borrowed, petrol/diesel energy were statistically significant at 5% and 10% levels respectively and were positively related with technical efficiency. While labour, labour² and water used² were statistically significant at 1%, 5% and 10% levels respectively and negatively related with technical efficiency. Result of the determinants of technical efficiency in traditional palm oil processing showed that age, educational level and net processing income were negatively related with palm oil processing but significant at 5%, 1% and 10% level respectively. Depreciation on fixed assets, litre of petrol/diesel energy, cooperative membership, credit availability, interest on loan, mill membership and mechanization energy were statistically significant at 1%, 5% and 10% level respectively. The frequency distribution of technical efficiency indices showed the maximum technical efficiency (0.97), minimum technical efficiency (0.16) and the mean technical efficiency (0.86).

Tanko and Opara (2010) used stochastic frontier production function in the measurement of technical efficiency in maize production in Bosso Local Government Area of Niger State of Nigeria. Farm size, labour and fertilizer were found to be significantly related with maize output at 1% levels of probability. The mean technical efficiency is 0.873 which implies that on the average the respondents are able to obtain a little over 87.3% of potential output from a given mix of production inputs, suggesting a wider scope for the farmers to increase their level of technical efficiency by allocating existing resources more optimally. The summary of the results indicated that the best farm has technical efficiency of 0.983 (98.3%) while the worst farm has a technical efficiency of 0.434 (43.3%) implying that some of the farmers are operating far away from the frontier region. The results of the determinants of technical

inefficiency in maize production showed that education, farming experience, and credit were significantly related with technical efficiency at 1% levels.

Mohammad-Lawal *et al.* (2009) used Cobb-Douglas frontier production function model to estimate technical efficiency of youths participating in agricultural programs in Ondo State, South-Western Nigeria. The estimated individual technical efficiencies ranges between 32.62% and 96.25%, with a mean technical efficiency of 85.23%. The result showed that 86% of the respondents were operating at 80% level of technical efficiency. The determinants of technical efficiency were years of participation in agricultural programme, household size, usage of extension service and education.

Chukwuji (2004) studied the technical efficiency of Gari processors in Delta State by using stochastic frontier function. The result showed that 71% and 67% of the variations in output is attributable to difference in technical inefficiencies. Mean technical efficiencies for mixed crop and mono-crop farmers were 80 and 71 percent respectively. The determinants of technical inefficiency are Level of formal education, contact with extension agents, farming experience and capital to labour ratio and credit to total cost ratio.

Abdulrahman *et al* (2015) used the Cobb-Douglas Stochastic Frontier model to estimate the technical efficiency of cocoyam production in Kaduna state, Nigeria. The result showed that 83% of the farmers had technical efficiency (TE) of 0.81 and above 17% of the farmers operates at less than 0.8 efficiency level. The determinants of technical efficiency area Age, education and household size had negative effect on efficiency, while seed, fertilizer, labour and extension contact had positive effect on efficiency.

2.9 Factors Constraining Agricultural Production

The major factors constraining agricultural production in Nigeria are as follows (Maniyong *et al.*, 2005):

2.8.1 Technical constraints

Technical constraints include the high incidence of pests and disease, inadequate infrastructural facilities, dependence on unimproved inputs, and rudimentary technology. Others are inadequate extension services, an inefficient inputs supply and distribution system, and high environmental hazards.

2.8.2 Resource constraints

A major problem of agricultural labour supply arises from the increasing migration of able-bodied youths from rural to urban areas. The consequence of the massive migration of youth is seasonal labour shortage, especially at the peak periods of labour demand (during land preparation, planting, weeding, harvesting). There is also the problem of low agricultural labour productivity. There is an increasing population pressure on land as well as a declining quality of land. Rate of land improvement is low because of the low rate of capital investment by the predominantly traditional farmers (Maniyong *et al.*, 2005)

2.8.3 Socioeconomic constraints

The socioeconomic problems that constrain Nigeria's agriculture include scarcity and high cost of improved farm inputs, inefficient marketing arrangements characterized by high marketing margins, lack of grades and standards, and lack of legally enforceable ownership and control rights over land which serves as a disincentive to investing in agriculture and which arises from

the lack of an appropriate land tenure system. Other socioeconomic factors are inadequate extension services and credit facilities; low rate of growth in international demand for primary export commodities arising largely from competition with synthetic products; low income elasticity of demand; and increasing food deficit and high dependence on food import arising from disequilibria in national agricultural resource base, a largely traditional agricultural production system, and some domestic population dynamics (Maniyong *et al.*, 2005)

2.8.4 Organizational constraints

Agricultural production is predominantly in the hands of a multitude of small-scale, unorganized farmers scattered across the country. Lack of organization, coupled with the dispersed nature of farm settlements, hinders the participation of farmers in agricultural and rural development. It particularly hinders the supply of extension services, farm credit, and other vital inputs to farmer (Maniyong *et al.*, 2005)

CHAPTER THREE

METHODOLOGY

3.1 Description of the Study Area

The Study was conducted in Giwa and Soba Local Government Areas of Kaduna State, Nigeria. Kaduna State is located between latitudes 9° and 12° N and longitudes 6° and 9° E of the Prime Meridian (Kaduna State Bureau of Statistics, 2011). Giwa LGA lies between latitudes 11°-12°N and longitudes 7°-34°E of the Prime Meridian (Kaduna State Bureau of Statistics, 2011). Giwa has 11 wards and 11 districts. The wards are Giwa, Shika, Yakawada, Idasu, Panhauya, Galadimawa, Kidandan, Kadage, Gangara, Dan mahauwayi and Kakangi. The districts are; Giwa, Shika, Yakawada, Fatika, Karau-karau, Galadimawa, Kidandan, Kadage, Gangara, Dan mahauwayi and Kakangi. Giwa LGA is bounded in the north by Funtua LGA in Katsina State, in the west by Birnin Gwari and Igabi LGAs of Kaduna State as well as Faskari and Sabuwa LGAs of Katsina State, and in the south, Giwa is bounded by Zaria and Sabon Gari LGAs of Kaduna State. According to National Population Commission (NPC) (2006), the population figure for Giwa is 286,427. The projected population is 359,294 people as at 2014, based on growth rate of 3.2% per annum.

Soba LGA, on the other hand, covers an area of approximately 2955 square kilometres and lies between latitudes 9° and 11°N and longitude 7 and 8° 30 North-east. The population of Soba as at 2006 was 238,719, projected to 298,722 in 2014 based on growth rate of 3.2% per annum (Kaduna State Bureau of Statistics, 2011). The LGA was carved out of Zaria LGA. Soba LGA is made up of 10 wards, namely; Turawa, Gamagari, Rahama, Dan Wata,

Garu, Maigana, Kinkina, Kwasallo, Richifa, and Gimba and 8 districts, namely; Maigana, Yakasai, Turawa, Rahama, Gamagari, Kwasallo, Richifa and Soba (Soba LGA Desk Officer, 2014).

There are two distinct seasons in the study areas; the rainy season and the dry season. The rainy season commences between April and October and the length varies from 90 days to 200 days. The mean annual rainfall in the two LGAs varies from 635 mm to 1,524 mm. The dry season extends from October to early June and is marked by hot dry north-eastern harmattan winds. The lowest mean temperature is usually recorded during the harmattan period. This occurs between November and February ranging from 18°C to 23°C.

Agriculture is considered as a major economic activity in both LGAs. Approximately 70% of the population is engaged in agricultural production of grains (maize, sorghum, millet, acha), root crops (cassava, irish potato, sweet potato), legumes (cowpea, groundnut, soya bean, melon), vegetables (tomato, okra, ginger) and livestock (cattle, goat, sheep, pigs) as a means of livelihood and employment, while 20% are civil servants and 10% are engaged in trading.

two from Soba the Local Government Areas. This is because of the intensity of production of cowpea in the areas. The second stages involved random selection of 10% of cowpea farmers from the list of cowpea farmers provided by the desk officers on agricultural extension as shown in Table 3. Thus, a total of 158 cowpea farmers will be interviewed.

Table 3.1: Distribution of Cowpea Farmers in the Study Area.

LGAs	Districts	Wards	Sample Frame*	Sample Size (10%)
GIWA	Giwa	Giwa	352	35
	Shika	Shika	248	25
SOBA	Maigana	Maigana	475	48
	Yakasai	Yakasai	495	50
TOTAL			1570	158

Source: Giwa and Soba LGAs Desk Officers, 2014.

3.3 Data Collection

Primary data were used for the study. The primary data were collected through the use of a structured questionnaire. Data were collected on;

- (a) the socio-economic characteristics of the farmers such as age, farming experience, household size, level of education, extension contact, membership of cooperatives and amount of loan received,
- (b) Production data for farmers: (i) area of land cultivated (hectares) for cowpea;(ii) quantity of seeds planted (kg) and cost; (iii) quantity of fertilizer used (kg) and cost; (iv) quantity of labour used (man-hour) and cost; (v) quantity of agro-chemicals

used (litres) and cost;(vi) output of cowpea (kg) and (vii) constraints associated with cowpea production.

(c) Marketing data: sales of cowpea.

3.4 Analytical Techniques

The following analytical techniques were used, descriptive statistics, stochastic frontier production function, multiple regression analysis and net farm income.

3.4.1 Descriptive statistics

This was used to achieve objectives (i and v) of the study. It makes use of measure of central tendency such as frequency distributions, percentages, means, and coefficient of variation.

3.4.2 Stochastic frontier production function

This was used to achieve objective (ii). The Cobb Douglas function of the stochastic frontier production function model will be used in the empirical estimation of the model.

The reason is that it is linear in its logarithmic form and therefore easy to estimate by using ordinary least square estimate technique (OLS).

Then implicit form of the model specified in Cobb Douglas functional form is

$$Y = f(X_1+X_2+X_3+X_4+X_5+\dots+u)$$

The explicit form of the model specified in Cobb Douglas functional form is

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + (V_i - U_i) \dots \dots \dots (ii)$$

Where:

\ln = the natural logarithm

Y = output of cowpea (kg)

β_0 = constant term

β_1 - β_5 = regression coefficients

X_1 = farm size (hectares)

X_2 = quantity of seed (kg)

X_3 = quantity of labour (man-hour)

X_4 = quantity of fertilizer (kg)

X_5 = quantity of agro-chemicals (litres)

V_i = random error accounting for measurement errors and other random factors

U_i = random error associated with technical inefficiency.

The technical inefficiency model

The determinants of technical inefficiency are modeled in terms of factors that are assumed to affect the inefficiency of production of cowpea farmers. The inefficiency variables are the socio-economic variables of the farmers. These variables are assumed to influence technical inefficiency of the farmers. The inefficiency model is expressed explicitly as:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + u \dots \dots \dots (iii)$$

Where:

U_i = Technical inefficiency of the i^{th} farmer

δ_0 = constant term

δ_0, δ_6 = Coefficients to be estimated

Z_1 = Age (years)

Z_2 = Household size (number)

Z_3 = Farming experience (years)

Z_4 = Education (years)

Z_5 = Membership of cooperatives (years)

Z_6 = Amount of credit received (₦)

Z_7 = Extension contact (numbers)

u = error term

3.4.3 Measurement and Rationalization of variables in the Technical inefficiency Models.

- i. **Age:** Age is the number of years lived. It was measured in years given by the respondent at the time of the study. For the purpose of analysis respondents will be grouped into three categories: (1) young farmers (under 40 years old), (2) medium age farmers (40-49 years old) and (3) old farmers (50 years and above) Atala (1984). This variable is expected to be positively related with technical inefficiency. The means that the older the farmer, the more technically inefficient the farmer

becomes. The reason is that older farmers are more likely not to adopt new technical innovations. The younger farmers are expected to adopt agricultural innovations more readily than the older ones, which reduce their technical inefficiency and increases the technical inefficiency of the older ones (Obeta and Nwagbo, 1991)

- ii. **Farming experience:** This variable is expected to be negatively related with technical inefficiency. This means that the more experienced the farmer is, the less technically inefficient he is. The reason may be that farmers who possess longer experience in farming would have known the profitability in cowpea production and would more readily accept any useful innovation to expand production than farmers with a shorter farming experience, thereby reducing the technical inefficiency.

- iii. **Household size:** This variable will be measured by adding the number of wives, children, relatives and the dependents actually living with the respondent in his household at the time of the investigation. The following categorization will be used: household with less than 5 members will be regarded as small household, those with 5 and 6 members will be regarded as medium size household, and those with over 6 members will be regarded as large household (Atala, 1984). This variable is expected to be positively related to technical inefficiency. This means that the larger the household, the higher the technical inefficiency. A possible explanation for this relationship may be that the rural household generally are known to be poor, thus the little they have in terms of financial resources may not

go far enough to purchase modern inputs after the other commitments of the family have been taken care of, thereby increasing their technical inefficiency (Voh, 1979).

- iv. **Education:** This will be measured by the number of years of formal schooling. The respondent will be asked to give the number of years he spent in primary school and the number of years he spent in post primary school. The final score for him will be the sum of years of primary school plus years of post-primary school. Three categories will be considered: (1) those who never attended a formal school, (2) those that have less than 4 years of formal schooling, and (3) those who have 4 or more years of formal schooling (Atala, 1984). The level of education is expected to be negatively related with technical inefficiency. The means that the more educated a farmer is, the less technically inefficient he becomes. The reason may be that education raises the technical competence of an entrepreneur and enables him/her cope with the complexities associated with the adoption of improved technologies, thereby reducing his/her technical inefficiency (Tanko and Opara, 2010).
- v. **Membership of cooperatives:** The member of cooperatives is expected to be negatively related with technical inefficiency. The reason is that farmers who are members of cooperative organizations adopt more technologies than non-members. Cooperative members enhance access to information on improved technologies, material inputs of the technologies such as fertilizers and chemicals, and credit for purchase of inputs and payment of hired labour, thereby reducing technical inefficiency among farmers (Njoku, 1991).

- vi. **Amount of credit received:** Amount of credit received is expected to be negatively related with technical inefficiency. The reason may be that sustained use of improved technologies involves purchase of the improved inputs and payment for extra labour required for additional farm operations. Credit is, therefore, required to finance these incidental expenses to reduce the technical inefficiency of farmers. (Obeta and Nwagbo, 1991).

- vii. **Extension contact:** This is expected to be negatively related with technical inefficiency. This means that the more extension contact the farmer has, the less technically inefficient he becomes. The reason may be that constant meeting between the extension personnel and the farmer would enlighten the latter and create greater awareness of the potential gains of improved agricultural innovations, thereby reducing the technical inefficiency of the farmers (Obeta and Nwagbo, 1991).

3.4.4 The stochastic frontier cost function (Allocative Efficiency) model is explicitly specified as:

$$\text{Ln}C = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + Y + (V_i + U_i) \dots \dots \dots (iv)$$

Where:

Ln = the natural log

β_0 = constant term

$\beta_1 - \beta_5$ = regression coefficients

C = cost of production of cowpea for the i^{th} farmer (Naira)

X_1 = cost of seed (Naira)

X_2 = cost of fertilizer (Naira)

X_3 = cost of agro-chemicals (Naira)

X_4 = cost of labour (Naira)

Y = Output

V_i = cost frontier

U_i = cost inefficiency effect.

The allocative inefficiency model is expressed as

$$U_i = \alpha_1 \ln Z_1 + \alpha_2 \ln Z_2 + \alpha_3 \ln Z_3 + \alpha_4 \ln Z_4 + \alpha_5 \ln Z_5 + \alpha_6 \ln Z_6 + \alpha_7 \ln Z_7 + e \dots \dots \dots (v)$$

Where:

U_i = Allocative inefficiency of the i^{th} farmer

α = constant

$\alpha_1 - \alpha_7$ = parameters to be estimated

Z_1 = age of the farmer (years)

Z_2 = household size (numbers)

Z_3 = Farming experience (years)

Z₄ = Education (year of schooling)

Z₅= Membership of cooperatives (years)

Z₆= Amount of credit received (naira)

Z₇ = Extension contact (numbers)

u = error term

Economic efficiency

The product of technical efficiency (TE) and allocative efficiency (AE) provides the measurement of economic efficiency (EE).

$$EE = TE \times AE \dots\dots\dots(vi)$$

$$TE = \frac{\textit{Actual output (Ya)}}{\textit{frontier output (Yf)}}$$

$$AE = \frac{\textit{frontier output (Yf)}}{\textit{Optimal output (Yo)}}$$

Where:

EE= Economic Efficiency

TE= Technical Efficiency

AE= Allocative Efficiency

(Coelli, 1996; Coelli *et al.*, 2005)

3.4.5 Multiple regression analysis

This was used to achieve objective (iii) that is to determine the factors that influence the level of economic efficiency of cowpea farmers and to test hypotheses i and ii. The regression model specification is

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + e \dots \dots \dots (vii)$$

Where;

Y_i = Economic Efficiency Estimates (mean score).

X_1 = Age (Years).

X_2 = Education (year of schooling)

X_3 = Household size (number of persons)

X_4 = Farming experience (years)

X_5 = Cooperative association (years of membership).

X_6 = Extension contact (number of contact).

X_7 = Farm size (ha).

X_8 = Capital (Naira).

X_9 = Amount of credit (Naira)

β_i = The coefficients for the respective variables.

3.4.6 Net farm income

The Net Farm Income (NFI) was employed to achieve objective two (iv). It was used to estimate the costs and returns of cowpea production. The formula for the net farm income model is stated as follows.

$$NFI = TR - TC \dots \dots \dots (viii)$$

Where,

NFI= net farm income (₦);

TR= total revenue (₦);

TC= total cost of production (₦); Also,

TC= TVC+TFC

Where,

TVC= total variable cost (₦) and

TFC= total fixed cost (₦).

Total Cost (TC) = Total Variable Cost (TVC) + Total Fixed Cost (TFC)

TVC = (cowpea seed, fertilizer, agrochemical and labour)

TFC = (cost of renting land and depreciation of tools (hoe, cutlasses)

The fixed inputs are not normally used up at short run in a production cycle. They were depreciated using the straight line method given by:

$$D = \frac{(P-S)}{N} \dots\dots\dots(ix)$$

Where:

D = depreciation (₦),

P = Purchase value (₦),

S = salvage value (₦) and

N = life span of asset (years).

Returns per naira invested (RNI) was obtained by dividing the gross income (GI) by the total cost (TC).

Therefore,

$$RNI = \frac{GI}{TC} \dots\dots\dots(x)$$

Where,

RNI = returns per Naira invested

GI = gross income and

TC = total cost.

Decision Rule:

RNI > 1, it implies the enterprise is profitable;

RNI = 1, it implies that the farmer is operating at breakeven point and

RNI < 1, the farmer is at loss

3.4.7 Z – Test Statistic

Z-test was used to test hypothesis (iii) which is there is no significant relationship between costs and returns of cowpea farmers. It was used for larger sample greater than thirty (30).

Z-test model was be used in the study to compare the differences in costs and returns of cowpea farmers in the study area. The Z-statistic is expressed as follows:

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s^2_1}{n} + \frac{s^2_2}{n}}} \dots\dots\dots(xi)$$

Where Z = calculated Z value

—

X_1 = Average costs of cowpea farmers.

\bar{X}_2 = Average returns of cowpea farmers.

S_1 = Standard deviation for costs of cowpea farmers.

S_2 = Standard deviation for returns of cowpea farmers.

n = Sample size of cowpea farmers.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socioeconomic Characteristics of Cowpea Farmers

In this section the general socio-economic characteristics of cowpea farmer is provided. These include age, educational level, household size, farming experience, farm size, membership association and income level.

4.1.1 Age distribution of cowpea farmers

The result in Table 4.1 revealed that majority (61%) of the respondents fall between the ages of 34-53 years. The mean ages of the farmers are 43 years. This implies that majority of respondents are still within a productive and active working age range, hence their ability to produce to earn some income from farming and non-farming activities. This finding concurred with the findings of Yusuf *et al.* (2007) that most farmers are within their active years and can make positive contribution to agricultural production.

Table 4.1: Age Distribution of cowpea farmers

Age category	Frequency	Percentage
1-24	0	0
24-33	37	23
34-43	47	30
44-53	49	31
54-63	21	13
64-73	4	3
Mean	43	
Maximum	73	
Minimum	24	

Total	158	100
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4.1.2 Educational level

The result in Table 4.2 revealed that about 38% of the respondents had secondary education, 34% had primary education, 13% had tertiary education, while only about 15% of the respondents had no formal education. Thus majority (85%) of the respondents had some form of educational level of qualification. Oluwatayo *et al.* (2008) observed that the more educated a farmer is, the more the chances that the farmer will adopt innovations than the uneducated ones. Mohammed-Lawal *et al.* (2009) noted that level of education is expected to influence farmers' adoption of agricultural innovations and decision on various aspects of farming. They all maintained that education is highly important for sustainable agricultural growth and development.

Table 4.2: Educational Level of cowpea farmers

Educational level	Frequency	Percentage
No formal education	23	15
Primary	54	34
Secondary	60	38
Tertiary	21	13
Total	158	100

4.1.3 Household size

The result in Table 4.3 revealed that majority about 71% of the respondents had between 6-17 household sizes. The mean household size of the respondents is 11. The implication is that the relatively large household size may likely enhance the family labour supply on the farms, hence supporting favorably, productive capacities of the farmers already enhanced

by their age. This corroborate with the findings of Adegbite and Oluwalana (2004); Adegbite *et al.* (2007) that the larger the household size, the higher the likelihood of sustainable labour efficiency on farmers' farm, given the constant labour supply

Table 4.3: Distribution of cowpea farmers according to Household Size

Household size	Frequency	Percentage
1-5	25	16
6-11	54	34
12-17	58	37
18-23	13	8
24-29	8	5
Mean	11	
Minimum	1	
Maximum	29	
Total	158	100

4.1.4 Farming experience

The result in Table 4.4 revealed that majority (81%) of the respondents had between 12-21 years of farming experience. The mean farming experience for respondents is 15 years. This depicts good signal for high productivity. Farming experience is used as a measure of management ability, the more experienced the farmer is, the more his ability to make better informed farm decision. This result showed that most of the respondents had long years of farming experience, implying that such farmers are likely to make decisions that would increase their output and income. This finding is in tandem with the findings of kebbeh *et al.* (2003).

Table 4.4: Distribution of cowpea farmers according to Farming Experience

Farming experience	Frequency	Percentage
2-11	69	44
12-21	59	37
22-31	19	12
32-41	9	6
42-51	2	1
Mean	15	
Minimum	2	
Maximum	51	
Total	158	100

4.1.5 Farm size

The result in Table 4.5 revealed that majority about 73% of the respondents had between 1.0-2.9 hectare of the same farmland while about 11% of the respondents had 5.0 and above hectare of farmland. The mean farm size for the respondents is 2 hectares. This implied that farmers in the study area are largely small scale farmers based on the Ojuekaiye's (2001) classification of farms. He classified farmers with 0.1 hectares and 5.9 hectares as small-scale. Since the majority of respondents have farm holdings between one and two hectares, it means that these small-scale farmers cannot achieve economies of large-scale production.

Table 4.5: Distribution of cowpea farmers according to Farm Size

Farm size	Frequency	Percentage
1.0-1.9	91	58
2.0-2.9	23	15
3.0-3.9	10	6
4.0-4.9	16	10
5.0 and above	18	11
Mean	2	
Total	158	100

4.1.6 Cooperative association

Membership of cooperatives influences adoption of improved technologies resulting in higher productivity and poverty alleviation (Amaza *et al.* 2009). The result in Table 4.6 revealed that majority (75%) of the cowpea farmers have been in cooperative association for the period of 1-10 years. The average years of membership of cooperative society was 8 years. The effect of this result is that most of the cowpea farmers in the study area enjoy the assumed benefits accrued to co-operative societies through pooling of resources together for a better expansion, efficiency and effective management of resources for profit maximization. This finding is in line with Odebiyi (2010) that cooperative groups ensure that their members derive benefits from the groups such as they could not derive individually. According to Idiong *et al.* (2007), membership of cooperative affords the farmers opportunities of sharing information on modern rice practices. This implies that belonging to cooperative society is not new among the respondents. Membership of

clubs, association or cooperatives avails a farmer the opportunity of not only obtaining credit and agricultural inputs but also information on how to improve his/her farming activities. Membership of a cooperative enables farmers to interact with other farmers, share their experiences and assist themselves through the exchange of valuable farming information. Interaction of farmers with other farmers is an avenue through which innovation diffusion can occur.

Table 4.6: Distribution of cowpea farmers according to years of Membership of Cooperative Association

Cooperative association	Frequency	Percentage
1-5	63	40
6-10	56	35
11-15	23	15
16-20	5	3
21-25	11	7
Mean	8	
Minimum	1	
Maximum	25	
Total	158	100

4.1.7 Income level

The results in Table 4.7 revealed that majority of the respondents about 89% had between ₦82,000-₦283,000, while only about 3% of the respondents had between ₦585,000-₦685,000. The mean Income Level for respondents' is ₦204071. This means that farmers in these communities relied absolutely on farm business and must have acquired a lot of farming experience over time. According to FAO (1999), employment in non-farm activities is essential for diversification of the sources of farm household's livelihood. It

enables households to modernize their production by giving them an opportunity to apply the necessary inputs.

Table 4.7: Distribution of cowpea farmers according to Income Level

Income level (₦)	Frequency	Percentage
82000-182000	81	51
183000-283000	60	38
284000-384000	11	7
385000-485000	2	1
585000-685000	4	3
Mean	204071	
Minimum	82000	
Maximum	685000	
Total	158	100

Test of Hypothesis i

The result of the null hypothesis (H_0) which stated that there is no significant relationship between inputs and output in cowpea production are presented in Table 4.8. Based on the result the null hypothesis is rejected because four variables (fertilizer, agrochemical, labour and farm size) were significantly related to output at 1% and 10% levels of significant.

Table 4.8: Result of differences between Inputs and Output relationship in cowpea production

Variable	Coefficients	Standard Error	T –stat
Constant	344.8834	239.1537	1.442099
Seed	1.535553	45.94926	0.033418
Fertilizer	76.40443***	17.38136	4.395769
Agrochemical	21.48628***	5.633452	3.814052
Labour	-6.42814*	3.231085	-1.98947
Farm size	240.579***	65.33238	3.682385

R square	0.677
Adjusted R square	0.657
F-value	18.43614

***P<0.01, **P<0.05 and *P<0.10

4.2 Efficiency of Cowpea Production

4.2.1 Estimated technical efficiency of cowpea farmers

The model specified was estimated by the maximum likelihood (ML) method using FRONTIER 4.1 software developed by Coelli (1995). The ML estimates and inefficiency determinants of the specified frontier are presented in Table 4.9. The study revealed that the generalized log likelihood function was -131.431. The log likelihood function implies that inefficiency exist in the data set. The log likelihood ratio value represents the value that maximizes the joint densities in the estimated model. Thus, the functional form that is, Cobb-Douglas used in this estimation is an adequate representation of the data. The value of gamma (γ) is estimated to be 0.0738 and it was not significant. This is inconsistent with the theory that true γ -value should be greater than zero. This implies that 7.38% of random variation in the yield of the farmers was due to the farmers' inefficiency in their respective sites and not as a result of random variability. Since these factors are under the control of the farmer, reducing the influence of the effect of γ will greatly enhance the technical efficiency of the farmers and improve their yield. The value of sigma squared (σ^2) was significantly different from zero level of probability. This indicates a good fit and correctness of the specified distributional assumptions of the composite error terms while the gamma γ indicates the systematic influences that are unexplained by the production function and the dominant sources of random error. This means that the inefficiency effects make significant contribution to the technical inefficiencies of cowpea farmers.

However, the estimated coefficients of all the parameters of production function (seed, fertilizer, agrochemical and labour) were positive but only cooperative association is negative and significant at 1% level of probability and hence play a major role in cowpea production in the study area. The average technical efficiency for the farmers was 0.73 implying that, on the average, the respondents are able to obtain 73% of potential output from a given mixture of production inputs. Thus, in the short run, there is minimal scope (27%) of increasing the efficiency, by adopting the technology and techniques used by the best cowpea farmer.

Table 4.9: Results of maximum likelihood estimates of stochastic frontier production function of cowpea production

Variables	Parameters	Coefficient	Standard-error	T-value
Constant	β_0	7.78	1.02	7.59
Seed	β_1	0.480***	0.144	3.33
Fertilizer	β_2	0.0387***	0.00934	4.14
Agrochemical	β_3	0.114***	0.0265	4.29
Labour	β_4	0.436***	0.135	3.24
Capital	β_5	0.290***	0.103	2.83
Inefficiency model				
Constant	Z_0	0.147	0.591	0.249
Age	Z_1	-0.128*	0.00721	-1.78
Household size	Z_2	0.0302**	0.0133	2.28
Farming experience	Z_3	-0.0200**	0.00792	-2.52
Education	Z_4	0.000814 ^{NS}	0.0199	0.0490
Cooperative association	Z_5	-0.0354***	0.0138	-2.57
Amount of credit	Z_6	0.0000122**	0.00000576	2.12
Extension contact	Z_7	0.0118 ^{NS}	0.0172	0.687
Sigma-squared	(σ^2)	0.334	0.0471***	7.11
Gamma	(γ)	0.0738	0.143	0.517
Log likelihood function	L/f		-131.431	
LR test		22.9595		
Total number of observation		158		
Mean efficiency		0.734		

***P<0.01, **P<0.05 and *P<0.10

The estimated coefficient for seed is 0.480 which is positive and statistically significant at 1% level. The estimated 0.480 elasticity of seed implies that increasing seed by 1% will increase cowpea output by less than 1% which means, all things being equal the output is inelastic to changes in the quantity of seed used. The significance of seed quantity is however, due to the fact that seed determines to a large extent the output obtained. If correct seed rates and quality seeds are not used, output will be low even if other inputs are in abundance. This is inconsistent with the findings of Shehu *et al* (2010) who observed that the estimated coefficient of seed and labour inputs were positive as expected and significant at 1% level which implies that the more seed is applied and the more labour employed the better the output of cowpea.

The production elasticity of output with respect to quantity of fertilizer is 0.0387 which is positive and statistically significant at 1% level. This implies that a 1% increase in fertilizer will increase cowpea output by 0.04%. Fertilizer is a major land augmenting input because it improves the quality of land by raising yields per hectare. This study is in tandem with the findings of Maurice (2004).

The coefficient of agrochemical is 0.114 which is positive and statistically significant at 1% level. The estimated 0.114 of agrochemical implies that increasing agrochemical by 1% will increase cowpea output by 0.11% which means, all things being equal the output is elastic to changes in the quantity of agrochemical used. However, this finding is in line with the findings of Shehu *et al* (2010) who observed that the estimated coefficient of

agrochemical input was positive as expected and significant at 1% level implies that the more agrochemical is applied and the more labour employed the better the output of rice.

The coefficient of labour was 0.436 which is positive and statistically significant at 1% level. This shows that labour is an important variable in cowpea farming in the study area. This is in line with several studies by Umoh (2006) and Okike (2000) which show the importance of labour in farming, particularly in developing countries where mechanization is rare on small scale farms. In the study area, human power plays a crucial role in virtually all farming activities. This situation has variously been attributed to the practice of split-plot cropping on small scattered land holdings and lack of affordable equipment (Umoh, 2006).

The coefficient of capital is positive and significant at 1% level of significance. The estimated coefficient of capital is 0.290 implying that for every 1% increment in capital for cowpea production, the output of cowpea will be increased by 0.290%.

The result of the inefficiency model is contained in table 4.9. The estimated coefficients with negative signs attached indicate that they reduce technical inefficiency among the sesame farmers, while positive signs indicate that the coefficients increase technical inefficiency or reduce technical efficiency. The results showed that Age, household size, farming experience, cooperative association and amount of credit were the determinants of technical inefficiency among the sesame farmers. Age, farming experience and cooperative association were negatively related with technical inefficiency, while household size and amount of credit were positively related with technical inefficiency.

The coefficient of age (-0.128) is negative and significant at 10% probability level. This implies that holding other factors constant, a unit increase in the age of cowpea farmer will reduce their technical inefficiency by magnitude of 0.128. This finding is at variance with Kolawole and Ojo (2007) who in their study of small scale out-growers in Nigeria found age to be positively related to inefficiency.

The coefficient of Household size (0.0302) is positive and significant at 5% probability level. This implies as household size increases, the technical inefficiency increases thereby reducing technical efficiency of farmers. It also implies that technical efficiency of farmers can be improved without taken into consideration the household size of the cowpea farmers. This finding agrees with Mohammed Lawal *et al.*, (2009) who reported that as household size increases the technical efficiency decreases. They observed that this may be as a result of the fact that most of the household members who are still at a very young age may not be able to contribute to labour supply since they are likely to be in school during the period of agricultural production activities.

The coefficients of Farming experience (-0.0200) is negative and significant at 5% probability level. This means being an experienced farmer was not enough to significantly cause a farmer to attain higher levels of efficiency if he cannot rearrange his inputs to obtain higher output levels with a given technology. This finding is in consistent with that of Onu *et al.*, (2000) whose result showed a negative relationship farming experience and technical efficiency in cotton production in Nigeria.

Cooperative association (-0.0354) is negative and significant at 1% probability level. This implies that cooperative association contributes towards increase in the technical efficiency of the cowpea farmers. Cooperative association have more access to agricultural information, credit and other production inputs as well as more enhanced ability to adopt information. This finding is consistent with that of Onyenweaku and Nwaru (2005) that membership of cooperative society enhances technical efficiency of farmers.

The coefficient of the amount of credit received (0.0000122) is positive and significant at 1% probability level. The implication of this is that the higher the amount of credit a cowpea farmer receives, the more technically inefficient he becomes. This may be due to the fact that credit received by some cowpea farmers in the study areas is used for some other purposes other than cowpea production, such as household upkeep, production of other crops, settlement of bills (medical, electricity, rent etc.). Credit is an important part of agricultural production, the absence of which poses severe constraints to agricultural development in low-income countries, like Nigeria. This result is in agreement with that of Onyenweaku and Nwaru (2005) who found a positive relationship between credit and technical inefficiency.

4.2.2 Estimated stochastic frontier cost functions

The Maximum Likelihood (ML) estimates of the stochastic frontier cost parameters for cowpea are presented in Table 4.10. For the cost function, the sigma ($\sigma^2 = 3.11$) and the gamma ($\gamma=0.0998$) are quite high and highly significant at 1.0% level of probability. The high and significant value of the sigma square (σ^2) indicate the goodness of fit and

correctness of the specified assumption of the composite error terms distribution (Idiong, 2005). The gamma ($\gamma = 0.0998$) shows that 9.98% of the variability in the output of cowpea farmers that are unexplained by the function is due to allocative inefficiency.

The results of stochastic frontier cost function for cowpea in Kaduna State are shown in Table 12. The estimated coefficients of the parameters of the cost function are positive except that of fertilizer which is negative. The cost variables seed, agrochemical, labour and output are significant at 1% level while fertilizer is not significantly different from zero.

The coefficient of the cost of seed (0.414) is positive and significant at 1.0% level of probability. This implies that seed are important in crop production in cowpea farms. The implication of this is that 1% increase in the cost of seed will give rise to 0.41% increase in the cost of cowpea production. The cost of labour (0.474) is positive and significant at 1% significance level. This implies that 1% increment in cost of labour will increase the cost of cowpea production by 0.47%. The significant influence of seed cost and labour cost is in agreement with the findings of Okoh (2009), similarly found seed and labour cost as determinant of allocative efficiency in the Fadama production of tomato in Benue State.

The coefficient of the cost of agrochemical (0.0743) is positive and significant at 1.0% level of probability. This is an indication that 100% increase in the cost of agrochemical will result to 0.074 % increase in the cost of cowpea production.

The coefficient of cowpea output (0.302) is positive and significant at 1.0% level of probability. This implies that as the quantity of cowpea produced increases, the cost of cowpea production increases accordingly. This shows that the cost of production is

influenced by the quantity of cowpea output realized. This finding concurs with the one of Ogundari *et al.*, (2006) that reported direct effect of output on cost of production in the study on economies of scale and cost efficiency in small scale maize production in Nigeria.

The result of the inefficiency model of the stochastic frontier cost function revealed that household size, farm experience, amount of credit received and extension contact were the determinants of allocative efficiency among the cowpea farmers. The coefficients of the variables were all significant at 1% level of significance, with exception of household size and farming experience that are significant at 10 % significance level.

Household size has an estimated coefficient of 0.0888. The implication of this result is that larger cowpea households are more allocative inefficient than small cowpea household size. That is to say, the smaller a cowpea household, the more efficient it will be in the allocation of productive resources. This may be due to the fact that larger cowpea households have more mouths to feed than small sesame households, as a result of this, the ability to make appropriate choices between alternative farm inputs is constrained by the shortage of financial resources.

Farming experience has an estimated coefficient of 0.0421. This implies that the more experienced a cowpea farmer is, the higher will be his allocative inefficiency. The more experienced the farmer the better the ability of the farmer as a decision maker to obtain and process information about prices and technology.

Amount of credit received has a coefficient of 0.0000464. The implication of this is that the more credit a cowpea farmer receives, the more allocatively inefficient he becomes. This

result is corroborated by one of Okike *et al.*, (2000) that showed that receiving credit contributed to farmers' economic inefficiency. They contended that this could be the result of disbursement of credit in cash rather than in kind and loan misapplication endangered by resource poverty.

The coefficient of extension contact is -0.7041. This is an indication that extension contact contributed towards reducing allocative inefficiencies among the cowpea farmers. This finding agrees with the study of Ajani (2000) who observed that extension contact enhance farm productivity and efficiency in his study of resources productivity in food crop farming in Northern area of Oyo State Nigeria.

Table 4.10: Results of Maximum Likelihood Estimates of Frontier Cost Function for Cowpea.

Variable	Parameters	Coefficient	Standard-error	T-value
Constant	β_0	5.14	0.601	8.56
Seed	β_1	0.414***	0.0595	6.96
Fertilizer	β_2	-0.0751	0.0576	-1.30
Agrochemical	β_3	0.0743***	0.00927	8.02
Labour	β_4	0.474***	0.0927	5.11
Output	β_5	0.302***	0.0982	3.07
Inefficiency model				
Constant	Z_0	-1.21	1.12	-1.08
Age	Z_1	-0.0445	0.029	-1.55
Household size	Z_2	0.0888*	0.0520	1.71
Farming experience	Z_3	0.0421*	0.0220	1.91
Education	Z_4	0.00920	0.0383	0.240
Cooperative association	Z_5	0.0600	0.0439	1.37
Amount of credit	Z_6	0.0000464***	0.0000134	3.46
Extension contact	Z_7	-0.7041***	0.206	-3.41
<hr/>				
Sigma-squared		3.11***	0.989	3.14
Gamma		0.0998***	0.0106	9.41
Log likelihood function		-94.777		
LR test		13.145		
Total number of observation		158		

4.2.3 Distribution of respondents according to technical efficiency of cowpea farmers in the study area.

The frequency distribution of the technical efficiency estimates for cowpea farmers in the study area as obtained from the stochastic frontier model is presented in Table 4.11. The study revealed that 39% of the cowpea farmers had technical efficiency (TE) of 0.61 and above while 61% of the farmers operate at less than 0.61 efficiency level. The cowpea farmers with the best and least practices had technical efficiencies of 0.98 and 0.33 respectively. This implies that on the average, cowpea output fall by 2% from the maximum possible level of 1.00 due to technical inefficiencies. The result also showed a mean technical efficiency of 0.73. This means that majority of the cowpea farmers operated closer to their production frontier. Also, this implies that on the average, cowpea farmers are able to obtain 73% potential output from a given mix of productive resources. In a short-run, there is scope for increasing cowpea output by 27% by adopting the techniques and technologies employed by the best cowpea farmers.

Furthermore, the study also revealed that for the average cowpea farmer in the study areas to become the most efficient cowpea farmer, he will need to realize about 27% [$1 - (0.73/0.98) * 100$] cost savings, while on the other hand, the least technically efficient cowpea farmer will need about 34% [$1 - (0.33/0.98) * 100$] cost savings to become the most technically efficient cowpea farmer.

4.2.4 Frequency distribution of allocative efficiency estimates of cowpea farmers.

Table 4.11 below depicts the frequency distribution of the allocative efficiency estimates of cowpea farmers in the study areas. The result revealed that 24% of the cowpea farmers had allocative efficiency (AE) of 0.61 and above while 76% of the farmers operate at less than 0.61 allocative efficiency levels. This implies that the greater majority of cowpea farmers were not allocative efficient as 24% of them attained efficiency level greater than 0.61 and above. In other words, the clustering of allocative efficiencies in the region of 0.61 – 1.00 efficiency range implies that the cowpea farmers are not efficient. That is, the farmers are not efficient in producing cowpea at a given level of output using the cost minimizing input ratio as about 24% of the cowpea farmers have allocative efficiencies of 0.61 and above. High values of allocative efficiencies represent less efficiency or more inefficiency among the cowpea farmers during the course of cowpea production in the study areas. The estimated allocative efficiencies differ substantially among the cowpea farmers ranging between the minimum value of 0.20 and maximum value of 0.99. This means that the most allocative inefficient cowpea farmers operated closer to their cost frontier or minimum cost of 1.00. The mean allocative efficiency was 0.64. The study also revealed that for the average cowpea farmer in the study areas to become the most allocative efficient cowpea farmer, he will need to realize about 35% cost saving i.e. $[1-(0.64/0.99)*100]$ while on the other hand, the least technically efficient cowpea farmer will need about 80% $[1-(0.20/0.99) \times 100]$ cost savings to become the most allocative efficient cowpea farmer.

4.2.5 Frequency distribution of economic efficiency estimates of cowpea farmers.

The frequency distribution of the economic efficiency estimates of cowpea farmers in the study areas is contained in Table 4.11. The result revealed that 4% of the cowpea farmers

had economic efficiency (EE) of 0.61 and above while the remaining 96% of the cowpea farmers operated at less than 0.61 efficiency level. The mean economic efficiency of the cowpea farmers in the study areas was 0.48. This implies that on the average, there was a fall in the cowpea output level by 52% from the maximum feasible level due to economic inefficiency. The cowpea farmer with the best and least practice had economic efficiencies of 0.93 and 0.12 respectively.

In the same vein, the study also revealed that for the average cowpea farmer in the study area to achieve economic efficiency of his most efficient counterpart, he will have to realise about 48% $[1-(0.48/0.93)*100]$ cost savings while on the other hand, the least economic efficient cowpea farmers will have to realize about 87% $[1-(0.12/0.93)*100]$ cost savings to become the most economic efficient cowpea farmer. However, the result indicates that the highest number of cowpea farmers have economic efficiencies between 0.21-0.40, representing about 35% of the 158 cowpea farmers. This is an indication that the cowpea farmers were not economic efficient in producing cowpea at a minimum cost for a given level of technology.

Table 4.11: Frequency distribution of technical, allocative and economic estimates from the stochastic frontier model

Efficiency level	Technical efficiency		Allocative efficiency		Economic efficiency	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<0.20	3	1.9	31	19.6	54	34.2
0.21-0.40	43	27.2	15	9.5	56	35.4
0.41-0.60	50	31.6	74	46.8	42	26.6
0.61-0.80	62	39.2	38	24.1	6	3.8
0.81-1.00	0	0.0	0	0.0	0	0.0

Total	158	100.0	158	100.0	158	100.0
Minimum	0.326		0.203		0.124	
Maximum	0.981		0.996		0.927	
Mean	0.734		0.643		0.476	

4.3 Socio-Economic Factors Influencing the Economic Efficiency of Cowpea Production.

The result of the multiple regression estimates of the factors influencing the economic efficiency of cowpea farmers is presented in table 4.12. The adjusted R square of 0.65 implies that 65% in the variability in the economic efficiency of cowpea farmers in the study area is explained by the explanatory variables (age, education, household size, farming experience, cooperative association, extension contact, farm size, capital and amount of credit) specified in the model. The F statistics of 15.543 is statistically significant at 1% probability level and this indicates the joint significance of the specified variables on the economic efficiency of cowpea farmers in the study area suggesting that the model has a good explanatory power on the variation in the economic efficiency of cowpea farmers. The factors that had significant influence on economic efficiency of cowpea farmers in the study area were age, household size, farming experience, cooperative association, extension contact and amount of credit.

The coefficient of age was found to be positive and significantly related with economic efficiency. The estimated coefficient of 0.00038 implies that the economic efficiency of cowpea farmers will increase by a magnitude of 0.00038 as age increases by one unit. Probably because accumulated knowledge and experience of farming systems a farmer acquired pays off over a long period of time (Bonabana-Wabbi, 2002).

The coefficient household size was found to be positive and significantly related with the level of economic efficiency of cowpea farmers. The estimated coefficient of 0.0118 implies that the economic efficiency of cowpea farmers will increase by a magnitude of 0.0118 as household size increases by one unit. This means that larger household size also augments the total labour supply of the farm household and thereby enhances its farm income generating potentials. This implication is that majority of the household contributes to farm income by supplementing its labour supply especially during peak period of labour requirement such as harvest and weeding period (Tasie, 2012).

The coefficient of farming experience was found to have a direct relationship with the economic efficiency of cowpea farmers in the study area in line with *a priori* expectation and statistically significant at 1% level of probability. The estimated coefficient of 0.00608 implies that the economic efficiency of cowpea farmers will increase by a magnitude of 0.00608 as farming experience increases by one unit. This finding corroborates that of Tsoho *et al.*, (2012) who reported that farming experience was positively related to the economic efficiency of dry season vegetable out-growers in Sokoto State, Nigeria.

The coefficient of cooperative association had the expected positive relationship with the economic efficiency of cowpea farmers and is significant at 1% probability level. The estimated coefficient of 0.01149 implies that the economic efficiency of cowpea farmers will increase by a magnitude of 0.01149 as their membership of association increases by one unit. This is not farfetched as membership of association by cowpea farmers offers them the opportunity of having easy access to information on best crop production management practices, access to production input at reduced cost, access to credit facilities

and access to marketing information. This result agrees with that of Kadurumba *et al.* (2009) who reported that membership of association was significant in influencing economic efficiency.

The coefficient of credit had a negative relationship with the economic efficiency of cowpea farmers and is significant in at 1% probability level. The estimated coefficient of -0.0000031 implies that the economic efficiency of cowpea farmers will decrease by a magnitude of -0.0000031 as the amount of credit obtained increases by one unit. This result agrees with that of Adewuyi and Okunmadewa (2013) who reported that access to credit was significant in influencing the economic efficiency of certified rice seed outgrowers in a study on production efficiency of credit and non-credit users of certified rice seed in Ogun State, Nigeria.

The coefficient of extension contact had the expected positive relationship with the economic efficiency of cowpea farmers and is significant at 1% probability level. This implies that holding other factors constant, a unit increase in the extension contact to cowpea farmers will increase their economic efficiency by magnitude of 0.009234. This finding is in agreement with the study of Ajani (2000) who observed that extension contact enhance farm productivity and efficiency in his study of resources productivity in food crop farming in Northern area of Oyo State Nigeria.

Test of Hypothesis ii

The null hypothesis (H_0) which stated that there is no significant relationship between socioeconomic characteristics of cowpea producers and economic efficiency estimates was

tested using the result of regression analysis presented in Table 4.13. Based on the result the null hypothesis is rejected because of the six variables, four variables (age, household size, farming experience and amount of credit) significantly influence economic efficiency.

Table 4.12: Socioeconomic factors influencing economic efficiency of cowpea farmers in the study area

Variable	Coefficients	Standard error	T- stat
Constant	0.396618	0.063918	6.205128
Age	0.003778****	0.001465	2.57975
Education	-0.00154	0.002759	-0.5565
Household size	0.01181****	0.002866	4.121
Farming experience	0.006083****	0.001564	3.888596

Cooperative association	0.011499***	0.002225	5.168776
Extension contact	0.009234***	0.002894	3.190576
Farm size	-0.00185	0.008432	-0.21916
Capital	-1.2E-07	2.34E-07	-0.52655
Amount of credit	-3.1E-06***	4.04E-07	-7.56229
R Square	0.685911		
Adjusted R Square	0.654649		
F-value	15.54312		

***P<0.01, **P<0.05 and *P<0.10

4.4.0 Costs and Returns of Cowpea Production in the Study Area

The summary statistics of the level of inputs used and output realized in the study area are reported in Table 4.13. The inputs that were used in cowpea production include; land, seed, fertilizer, agrochemical and labour.

Land size. It revealed the mean farm size was 2.07 hectares. The minimum and maximum land areas were 0.5 ha and 9 ha, respectively. Going by Ojuekaiye (2001), classification of farm size of 0.1 hectare to 5.9 hectares as small farms, Since the majority of respondents have farm holdings between one and two hectares, it means that these small-scale farmers cannot achieve economies of large-scale production.

Seed. The average quantity of seed used by cowpea farmers was 232.15 kg/ha, and this is beyond the recommended rate of 30kg per ha (KADP, 2001) which shows over utilization of seed by the farmers in the study area.

Fertilizer. Average fertilizer used by cowpea farmers is 195.71 kg/ha in accordance with the recommended fertilizer application rate by KADP(2001) of 4 bags of 50kg each while the minimum and maximum were found to be 0.01kg/ha and 2500kg/ha, respectively.

Agrochemical. Average agrochemical used by cowpea farmers is 6.17 L/ha while the minimum and maximum were found to be zero and 79L/ha, respectively.

Labour. The mean labour recorded is 23.53man-day/ha while the minimum and maximum were observed to be 26.25 man/days/ha and 232 man/days/ha, respectively.. This shows that agricultural production in the study area is of small scale and labour intensive.

The coefficient of variation of each variable inputs used and output realized are presented in Table 4.13. The higher the coefficient of variation, the greater the dispersion in the variable while the lower the ratio of standard deviation to mean return, the better your risk-return tradeoff. The CV for a model aims to describe the model fit in terms of the relative sizes of the squared residuals and outcome values. The lower the coefficient of variation (CV), the smaller the residuals relative to the predicted value. This is suggestive of a good model fit.

Table 4.13 shows that the coefficient of variation of all the variable inputs such as the labour, size, seed, fertilizer, agrochemical and labour were 87.56, 74.96, 239.54, 267.54 and 133.30 respectively. The high coefficient of variation of variable inputs implies high level of variation in the use of variable input among cowpea farmers in the study area. However, the coefficient of variation for seed and land were lower compared to other variable inputs used for cowpea production. The wide variation in input used by the farmers could be attributed to the fact that they differ in purchasing power and size of production. The coefficient of variation in cowpea output was 103.66% which implies high variability in output level among cowpea farmers in the study area. This will help the country in attaining food security as greater proportion of farmers produces above average.

The output of cowpea could be attributed to inconsistency and inadequacy of variable inputs among farmers in the study area.

Table 4.13: Level of input utilized and output realized in cowpea production

Variable	Mean	Std dev	Min	Max	CV
Seed(kg/ha)	232.15	174.034	100	1000	74.96
Fertilizer(kg/ha)	195.71	468.813	0.01	2500	239.54
Agrochemical(L/ha)	6.17	16.49442	0	79	267.54
Labour(manday/ha)	23.53	31.36074	26.25	232	133.30
Yield(kg/ha)	541.80	1160.618	200	7400	214.22

4.4.1 Cost of cowpea production in the study area

Cowpea seed used by the farmers in the study area were mainly unimproved seeds taken from the last crop harvest. The quantity of cowpea seed is 232.15kg/ha with an average market price of ₦120 per kg was used; this constitutes 42.07% of the total cost of production. The quantity of fertilizer is 195.71kg/ha with an average market price of ₦100 per kg was used and this constitutes 29.55% of the total cost of production. The quantity of agrochemical is 6.17L/ha with an average market price of ₦800 per L was used and this constitutes 7.45% of the total cost of production.

Labour costs consisted of cost of land preparation, planting, fertilizer application, weeding and harvesting. The family labour was computed on the basis of opportunity cost in man-days. The wage rate varied according to farm operation performed. An average wage rate of ₦400 per man-day was used, giving the average labour cost per hectare to be ₦9410.83 and this constitutes 14.21% of the total cost of production, while the total cost of fixed

inputs (cost of renting land and depreciation of tools) incurred on cowpea production was ₦4,080 and this constitute 6.20% of the total fixed cost.

4.4.2 Returns to investment in cowpea production.

Results presented in Table 4.14 indicated that the total revenue (TR) was ₦82352.91 while the total cost (TVC + TFC) is ₦65852.55. The net farm income is therefore ₦16500.36. The average rate of returns on investment (return per naira invested) was ₦1.25k, indicating that for every ₦1 invested in cowpea production in the study area; a profit of 25 kobo was made. Thus, it could be concluded that cowpea production in the study area though on a small scale, was profitable. This finding is similar to that of Okoye *et al.*, (2009) in Determinants of labour productivity on small-holder cocoyam farms in Anambra State, Nigeria, observed that cocoyam production is profitable with returns of ₦1.80 to every ₦1.00 spent.

Table 4.14: Average Costs and Returns per Hectare of cowpea production

Variables	Price	Quantity	Value/ha(₦)	% Contribution
A. Variable Costs				
i. Seed(Kg)	120	232.15	27858.51	42.30

ii. Fertilizer(Kg)	100	195.71	19571	29.72
iii. Agrochemical(Litres)	800	6.17	4932.204	7.49
iv. Labour(Man/day)	400	24	9410.83	14.29
Total Variable Cost=(i+ii+iii+iv)			61772.55	
B. Fixed Costs				
i. Cost of Renting Land			2,800	4.25
ii. Depreciation of Tools (Hoes, Cutlasses)			1,280	1.94
Total Fixed Cost=(i+ii)			4,080	
C. Total Cost=(TVC+TFC)			65852.55	
D. Gross Income(GI)			82352.91	
E.Net Farm Income(NFI)=(D-C)			16500.36	
F. Return Per Naira Invested (RNI)=D/C			1.25	100

Test of Hypothesis iii

The null hypothesis (H_0) which stated that there is no significant relationship between cost of production and return in cowpea production was tested using the result of the z-test presented in Table 4.15. It reveals that the average cost is 60928.16 and average return is 12837342. Calculated z-value is 12.74 and exceeds the critical value (z-critical two tails) of 1.99. Therefore H_0 is rejected at 5% level of significance. The result of the analysis indicates that cowpea production is profitable in the study area.

Table 4.15: The result of Z-test showing significant differences between costs and return in cowpea production.

Variable	Average cost	Average return
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Mean	60928.16	12837342
Standard deviation	3.02E+09	1.59E+14
Observations	158	158
Hypothesized Mean Difference	0	
Z	-12.7361	
P(Z<=z) one-tail	0	
z Critical one-tail	1.644854	
P(Z<=z) two-tail	0	
z Critical two-tail	1.959964	

***P<0.01, **P<0.05 and *P<0.10

2.10 Constraints Faced By Cowpea Farmers

The constraints faced by cowpea farmers are presented in Table 4.16. It was found that about 18% of the respondents ranked high cost of farm inputs as the major constraints. This finding is in line with Ekong (2003), opined that most farmers have little or no access to improved seeds and continues to recycle seeds that have become exhausted after generations of cultivation.

About 17% of the respondents ranked low price as the second constraints. Also, about 16% of the respondent's ranked low capital and high cost of labour as third constraints. It agrees with findings of Nasiru, (2010) who noted that access to micro-credit could have prospect in improving the productivity of farmers and contributing to uplifting the livelihoods of disadvantaged rural farming communities. It agrees with Ugbajah and Uzuegbuna (2012) who opined that labour shortage (58%) was responsible for causative factors of decline in cocoyam production in Ezeagu Local Government Area of Enugu State. while short period of rainy season, does not store well, lack of government support, difficulty in obtaining labour, poor soil and lack of transportation was ranked by 12%, 8%, 6%, 4% and 2% of the respondents as fifth, sixth, seventh, eighth, ninth and tenth constraints respectively. It

indicates that high cost of farm input ranks foremost followed by low price, low capital, high cost of labour, and short period of rainy season, does not store well, lack of government support, difficulty in obtaining labour, poor soil and lack of transportation amongst the respondents respectively. This finding agrees with that of Hyun *et al.*, (2008), Tekana and Oladele (2011) and Onuk *et al.*, (2010) who observed that high cost of farm inputs, inadequate capital and government interference, inadequate transportation facility inadequate storage/processing facilities and inadequate rainfall were among the constraints faced by farmers. This revealed that farmers in the study area are faced with constraints that limit cowpea production.

Table 4.16: Constraints Faced by Cowpea Farmers

Constraints	Frequency	Percentage	Rank
High Cost of Inputs	101	18	1 st
Low Price	96	17	2 nd
Low Capital	91	16	3 rd
High Cost of Labour	87	16	4 th
Short Period of Rainy Season	65	12	5 th
Does not Store Well	46	8	6 th
Lack of Government Support	34	6	7 th
Difficulty in Obtaining Labour	22	4	8 th
Poor Soil	10	2	9 th
Lack of Transportation	9	2	10 th
Total	561	100	

Multiple Response Allowed*

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study focused on the economics of cowpea production in Giwa and Sabo local government area of Kaduna State, Nigeria. A combination of purposive and random selection of two districts from the two LGAs and 158 farmers were selected for this area and to achieve this, the study came up with five specific objectives. These were to: describe the socio-economic characteristics of cowpea farmers, determine the level of technical, allocative and economic efficiencies in cowpea production, determine the socio-economic factors influencing technical, allocative and economic efficiencies in cowpea production, determine the profitability of cowpea production and to describe the constraint faced by smallholder cowpea farmers in the study Area.

Primary data were collected from 158 respondents through the use of random sampling techniques with the aid of structured questionnaire. The statistical tools used to analyze the data were descriptive statistics, stochastic production frontier function model, net farm income and profit function model. A descriptive analysis of the sample farmers was done to understand and describe the socio-economic factors influencing cowpea production and as well as income made from the production in the study area.

The results of the socio-economic analysis shows that (61%) of the respondents fall within the age range of 34-54years, the majority of the farmers (85%) had some form of education. the household size ranged from 6-17 persons with 71%. Majority of the farmers, (77%) were members of a cooperative society.

The average costs incurred and revenue obtained per hectare for cowpea were estimated to determine the profitability or otherwise of cowpea production in the study area (table 15).

The total revenue (TR) is ₦82,352.91 while the total cost (TVC + TFC) is ₦ 65,852.55. The net farm income is therefore ₦16,500.36. The average rate of return on investment (return per naira invested) is ₦1.25, indicating that for every ₦1 invested in cowpea production in study area; a profit of 25 kobo was made. Thus, it could be concluded that cowpea production in the study area though on a small scale, was economically viable.

The stochastic frontier production function was estimated for technical, allocative and economic efficiency. It was observed from the study that 39% of the farmers are technical efficiency (TE) (0.61) and above while 61% of the farmers operate at less than 0.6 efficiency level. The mean technical efficiency for the 158 sampled farmers in the study area was 0.73. The farmer with the best practice has a technical efficiency of 0.98 while 0.33 is for the least efficient farmers. This implies that on the average, output fall by 2% from the maximum possible level due to inefficiency. The mean allocative efficiency was 0.64. The result indicates that average cowpea farmer in the state would enjoy cost saving of about 35% while allocative inefficient farmer will have an efficiency gain of 80% to attain the level of most efficient farmer among the respondents. The mean economic efficiency was 0.48. The farmer with the best practice has an economic efficiency of 0.98 while 0.12 was for the least efficient farmers. This implies that on the average, output fall by 52% from the maximum possible level due to inefficiency.

Multiple regression analysis showed that age, household size, farming experience, cooperative association, extension contact and amount of credit were the significant factors that influence the level of economic efficiency of the cowpea farmers in the study area.

Finally, among the constraints identified in the study area, the majority of the respondent attested to the fact that high cost of inputs, low price, low capital and high cost of labour were the major constraints they faced in cowpea production in the area.

5.2 Conclusion

The study revealed that cowpea farmers in the study area did not achieve absolute efficiency in the use of variable inputs.

It was found that cowpea production in the study area is profitable with the return on investment (return per naira invested) of 25 kobo for every ₦1 invested in cowpea production. Thus, it could be concluded that cowpea production in the study area though on a small scale, was economically viable.

It was observed from the study that the mean economic efficiency was 0.48. The farmer with the best practice has an economic efficiency of 0.98 while 0.12 was for the least efficient farmers. This implies that on the average, output fall by 52% from the maximum possible level due to inefficiency.

Finally, among the constraints identified in the study area, the majority of the respondent attested to the fact that high cost of inputs, low price, low capital and high cost of labour were the major constraints they faced in cowpea production in the area.

Recommendations

- i. Cooperative association significantly influence efficiency, implying that the making and implementing of policies that would encourage cowpea farmers to form cooperatives society or join existing ones will be a step in the right direction. This will enable the farmers to benefit from the government and non-governmental organization through the provision of seed, fertilizer, agrochemicals etc.
- ii. Fertilizer and agrochemicals are some of the inputs that positively and significantly influence cowpea production in the study area. Therefore, government should ensure timely and adequate supply of fertilizer to farmers through its GESS (Growth Enhancement Support Scheme) programme at affordable prices in order to enhance the production of this crop.
- iii. Most of the respondents complained of high cost of farm input Such as fertilizers, improved seeds and agrochemical as part of the constraints they faced. The cooperative societies will link-up the farmers with sources of input. This will enable the groups to buy inputs at factory price thereby helping to minimize cost of production.
- iv. The positive relationship between amount of credit accessed and efficiency of the farmers implies that policies that will make micro-credit from government and non-governmental agencies accessible to these farmers will go a long way in addressing their resource use inefficiency problems.

- v. Government in partnership with private sector should encourage farmers to increase their technical efficiency in cowpea production which could be achieved through improved farmer specific efficiency factors, which include improved farmer education, access to credit, access to improved extension services.

5.4 Contribution of the Study to Knowledge

- i. The study revealed that cowpea production in the study area is profitable with net farm income of ₦16500.36 despite the problems identified.
- ii. It was found that age, household size, farming experience, membership of cooperative association, extension contact and amount of credit were the significant socio-economic factors that influence farmers level economic efficiency at 1% level of significance.
- iii. It was revealed that cowpea farms were economically inefficient in the study area having an economic efficiency of 48%.
- iv. The study revealed that cowpea farmers in the study area achieved technical efficiency of 73 %.

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Appendices

Dear Respondent,

This questionnaire will be used by a student of the Department of Agricultural Economics and Rural sociology, Ahmadu Bello University, Zaria. Please, fill as appropriate. All information will be treated with confidentiality and strictly for the purpose of research. Thanks for your co-operation.

Village/Community.....L.G.A

.....

A. SOCIO –ECONOMICS CHARATERISTICS

1. Name of farmer.....
2. Sex: Male () Female ()
3. Age (years).....
4. Marital status: Married () Single ()
5. Highest level of Education:
(a) No Formal Education () (b) Primary school Education () (c) Secondary School Education () (d) Tertiary Education ()
6. Family Size (All the number of the people depending on you for living).....
(a) No of Adult Male () (b) No of Adult female () (c) Children >15yrs () (d) Children <15yrs ()
7. How long have you been in cowpea farming? (Years of experience).....
8. Do you belong to any co-operative/Association? Yes () No ()

9. If yes, (Years of participation) -----
10. What benefit did you derive as a member?
11. Do you have access to credit (a) Yes () (b) No
12. What is your major source of capital for cowpea farming?
 A .Personal savings () b. credit (borrow) () c. Friends and family ()
 d. Money Lenders (Borrow) ()
13. If you borrow, what were the sources of the credit?
 a. commercial bank() b. Bank of Agriculture () c. Cooperative Society ()
 d. Money Lenders () e. Friends and Family () f. Others (specify).....

14. How much did you borrow to finance last production? (Fill for the source you indicated in Q .12)

SOURCE OF LOAN	AMOUNT(₦)	INTERST RATE (%)
Commercial Bank		
Bank of Agriculture		
Cooperative Societies		
Money Lenders		
Friends And Family		
Others (Specify)		

15. Have you been visited by an extension agent? Yes () No ()
16. If Yes, How many times in last one year.....?
17. What activities did the agent teach you?
18. Of what benefit were the techniques learnt to you to the success of your farm?

19. Have you been trained on Cowpea farming? Yes () No ()
20. If yes, which organization conducted the training?
21. Was the training beneficial to you?
 a. Not beneficial () b. somehow beneficial () c. beneficial () d. very beneficial ()

B. INFORMATION ON INPUTS

22. Farm size (Ha)

(i) How many cowpea farm plots do you have? Indicate and the size in the table below.

Plot NO	Plot Size (Ha)
1	
2	
3	

(ii). How did you acquire your land? (*Tick below*)

Plot	Mode of Acquisition				
	(a) Inheritance	(b) Lease	(c) Borrowed	(d) Gift	(e) Purchased
1					
2					
3					

(iii). what does it cost to rent one Hectare of land per season in your village?..... Naira

23. Variable inputs (Last production Cycle)

(i)Seed (Kg)

Plot No	Quantity of Seed(Kg)	Cost (₦)
1		
2		
3		

(ii).Fertilizer.

Plot No	Fertilizer type	Quantity(Kg)	Cost(₦)
1			
2			
3			

(iii) Agrochemical.

Plot No	Agrochemical type	Quantity(litres)	Cost(₦)
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1			
2			
3			

(iv) Labour input

(a) Land preparation

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(b) Planting

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(c) Fertilizer Application

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(e) First Weeding

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost (₦)	No of people	No of Hours	Cost (₦)
1						
2						
3						

(f) Second Weeding

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost(₦)	No of people	No of Hours	Cost(₦)
1						
2						
3						

(g)Harvesting

Plot No	Hire Labour			Family Labour		
	No of people	No of Hours	Cost(₦)	No of people	No of Hours	Cost(₦)
1						
2						
3						

(h) Information on cowpea output

Plot No	No. of output produced(number)	Total Quantity sold (Kg)	Price/Unit
1			
2			
3			

21. Where do you sell your produce?

a. Farm gate () b. Rural market () c. Urban market ()

22. When do you sell your produce?

a. immediately after harvesting () b. Few months after harvest () c. Off season ()

23. CONSTRAINTS TO COWPEA PRODUCTION

S/n	Constraints
1	
2	
3	
4	
5	
6	
7	

8	
9	
10	

24. What can you suggest as solutions to these constraints?

.....
.....
.....

Thanks for your Attention